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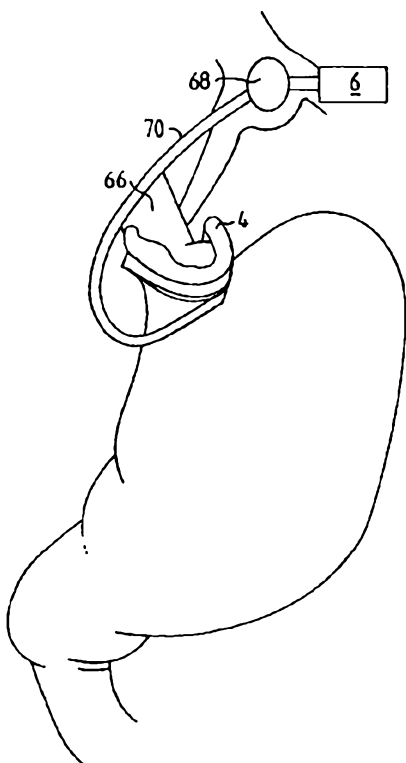
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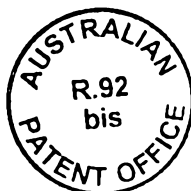
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(54) Title: HEARTBURN AND REFLUX DISEASE TREATMENT APPARATUS WITH ENERGY TRANSFORMING MEANS



(57) Abstract: A heartburn and reflux disease treatment apparatus comprises an operable restriction device implantable in a patient for engaging the stomach close to the cardia or engaging the esophagus to form a restricted food passageway. An energy transmission means for wireless transmission of energy of a first form from outside the patient's body is provided. The restriction device is operable in response to energy of a second form different than the energy of the first form to vary the restricted food passageway. An implantable energy transforming means is adapted to transform the energy of the first form transmitted by the energy transmission means into the energy of the second form.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**HEARTBURN AND REFLUX DISEASE TREATMENT APPARATUS WITH ENERGY
TRANSFORMING MEANS**

5 The present invention relates to a heartburn and reflux
disease treatment apparatus. More specifically, the invention
relates to a heartburn and reflux disease treatment apparatus
for surgical application in the abdomen of a patient for
forming a restricted food passageway in the esophagus or
10 stomach. The term "patient" includes an animal or a human
being.

Heartburn and reflux disease is a widespread medical
problem. This is often due to hiatal hernia, i.e. a portion of
the stomach immediately below the gastric fundus slides
15 upwardly through the esophageal hiatus. In consequence,
stomach acids and foods are regurgitated into the esophagus.

In the late 1970s a prior art prosthesis called
Angelchik, according to U.S. Patent No. 3,875,928, was used to
operatively treat heartburn and reflux disease. However, the
20 Angelchik prosthesis had a major disadvantage in that it was
not possible to adjust the size of the restriction opening
after the operation. A further disadvantage was that the
prosthesis did not satisfactorily protect the esophagus and
the surrounding area against injuries due to poor shape of the
25 prosthesis. Therefore, operations using the Angelchik
prosthesis are no longer practised.

An operation technique, semi-fundoduplicatio, is
currently in use for treating heartburn and reflux disease. A
most common operation is Nissen semi-fundoduplicatio, in which
30 one takes the fundus of the stomach and makes a three quarter
of a turn around the esophagus and sutures between the stomach
and esophagus. Although this operation works fairly well it

has three main disadvantages. Firstly, most patients treated in accordance to "ad modum Nissen" lose their ability to belch. Secondly, many of these patients get dysphagia, i.e. difficulties to swallow after the operation. Thirdly, it is not possible to adjust the food passageway in the esophagus or stomach in any way after the operation. Characteristic for these patients is the variation of their problems over the day. For example, many patients have difficulties during the night when they lie down because of stomach acid leaking up into the esophagus.

The object of the present invention is to provide a new convenient heartburn and reflux disease treatment apparatus, the performance of which may be affected by the patient at any time after operation, in particular when various needs arise over the day, so that the patient always is satisfied.

Accordingly, in accordance with the present invention, there is provided a heartburn and reflux disease treatment apparatus comprising an operable restriction device implantable in a patient for engaging the stomach close to the cardia or engaging the esophagus to form a restricted food passageway in the stomach or esophagus, an energy transmission means for wireless transmission of energy of a first form from outside the patient's body, the restriction device being operable in response to energy of a second form different than the energy of the first form to vary the restricted food passageway, and an energy transforming means implantable in the patient for transforming the energy of the first form wirelessly transmitted by the energy transmission means into the energy of the second form.

As a result, the advantage is achieved that the heartburn and reflux disease treatment apparatus of the invention provides simple and effective energy transmission which

ensures long reliable function of the apparatus, possibly for the rest of the patient's life.

In accordance with a preferred embodiment of the invention, the energy transforming means comprises at least
5 one element having a positive region and a negative region, wherein the element is capable of creating an energy field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy transmission means, and the energy field produces the energy
10 of the second form.

Alternatively, at least one semiconductor circuitry, transistor circuitry or microchip may be substituted for the element of the apparatus having positive and negative regions. Such a semiconductor circuitry, transistor circuitry or
15 microchip is adapted to create an energy field when exposed to the energy of the first form wirelessly transmitted by the energy transmission means, whereby the energy field provides the energy of the second form.

The restriction device preferably controls the cross-
20 sectional area of the food passageway in the stomach or esophagus, which gives the advantage that the patient is enabled to adjust the cross-sectional area of the food passageway whenever he likes during the day. This advantage should not be underestimated, because in case the patient
25 would need to vomit it would be very difficult for him to do so if he were unable to enlarge the cross-sectional area of the food passageway.

Advantageously, the restriction device is directly operated with the energy of the second form, preferably in a
30 non-magnetic and/or non-mechanical manner, as the energy transmission means transmits the energy of the first form. The restriction device may be directly operated with the energy of

the second form without externally touching subcutaneously implantable components of the apparatus. The advantage of directly using energy as it is transmitted is that the apparatus can be of a very simple design and the few
5 components involved makes the apparatus extremely reliable.

The restriction device may be non-inflatable, i.e. with no hydraulic fluid involved for the adjustments of the restriction device. This eliminates problems with fluid leaking from the restriction device.

10 Preferably, the element having positive and negative regions comprises an electrical junction element, which is capable of inducing an electric field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy transmission means, whereby the
15 energy of the second form comprises electric energy.

In consequence, the restriction device suitably is electrically operated, whereby the positive and negative regions of the electrical junction element supply electric energy for the operation of the restriction device. The
20 apparatus suitably comprises implantable electric conductors connected to the positive and negative regions of the electrical junction element, whereby the electrical junction element is capable of supplying an electric current, such as a direct current, a pulsating direct current, a combination of a
25 direct and pulsating direct current, an alternating current or a combination of a direct and alternating current, via the conductors. Furthermore, the electrical junction element may be capable of supplying a frequency, amplitude, or frequency and amplitude modulated analog, digital, or a combination of
30 analog and digital signal, which is used in connection with control of the restriction device.

The element, preferably in the form of an electrical

semiconductor junction element, suitably forms a flat and thin sheet and has a volume of less than 2000 cm³ to be suited for subcutaneous implantation, so that the electrical junction element can be located just behind the skin of the patient.

5 The electrical junction element should be designed to generate an output current exceeding 1 μ A when exposed to the energy of the first form transmitted by the energy transmission means. Of course, all the components of the energy transforming means including the electrical junction element in contact with the
10 patient's body should be of a biocompatible material.

Alternatively, it would be possible to implant the energy transforming means in the thorax or cephal region of the patient, or in an orifice of the patient's body and under the mucosa or intraluminal outside the mucosa of the orifice.

15 For *in vitro* appliances, a particular type of an electrical semiconductor junction element has been commonly used, namely a so called p-n (positive/negative) junction element, typically in the form of solar cells. A solar cell transforms solar energy in the form of visible light into
20 electric energy in the form of direct current. For example, a p-n junction element may comprise two layers of semiconductor, one p-type (positive) and the other n-type (negative), sandwiched together to form a "p-n junction". This p-n junction induces an electric field across the element when absorbing
25 quanta of light (photons).

To be more precise, the quanta of light transfer their energy to some of the semiconductor's electrons, which are then able to move about through the material. For each such negatively charged electron, a corresponding positive charge -
30 a "hole" - is created. In an ordinary semiconductor, these electrons and holes recombine after a short time and their energy is wasted as heat. However, when the electrons and

holes are swept across the p-n junction in opposite directions by the action of the electric field, the separation of charge induces a voltage across the p-n junction element. By connecting the p-n junction element to an external circuit, the electrons are able to flow thereby creating a current.

Surprisingly, it has been proved that although both the skin and subcutis absorb energy from an external light beam directed against the skin portion behind which a properly designed p-n junction element is located, the light energy transmitted through the skin can induce a current from the p-n junction element strong enough (minimum 1 μ A) to enable the operation of the electrically operated restriction device. Thus, such a p-n junction element is now for the first time used for *in vivo* applications.

However, the apparatus of the present invention is not limited to the use of visible light for the wireless transmission of energy. Thus, in accordance with a broad aspect of the invention, the energy transmission means transmits energy by at least one wireless signal, preferably containing radiant energy.

The wireless signal may comprises a wave signal, for example an electromagnetic wave signal, such as an infrared light signal, a visible light signal, an ultra violet light signal, a laser signal, a micro wave signal, a radio wave signal, an x-ray radiation signal, and a gamma radiation signal. Where applicable, one or more of the above signals may be combined. Alternatively, the wave signal may comprise a sound wave signal, such as an ultrasonic signal. Generally, the wireless signal may comprise a digital, analog or a digital and analog signal.

The energy of the first form transmitted by the energy transmission means may comprise an electric or magnetic field

transmitted in pulses, for example digital pulses.

Furthermore, the energy transforming means may transmit the energy of the first form, which may comprise polarized energy, into a direct current, pulsating direct current, a combination
5 of a direct and pulsating direct current, an alternating current or a combination of a direct and alternating current. Alternatively, the energy of the first form may comprise kinetic energy.

The energy of the second form may comprise a frequency,
10 amplitude or frequency and amplitude modulated analog, digital or combined analog and digital signal.

The apparatus may further comprise an implantable pulse generator for generating electrical pulses from the energy of the second form produced by the energy field created by the
15 element having positive and negative regions.

In accordance with a main embodiment of the invention, the apparatus comprises an implantable operation device for operating the restriction device and a control device for controlling the operation device, wherein the element powers
20 the operation device with the energy of the second form. The operation device preferably comprises a motor, for example an electric linear motor or an electric rotary motor which is controlled by the control device to rotate a desired number of revolutions. The electric motor may have electrically
25 conductive parts made of plastics. Alternatively, the motor may comprise a hydraulic or pneumatic fluid motor, wherein the control device controls the fluid flow through the fluid motor. Motors currently available on the market are getting smaller and smaller. Furthermore, there is a great variety of
30 control methods and miniaturized control equipment available. For example, a number of revolutions of a rotary motor may be analyzed by a Hall-element just a few mm in size.

In accordance with another embodiment of the invention, the restriction device comprises hydraulic means and the operation device comprises a pump for pumping a fluid in the hydraulic means, a motor for driving the pump, a valveless
5 fluid conduit between the pump and the hydraulic means of the restriction device, and a reservoir for fluid, wherein the reservoir forms part of the conduit. All of the hydraulic components involved are preferably devoid of any non-return valve. This is of great advantage, because with valves
10 involved there is always a risk of malfunction due to improperly working valves, especially when long time periods pass between valve operations. The reservoir may form a fluid chamber with a variable volume, and the pump may distribute fluid from the chamber to the hydraulic means of
15 the restriction device by reduction of the volume of the chamber and withdraw fluid from the hydraulic means to the chamber by expansion of the volume of the chamber.

The control device may reverse the operation device by shifting polarity of the energy of the second form. Where the
20 operation device comprises an electric motor the energy of the second form suitably comprises electric energy.

In accordance with yet another embodiment of the invention, the restriction device is operable to perform a reversible function, such as enlarging and restricting the
25 food passageway, and there is a reversing device implantable in the patient for reversing the function performed by the restriction device. Such a reversing function preferably involves enlarging and restricting the food passageway by the restriction device, suitably in a stepless manner. In this
30 connection, the control device suitably controls the reversing device, which may include a switch, to reverse the function performed by the restriction device. The reversing device may

comprise hydraulic means including a valve for shifting the flow direction of a fluid in the hydraulic means.

Alternatively, the reversing device may comprise a mechanical reversing device, such as a switch or a gear box.

5 Where the reversing device comprises a switch, the control device suitably controls the operation of the switch by shifting polarity of the energy supplied to the switch. The switch may comprise an electric switch and the source of energy may supply electric energy for the operation of the
10 switch.

 In accordance with an advantageous embodiment of the invention, the apparatus further comprises an energy storage device implantable in the patient for storing the energy of the second form and for supplying energy in connection with
15 the operation of the restriction device. The implantable energy storage device preferably comprises an electric source of energy, such as an accumulator, a rechargeable battery or a combination of an accumulator and rechargeable battery.

 The apparatus may further comprise a switch implantable
20 in the patient for switching the operation of the restriction device and a source of energy implantable in the patient. This embodiment is particularly suited for applications where the energy transmission efficiency of the apparatus is insufficient, *i.e.* where the implantable restriction device is
25 to perform more advanced operations. Such a source of energy preferably is a battery. Alternatively, the source of energy is an accumulator which also may store the energy of the second form.

 In accordance with a first alternative, the switch is
30 operated by the energy of the second form supplied by the energy storage device to switch from an off mode, in which the source of energy is not in use, to an on mode, in which the

source of energy supplies energy for the operation of the restriction device. In this case, the implantable source of energy may comprise a battery, preferably having a life-time of at least 10 years, or an accumulator. However, other kinds
5 of sources are also conceivable, such as a nuclear source of energy or a chemical source of energy.

In accordance with a second alternative, the apparatus further comprises a remote control for controlling the supply of energy of the implantable source of energy, wherein the
10 switch is operated by the energy of the second form supplied by the energy storage device to switch from an off mode, in which the remote control is prevented from controlling the source of energy and the source of energy is not in use, to a standby mode, in which the remote control is permitted to
15 control the source of energy to supply energy for the operation of the restriction device.

In accordance with a third alternative, the energy storage device is omitted, wherein the switch is operated by the energy of the second form supplied by the energy
20 transforming means to switch from an off mode, in which the remote control is prevented from controlling the source of energy and the source of energy is not in use, to a standby mode, in which the remote control is permitted to control the source of energy to supply energy for the operation of the
25 restriction device.

In accordance with a fourth alternative, also the remote control is omitted, wherein the switch is operated by the energy of the second form supplied by the energy transforming means to switch from an off mode, in which the source of
30 energy is not in use, to an on mode, in which the source of energy supplies energy for the operation of the restriction device. Where applicable, in the described embodiments the

switch may switch when the energy transmission means is transmitting wireless energy, preferably while the transformed energy of the second form is stabilized by an implantable capacitor, which may temporarily (for a few seconds) store the energy of the second form.

The switch mentioned above may comprise an electronic switch or, where applicable, a mechanical switch.

The advantage of using a switch above all is increased control safety, i.e. interfering signals in the patient's surroundings cannot affect the restriction device when the latter is implanted. Furthermore, the lifetime of the implantable source of energy will be significantly prolonged, since the energy consumption of the apparatus will be reduced to a minimum. During the above mentioned standby mode, the remote control uses energy from the implantable source of energy. By means of the energy transmission means energy may be transmitted to activate the switch to connect the implantable source of energy only when energy is required in connection with the operation of the restriction device.

All of the above embodiments may be combined with at least one implantable sensor for sensing at least one physical parameter of the patient, wherein the control device may control the restriction device in response to signals from the sensor. For example, the sensor may comprise a pressure sensor for directly or indirectly sensing the pressure in the food passageway. The expression "indirectly sensing the pressure in the food passageway" should be understood to encompass the cases where the sensor senses the pressure against the restriction device or human tissue of the patient. The control device may comprise an internal control unit implantable in the patient for, preferably directly, controlling the restriction device in response to signals from the sensor. In

response to sensings sensed by the sensor, for example pressure, the patient's position or any other important physical parameter, the internal control unit may send information thereon to outside the patient's body. The control
5 unit may also automatically control the restriction device in response to signals from the sensor. For example, the control unit may control the restriction device to further restrict the food passageway in the stomach in response to the sensor sensing that the patient is lying, or enlarge the food
10 passageway in response to the sensor sensing an abnormally high pressure against the restriction device.

Alternatively, the control device may comprise an external control unit outside the patient's body for, suitably directly, controlling the restriction device in response to
15 signals from the sensor. The external control unit may store information on the physical parameter sensed by the sensor and may be manually operated to control the restriction device based on the stored information. In addition, there may be at least one implantable sender for sending information on the
20 physical parameter sensed by the sensor.

An external data communicator may be provided outside the patient's body and an implantable internal data communicator may be provided for communicating with the external communicator. The internal data communicator may feed data
25 related to the patient, or related to the implantable restriction device, back to the external data communicator. Alternatively or in combination, the external data communicator may feed data to the internal data communicator. The internal data communicator may suitably feed data related
30 to at least one physical signal of the patient. The arrangement of external and internal data communicators gives the advantage, among other things, that a long term control of

activities related to the implantable restriction device is possible.

The apparatus may further comprise an implantable programmable control unit for controlling the restriction device, preferably over time in accordance with an activity schedule program. This will advance the apparatus and make possible an adaptation of the apparatus to the individual patients.

All of the above embodiments are preferably remote controlled. Thus, the apparatus advantageously comprises a wireless remote control transmitting at least one wireless control signal for controlling the restriction device. With such a remote control it will be possible to adapt the function of the apparatus to the patient's need in a daily basis, which is beneficial with respect to the treatment of the patient.

The wireless remote control may be capable of obtaining information on the condition of the implantable restriction device and of controlling the restriction device in response to the information. Also, the remote control may be capable of sending information related to the restriction device from inside the patient's body to the outside thereof.

In a particular embodiment of the invention, the wireless remote control comprises at least one external signal transmitter or transceiver and at least one internal signal receiver or transceiver implantable in the patient. In another particular embodiment of the invention, the wireless remote control comprises at least one external signal receiver or transceiver and at least one internal signal transmitter or transceiver implantable in the patient.

The wireless remote control may transmit a carrier signal for carrying the control signal, wherein the carrier signal is

frequency, amplitude or frequency and amplitude modulated and is digital, analog or digital and analog. Also the control signal used with the carrier signal may be frequency, amplitude or frequency and amplitude modulated.

5 The control signal may comprise a wave signal, for example, a sound wave signal, such as an ultrasound wave signal, an electromagnetic wave signal, such as an infrared light signal, a visible light signal, an ultra violet light signal, a laser signal, a micro wave signal, a radio wave
10 signal, an x-ray radiation signal, or a gamma radiation signal. Where applicable, two or more of the above signals may be combined.

 The control signal may be digital or analog, and may comprise an electric or magnetic field. Suitably, the wireless
15 remote control may transmit an electromagnetic carrier wave signal for carrying the digital or analog control signal. For example, use of an analog carrier wave signal carrying a digital control signal would give safe communication. The control signal may be transmitted in pulses by the wireless
20 remote control.

 The energy transforming means may be placed in the thorax, abdomen or cephal region, or implanted subcutaneously. In accordance with a third main aspect of the invention, a transistor circuitry is substituted for the element of the
25 apparatus having positive and negative regions.

 In accordance with a fourth main aspect of the invention, a microchips is substituted for the element of the apparatus having positive and negative regions.

 The present invention also provides a method for
30 implanting the heartburn and reflux disease apparatus of the invention, comprising the steps of providing a heartburn and reflux disease treatment apparatus as described above, cutting

an opening in a patient's mucosa in an orifice of the patient's body, and implanting the energy transforming means in the patient's body through the opening. Alternatively, the cutting step may comprise cutting an opening in the patient's skin and
5 the implanting step may comprise implanting the energy transforming means in the patient's body through the opening.

There is also provided a laparoscopical implanting method, in accordance with a first alternative, comprising the steps of providing a heartburn and reflux disease treatment
10 apparatus as described above, placing at least two laparoscopic cannula within a patient's body, and implanting the energy transforming means in the patient's body by using the at least two laparoscopic cannula.

In accordance with a second alternative there is provided
15 a laparoscopic surgical method of implanting a heartburn and reflux disease treatment apparatus, comprising the step of a) laparoscopically placing a restriction device of the apparatus through the abdomen or thorax of a patient, b) placing at least two laparoscopic trocar within the patient's body, c)
20 using at least one dissecting tool inserted through the laparoscopic trocar, dissecting the region of the esophagus or stomach, d) introducing the restriction device through the trocar, e) placing the restriction device in engagement with the stomach close to the cardia or in engagement with the
25 esophagus to form a restricted food passageway, and f) implanting an energy transforming means of the apparatus.

The energy transforming means of the apparatus may be implanted, for example subcutaneously, in the abdomen, thorax or cephal region, or other locations in the patient's body.
30

The invention is described in more detail in the following with reference to the accompanying drawings, in which

FIGURES 1 to 12 are schematic block diagrams illustrating twelve embodiments, respectively, of the heartburn and reflux disease treatment apparatus of the invention, in which wireless energy is transmitted from outside a patient's body to energy consuming components of the apparatus implanted in the patient;

FIGURE 13 is a schematic block diagram illustrating conceivable combinations of implantable components for achieving various communication options;

FIGURE 14 illustrates an electrical junction element for use in the apparatus of the present invention; and

FIGURE 15 illustrates the apparatus in accordance with the invention implanted in a patient.

Referring to the drawing figures, like reference numerals designate identical or corresponding elements throughout the several figures.

Fig. 1 schematically shows a most simple embodiment of the heartburn and reflux disease apparatus of the invention having some parts implanted in a patient and other parts located outside the patient's body. Thus, in Fig. 1 all parts placed to the right of the patient's skin 2 are implanted and all parts placed to the left of the skin 2 are located outside the patient's body.

The apparatus of Fig. 1 comprises an implanted operable restriction device 4, which engages the patient's stomach close to the cardia (or alternatively engages the esophagus) to form a restricted food passageway in the stomach. The restriction device 4 is capable of performing a reversible function, i.e. to enlarge and reduce the cross-sectional area of the food passageway, whereby the restriction device 4 works as an artificial sphincter. An implanted energy transforming means 6

is adapted to supply energy consuming components of the restriction device 4 with energy via a power supply line 12. An external energy transmission means 10 includes a wireless remote control transmitting a wireless signal which is
5 received by a signal receiver incorporated in the implanted energy transforming means 6. The implanted energy transforming means 6 transforms energy from the signal into electric energy which is supplied via the power supply line 12.

Fig. 2 shows an embodiment of the invention identical to
10 that of Fig. 1, except that a reversing device in the form of an electric switch 14 also is implanted in the patient for reversing the restriction device 4. The wireless remote control of the external energy transmission means 10 transmits a wireless energy carrying signal and the implanted energy
15 transforming means 6 transforms the wireless energy into a current for operating the switch 14. When the polarity of the current is shifted by the energy transforming means 6 the switch 14 reverses the function performed by the restriction device 4.

Fig. 3 shows an embodiment of the invention identical to
20 that of Fig. 1, except that an operation device in the form of a motor 15 for operating the restriction device 4 also is implanted in the patient. The motor 15 is powered with energy from the energy transforming means 6, as the remote control of
25 the external energy transmission means 10 transmits a wireless signal to the receiver of the energy transforming means 6.

Fig. 4 shows an embodiment of the invention identical to that of Fig. 1, except that an assembly 16 including a motor/pump unit 18 and a fluid reservoir 20 also is implanted
30 in the patient. In this case the restriction device 4 is hydraulically operated, i.e. hydraulic fluid is pumped by the motor/pump unit 18 from the reservoir 20 through a conduit 22

to the restriction device 4 to reduce the cross-sectional area of the food passageway, and hydraulic fluid is pumped by the motor/pump unit 18 back from the restriction device 4 to the reservoir 20 to enlarge the cross-sectional area. The

5 implanted energy transforming means 6 transforms wireless energy into a current for powering the motor/pump unit 18 via an electric power supply line 24.

Fig. 5 shows an embodiment of the invention comprising the external energy transmission means 10 with its wireless remote
10 control, the restriction device 4, in this case hydraulically operated, and the energy transforming means 6, and further comprising an implanted hydraulic fluid reservoir 30, an implanted motor/pump unit 32 and an implanted reversing device in the form of a hydraulic valve shifting device 34. The motor
15 of the motor/pump unit 32 is an electric motor. In response to a control signal from the wireless remote control of the external energy transmission means 10, the energy transforming means 6 powers the motor/pump unit 32 with energy carried by the control signal, whereby the motor/pump unit 32 distributes
20 hydraulic fluid between the reservoir 30 and the restriction device 4. The remote control of the energy transmission means 10 controls the shifting device 34 to shift the hydraulic fluid flow direction between one direction in which the fluid is pumped by the motor/pump unit 32 from the reservoir 30 to
25 the restriction device 4 to reduce the cross-sectional area of the food passageway, and another opposite direction in which the fluid is pumped by the motor/pump unit 32 back from the restriction device 4 to the reservoir 30 to enlarge the cross-sectional area.

30 Fig. 6 shows an embodiment of the invention identical to that of Fig. 1, except that a control unit 36 controlled by the wireless remote control of the external energy

transmission means 10, an accumulator 38 and a capacitor 40 also are implanted in the patient. The control unit 36 stores electric energy received from the energy transforming means 6 in the accumulator 38, which supplies energy to the
5 restriction device 4. In response to a control signal from the wireless remote control of the energy transmission means 10, the control unit 6 either releases electric energy from the accumulator 38 and transfers the released energy via power lines 42 and 44, or directly transfers electric energy from
10 the energy transforming means 6 via a power line 46, the capacitor 40, which stabilizes the electric current, a power line 48 and the power line 44, for the operation of the restriction device 4.

In accordance with one alternative, the capacitor 40 in the
15 embodiment of Fig. 6 may be omitted. In accordance with another alternative, the accumulator 38 in this embodiment may be omitted.

Fig. 7 shows an embodiment of the invention identical to that of Fig. 1, except that a battery 50 for supplying energy
20 for the operation of the restriction device 4 and an electric switch 52 for switching the operation of the restriction device 4 also are implanted in the patient. The switch 52 is operated by the energy supplied by the energy transforming means 6 to switch from an off mode, in which the battery 50 is
25 not in use, to an on mode, in which the battery 50 supplies energy for the operation of the restriction device 4.

Fig. 8 shows an embodiment of the invention identical to that of Fig. 7, except that a control unit 36 controllable by the wireless remote control of the external energy
30 transmission means 10 also is implanted in the patient. In this case, the switch 52 is operated by the energy supplied by the energy transforming means 6 to switch from an off mode, in

which the wireless remote control is prevented from controlling the control unit 36 and the battery is not in use, to a standby mode, in which the remote control is permitted to control the control unit 36 to release electric energy from the battery 50 for the operation of the restriction device 4.

Fig. 9 shows an embodiment of the invention identical to that of Fig. 8, except that an accumulator 38 is substituted for the battery 50 and the implanted components are interconnected differently. In this case, the accumulator 38 stores energy from the energy transforming means 6. In response to a control signal from the wireless remote control of the external energy transmission means 10, the implanted control unit 36 controls the switch 52 to switch from an off mode, in which the accumulator 38 is not in use, to an on mode, in which the accumulator 38 supplies energy for the operation of the restriction device 4.

Fig. 10 shows an embodiment of the invention identical to that of Fig. 9, except that a battery 50 also is implanted in the patient and the implanted components are interconnected differently. In response to a control signal from the wireless remote control of the external energy transmission means 10, the implanted control unit 36 controls the accumulator 38 to deliver energy for operating the switch 52 to switch from an off mode, in which the battery 50 is not in use, to an on mode, in which the battery 50 supplies electric energy for the operation of the restriction device 4.

Alternatively, the switch 52 may be operated by energy supplied by the accumulator 38 to switch from an off mode, in which the wireless remote control is prevented from controlling the battery 50 to supply electric energy and is not in use, to a standby mode, in which the wireless remote control is permitted to control the battery 50 to supply

electric energy for the operation of the restriction device 4.

Fig. 11 shows an embodiment of the invention identical to that of Fig. 7, except that a motor 15, a mechanical reversing device in the form of a gear box 54 and a control unit 36 for
5 controlling the gear box 54 also are implanted in the patient. The implanted control unit 36 controls the gear box 54 to reverse the function performed by the restriction device 4 (mechanically operated).

Fig. 12 shows an embodiment of the invention identical to
10 that of Fig. 10 except that the implanted components are interconnected differently. Thus, in this case the control unit 36 is powered by the battery 50 when the accumulator 38, suitably a capacitor, activates the switch 52 to switch to an on mode. When the switch 52 is in its on mode the control unit
15 36 is permitted to control the battery 50 to supply, or not supply, energy for the operation of the restriction device 4.

Fig. 13 schematically shows conceivable combinations of implantable components of the apparatus for achieving various communication options. Basically, there are the restriction
20 device 4, control unit 36 and motor/pump unit 18, and the external energy transmission means 10 including the external wireless remote control. As already described above the wireless remote control transmits a control signal which is received by the control unit 36, which in turn controls the
25 various implanted components of the apparatus.

A sensor 56 may be implanted in the patient for sensing a physical parameter of the patient, such as the pressure in the food passageway. The implanted control unit 36, or
alternatively the external wireless remote control of the
30 energy transmission means 10, may control the restriction device 4 in response to signals from the sensor 56. A transceiver may be combined with the sensor 56 for sending

information on the sensed physical parameter to the external wireless remote control. The wireless remote control may comprise a signal transmitter or transceiver and the implanted control unit 36 may comprise a signal receiver or transceiver.

5 Alternatively, the wireless remote control may comprise a signal receiver or transceiver and the implanted control unit 36 may comprise a signal transmitter or transceiver. The above transceivers, transmitters and receivers may be used for sending information or data related to the restriction device
10 4 from inside the patient's body to the outside thereof.

Where the motor/pump unit 18 and battery 50 for powering the motor/pump unit 18 are implanted, the battery 50 may be equipped with a transceiver for sending information on the condition of the battery 50.

15 Those skilled in the art will realize that the above various embodiments according to Figs. 1-13 could be combined in many different ways. For example, the energy operated switch 14 could be incorporated in any of the embodiments of Figs. 3, 6-12, the hydraulic shifting device 34 could be
20 incorporated in the embodiment of Fig. 4, and the gear box 54 could be incorporated in the embodiment of Fig. 3.

Figur 14 shows an energy transforming means in the form of an electrical junction element 58 for use in any of the above embodiments according to Figs. 1-13. The element 58 is a flat
25 p-n junction element comprising a p-type semiconductor layer 60 and an n-type semiconductor layer 62 sandwiched together. A light bulb 64 is electrically connected to opposite sides of the element 58 to illustrate how the generated current is obtained. The output of current from such a p-n junction
30 element 58 is correlated to the temperature. See the formula below.

$$I = I_0 (\exp(qV/kT) - 1)$$

where

I is the external current flow,

5 I₀ is the reverse saturation current,

q is the fundamental electronic charge of 1.602×10^{-19} coulombs,

V is the applied voltage,

k is the Boltzmann constant, and

10 T is the absolute temperature.

Under large negative applied voltage (reverse bias), the exponential term becomes negligible compared to 1.0, and I is approximately -I₀. I₀ is strongly dependent on the temperature
15 of the junction and hence on the intrinsic-carrier concentration. I₀ is larger for materials with smaller bandgaps than for those with larger bandgaps. The rectifier action of the diode - that is, its restriction of current flow to only one direction - is in this particular embodiment the
20 key to the operation of the p-n junction element 58.

An alternative way to design a p-n junction element is to deposit a thin layer of semiconductor onto a supporting material which does not absorb the kind of energy utilized in the respective embodiments. For use with wirelessly
25 transmitted energy in terms of light waves, glass could be a suitable material. Various materials may be used in the semiconductor layers such as but not limited to cadmium telluride, copper-indium-diselenide and silicon. It is also possible to use a multilayer structure with several layers of
30 p and n-type materials to improve efficiency.

The electric energy generated by the p-n junction element 58 could be of the same type as generated by solar cells, in

which the negative and positive fields create a direct current. Alternatively, the negative and positive semiconductor layers may change polarity following the transmitted waves, thereby generating an alternating current.

5 The p-n junction element 58 is designed to make it suited for implantation. Thus, all the external surfaces of the element 58 in contact with the human body are made of a biocompatible material. The p-n junction semiconductors are designed to operate optimally at a body temperature of 37° C
10 because the current output, which should be more than 1 μ A, is significantly depending on temperature as shown above. Since both the skin and subcutis absorb energy, the relation between the sensitivity or working area of the element 58 and the intensity or strength of the wireless energy transmission is
15 considered. The p-n junction element 58 preferably is designed flat and small. Alternatively, if the element 58 is made in larger sizes it should be flexible, in order to adapt to the patient's body movements. The volume of the element 58 should be kept less than 2000 cm³.

20 Fig. 15 generally illustrates how any of the above-described embodiments of the heartburn and reflux disease treatment apparatus of the invention may be implanted in a patient. Thus, a restriction device 4 engages the esophagus 66
25 close to the cardia to form an artificial sphincter around the food passageway in the esophagus. An implanted operation device 68, such as an electric motor or a motor/pump assembly, operates the restriction device 4 through a transmission member 70, such as a mechanical transmission cord or a fluid
30 tube. An energy transforming means in the form of an element 6 having a positive region and a negative region, as described above in more detail, is placed underneath the skin of the patient.

Wireless energy carried by a signal transmitted by a wireless remote control of an external energy transmission means 10 at least partly penetrates the patient's skin and hits the element 6. The energy thus hitting the element 6 is transformed into energy of a different form that is suited for powering the operation device 68. For example, where the operation device 68 is an electric motor the element 6 comprises an electric p-n junction element that transforms the wireless energy into an electric current for powering the electric motor. Where the operation device 68 comprises a pump, the element 6 may transform the wireless energy into kinetic energy for powering the pump.

The transformed energy may be utilized for directly operating the restriction device 4 or, where the restriction device 4 is electrically operated, for storage in a capacitor and/or an accumulator for later or parallel use. Preferably (but not necessarily) the element 6 is controlled by a microprocessor. The wireless remote control of the external energy transmission means 10 is used to control the utilization of the transmitted energy and any function or command to/from the implanted restriction device 4.

CLAIMS

1. A heartburn and reflux disease treatment apparatus,

5 comprising:

an operable restriction device implantable in a patient for engaging the stomach close to the cardia or engaging the esophagus to form a restricted food passageway in the stomach or esophagus,

10 an energy transmission means for wireless transmission of energy of a first form from outside the patient's body, the restriction device being operable in response to energy of a second form different than the energy of the first form to vary the restricted food passageway, and

15 an energy transforming means implantable in the patient for transforming the energy of the first form wirelessly transmitted by the energy transmission means into the energy of the second form.

20 2. An apparatus according to claim 1, wherein the energy transforming means comprises at least one element having a positive region and a negative region, the element is capable of creating an energy field between the positive and negative regions when exposed to the energy of the first form
25 transmitted by the energy transmission means, and the energy field produces the energy of the second form.

3. An apparatus according to claim 2, wherein the element comprises an electrical junction element, and the electrical
30 junction element is capable of inducing an electric field between the positive and negative regions when exposed to the energy of the first form transmitted by the energy

transmission means, whereby the energy of the second form comprises electric energy.

4. An apparatus according to claim 3, wherein the restriction
5 device is electrically operated, and the positive and negative regions of the electrical junction element supply electric energy for the operation of the restriction device.

5. An apparatus according to claim 4, further comprising
10 electric conductors connected to the positive and negative regions of the electrical junction element, whereby the electrical junction element is capable of supplying an electric current via the conductors.

6. An apparatus according to claim 5, wherein the electrical
15 junction element is capable of supplying a direct current or pulsating direct current via the conductors.

7. An apparatus according to claim 5, wherein the electrical
20 junction element is capable of supplying an alternating current or a combination of a direct and alternating current via the conductors.

8. An apparatus according to claim 4, wherein the electrical
25 junction element is capable of supplying a frequency or amplitude modulated signal.

9. An apparatus according to claim 4, wherein the electrical
junction element is capable of supplying an analog or digital
30 signal.

10. An apparatus according to claim 1, further comprising an

implantable operation device for operating the restriction device, wherein the energy transforming means powers the operation device with the energy of the second form.

5 11. An apparatus according to claim 10, wherein the operation device comprises a motor.

12. An apparatus according to claim 11, further comprising a control device, wherein the motor comprises a rotary motor,
10 and the control device controls the rotary motor to rotate a desired number of revolutions.

13. An apparatus according to claim 11, wherein the motor comprises a linear motor.

15

14. An apparatus according to claim 11, further comprising a control device, wherein the motor comprises a hydraulic or pneumatic fluid motor, and the control device controls the fluid motor.

20

15. An apparatus according to claim 11, wherein the motor comprises an electric motor having electrically conductive parts made of plastics.

25 16. An apparatus according to claim 10, wherein the restriction device comprises hydraulic means and the operation device comprises a pump for pumping a fluid in the hydraulic means.

30 17. An apparatus according to claim 16, wherein the operation device comprises a motor for driving the pump.

18. An apparatus according to claim 16, wherein the operation device comprises a fluid conduit between the pump and the hydraulic means of the restriction device, and a reservoir for fluid, the reservoir forming part of the conduit.

5

19. An apparatus according to claim 18, wherein the hydraulic means, pump and conduit are devoid of any non-return valve.

10

20. An apparatus according to claim 19, wherein the reservoir forms a fluid chamber with a variable volume, and the pump distributes fluid from the chamber to the hydraulic means of the restriction device by reduction of the volume of the chamber and withdraws fluid from the hydraulic means to the chamber by expansion of the volume of the chamber.

15

21. An apparatus according to claim 10, further comprising a control device for controlling the operation device.

20

22. An apparatus according to claim 21, wherein the control device shifts polarity of the energy of the second form to reverse the operation device.

25

23. An apparatus according to claim 22, wherein the operation device comprises an electric motor and the energy of the second form comprises electric energy.

30

24. An apparatus according to claim 21, wherein the restriction device is operable to perform a reversible function.

25. An apparatus according to claim 24, further comprising a reversing device implantable in the patient for reversing the

function performed by the restriction device.

26. An apparatus according to claim 25, wherein the control
device controls the reversing device to reverse the function
5 performed by the restriction device.

27. An apparatus according to claim 25, wherein the reversing
device comprises hydraulic means including a valve for
shifting the flow direction of a fluid flow in the hydraulic
10 means.

28. An apparatus according to claim 25, wherein the reversing
device comprises a mechanical reversing device.

15 29. An apparatus according to claim 28, wherein the reversing
device comprises a gear box.

30. An apparatus according to claim 25, wherein the reversing
device comprises a switch.
20

31. An apparatus according to claim 30, wherein the switch is
operable by the energy of the second form.

32. An apparatus according to claim 31, wherein the control
25 device controls the operation of the switch by shifting
polarity of the energy of the second form.

33. An apparatus according to claim 31, wherein the switch
comprises an electric switch and the energy of the second form
30 comprises electric energy.

34. An apparatus according to claim 2, wherein the element

forms a flat and thin sheet, and has a volume of less than 2000 cm³.

35. An apparatus according to claim 3, wherein the electrical
5 junction element comprises at least one semiconductor.

36. An apparatus according to claim 3, wherein the electrical
junction element is adapted to generate an output current
exceeding 1 μ A when exposed to the energy of the first form
10 transmitted by the energy transmission means.

37. An apparatus according to claim 1, further comprising an
energy storage device implantable in the patient for storing
the energy of the second form and for supplying energy in
15 connection with the operation of the restriction device.

38. An apparatus according to claim 37, wherein the energy
storage device comprises an accumulator.

20 39. An apparatus according to claim 38, wherein the energy of
the second form comprises electric energy and the energy
storage device comprises an electric accumulator.

40. An apparatus according to claim 39, wherein the electric
25 accumulator comprises at least one capacitor or at least one
rechargeable battery, or a combination of at least one
capacitor and at least one rechargeable battery.

41. An apparatus according to claim 37, further comprising a
30 switch implantable in the patient for directly or indirectly
switching the operation of the restriction device.

42. An apparatus according to claim 41, further comprising a source of energy implantable in the patient, wherein the switch is operated by the energy of the second form supplied by the energy storage device to switch from an off mode, in which the source of energy is not in use, to an on mode, in which the source of energy supplies energy for the operation of the restriction device.

43. An apparatus according to claim 41, further comprising a source of energy implantable in the patient, and a remote control for controlling the supply of energy of the source of energy, wherein the switch is operated by the energy of the second form supplied by the energy storage device to switch from an off mode, in which the remote control is prevented from controlling the source of energy and the source of energy is not in use, to a standby mode, in which the remote control is permitted to control the source of energy to supply energy for the operation of the restriction device.

44. An apparatus according to claim 1, further comprising a switch implantable in the patient for switching the operation of the restriction device.

45. An apparatus according to claim 44, further comprising a source of energy implantable in the patient for supplying energy for the operation of the restriction device, wherein the switch is operated by the energy of the second form supplied by the energy transforming means to switch from an off mode, in which the source of energy is not in use, to an on mode, in which the source of energy supplies energy for the operation of the restriction device.

46. An apparatus according to claim 44, further comprising a source of energy implantable in the patient for supplying energy for the operation of the restriction device, and a remote control for controlling the supply of energy of the implantable source of energy, wherein the switch is operated by the energy of the second form supplied by the energy transforming means to switch from an off mode, in which the remote control is prevented from controlling the source of energy and the source of energy is not in use, to a standby mode, in which the remote control is permitted to control the source of energy to supply energy for the operation of the restriction device.

47. An apparatus according to claim 1, wherein the energy transmission means transmits the energy of the first form by at least one wireless signal.

48. An apparatus according to claim 47, wherein the signal comprises a wave signal.

49. An apparatus according to claim 47, wherein the signal contains radiant energy.

50. An apparatus according to claim 48, wherein the wave signal comprises an electromagnetic wave signal including one of an infrared light signal, a visible light signal, an ultra violet light signal, a laser signal, a micro wave signal, a radio wave signal, an x-ray radiation signal, and a gamma radiation signal.

51. An apparatus according to claim 48, wherein the wave signal comprises a sound wave signal.

52. An apparatus according to claim 47, wherein the signal comprises a digital or analog signal, or a combination of a digital and analog signal.

5

53. An apparatus according to claim 1, wherein the energy of the first form transmitted by the energy transmission means comprises an electric field.

10 54. An apparatus according to claim 53, wherein the electric field is transmitted in pulses or digital pulses by the energy transmission means.

55. An apparatus according to claim 1, wherein the energy of
15 the first form transmitted by the energy transmission means comprises a magnetic field.

56. An apparatus according to claim 55, wherein the magnetic field is transmitted in pulses or digital pulses by the energy
20 transmission means.

57. An apparatus according to claim 1, wherein the energy of the first form comprises polarized energy.

25 58. An apparatus according to claim 1, wherein the energy transforming means transmits the energy of the first form into a direct current or pulsating direct current, or a combination of a direct current and a pulsating direct current.

30 59. An apparatus according to claim 1, wherein the energy transforming means transmits the energy of the first form into an alternating current or a combination of a direct and

alternating current.

60. An apparatus according to claim 1, wherein the energy of the second form comprises a frequency or amplitude modulated
5 signal, or a combination of a frequency and amplitude modulated signal.

61. An apparatus according to claim 1, wherein the energy of the second form comprises an analog or a digital signal, or a
10 combination of an analog and digital signal.

62. An apparatus according to claim 1, further comprising an implantable pulse generator for generating electrical pulses from the energy of the second form produced by the energy
15 field.

63. An apparatus according to claim 1, further comprising at least one implantable sensor for sensing at least one physical parameter of the patient.

20

64. An apparatus according to claim 63, wherein the sensor comprises a pressure sensor for directly or indirectly sensing the pressure in the food passageway.

25 65. An apparatus according to claim 63, further comprising a control device for controlling the restriction device in response to signals from the sensor.

30 66. An apparatus according to claim 65, wherein the control device comprises an internal control unit implantable in the patient for controlling the restriction device in response to signals from the sensor.

67. An apparatus according to claim 65, wherein the internal control unit directly controls the restriction device in response to signals from the sensor.

5

68. An apparatus according to claim 65, wherein the control device comprises an external control unit outside the patient's body for controlling the restriction device in response to signals from the sensor.

10

69. An apparatus according to claim 68, wherein the external control unit stores information on the physical parameter sensed by the sensor and is manually operated to control the restriction device based on the stored information.

15

70. An apparatus according to claim 63, further comprising at least one implantable sender for sending information on the physical parameter sensed by the sensor.

20 71. An apparatus according to claim 10, wherein the operation device comprises hydraulic means and at least one valve for controlling a fluid flow in the hydraulic means.

25 72. An apparatus according to claim 71, further comprising a wireless remote control for controlling the valve.

73. An apparatus according to claim 1, further comprising a wireless remote control transmitting at least one wireless control signal for controlling the restriction device.

30

74. An apparatus according to claim 73, wherein the remote control is capable of obtaining information on the condition

of the restriction device and to control the restriction device in response to the information.

75. An apparatus according to claim 73, wherein the remote
5 control comprises an implantable control unit for controlling the restriction device.

76. An apparatus according to claim 75, wherein the control unit comprises a microprocessor.

10

77. An apparatus according to claim 73, wherein the wireless remote control comprises at least one external signal transmitter or transceiver and at least one internal signal receiver or transceiver implantable in the patient.

15

78. An apparatus according to claim 73, wherein the wireless remote control comprises at least one external signal receiver or transceiver and at least one internal signal transmitter or transceiver implantable in the patient.

20

79. An apparatus according to claim 73, wherein the remote control is capable of sending information related to the restriction device from inside the patient's body to the outside thereof.

25

80. An apparatus according to claim 79, wherein the remote control controls the restriction device in response to the information.

30

81. An apparatus according to claim 73, wherein the remote control comprises a control signal transmitter for transmitting the control signal, and the energy transmission

means comprises the control signal transmitter, whereby the energy of the first form is transmitted by the control signal.

82. An apparatus according to claim 73, wherein the energy
5 transmission means transmits the energy of the first form by
at least one signal separate from the control signal.

83. An apparatus according to claim 73, wherein the remote
control transmits a carrier signal for carrying the control
10 signal.

84. An apparatus according to claim 73, wherein the energy
transmission means transmits the energy of the first form by
at least one signal, which is used as a carrier signal for the
15 control signal transmitted by the remote control.

85. An apparatus according to claim 84, wherein the carrier
signal is frequency or amplitude modulated, or frequency and
amplitude modulated.
20

86. An apparatus according to claim 84, wherein the carrier
signal comprises digital or analog waves, or a combination of
digital and analog waves.

25 87. An apparatus according to claim 84, wherein the control
signal used with the carrier signal is frequency or amplitude
modulated, or frequency and amplitude modulated.

88. An apparatus according to claim 84, wherein the control
30 signal used with the carrier signal is digital or analog, or
digital and analog.

89. An apparatus according to claim 73, wherein the control signal comprises a wave signal comprising one of a sound wave signal including an ultrasound wave signal, an electromagnetic wave signal including an infrared light signal, a visible light signal, an ultra violet light signal and a laser light signal, a micro wave signal, a radio wave signal, an x-ray radiation signal, and a gamma radiation signal.

90. An apparatus according to claim 73, wherein the control signal comprises an electric or magnetic field, or an electric and magnetic field.

91. An apparatus according to claim 73, wherein the control signal comprises a digital or analog control signal, or a digital and analog control signal.

92. An apparatus according to claim 91, wherein the remote control transmits an electromagnetic carrier wave signal for carrying the digital or analog control signal.

93. An apparatus according to claim 1, wherein the energy of the second form used for operating the restriction device is wirelessly transmitted by the energy transforming means.

94. An apparatus according to claim 1, further comprising an implantable control unit for controlling the restriction device.

95. An apparatus according to claim 94, wherein the control unit is programmable for controlling the restriction device in accordance with a program.

96. An apparatus according to claim 95, wherein the control unit controls the restriction device over time in accordance with an activity schedule program

5 97. An apparatus according to claim 95, further comprising an external wireless remote control for programming the control unit.

98. An apparatus according to claim 1, further comprising an
10 external data communicator and an implantable data communicator communicating with the external data communicator, wherein the implantable data communicator feeds data related to the restriction device back to the external data communicator or the external data communicator feeds data
15 to the implantable data communicator.

99. An apparatus according to claim 98, wherein the implantable data communicator feeds data related to at least one physical signal of the patient.

20

100. An apparatus according to claim 1, wherein the restriction device controls the cross-sectional area of the food passageway.

25 101. An apparatus according to claim 1, wherein the restriction device is non-inflatable.

102. An apparatus according to claim 1, wherein the restriction device is directly operated with the energy of the
30 second form, as the energy transmission means transmits the energy of the first form.

103. An apparatus according to claim 101, wherein the restriction device is directly operated with the energy of the second form in a non-magnetic manner.

5 104. An apparatus according to claim 101, wherein the restriction device is directly operated with the energy of the second form without externally touching subcutaneously implantable components of the apparatus.

10 105. An apparatus according to claim 1, wherein the energy of the first form comprises kinetic energy.

106. An apparatus according to claim 1, wherein the energy transforming means is implantable subcutaneously or in the
15 abdomen of the patient.

107. An apparatus according to claim 1, wherein the energy transforming means is implantable in the thorax or in the cephal region of the patient.

20 108. An apparatus according to claim 1, wherein the energy transforming means is implantable in an orifice of the patient's body and under the mucosa or intraluminal outside the mucosa of the orifice.

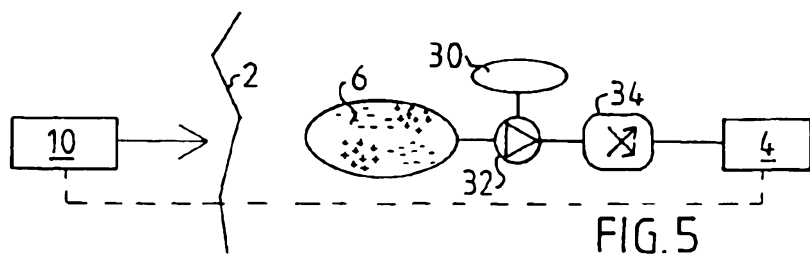
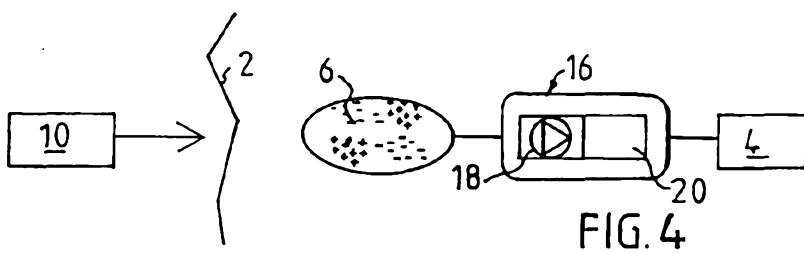
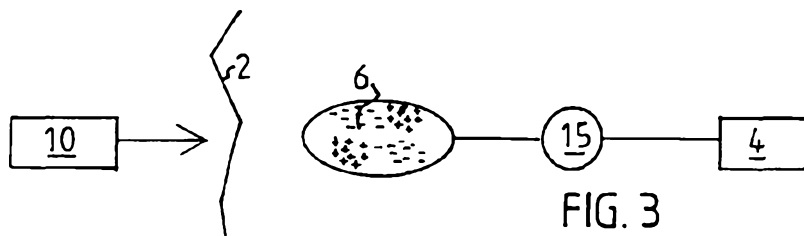
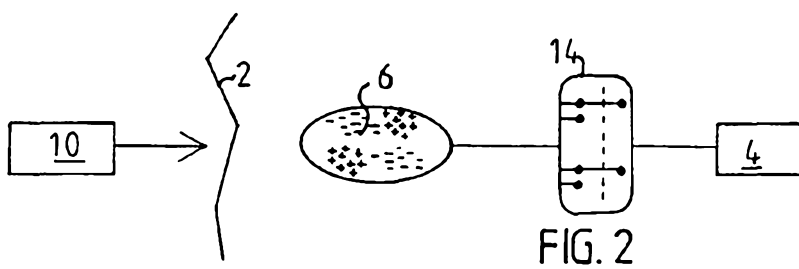
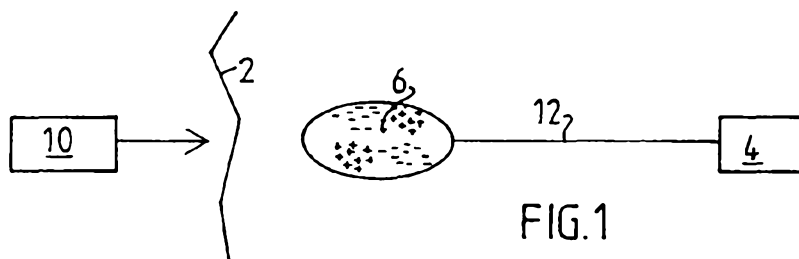
25 109. An apparatus according to claim 1, wherein the energy transforming means comprises at least one semiconductor circuitry capable of creating an energy field when exposed to the energy of the first form transmitted by the energy
30 transmission means, and the energy field produces the energy of the second form.

110. An apparatus according to claim 1, wherein the energy transforming means comprises at least one transistor circuitry capable of creating an energy field when exposed to the energy of the first form transmitted by the energy transmission

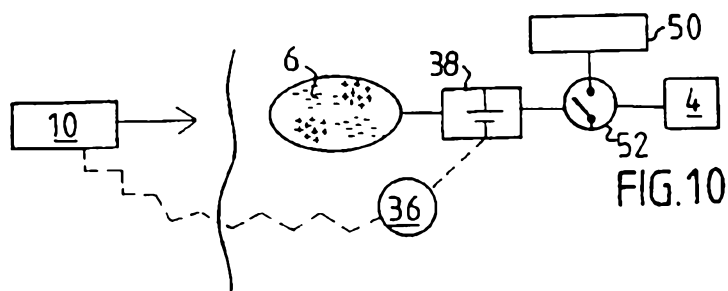
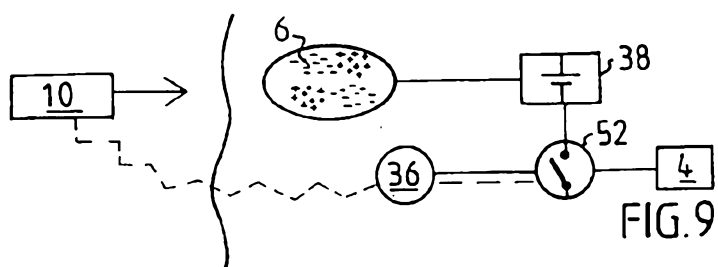
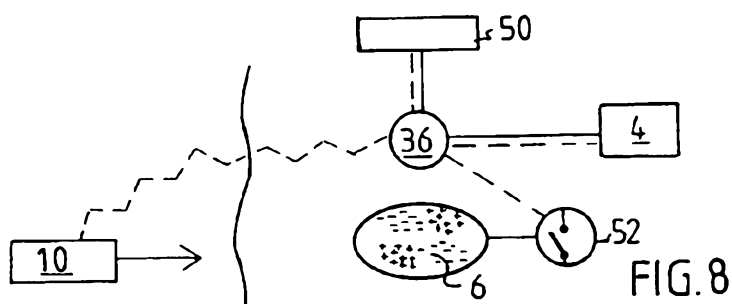
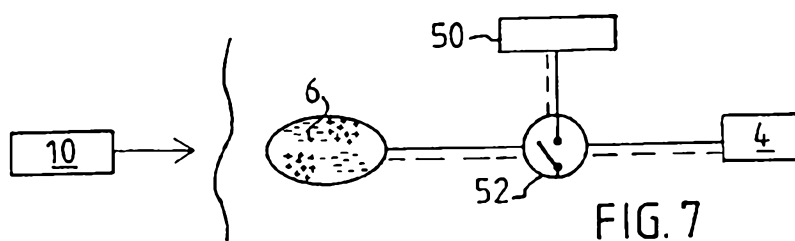
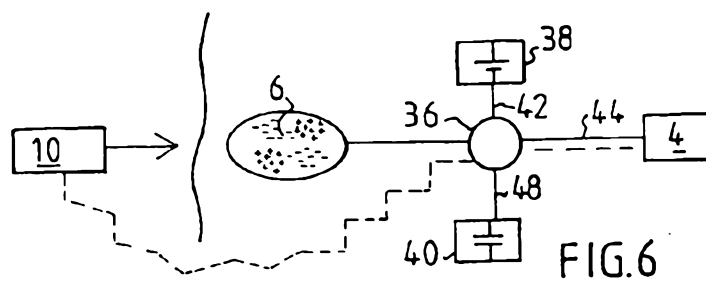
5 means, and the energy field produces the energy of the second form.

111. An apparatus according to claim 1, wherein the energy transforming means comprises a microchip capable of creating
10 an energy field when exposed to the energy of the first form transmitted by the energy transmission means, and the energy field produces the energy of the second form.

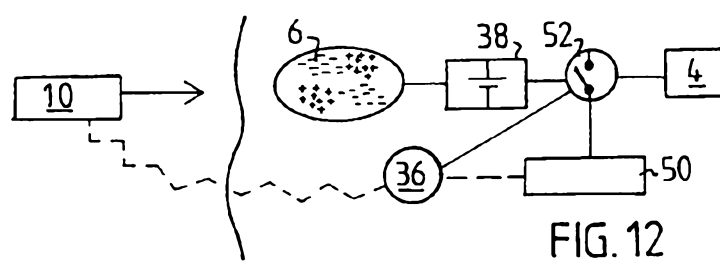
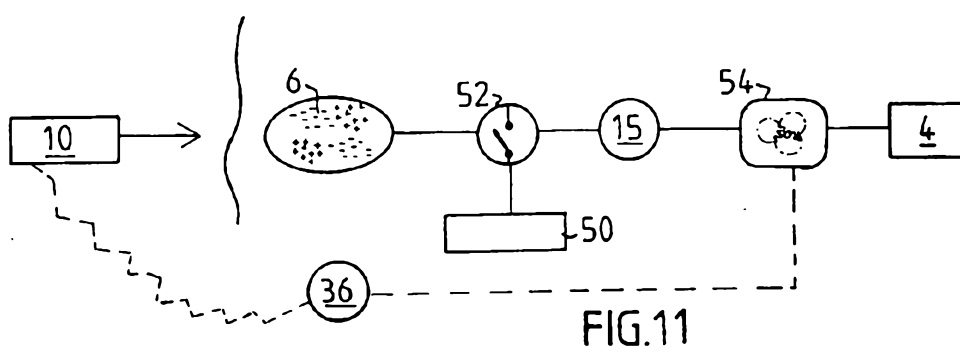
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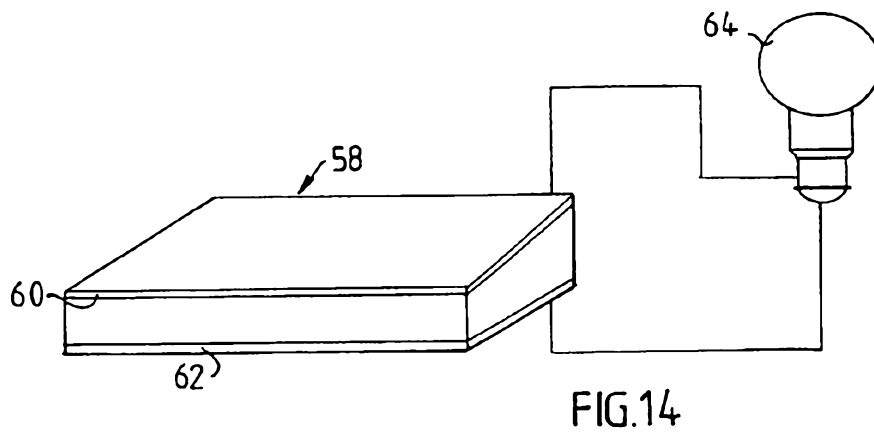
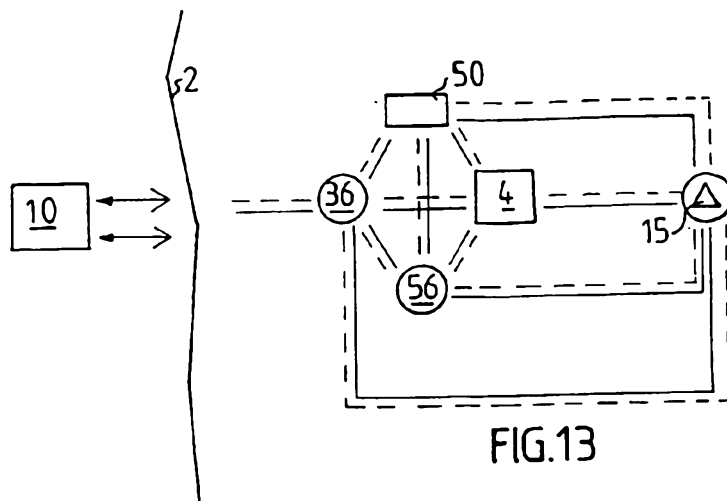
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