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(54) **IMPLANTABLE SYSTEM**

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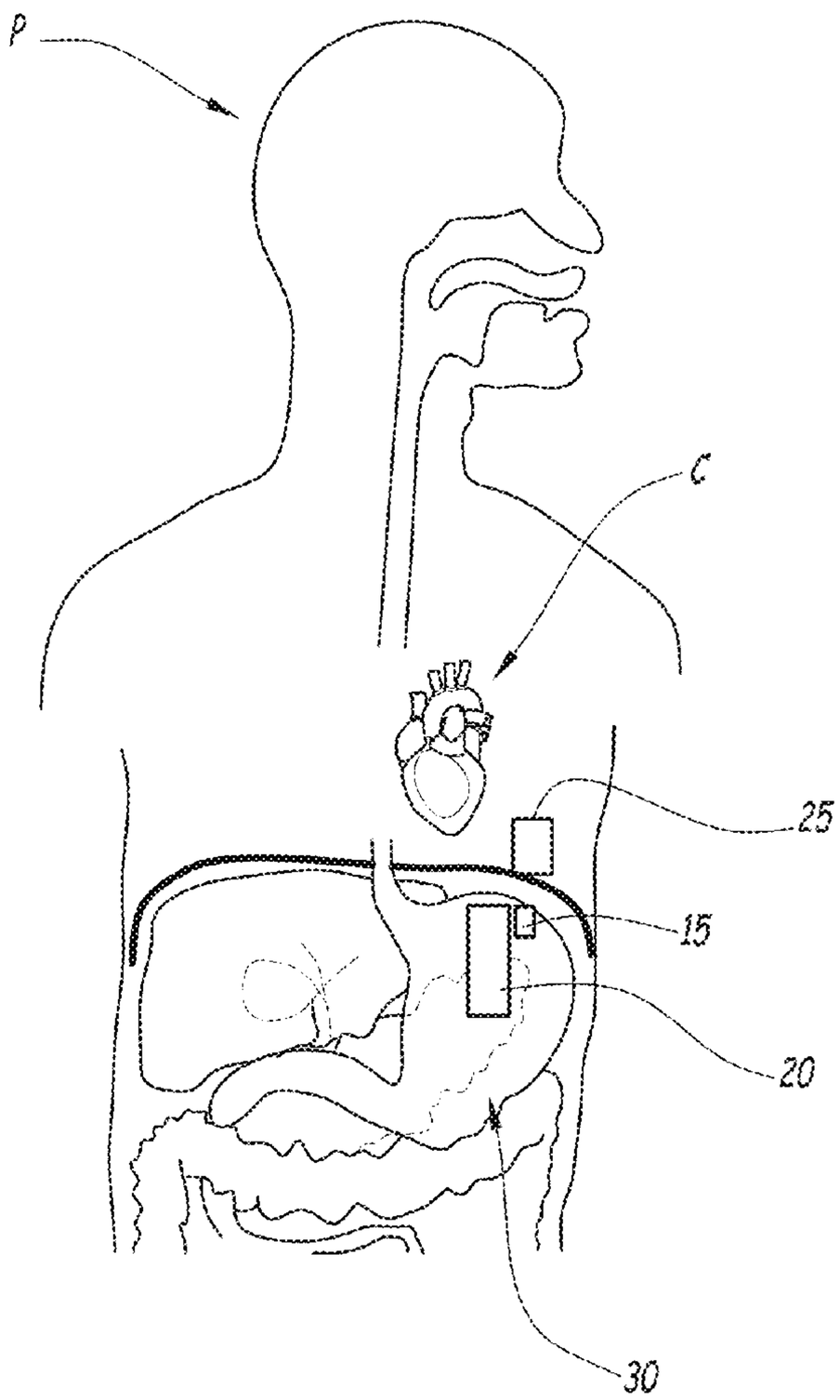
(57) **ABSTRACT**

An implantable system comprising a first device, also called a centralisation device, suitable for being implanted in a fixation position inside the patient's body and at least one second device suitable for stimulating an organ of the patient when the second device is implanted, in a stimulation position, in the patient's body. The first device being further configured to command a stimulation of the organ by the second device. The implantable system being characterised in that the organ is a separate organ from the stomach and in that, when the first device is in the fixation position, the first device is accommodated in the patient's stomach and fixed to a stomach wall.



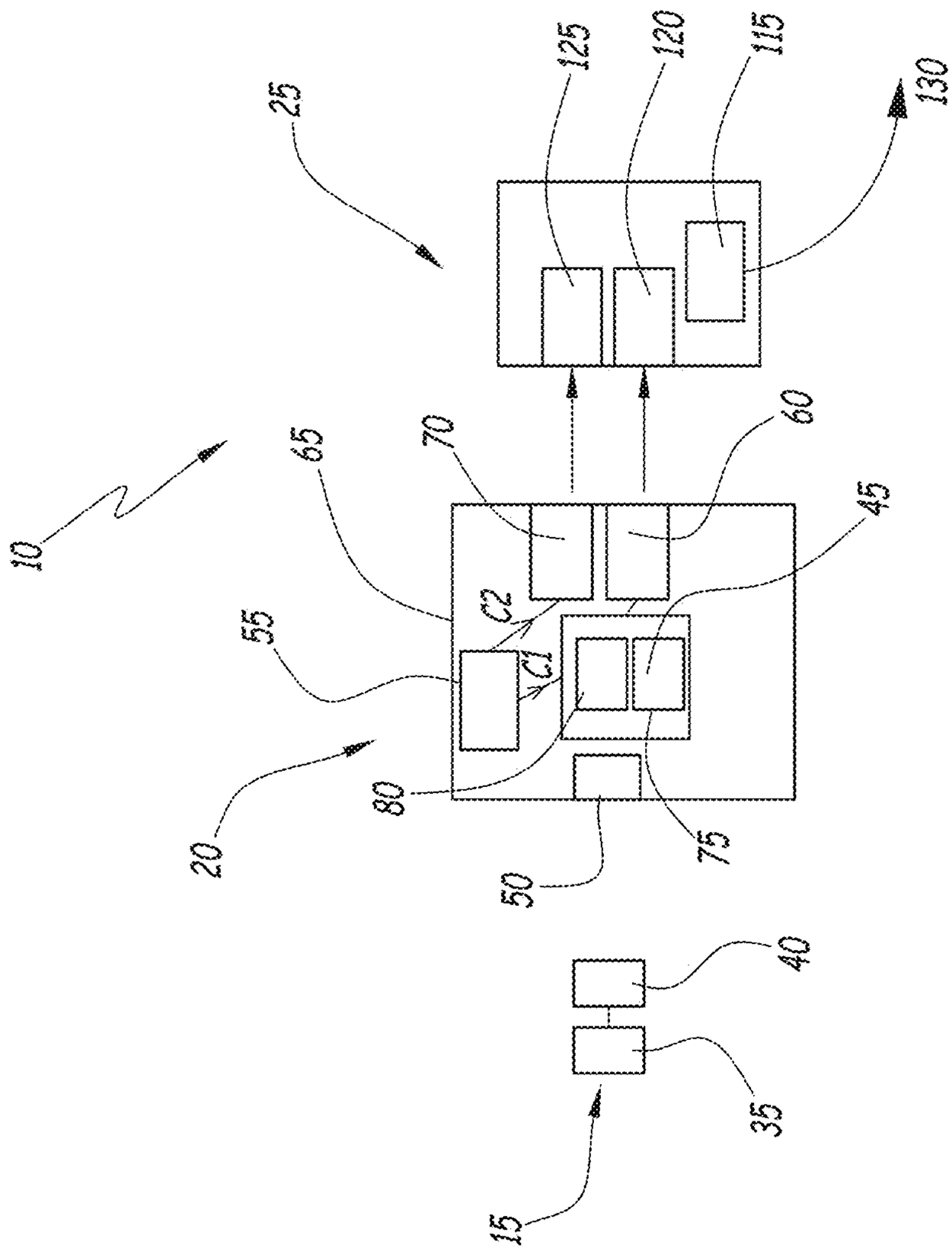


Fig.1

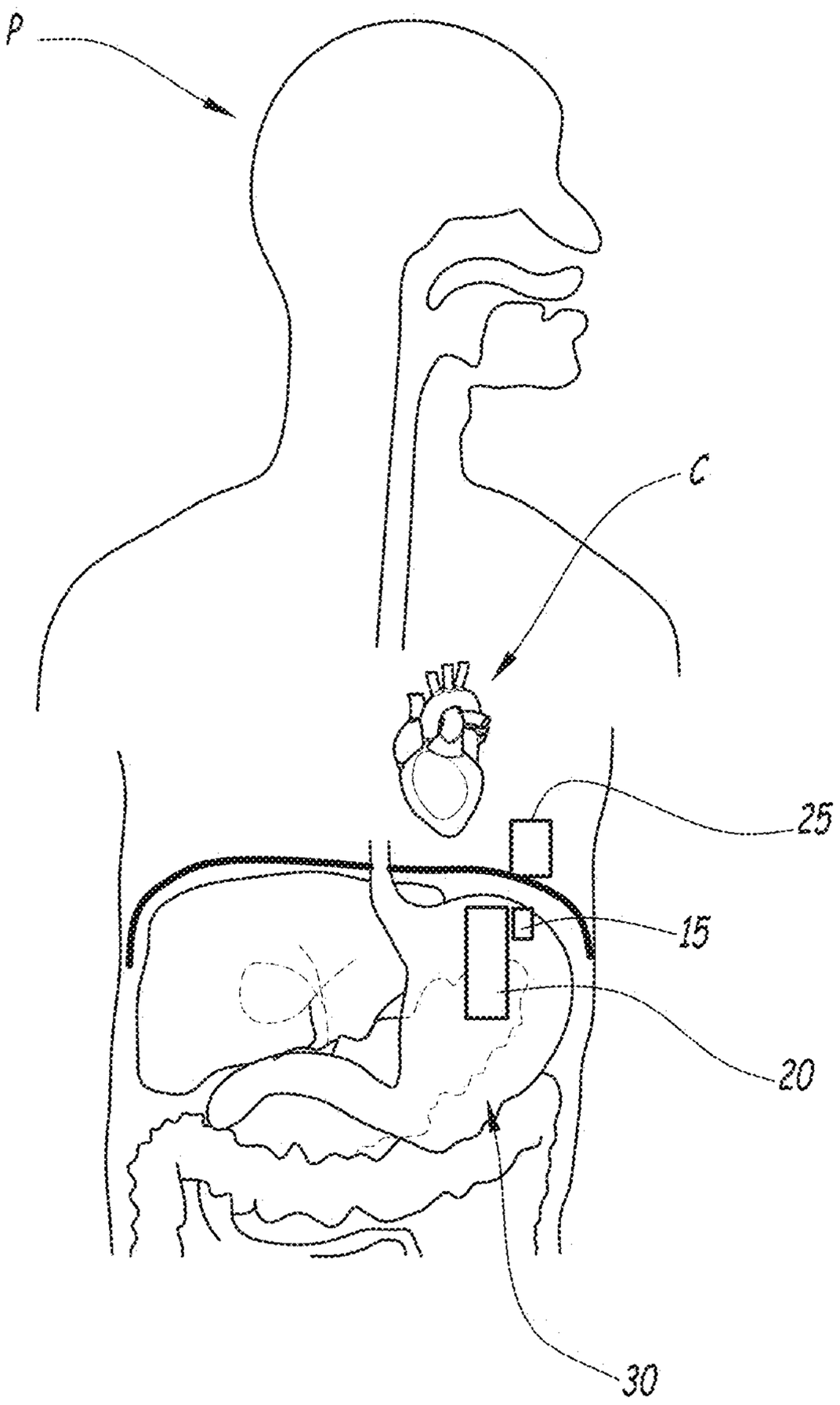
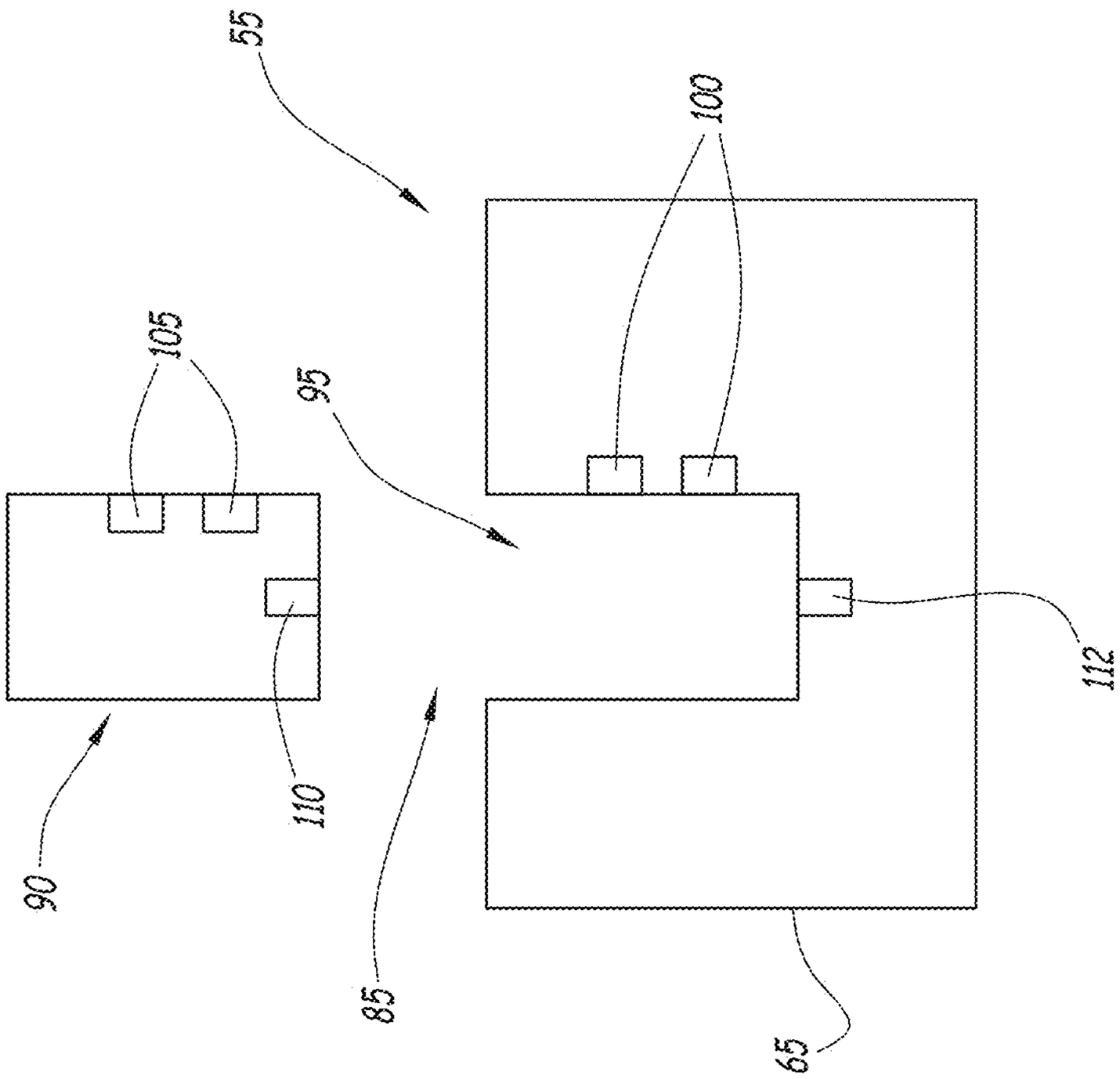


Fig.2

Fig.3



IMPLANTABLE SYSTEM

[0001] The present invention relates to an implantable system.

[0002] A large number of implantable devices are used for monitoring or stimulating certain organs of the human body. For example, cardiac stimulation devices (or "pacemakers") are implanted in many patients. These devices generally include a power source such as a battery, one or a plurality of sensors for monitoring the behaviour of the organ monitored and/or a stimulation module envisaged to exert an action on the stimulated organ.

[0003] However, it is necessary to recharge or replace the batteries of such implantable devices regularly. In particular, in numerous cases, this replacement is carried out by means of a surgical procedure. Such a procedure is relatively expensive and restrictive for the patient since it takes place in a hospital facility operating theatre and anaesthesia is required, as well as a prolonged stay in the hospital facility for the purposes of post-operative monitoring. Furthermore, as for any surgical procedure, there are risks of the patient contracting an infection during the operation.

[0004] In other cases, implanted devices of the type mentioned above are externally powered by an energy storage module which is borne by the patient outside their body. For example, some power supply devices may transmit energy via ultrasound waves to the stimulation device, through the patient's skin and rib-cage. However, ultrasound waves pass poorly through bones, and great precision in the placement of the ultrasound source is then required, in cases where the implanted device is situated in front of the rib-cage, so as to provide a satisfactory power supply of the implanted device. Furthermore, such a power supply device outside the patient's body is unsightly.

[0005] Some implantable devices may be equipped with wired connectors, enabling an electrical connection or fluid transfer between the implantable device and an external device. In this way, an electrical power supply current or data measured by the sensors of the implanted device are exchanged with the external device. Here again, these connectors emerging through the patient's skin are unsightly, and necessarily involve health risks as well as significant constraints for the patient's day-to-day life.

[0006] Therefore, there is a need for an implantable system that is less restrictive for the patient.

[0007] For this purpose, there is proposed an implantable system comprising a first device, also called centralisation device, suitable for being implanted in a fixation position inside the patient's body and at least one second device suitable for stimulating an organ of the patient when the second device is implanted, in a stimulation position, in the patient's body, the first device being further configured to command a stimulation of the organ by the second device, the implantable system being characterised in that the organ is a separate organ from the stomach and in that, when the first device is in the fixation position, the first device is accommodated in the patient's stomach and fixed to a stomach wall.

[0008] According to the embodiments, the implantable system comprises one or a plurality of the following features, taken in isolation or according to any technically possible combinations:

[0009] the first device is configured to supply the second device with power;

[0010] the centralisation device includes an acoustic wave emitter and the second device includes a stimulator suitable for stimulating the organ and a converter of acoustic energy into electrical energy, the converter being suitable for receiving the acoustic waves emitted by the centralisation device and for generating in response an electrical power supply current of the stimulator;

[0011] the acoustic wave is an ultrasound wave;

[0012] the centralisation device includes an electromagnetic wave emitter and the second device includes a stimulator suitable for stimulating the organ and a converter suitable for receiving the electromagnetic waves emitted by the centralisation device and for generating in response an electrical power supply current of the stimulator;

[0013] the organ is the patient's heart;

[0014] the implantable system includes at least two second devices;

[0015] a second device is envisaged to be implanted in the right ventricle and a further second device is envisaged to be implanted in the left ventricle of the patient's heart;

[0016] the organ is a nerve of the patient;

[0017] the organ is the patient's phrenic nerve;

[0018] the organ is the patient's diaphragm;

[0019] when the centralisation device is in the fixation position, the centralisation device is accommodated in the upper part of the stomach;

[0020] the centralisation device or the second device includes at least one sensor suitable for measuring at least one value of a parameter of the organ and the centralisation device comprises a controller suitable for commanding the stimulation of the organ, by the second device, according to the measured value(s);

[0021] the centralisation device comprises a controller and an electrical power supply including a removable electrical energy reserve and a connector suitable for accommodating the electrical energy reserve, the electrical energy reserve being suitable for electrically powering the controller when the electrical energy reserve is connected electrically to the connector in a connection position and preferably being configured to be swallowed by the patient and to move spontaneously to the connection position from a disconnection position wherein the electrical energy reserve is accommodated in the stomach of the patient (P) and is disconnected from the connector;

[0022] the centralisation device comprises a controller and an electrical power supply suitable for generating an electrical power supply current of the controller by reacting at least one chemical species present in the patient's body, particularly glucose;

[0023] the centralisation device comprises a controller and an electrical power supply suitable for generating an electrical power supply current of the controller by converting mechanical energy into electrical energy.

[0024] Features and advantages of the invention will emerge on reading the following description, given merely by way of non-limiting example with reference to the appended drawings, wherein:

[0025] FIG. **1** is a diagram of an example of an implantable system including an electrical power supply,

[0026] FIG. **2** is a schematic representation of the implantable device in FIG. **1**, implanted in a patient's body, and

[0027] FIG. **3** is a schematic representation of the power supply in figure

[0028] A first example of an implantable system **10** is represented in figure

[0029] The implantable system **10** includes an anchor **15**, a first device **20**, also called centralisation device, and at least one second device **25**.

[0030] It is understood by "implantable system" that at least one element from the list formed by the anchor **15**, the first device **20** and the second device **25** is envisaged to be implanted in the human body.

[0031] In particular, it is understood by "implantable" that at least one element from the anchor **15**, the centralisation device **20** and the second device **25** is envisaged to remain in the body of a patient P for a period strictly greater than one week, preferably greater than one month, preferably greater than or equal to one year.

[0032] The implantable system **10** has been represented schematically in FIG. **2** when the implantable system **10** is implanted in the body of the patient P.

[0033] According to the example in FIG. **2**, the anchor **15**, the centralisation device **20** and the second device **25** are each implanted in the body of the patient P.

[0034] The anchor **15** is suitable for being fixed in a predetermined position in the stomach **30** of the patient P.

[0035] For example, the anchor **15** is configured to be fixed in the upper part of the stomach **30**. In particular, the anchor **15** is configured to be fixed in the gastric fundus of the stomach **30**. For example, the anchor **15** is envisaged to be fixed as close as possible to the angle of His in the gastric fundus.

[0036] Alternatively, the anchor **15** is configured to be fixed in the lower part of the stomach **30**.

[0037] The anchor **15** is configured to support the centralisation device **20**, preferably removably. In particular, the anchor **15** and the centralisation device **20** are configured to be fixed to one another, by a fixation device, and the anchor **15** is configured to hold the centralisation device **20** in a fixation position when the anchor **15** is fixed in the stomach **30**.

[0038] The anchor **15** includes a head **35** and a first connector **40**.

[0039] The head **35** is configured to anchor the anchor **15** in the predetermined position. In particular, the head **35** is configured to anchor the anchor **15** to the wall of the stomach **30**.

[0040] The head **35** is, for example, a gastrointestinal clip configured to grip between two branches of the head **35** a portion of the wall of the stomach **30**.

[0041] Alternatively, the head **35** is suitable for being sutured using a suture to the wall of the stomach **30**.

[0042] According to a further alternative embodiment, the head **35** is suitable for being embedded inside the gastric mucosa after the latter has been dissected.

[0043] The first connector **40** is configured to fix the centralisation device **20** to the head **35**.

[0044] The centralisation device **20** is configured to supply the second device **25** with power.

[0045] The centralisation device **20** includes a first controller **45**, a second connector **50**, an electrical power supply **55**, a first emitter/receiver **60**, a housing **65** and a transmitter **70**.

[0046] The first controller **45** is a data processing unit. The first controller **45** includes a first memory **75** and a first processor **80**.

[0047] Alternatively, the first controller **45** is embodied in the form of a dedicated integrated circuit, or programmable logic components.

[0048] The first processor **80** is suitable for processing and/or converting data represented as electronic or physical quantities in the first memory **75** into other similar data corresponding to physical data in the first memory **75**, in registers or other types of display, transmission or storage devices.

[0049] The first processor **80** is further configured to exchange data with the first emitter/receiver **60**.

[0050] The second connector **50** is configured to cooperate with the first connector **40** to hold the centralisation device **20** in the fixation position.

[0051] For example, the second connector **50** is configured to cooperate with the first connector **40** by snap-fitting.

[0052] Alternatively, the second connector **50** includes a magnet configured to fix the second connector to the first connector. The magnet is, for example, an electromagnet.

[0053] According to a further alternative embodiment, the first connector **40** is configured to be secured to the second connector **50** by screwing.

[0054] Alternatively, the first connector **40** includes one or preferably two bayonets complementary with fixation orifices formed in the second connector **50**.

[0055] Preferably, the second connector **50** is envisaged such that the centralisation device **20** is separable from the anchor **15**. In particular, the second connector **50** is configured such that the centralisation device **20** is separable from the anchor **15** when the anchor **15** is fixed in the stomach **30** of the patient P.

[0056] The electrical power supply **55** has been represented in FIG. **3**.

[0057] The electrical power supply **55** is configured to supply the first controller **45** with a first power supply current C**1**.

[0058] The electrical power supply **55** is further configured to supply the transmitter **70** with a second power supply current C**2**.

[0059] The electrical power supply **55** includes a third connector **85** and a first electrical energy reserve **90**.

[0060] The third connector **85** is configured to receive from the first electrical energy reserve **90** the first power supply current C**1** and the second power supply current C**2** and to supply the first controller **45** and the transmitter **70** with, respectively, the first power supply current C**1** and the second power supply current C**2**.

[0061] The third connector **85** is configured to accommodate the first electrical energy reserve **90**. In particular, the third connector **85** delimits a cavity **95** configured to accommodate at least partially the first electrical energy reserve **90** in a connection position.

[0062] According to the example in FIG. **3**, the cavity **95** emerges outside of the housing **65**. In particular, the cavity **95** is configured to enable the insertion of the first electrical energy reserve **90**, from outside the housing **65**, into the cavity **95**.

[0063] The third connector **85** further includes two first electrical contacts **100**, configured to be connected electrically to the first electrical energy reserve **90** when the first

electrical energy reserve **90** is in the connection position. In particular, the two first electrical contacts **100** emerge inside the cavity **95**.

[0064] The first electrical energy reserve **90** is configured to store electrical energy. In particular, the first electrical energy reserve **90** is configured to be charged with electrical energy outside the body of the patient P and to be discharged when the first electrical energy reserve **90** is in the connection position. For example, the first electrical energy reserve **90** includes a battery. Alternatively, the first electrical energy reserve **90** includes at least one capacitor or a supercapacitor.

[0065] The first electrical energy reserve is configured to supply the first controller **45** with the first power supply current C**1** when the first electrical energy reserve **90** is in the connection position. Furthermore, the first electrical energy reserve **90** is configured to supply the transmitter **70** with the second power supply current C**2** when the first electrical energy reserve **90** is in the connection position.

[0066] According to the example in FIG. **3**, the first electrical energy reserve **90** includes two second electrical contacts **105** complementary with the first electrical contacts **100**.

[0067] The first electrical energy reserve **90** may be envisaged to be swallowed by the patient P.

[0068] According to an alternative embodiment, the first energy reserve **90** is suitable for being replaced by endoscopy.

[0069] In particular, the first electrical energy reserve **90** has a volume strictly less than 6 millilitres (ml).

[0070] The first electrical energy reserve **90** further has three dimensions each measured along a respective direction, each direction being perpendicular to the two other directions, and each dimension is strictly less than 5 centimetres (cm).

[0071] The first electrical energy reserve **90** is movable between the connection position and a disconnection position. When the first electrical energy reserve **90** is in the disconnection position, the first electrical energy reserve **90** is accommodated in the stomach **30** of the patient P but is not connected electrically to the third connector **85**. For example, when the first electrical energy reserve **90** is in the disconnection position, the first electrical energy reserve is fully removed from the cavity **95**.

[0072] The first electrical energy reserve **90** is configured to move spontaneously from the disconnection position to the connection position. For example, the first electrical energy reserve **90** includes attractors **110**.

[0073] The attractors **110** are configured to exert on the first electrical energy reserve **90**, when the first electrical energy reserve **90** is in the disconnection position, a force tending to move the first electrical energy reserve **90** from the disconnection position to the connection position.

[0074] Furthermore, the attractors **110** are configured to hold the first electrical energy reserve **90** in the connection position.

[0075] The attractors **110** include, for example, a first magnet suitable for cooperating with a second magnet **112** of the third connector **85**. Alternatively, the first magnet is suitable for cooperating with a ferromagnetic portion of the third connector **85**. The first magnet and the second magnet **112** are, for example, electromagnets.

[0076] The first emitter/receiver **60** is configured to exchange data with the second device **25**. The first emitter/receiver **60** thus forms communication means with the second device **25**.

[0077] The first emitter/receiver **60** is, for example, a radiofrequency communication module. It is understood by "radiofrequency communication module" that the first emitter/receiver **60** is configured to communicate with the second device **25** via a signal including at least one radiofrequency electromagnetic wave. The radiofrequency electromagnetic waves are electromagnetic waves having a frequency between 3 kilohertz and 3 gigahertz.

[0078] According to one embodiment, the first emitter/receiver **60** is suitable for exchanging data with the second device **25** according to a Bluetooth Low Energy protocol. The Bluetooth Low Energy protocol is a protocol based on a "Bluetooth special interest group" standard and functioning in the range between 2400 megahertz (MHz) and 2483.5 MHz.

[0079] Alternatively, data transmission modes in the 402-405 megahertz (MHz) (Medical Implant Communication Service) or 2360-2390 MHz (Medical Body Area Networks) ranges may be used.

[0080] The housing **65** is configured to isolate the first controller **45** from outside the housing **65**. For example, the housing **65** delimits a chamber receiving at least the first controller **45**, the first emitter/receiver **60** and the transmitter **70**.

[0081] The transmitter **70** is configured to transmit power to the second device **25**.

[0082] For example, the transmitter **70** includes an acoustic wave emitter/receive configured to emit an acoustic wave and to route the acoustic wave to the second device **25**.

[0083] Alternatively, the transmitter **70** is configured to emit an electromagnetic wave. The electromagnetic wave has, for example, a high frequency such as a frequency in the region of 13.56 Megahertz (MHz). For example, the transmitter **70** includes a coil configured to emit the electromagnetic wave.

[0084] Alternatively, the transmitter **70** is connected to the second device **25** by an electrical conductor and is configured to transmit an electric current to the second device **25** via a wired link.

[0085] The second device **25** is suitable for stimulating an organ C of the patient P.

[0086] The organ C is separate from the stomach **30** of the patient P.

[0087] The second device **25** is configured to be implanted in the body of the patient P in a stimulation position. The second device **25** is then configured to stimulate the organ C when the second device **25** is in the stimulation position.

[0088] When the second device **25** is in the stimulation position, the second device **25** is situated outside the stomach **30**.

[0089] It is understood by "stimulate" that the second device **25** is suitable for exerting an action on the organ C and triggering in response an action of the organ C. A muscle contraction is an example of action of an organ C. Nerve signal transmission is a further example of action.

[0090] The organ C is the heart of the patient P.

[0091] In one embodiment, the second device **25** may be implanted in the endocardium of the heart of the patient P, for example in the right ventricle, when the second device is in the stimulation position thereof.

[0092] The second device **25** includes a stimulator **115**, a second emitter/receiver **120**, and a converter **125**.

[0093] The stimulator **115** is configured to stimulate the organ C. In particular, the stimulator **115** is configured to trigger a contraction of the heart of the patient P.

[0094] The stimulator **115** includes, for example, an electrode **130** connecting electrically the second device **25** to a predetermined location of the organ C of the patient P.

[0095] The second emitter/receiver **120** is configured to exchange data with the first emitter/receiver **60**.

[0096] The converter **125** is configured to receive energy from the transmitter **70** and to convert the energy received into electrical energy.

[0097] In particular, the converter **125** is configured to supply the stimulator **115** with a third power supply current C**3**.

[0098] For example, the converter **125** is configured to receive the acoustic wave emitted by the transmitter **70** and to generate in response the third power supply current C**3**.

[0099] The converter **125** includes, for example, piezo-electric elements suitable for converting a force into electric voltage. In particular the piezo-electric elements are suitable for converting the acoustic wave emitted by the transmitter **70** into electric voltage.

[0100] Alternatively, the converter **125** is configured to receive an electromagnetic wave emitted by the transmitter **70** and to generate in response the third power supply current C**3**. The converter **125** includes, for example, a coil suitable for resonating at the frequency of the electromagnetic wave emitted by the transmitter **70**.

[0101] The operation of the implantable system **10** will now be described.

[0102] During a first step prior to the implantation of the anchor **15**, the centralisation device **20** and the second device **25** in the body of the patient P, the first electrical energy reserve **90** is charged with electrical energy. The first electrical energy reserve **90** therefore generates the first power supply current C**1** intended for the first controller **45**.

[0103] During a second step, the anchor **15**, the centralisation device **20** and the second device **25** are implanted in the body of the patient P.

[0104] During a third step, an activation message is transmitted, by an external device, to the centralisation device **20**. In particular, the activation message is transmitted by radiofrequency communication. The activation message informs the first controller **45** that the implantable system **10** has indeed been implanted in the body of the patient P.

[0105] During a fourth step after the third step, the first controller **45** commands the power supply of the second device **25** by the transmitter **70**. For example, the first controller **45** commands the closure of a switch connecting electrically the third connector **85** to the transmitter **70**. The third connector **85** then transmits the second power supply current C**2** to the transmitter **70**.

[0106] During the fourth step, the transmitter **70** then emits an acoustic wave and routes the acoustic wave to the second device **25**.

[0107] The acoustic wave is, for example, an ultrasound wave. Ultrasound waves are acoustic waves having a frequency between 20 kilohertz and 100 megahertz.

[0108] During a fifth step, the converter **125** receives the wave emitted by the transmitter **70**. The converter **125** converts at least a portion of the energy of the wave received into electrical energy. The converter **125** then generates the third electric current C**3** from the wave received and supplies the stimulator **115** with the third electric current C**3**.

[0109] During a sixth step, the third electric current C**3** is transmitted to the heart of the patient P by the electrode **130**. The patient's heart then contracts in response to the third electric current C**3**. For example, the third electric current C**3** is suitable for correcting a cardiac rhythm disorder such as a fibrillation.

[0110] During a seventh step, the first controller **45** commands the interruption of the second power supply current C**2**. The second device **25** is therefore no longer supplied with power, and the third electric current C**3** is therefore no longer transmitted to the heart of the patient P. The stimulation of the contraction of the heart C therefore ends.

[0111] The fourth, fifth, sixth and seventh steps are, for example, repeated successively in this order with a predetermined time period. The time period is, typically, a period corresponding to the number of contractions per minute sought, for example about **70** contractions per minute.

[0112] By means of the invention, the electrical power supply of the second device **25** is provided from the centralisation device **20**. The second device **25** is then a passive device, since it is only activated by the transmission of energy from the centralisation device **20**. The second device **25** has the sole function of converting the wave emitted by the centralisation device **20** into an electric current transmitted to the heart C.

[0113] The second device **25** is then simple to produce. Furthermore, the volume of the second device **25** is small, since it contains no electrical energy reserve. The implantation of the second device **25** is therefore rendered easier, and is possible in a greater number of locations.

[0114] Given that the centralisation device **20** is in the stomach, the replacement of the first electrical energy reserve **90** is easy and may, for example, be carried out endoscopically via the oesophagus, simply and quickly. Furthermore, the replacement of the first electrical energy reserve **90** involves few risks of infection since no incision is made.

[0115] The use of the attractors **110** renders the positioning of the first electrical energy reserve **90** even simpler, even without endoscopy, since it is simply necessary for the patient P to swallow the first electrical energy reserve **90**.

[0116] Furthermore, the implantable system **10** does not mean that the patient P continuously bears electrical energy storage means outside their body, or that unsightly electrical conductors emerge out of the body of the patient P. The implantable system **10** therefore involves few constraints for the patient.

[0117] The positioning of the centralisation device in the stomach **30** of the patient P makes it possible to interact effectively with the second device **25**, for a great variety of organs C and therefore a great variety of locations of the second device **25**.

[0118] Indeed, although the first example has been described in the case of cardiac stimulation, it is to be noted that the invention is suitable for being applied to a large number of separate organs C.

[0119] According to one alternative embodiment, the organ C is a nerve of the patient P.

[0120] For example, the organ C is the phrenic nerve of the patient P. For example, the second device **25** is configured to stimulate the phrenic nerve electrically.

[0121] Alternatively, the organ C is a nerve wherein the stimulation makes it possible to suppress a pain nerve signal of the patient P.

[0122] According to a further alternative embodiment, the organ C is a muscle of the patient P different to the heart. For example, the organ C is the diaphragm of the patient P.

[0123] According to a further alternative embodiment, the implantable system **10** comprises at least two second devices **25**. For example, the second devices **25** are suitable, each, for stimulating a respective organ C.

[0124] Alternatively, at least two second devices **25** are configured to stimulate the same organ C. For example, one of the second devices **25** is implanted in the left ventricle and the other second device **25** is implanted in the right ventricle. The stimulation of the heart of the patient P is then closer to the physiological state than when the implantable system **10** includes a single second device **25**. The implantable system **10** is then particularly suitable for the case of the treatment of certain types of heart failure.

[0125] According to a further alternative embodiment, the second device **25** does not include a second emitter/receiver **120**. In this embodiment, the acoustic wave emitted by the transmitter **70** and received by the converter **125** is the only form of communication between the centralisation device **20** and the second device **25**.

[0126] A second example of an implantable system **10** will now be described. Identical elements to the first example of an implantable system **10** in FIG. **1** are not described again. Only the differences are highlighted.

[0127] The stimulator **115** includes a second electrical energy reserve. The second reserve includes, for example, a capacitor. The second reserve is suitable for receiving the third power supply current C**3** and for storing at least a portion of the electrical energy of the third power supply current C**3**.

[0128] The stimulator **115** is configured to generate an electrical pulse from the electrical energy stored in the second reserve.

[0129] The operation of the second example will now be described.

[0130] The first, second and third steps are identical to the first, second and third steps of the first example.

[0131] The fourth step has a duration strictly greater than the time period. The duration is, for example, greater than or equal to one hour, in particular greater than or equal to one week.

[0132] For example, the fourth step starts upon the reception of the activation message by the second device **25** and ends following the reception of a deactivation message. The deactivation message is a radiofrequency message. For example, the deactivation message is generated by an external device to the implantable system **10** when a medical practitioner instructs that the implantable system **10** is to be removed from the body of the patient P.

[0133] The fifth step has an identical duration to the fourth step. During the fifth step, the second reserve is supplied with the third power supply current C**3**. The second reserve is therefore charged progressively with electrical energy.

[0134] During the sixth step, the centralisation device **20** transmits to the emitter/receiver **120** a command message of a stimulation of the organ C by the stimulator **115**.

[0135] In response to the command message, the stimulator **115** generates an electrical pulse.

[0136] The electrical pulse is conducted to the heart of the patient P by the electrode **130**. The patient's heart then contracts in response to the third electric current C**3**.

[0137] The sixth step is implemented periodically with the time period.

[0138] The seventh step is not implemented.

[0139] In the second example, the power supply of the second device **25** is continuous. The amplitude of the wave used is then smaller. The implantable system **10** is therefore compatible with a greater number of transmitters **70**.

[0140] A third example of an implantable system **10** will now be described. Identical elements to the first example of an implantable system **10** in FIG. **1** are not described again. Only the differences are highlighted.

[0141] The second device **25** includes at least one sensor **117**. Each sensor **117** is suitable for measuring a value of a representative parameter of a physiological phenomenon of the patient P. The second emitter/receiver **120** is then configured to transmit to the centralisation device **20** the values measured.

[0142] The first controller **45** is configured to detect at least one physiological phenomenon occurring in the patient P. In particular, the first controller **45** is configured to detect the physiological phenomenon based on the values measured by the sensor integrated in the second device **25**.

[0143] The physiological phenomenon is, for example, sleep apnoea. For example, the organ C is the phrenic nerve.

[0144] In this case, the sensor **117** is suitable for detecting a movement of the diaphragm of the patient P, indicating an inhalation. When an inhalation has not been detected for a predetermined duration, the first controller **45** detects sleep apnoea.

[0145] When the physiological phenomenon is detected, the centralisation device **20** commands in response the stimulation of the organ C. In particular, the second device **25** stimulates electrically the organ C in response to the command transmitted by the centralisation device **20**.

[0146] For example, the centralisation device **20** commands the stimulation, by the second device **25**, of the patient's phrenic nerve. The stimulation of the phrenic nerve then triggers a cough unblocking the upper airways of the patient P.

[0147] Alternatively, the organ C is the diaphragm. The stimulation then triggers a reflex contraction of the diaphragm which induces an inhalation.

[0148] According to a further alternative embodiment, the physiological phenomenon is a cardiac rhythm disorder, for example a bradycardia or a syncope. In this case, the sensor(s) **117** are suitable for measuring values of parameters relative to rhythm disorders such as an electrical or mechanical activity of the heart. For example, the sensor(s) **117** are suitable for measuring a difference in potential between two electrodes and/or an acceleration caused by a cardiac contraction. In this case, the second device **25** is suitable for stimulating the heart.

[0149] According to a further alternative embodiment, at least one sensor **117** is suitable for measuring a level of a biological marker in a bodily fluid F of the patient P.

[0150] According to a fourth example, the centralisation device **20** includes at least one sensor **117**. For example, the centralisation device **20** includes two sensors **117**.

[0151] Each sensor **117** is external to the first controller **45** but is suitable for communicating with the first controller **45**.

[0152] Each sensor **117** is configured to measure values of a physiological parameter of the patient P. The physiological parameter is, for example, a parameter of the organ C.

[0153] For example, at least one sensor **117** is suitable for measuring values of a parameter of the heart.

[0154] For example, a sensor **117** is suitable for measuring a value of an acceleration of the centralisation device **20**, such as an acceleration caused by a contraction of the heart C.

[0155] Alternatively or additionally, a sensor **117**, for example integrated in the centralisation device **20**, is suitable for measuring a value of a difference in electrical potential between two electrodes of the sensor **117**. The difference in electrical potential is, for example, measured between two points of the stomach wall, i.e. the two electrodes are in contact with the stomach wall. Alternatively, the sensor **117** only includes one electrode, and is suitable for measuring the difference in electrical potential between the electrode and the anchor **15**.

[0156] A fifth example of an implantable system **10** will now be described. Identical elements to the first example of an implantable system **10** are not described again. Only the differences are highlighted.

[0157] The electrical power supply **55** does not include a third connector **85** or electrical energy reserve **90**.

[0158] The electrical power supply **55** includes an electrical energy generator. It is understood by "electrical energy generator" that the electrical energy generator is not configured to be charged with electrical energy by an electric current.

[0159] The electrical energy generator is suitable for generating at least one electric current by reacting at least one chemical species present in the body of the patient P. More specifically, the electrical energy generator is suitable for generating the first power supply current C**1** and the second power supply current C**2**.

[0160] For example, the electrical energy generator comprises two electrodes, the electrodes being immersed in the gastric juices of the patient P when the centralisation device **20** is in the fixation position. Alternatively, the electrodes of the electrical energy generator are envisaged to be immersed in the intestine of the patient P when the centralisation device **20** is in the fixation position.

[0161] Each electrode includes at least one enzyme. Alternatively, each electrode includes at least one microorganism. For example, each electrode of the electrical energy generator includes an electrical conductor coated with the enzyme or microorganism, the whole thus formed being surrounded by a membrane. The membrane is, for example, configured to be traversed by certain chemical species naturally present in the stomach of the intestine of the patient P.

[0162] When the electrodes of the electrical energy generator are immersed in the gastric juices or in the intestinal fluid, one of the electrodes acts as an anode in an oxidation-reduction reaction involving a first chemical species. At the same time, the other electrode acts as a cathode in an oxidation-reduction reaction involving a second chemical species.

[0163] By the simultaneous oxidation and reduction of the first chemical species and the second chemical species, an electrical voltage appears between the two electrical conductors. The first power supply current C**1** and the second power supply current C**2** are then generated.

[0164] The first chemical species is, for example, glucose. The second chemical species is, for example, oxygen.

[0165] The sixth example of an implantable system **10** does not require electrical charging of an electrical energy reserve **90** or insertion of the electrical energy reserve **90** in the body of the patient P.

[0166] The constraints for the patient P are, here again, reduced.

[0167] According to a sixth example, the electrical energy generator is suitable for generating at least one electric current by converting mechanical energy into electrical energy. In particular, the electrical energy generator is suitable for generating at least one electric current from the movements of the stomach **30**.

[0168] In the above description, the functions of the implantable system **10** have been separated into several examples to facilitate the comprehension thereof by the reader. However, it is to be noted that the preceding examples may be combined to give rise to new embodiments.

[0169] For example, when the second device **25** is a device for stimulating the organ C, the centralisation device **20** is suitable for including a sensor **117**, the stimulation time period of the organ C then being computed by the first controller **45** based on the values measured by the sensor **117**.

[0170] Furthermore, the above description has been given in the case wherein the anchor **15** and the centralisation device **20** form two separate devices. Those skilled in the art will readily understand that the centralisation device **20** and the anchor **15** are suitable for forming a single device, the anchor **15** and the centralisation device **20** then not being separable from one another. For example, the anchor **15** is integral with the housing **65** of the centralisation device **20**.

[0171] According to a further example, the head **35** includes at least one base situated outside the stomach **30**. For example, the head **35** includes two bases.

[0172] Each base is configured to bear against the outer face of the wall of the stomach **30** and to be connected to the implantable device **20** so as to exert a force tending to press the implantable device **20** against the inner face of the wall of the stomach **30**. According to an alternative embodiment, each base is configured to be placed between the visceral layer and the parietal layer of the peritoneum and to bear against the visceral layer to press the implantable device **20** against the inner face of the wall of the stomach **30**.

[0173] Each base is, for example, a plate. Alternatively, each base includes a lattice of strands stretched on a frame, in particular a flexible frame suitable for being bent and inserted into to an endoscope or a hollow needle.

[0174] The first connector **40** includes, for example, one or a plurality of rings rigidly connected to the housing **65**. Each base is, for example, fixed to the implantable device **20** by one or a plurality of strands fixed to one or a plurality of rings.

[0175] Fixation by one or a plurality of bases makes it possible to distribute the pressure exerted by the implantable device over a larger surface of the wall of the stomach **30** and therefore decrease the pressure exerted. Furthermore, this fixation mode does not imply generating in the stomach wall a fold reducing the volume of the stomach, which is liable to give rise to tensions in the anchor fixed thereto.

Since the forces exerted on the stomach wall are reduced, the risks of onset of an inflammatory reaction of the gastric mucosa are limited.

1. An implantable system comprising:

a first device, called centralisation device, suitable for being implanted in a fixation position inside the body of a patient and

at least one second device including an electrode suitable for electrically connecting the second device to an organ of the patient when the second device is implanted, in a stimulation position, in the body of the patient,

the first device being further configured to command the transmission, by the electrode, of an electric current for stimulating the organ by the second device,

wherein the implantable system includes an anchor including a head configured to anchor the anchor to the wall of the patient's stomach, the anchor being configured to be fixed to the first device and to hold the first device in the fixation position thereof when the anchor is fixed in the stomach, the first device being accommodated in the stomach when the first device is in the fixation position thereof.

2. The implantable system according to claim **1**, wherein the first device is configured to supply the second device with power.

3. The implantable system according to claim **2**, wherein the centralisation device includes an acoustic wave emitter and the second device includes a stimulator suitable for stimulating the organ and a converter of acoustic energy into electrical energy, the converter being suitable for receiving the acoustic waves emitted by the centralisation device and for generating in response an electrical power supply current of the stimulator.

4. The implantable system according to claim **3**, wherein the acoustic wave is an ultrasound wave.

5. The implantable system according to claim **2**, wherein the centralisation device includes an electromagnetic wave emitter and the second device includes a stimulator suitable for stimulating the organ and a converter suitable for receiving electromagnetic waves emitted by the centralisation device and for generating in response an electrical power supply current of the stimulator.

6. The implantable system according to claim **1**, wherein the electrode is suitable for electrically connecting the second device to the heart of the patient.

7. The implantable system according to claim **6**, including at least two second devices.

8. The implantable system according to claim **1**, wherein the electrode is suitable for electrically connecting the second device (**25**) to a nerve of the patient (P).

9. The implantable system according to claim **8**, wherein the electrode is suitable for electrically connecting the second device to the phrenic nerve of the patient (P).

10. The implantable system according to claim **1**, wherein the electrode is suitable for electrically connecting the second device to the diaphragm of the patient.

11. The implantable system according to claim **1**, wherein the centralisation device or the second device includes at least one sensor suitable for measuring at least one value of a parameter of the organ and the centralisation device comprises a controller suitable for commanding the stimulation of the organ, by the second device, according to the measured value(s).

12. The implantable system according to claim **1**, wherein the centralisation device comprises a controller and an electrical power supply including a removable electrical energy reserve and a connector suitable for accommodating the electrical energy reserve, the electrical energy reserve being suitable for electrically powering the controller when the electrical energy reserve is connected electrically to the connector in a connection position and preferably being configured to be swallowed by the patient and to move spontaneously to the connection position from a disconnection position wherein the electrical energy reserve is accommodated in the stomach of the patient and is disconnected from the connector.

13. The implantalbe system according to claim **1**, wherein the centralisation device comprises a controller and an electrical power supply suitable for generating an electrical power supply current of the controller by reacting at least one chemical species present in the body of the patient, particularly glucose.

14. The implantable system according to claim **1**, wherein the centralisation device comprises a controller and an electrical power supply suitable for generating an electrical power supply current of the controller by converting mechanical energy into electrical energy.

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