



US006461293B1

(12) **United States Patent**  
**Forsell**

(10) **Patent No.: US 6,461,293 B1**  
(45) **Date of Patent: \*Oct. 8, 2002**

(54) **CONTROLLED FOOD INTAKE  
RESTRICTION**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/503,149**

(22) Filed: **Feb. 11, 2000**

**Related U.S. Application Data**

(60) Provisional application No. 60/148,345, filed on Aug. 12, 1999.

(51) **Int. Cl.<sup>7</sup>** ..... **A61F 2/04**

(52) **U.S. Cl.** ..... **600/37; 128/899**

(58) **Field of Search** ..... 128/897-899;  
600/29-32, 37, 593; 604/27-28; 606/139-141,  
151, 157, 201-203, 213, 228; 607/41

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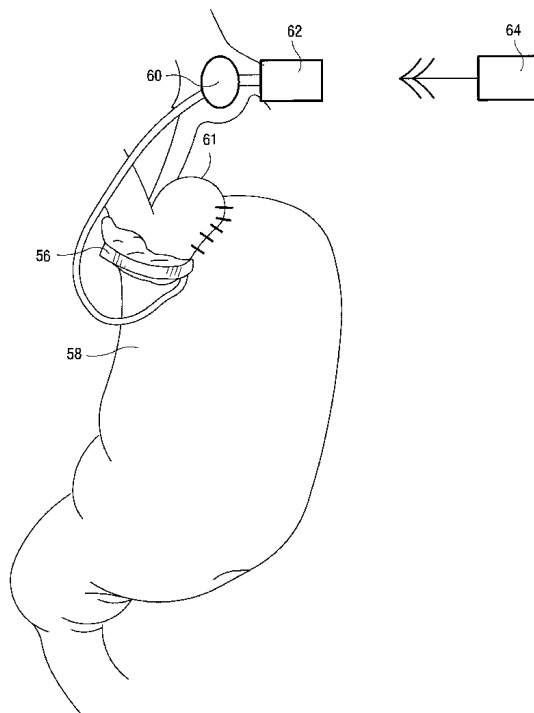
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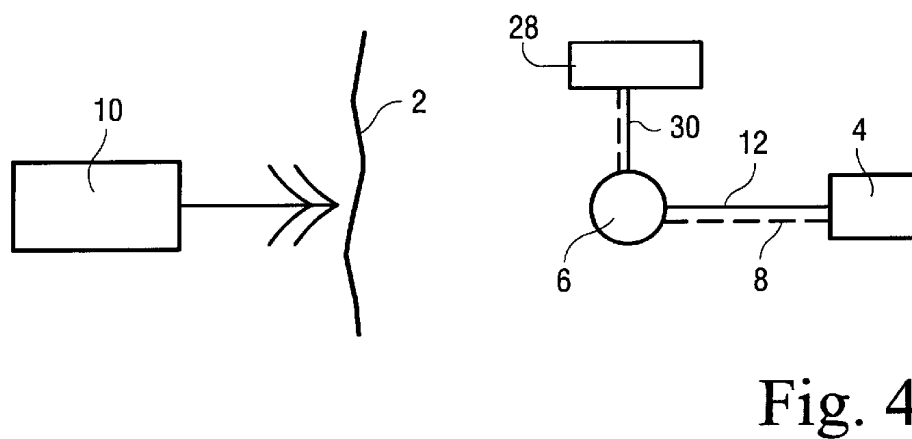
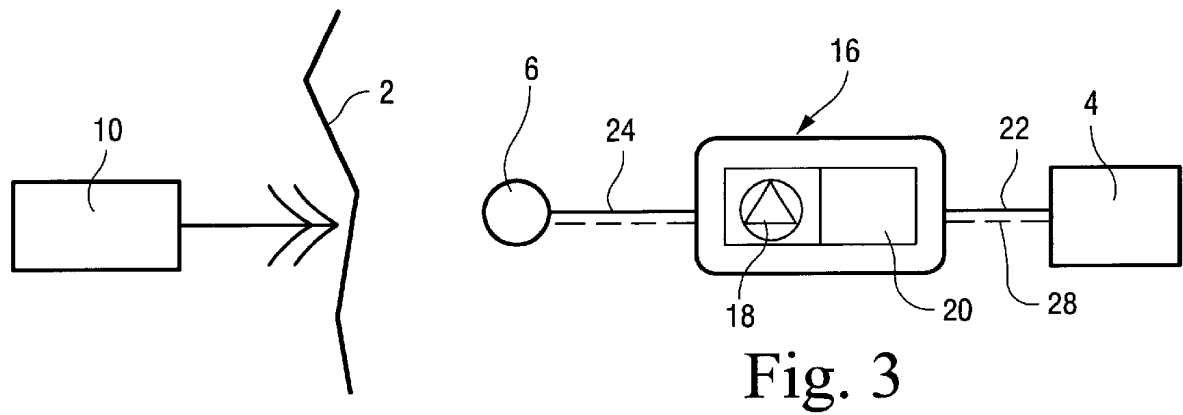
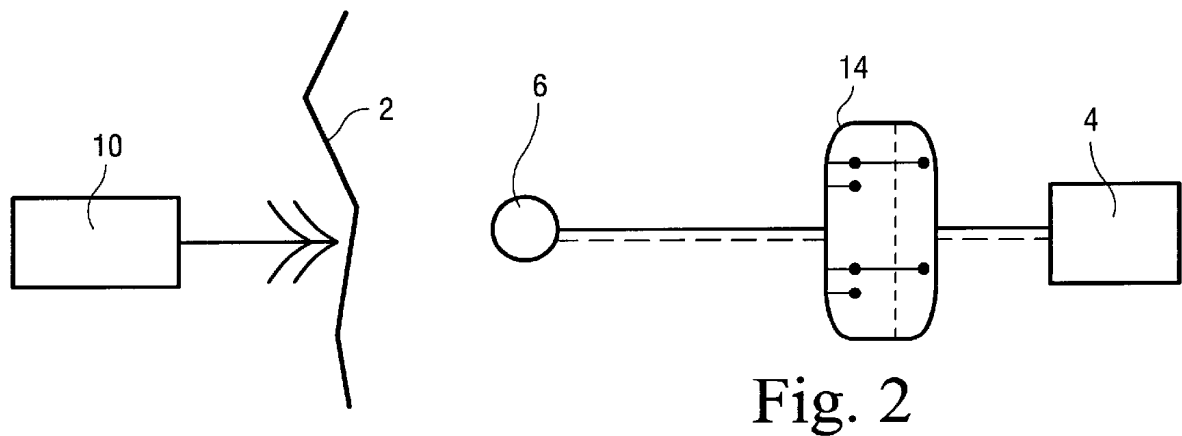
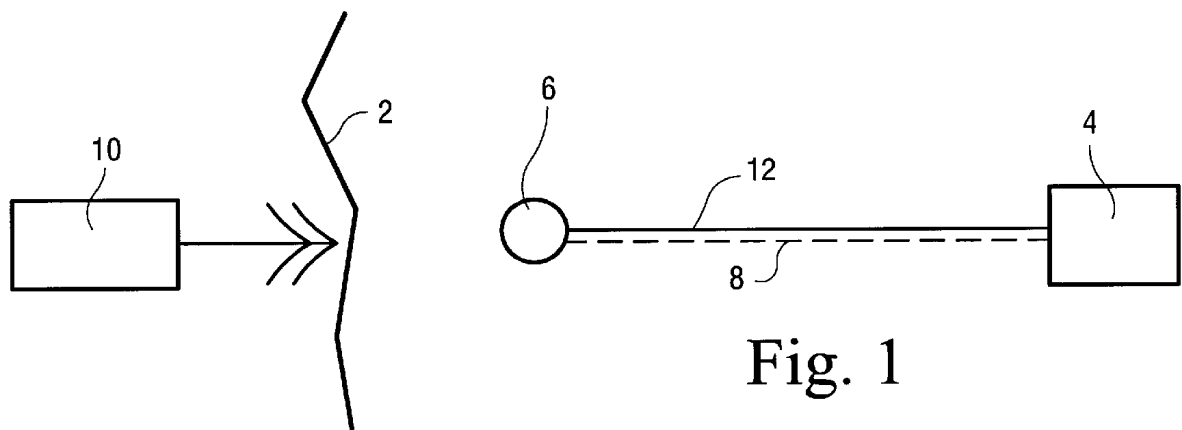
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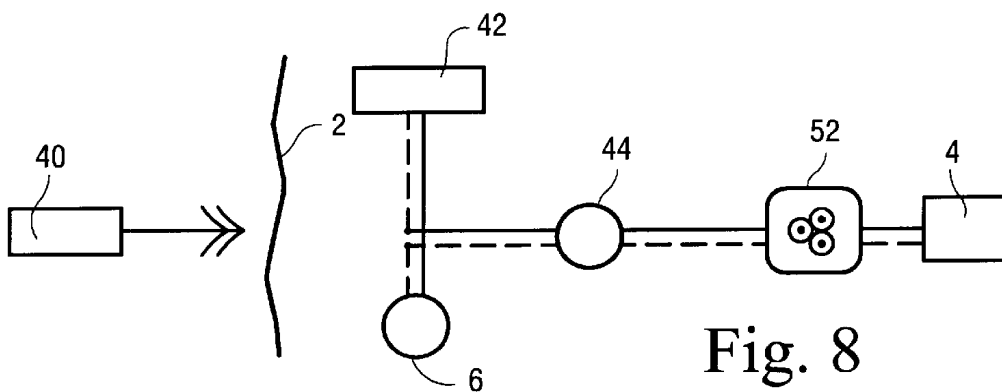
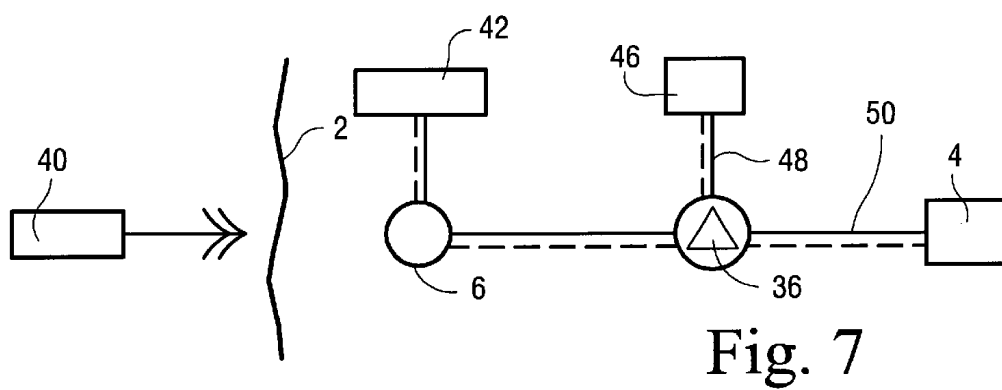
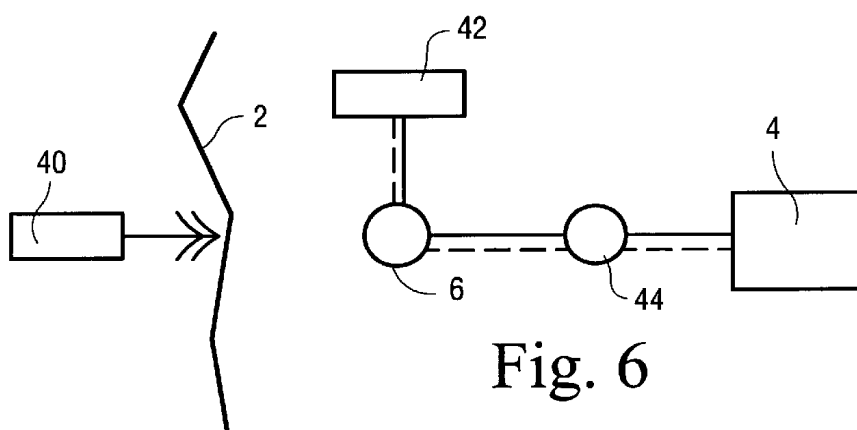
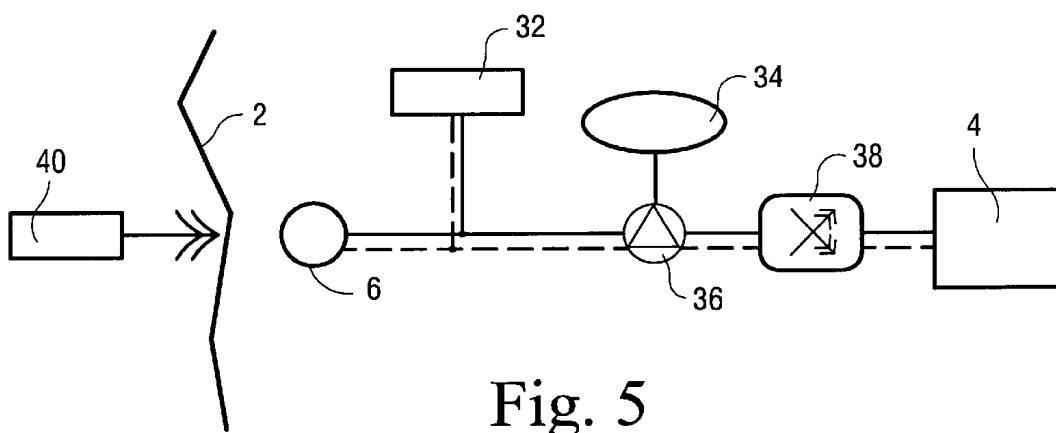
(57) **ABSTRACT**

A food intake restriction apparatus and method includes and uses an operable restriction device implanted in a patient and engaging the stomach or esophagus to form a restricted stoma opening in the stomach or esophagus. A source of energy for energizing the restriction device, and a control device for releasing energy from the source of energy from outside the patient's body are provided. The released energy is used in connection with the operation of the restriction device to vary the size of the stoma opening to allow or substantially prevent the passage of food therethrough.

**201 Claims, 6 Drawing Sheets**







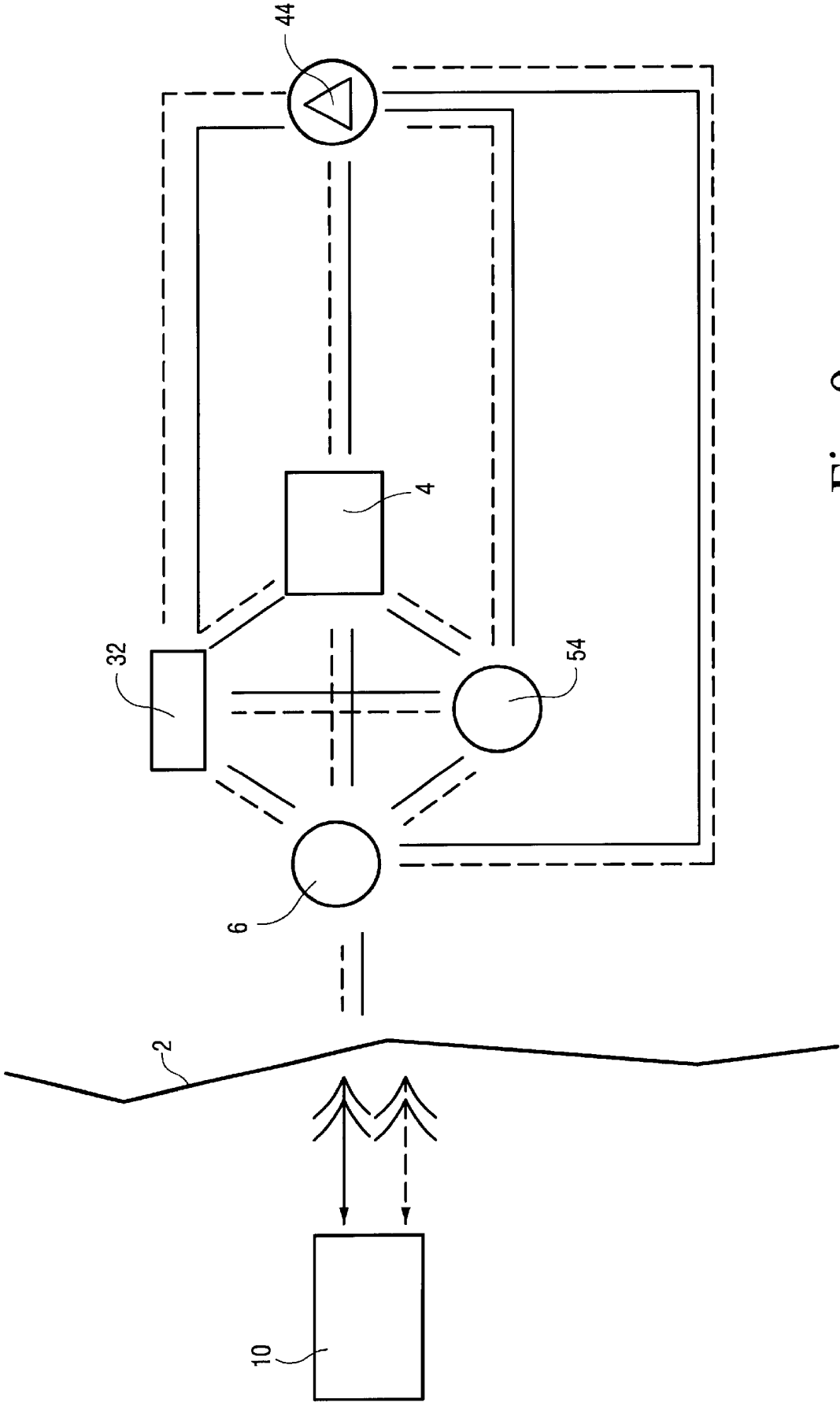
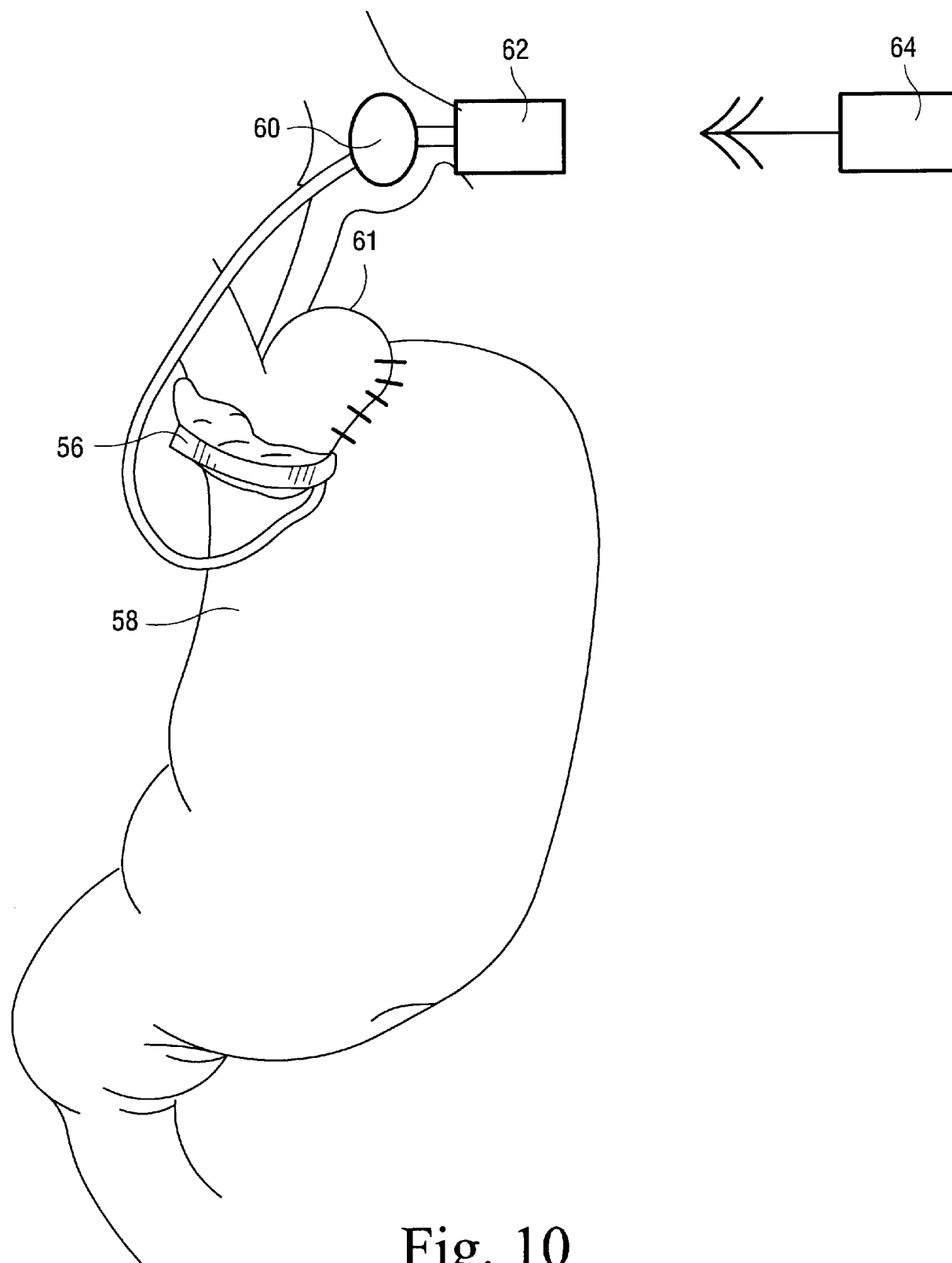
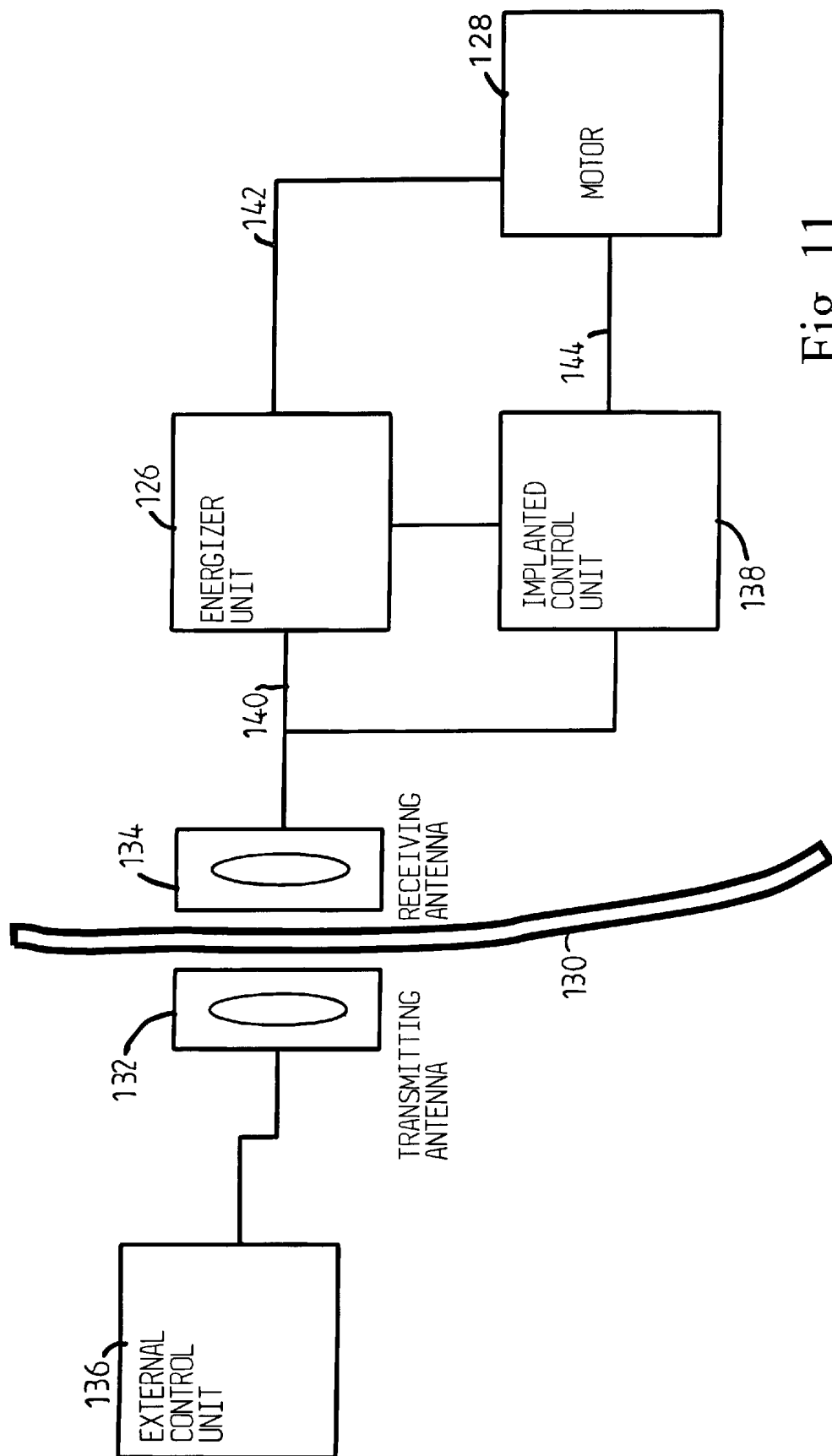


Fig. 9





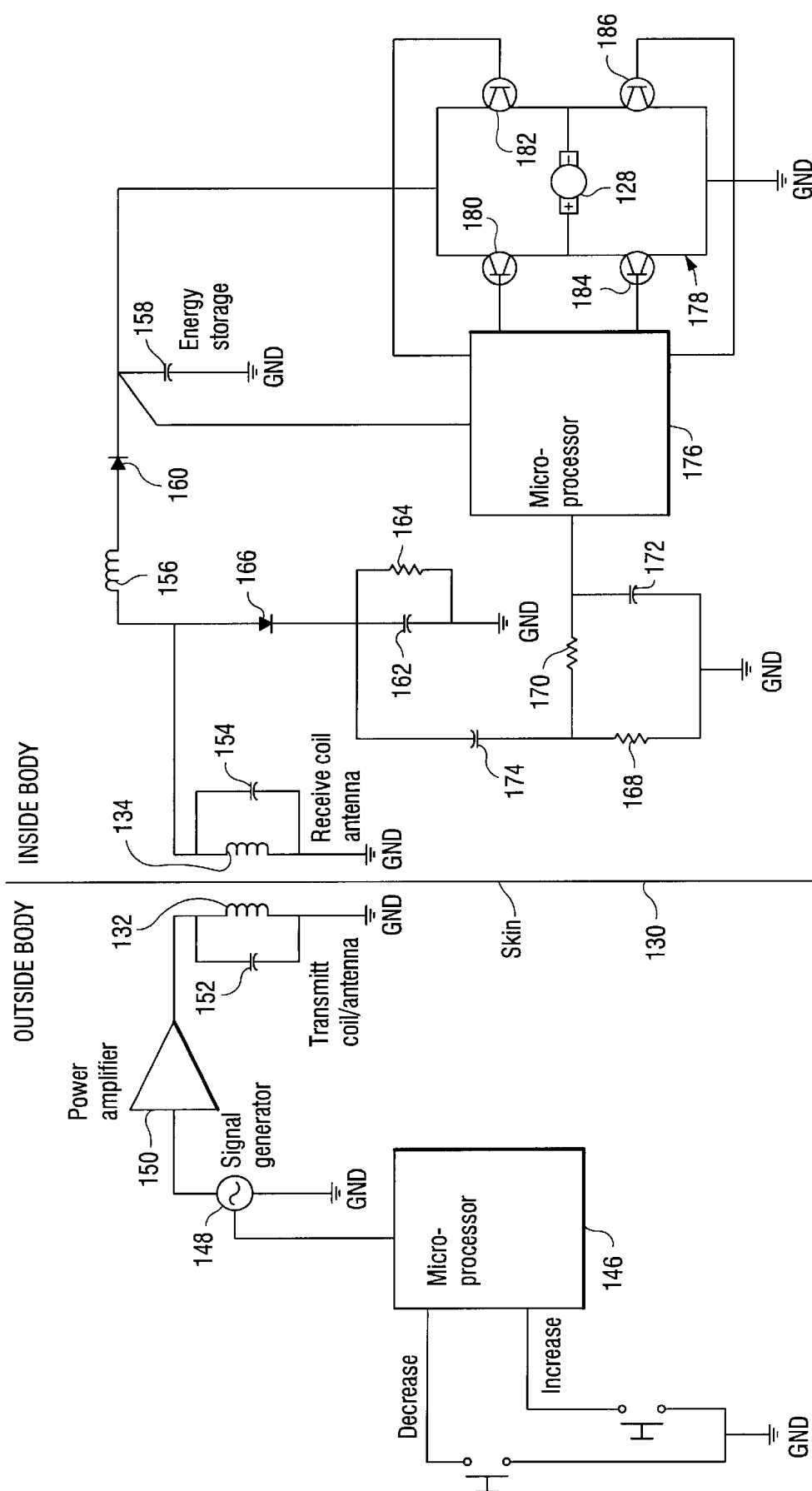


Fig. 12

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## CONTROLLED FOOD INTAKE RESTRICTION

### CROSS REFERENCE TO RELATED APPLICATION

This application incorporates herein by reference the disclosure of provisional application Ser. No. 60/148,345 filed Aug. 12, 1999.

### BACKGROUND OF THE INVENTION

The present invention relates to a food intake restriction apparatus and method. More specifically, the invention relates to a food intake restriction apparatus and method for surgical application in the abdomen of a patient for forming an upper pouch and a stoma opening in the stomach or esophagus. The term patient includes an animal or a human being.

Food intake restriction apparatus in the form of a gastric banding device, in which a band encircles a portion of a patient's stomach to restrict the food intake of the patient, have been used in surgery for morbid obesity to form a small gastric pouch above the band and a reduced stoma opening in the stomach. Although such a band is applied around the stomach to obtain an optimal stoma opening during surgery, some prior gastric banding devices are provided with an adjustment means enabling a minor post-operation adjustment of the size of the stoma opening. In all such prior art devices such as disclosed in U.S. Pat. No. 4,592,339, European Patent No. 0611561 and International Patent Application WO 94/27504, the adjustment means typically comprises an inflatable cavity in the band and an injection port in fluid connection with the inflatable cavity for adding fluid to or withdrawing fluid from the latter. In practice, the band is made of silicone rubber which is a material approved for implantation and the fluid is a liquid such as an isotonic salt solution.

It has also been found that the volume of the gastric pouch above the band increases in size up to ten times after operation. Therefore the pouch volume during surgery needs to be very small, approximately 7 ml. To enable the patient to feed the stomach with sufficient nutrition immediately after an operation considering such a small gastric pouch, the stoma initially needs to be relatively large and later needs to be substantially reduced, as the pouch volume increases. To be able to achieve a significant range of adjustment of the band, the cavity in the band has to be relatively large and is defined by a thin flexible wall, normally made of silicone material. Furthermore, the size of the stoma opening has to be gradually reduced during the first year after surgery as the gastric pouch increases in size. As indicated above, the reduction of the stoma opening using the prior art devices is achieved by adding liquid to the cavity of the band via the injection port to expand the band radially inwardly.

A great disadvantage of repeatedly injecting liquid via the injection port is the increased risk of the patient getting an infection in the body area surrounding the injection port. If such an infection occurs the injection port has to be surgically removed from the patient. Moreover, such an infection might be spread along the tube interconnecting the injection port and the band to the stomach, causing even more serious complications. Thus, the stomach might be infected where it is in contact with the band, which might result in the band migrating through the wall of the stomach. Also, it is uncomfortable for the patient when the necessary, often many, post-operation adjustments of the stoma opening are carried out using an injection needle penetrating the skin of the patient into the injection port.

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It may happen that the patient swallows pieces of food too large to pass through the restricted stoma opening. If that occurs the patient has to visit a doctor who can remove the food pieces, if the band design so permits, by withdrawing some liquid from the band to enlarge the stoma opening to allow the food pieces to pass the stoma. Then, the doctor has to add liquid to the band in order to regain the restricted stoma opening. Again, these measures require the use of an injection needle penetrating the skin of the patient, which is uncomfortable for the patient.

### SUMMARY OF THE INVENTION

An object of the invention is to provide a food intake restriction apparatus for forming a stoma opening in the stomach or esophagus of a patient which permits regular post-operation adjustments that are comfortable for the patient.

Another object of the present invention to provide a new food intake restriction which is easy to adjust and does not require the use of an injection needle for accomplishing post-operation adjustments of the stoma opening.

Accordingly, there is provided a food intake restriction apparatus, comprising an operable restriction device implanted in a patient and engaging the stomach or esophagus to form an upper pouch and a restricted stoma opening in the stomach or esophagus, a source of energy for energizing the restriction device, and a control device operable from outside the patient's body for releasing energy from the source of energy, wherein the released energy is used in connection with the operation of the restriction device.

As a result, the advantage is achieved that the implanted restriction device can be non-invasively operated, when the restriction device has to be adjusted. Furthermore, the apparatus of the invention provides a simple and effective control of the energy supplied to implanted components of the apparatus which ensures an extended and reliable functionality of the apparatus, possibly for the rest of the patient's natural life, and at least many years.

The restriction device preferably controls the size of the stoma opening. This may allow the patient to temporarily open up the stoma opening to remove food pieces stuck therein.

The control device may also control the restriction device. The control device may comprise an internal control unit, preferably including a microprocessor, implanted in the patient for controlling the restriction device. The control device may further comprise an external control unit outside the patient's body, wherein the internal control unit is programmable by the external control unit, for example for controlling the restriction device over time. Alternatively, the internal control unit may control the restriction device over time in accordance with an activity schedule program, which may be adapted to the patient's needs.

Conveniently, the external control unit may load the internal control unit with data in accordance with a loading mode only authorized for a doctor. For specialized controls of the restriction device, the external control unit may control the internal control unit in accordance with a doctor mode, only authorized for the doctor. For simple controls of the restriction device, the external control unit may control the internal control unit in accordance with a patient mode permitted for the patient. Thus, by using the external control unit in accordance with different modes it is possible to have certain functions of the restriction device controlled by the patient and other more advanced functions controlled by the doctor resulting, which enables a flexible post-operation treatment of the patient.



Generally, the apparatus further comprises an operation device implanted in the patient for operating the restriction device, wherein the control device controls the operation device to operate the restriction device. The control device may directly power the operation device with energy released from the source of energy and/or power other implanted energy consuming components of the apparatus. The term directly is used to mean, on one hand, that the operation device is powered with released energy while the latter is being released by the control device, on the other hand, that the released energy may be somewhat delayed, in the order of seconds, by for instance an energy stabilizer before powering the operation device. The advantage of directly using energy as it is released is that the apparatus can be of a very simple design and the few 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.

The operation device may comprise hydraulic means and at least one valve for controlling a fluid flow in the hydraulic means. The control device may suitably comprise a wireless remote control for controlling the valve. The restriction device may comprise hydraulic means and the operation device may comprise a reservoir forming a fluid chamber with a variable volume connected to the hydraulic means. The operation device may distribute fluid from the chamber to the hydraulic means 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.

In accordance with a first main aspect of the invention, the source of energy is external to the patient's body and the control device releases wireless energy from the source of energy. An energy storage device, preferably an electric accumulator, may be implanted in the patient for storing the wireless energy released from the external source of energy. The electric accumulator may comprise at least one capacitor or at least one rechargeable battery, or a combination of at least one capacitor and at least one rechargeable battery. Alternatively, a battery may be implanted in the patient for supplying electric energy to implanted electric energy consuming components of the apparatus, in addition to the supply of wireless energy. Where the control device comprises an implanted control unit the electronic circuit thereof and the restriction device may be directly powered with transformed wireless energy, or energy from either the implanted energy storage device or battery.

In a first particular embodiment in accordance with the first main aspect of the invention, the operation device comprises a motor, preferably an electric motor which may have electrically conductive parts made of plastics. The motor may include a rotary motor, wherein the control device is adapted to control the rotary motor to rotate a desired number of revolutions. Alternatively, the motor may include a linear motor, or a hydraulic or pneumatic fluid motor, wherein the control device is adapted to control 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 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 a second particular embodiment in accordance with the first main aspect of the invention, the control device is adapted to shift polarity of the released energy to reverse the

operation device. The operation device may suitably comprise an electric motor and the released energy may comprise electric energy.

In a third particular embodiment in accordance with the first main aspect of the invention, the restriction device is operable to perform a reversible function and there is a reversing device implanted 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 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.

Where the reversing device comprises a switch the control device suitably controls the operation of the switch by shifting polarity of released 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 switch. The switch mentioned above may comprise an electronic switch or, where applicable, a mechanical switch.

In accordance with the third particular embodiment, the operation device preferably comprises a motor, wherein the reversing device reverses the motor.

In a fourth particular embodiment in accordance with the first main aspect of the invention, the restriction device comprises hydraulic means, for example including an expansible/contractible cavity for fluid. The operation device preferably comprises a pump for pumping a fluid in the hydraulic means, a motor for driving the pump, a valveless 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 involved there is always a risk of malfunction due to improperly working valves, especially when long time periods passes 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 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.

In accordance with a second main aspect of the invention, the source of energy is implanted in the patient. Thus, the control device releases energy from the implanted source of energy from outside the patient's body. This solution is advantageous for embodiments of the apparatus that have a relatively high energy consumption which cannot be satisfied by direct supply of wireless energy.

The source of energy thus implanted may comprise an accumulator, preferably an electric source of energy, such as a battery having a life-time of at least 10 years.

The above first, second, third and fourth particular embodiments described in connection with the first main aspect of the invention are also applicable in accordance with the second main aspect of the invention, i.e. where the source of energy is implanted.

All of the above embodiments may be combined with at least one implanted 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 stomach. The expression "indirectly sensing the pressure in the food stomach" should be understood to encompass the cases where the sensor senses the pressure against the restriction device or human tissue of the patient. The pressure sensor may be any suitable known or conventional pressure sensor such as shown in U.S. Pat. Nos. 5,540,731, 4,846,181, 4,738,267, 4,571,749, 4,407,296 or 3,939,823; or an NPC-102 Medical Angioplasty Sensor. Where the control device comprises an internal control unit implanted in the patient, the internal control unit may suitably directly control the restriction device in response to signals from the sensor. In response to signals from 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 unit may also automatically control the restriction device in response to signals from the sensor.

Where the control device comprises an external control unit outside the patient's body, the external control unit may, suitably directly, control the restriction device in response to signals by 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 implanted sender for sending information on the physical parameter sensed by the sensor.

An external data communicator may be provided outside the patient's body and an internal data communicator may be implanted in the patient for communicating with the external communicator. The implanted communicator may feed data related to the patient, or related to the implanted restriction device, back to the external communicator. Alternatively or in combination, the external communicator may feed data to the internal communicator. The implanted communicator may suitably feed data related to at least one physical signal of the patient.

Generally, the apparatus of the invention may comprise a switch implanted in the patient for directly or indirectly switching the energy released from the source of energy. The restriction device may control the size of the stoma opening in the stomach or esophagus. For example, the restriction device may be operable to open and close the stoma opening or may steplessly control the latter. A pressure sensor may be provided for directly or indirectly sensing the pressure in the stomach. The control device may control the restriction device in response to signals from the pressure sensor.

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.

The apparatus may comprise an implanted energy transfer device, wherein the control device releases electric energy and the energy transfer device transfers the electric energy into kinetic energy for, preferably direct, operation of the restriction device. Suitably, an implanted stabilizer, such as a capacitor or a rechargeable accumulator, or the like, may be provided for stabilizing the electric energy released by the control device. In addition, the control device may release energy for a determined time period or in a determined number of energy pulses. All of the above embodiments are preferably remote controlled. Thus, the control device 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 over a period of time, 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 implanted 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 implanted 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 implanted in the patient.

The 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.

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 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 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 remote control.

In all of the above solutions, the control device advantageously releases energy from the source of energy in a non-invasive, mechanical or non-mechanical manner.

The control device may release magnetic, electromagnetic, kinetic or thermal energy, or non-magnetic, non-thermal, non-electromagnetic or non-kinetic energy.

Another object of the present invention is to provide methods for treating morbid obesity.

Accordingly, in accordance with a first alternative there is provided a method of treating morbid obesity, comprising the steps of implanting an operable restriction device in a patient in engagement with the stomach or the esophagus to form a restricted stoma in the stomach or esophagus, providing a source of energy for energizing the restriction device, and controlling the source of energy to release energy for use in connection with the operation of the restriction device. The method may further comprise using energy released from the source of energy to operate the restriction device to enlarge and reduce, respectively, the food passageway.

In accordance with a second alternative there is provided a method of treating morbid obesity, comprising the steps of placing at least two laparoscopic trocars in a patient's body, inserting a dissecting tool through the trocars and dissecting an area of the stomach or esophagus, placing an operable restriction device in the dissected area, so that the

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restriction device engages the stomach or the esophagus to form a restricted stoma in the stomach or esophagus, implanting a source of energy in the patient, and controlling the implanted source of energy from outside the patients body to release energy for use in connection with the operation of the restriction device.

In accordance with a third alternative there is provided a method of treating morbid obesity, comprising the steps of placing at least two laparoscopic trocars in a patient's body, inserting a dissecting tool through the trocars and dissecting an area of the stomach or esophagus, implanting an operable restriction device in the dissected area in engagement with the stomach or esophagus to form a restricted stoma in the stomach or esophagus, implanting an energy transfer device in the patient, providing an external source of energy, controlling the external source of energy to release wireless energy, and transferring the wireless energy by the energy transfer device into energy suited for use in connection with the operation of the restriction device.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 to 4 are schematic block diagrams illustrating four embodiments, respectively, of the invention, in which wireless energy is released from an external source of energy;

FIGS. 5 to 8 are schematic block diagrams illustrating four embodiments, respectively, of the invention, in which energy is released from an implanted source of energy;

FIG. 9 is a schematic block diagram illustrating conceivable combinations of implanted components for achieving various communication options;

FIG. 10 illustrates the apparatus in accordance with the invention implanted in a patient;

FIG. 11 is a block diagram illustrating remote control components of an embodiment of the invention; and

FIG. 12 is a schematic view of exemplary circuitry used for the components of the block diagram of FIG. 11.

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

#### DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically shows an embodiment of the food intake restriction 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 or esophagus to form an upper pouch and a restricted stoma opening in the stomach. The restriction device 4 is capable of performing a reversible function, i.e. to enlarge and reduce the size of the stoma opening. An implanted control unit 6 controls the restriction device 4 via a control line 8 to form an adequate size of the stoma opening. An external control unit 10 includes an external source of energy and a wireless remote control transmitting a control signal generated by the external source of energy. The control signal is received by a signal receiver incorporated in the implanted control unit 6, whereby the control unit 6 controls the implanted restriction device 4 in response to the control signal. The implanted control unit 6 also uses energy from the control signal for operating the restriction device 4 via a power supply line 12.

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FIG. 2 shows an embodiment of the invention identical to that of FIG. 1, except that a reversing device in the form of a switch 14 also is implanted in the patient for reversing the restriction device 4. The control unit 6 uses the switch 14 to reverse the function performed by the restriction device 4, i.e. enlarging and restricting the stoma opening. More precisely, the external control unit 10 releases energy carried by a wireless signal and the implanted control unit 6 transfers the wireless energy into a current for operating the switch 14. When the control unit 6 shifts the polarity of the current the switch 14 reverses the function performed by the restriction device 4.

FIG. 3 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 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 size of the stoma opening, and hydraulic fluid is pumped by the motor/pump unit 18 back from the restriction device 4 to the reservoir 20 to enlarge the size of the stoma opening. The external control unit 10 releases energy carried by a wireless signal and the implanted control unit 6 transfers the wireless energy into a current, for example a current, for powering the motor/pump unit 18 via an electric power supply line 24. The implanted control unit 6 controls the motor/pump unit 16 and the restriction device 4 via control lines 26 and 27.

FIG. 4 shows an embodiment of the invention identical to that of FIG. 1, except that an accumulator 28 also is implanted in the patient. The control unit 6 stores energy received from the external control unit 10 in the accumulator 28. In response to a control signal from the external control unit 10 the implanted control unit 6 releases energy from the accumulator 28 via a power line 30 for the operation of the restriction device 4.

FIG. 5 shows an embodiment of the invention comprising the restriction device 4, hydraulically operated, and the implanted control unit 6, and further comprising a source of energy in the form of a battery 32, a hydraulic fluid reservoir 34, a motor/pump unit 36 and a reversing device in the form of a hydraulic valve shifting device 38, all of which are implanted in the patient. The motor of the motor/pump unit 36 is an electric motor. An external control unit 40 includes a wireless remote control transmitting a control signal which is received by the signal receiver incorporated in the implanted control unit 6.

In response to a control signal from the external control unit 40 the implanted control unit 6 powers the motor/pump unit 36 with energy from the battery 32, whereby the motor/pump unit 36 distributes hydraulic fluid between the reservoir 34 and the restriction device 4. The control unit 6 controls the shifting device 38 to shift the hydraulic fluid flow direction between one direction in which the fluid is pumped by the motor/pump unit 36 from the reservoir 34 to the restriction device 4 to reduce the size of the stoma opening, and another opposite direction in which the fluid is pumped by the motor/pump unit 36 back from the restriction device 4 to the reservoir 34 to enlarge the size of the stoma opening.

FIG. 6 shows an embodiment of the invention identical to that of FIG. 4, except that a battery 42 is substituted for the accumulator 28, the external control unit 40 of the embodiment of FIG. 5 is substituted for the external control unit 10 and an electric motor 44 is implanted in the patient for operating the restriction device 4. In response to a control

signal from the external control unit **40** the implanted control unit **6** powers the motor **44** with energy from the battery **42**, whereby the motor **44** operates the restriction device **4**.

FIG. 7 shows an embodiment of the invention identical to that of FIG. 6, except that the motor/pump unit **36** of the embodiment of FIG. 5 is substituted for the motor **44** and a fluid reservoir **46** also implanted in the patient and via fluid conduits **48** and **50** connected to the motor/pump unit **36** and the restriction device **4**, which in this case is hydraulically operated. In response to a control signal from the external control unit **40** the implanted control unit **6** powers the electric motor of the motor/pump unit **36** with energy from the battery **42**, whereby the motor/pump unit **36** distributes hydraulic fluid between the fluid reservoir **46** and the restriction device **4**.

FIG. 8 shows an embodiment of the invention identical to that of FIG. 6, except that a mechanical reversing device in the form of a gear box **52** also is implanted in the patient. The implanted control unit **6** controls the gear box **52** to reverse the function performed by the restriction device **4** (mechanically operated), i.e. enlarging and restricting the food passageway.

FIG. 9 schematically shows conceivable combinations of implanted components of the apparatus for achieving various communication possibilities. Basically, there are the implanted restriction device **4**, the implanted control unit **6** and the external control unit **10** including the external source of energy and the wireless remote control. As already described above the remote control transmits a control signal generated by the external source of energy, and the control signal is received by a signal receiver incorporated in the implanted control unit **6**, whereby the control unit **6** controls the implanted restriction device **4** in response to the control signal.

A sensor **54** may be implanted in the patient for sensing a physical parameter of the patient, such as the pressure in the stomach. The control unit **6**, or alternatively the external control unit **10**, may control the restriction device **4** in response to signals from the sensor **54**. A transceiver may be combined with the sensor **54** for sending information on the sensed physical parameter to the external control unit **10**. The wireless remote control of the external control unit **10** may comprise a signal transmitter or transceiver and the implanted control unit **6** may comprise a signal receiver or transceiver. Alternatively, the wireless remote control of the external control unit **10** may comprise a signal receiver or transceiver and the implanted control unit **6** 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 from inside the patient's body to the outside thereof.

The motor **44** may be implanted for operating the restriction device **4** and also the battery **32** may be implanted for powering the motor **44**. The battery **32** may be equipped with a transceiver for sending information on the charge condition of the battery.

Those skilled in the art will realize that the above various embodiments according to FIGS. 1-9 could be combined in many different ways. For example, the energy operated switch **14** could be incorporated in any of the embodiments of FIGS. 3,4,6-8, the hydraulic shifting device **38** could be incorporated in any of the embodiments of FIGS. 3 and 7, and the gear box **52** could be incorporated in any of the embodiments of FIGS. 1, 4 and 6.

FIG. 10 illustrates how any of the above-described embodiments of the food intake restriction apparatus of the

invention may be implanted in a patient. Thus, an assembly of the apparatus implanted in the patient comprises a restriction device **56** engaging the stomach **58**, and an operation device **60** for operating the restriction device **56**. The restriction device **56** engages the stomach **58** and a portion of the stomach, thereby forming an upper pouch **61** of the stomach. And an internal control unit **62**, which includes a signal receiver, for controlling the operation device **60**. An external control unit **64** includes a signal transmitter for transmitting a control signal to the signal receiver of the implanted control unit **62**. The implanted control unit **62** is capable of transferring signal energy from the control signal into electric energy for powering the operation device **60** and for energizing energy consuming implanted components of the apparatus.

FIG. 11 shows the basic parts of a wireless remote control of the apparatus of the invention including an electric motor **128** for operating a restriction device, for example of the type illustrated in FIG. 10. In this case, the remote control is based on the transmission of electromagnetic wave signals, often of high frequencies in the order of 100 kHz-1 GHz, through the skin **130** of the patient. In FIG. 11, all parts placed to the left of the skin **130** are located outside the patient's body and all parts placed to the right of the skin **130** are implanted. Any suitable remote control system may be used.

An external signal transmitting antenna **132** is to be positioned close to a signal receiving antenna **134** implanted close to the skin **130**. As an alternative, the receiving antenna **134** may be placed for example inside the abdomen of the patient. The receiving antenna **134** comprises a coil, approximately 1-100 mm, preferably 25 mm in diameter, wound with a very thin wire and tuned with a capacitor to a specific high frequency. A small coil is chosen if it is to be implanted under the skin of the patient and a large coil is chosen if it is to be implanted in the abdomen of the patient. The transmitting antenna **132** comprises a coil having about the same size as the coil of the receiving antenna **134** but wound with a thick wire that can handle the larger currents that is necessary. The coil of the transmitting antenna **132** is tuned to the same specific high frequency as the coil of the receiving antenna **134**.

An external control unit **136** comprises a microprocessor, a high frequency electromagnetic wave signal generator and a power amplifier. The microprocessor of the control unit **136** is adapted to switch the generator on/off and to modulate signals generated by the generator to send digital information via the power amplifier and the antennas **132,134** to an implanted control unit **138**. To avoid that accidental random high frequency fields trigger control commands, digital signal codes are used. A conventional keypad placed on the external control unit **136** is connected to the microprocessor thereof. The keypad is used to order the microprocessor to send digital signals to either contract or enlarge the restriction device. The microprocessor starts a command by applying a high frequency signal on the antenna **132**. After a short time, when the signal has energized the implanted parts of the control system, commands are sent to contract or enlarge the restriction device in predefined steps. The commands are sent as digital packets in the form illustrated below.

Start pattern, 8 bits	Command, 8 bits	Count, 8 bits	Checksum, 8 bits
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The commands are sent continuously during a rather long time period (e.g. about 30 seconds or more). When a new

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contract or enlarge step is desired the Count byte is increased by one to allow the implanted control unit **138** to decode and understand that another step is demanded by the external control unit **136**. If any part of the digital packet is erroneous, its content is simply ignored.

Through a line **140**, an implanted energizer unit **126** draws energy from the high frequency electromagnetic wave signals received by the receiving antenna **134**. The energizer unit **126** stores the energy in a power supply, such as a large capacitor, powers the control unit **138** and powers the electric motor **128** via a line **142**.

The control unit **138** comprises a demodulator and a microprocessor. The demodulator demodulates digital signals sent from the external control unit **136**. The microprocessor of the control unit **138** receives the digital packet, decodes it and, provided that the power supply of the energizer unit **126** has sufficient energy stored, sends a signal via a signal line **144** to the motor **128** to either contract or enlarge the restriction device depending on the received command code.

Alternatively, the energy stored in the power supply of the energizer unit may only be used for powering a switch, and the energy for powering the motor **128** may be obtained from another implanted power source of relatively high capacity, for example a battery. In this case the switch is adapted to connect said battery to the control unit **138** in an on mode when said switch is powered by said power supply and to keep said battery disconnected from the control unit in a standby mode when said switch is unpowered.

With reference to FIG. 12, the remote control schematically described above will now be described in accordance with a more detailed embodiment. The external control unit **136** comprises a microprocessor **146**, a signal generator **148** and a power amplifier **150** connected thereto. The microprocessor **146** is adapted to switch the signal generator **148** on/off and to modulate signals generated by the signal generator **148** with digital commands that are sent to implanted components of the apparatus. The power amplifier **150** amplifies the signals and sends them to the external signal transmitting antenna **132**. The antenna **132** is connected in parallel with a capacitor **152** to form a resonant circuit tuned to the frequency generated by the signal generator **148**.

The implanted signal receiving antenna coil **134** forms together with a capacitor **154** a resonant circuit that is tuned to the same frequency as the transmitting antenna **132**. The signal receiving antenna coil **134** induces a current from the received high frequency electromagnetic waves and a rectifying diode **160** rectifies the induced current, which charges a storage capacitor **158**. A coil **156** connected between the antenna coil **134** and the diode **160** prevents the capacitor **158** and the diode **160** from loading the circuit of the signal receiving antenna **134** at higher frequencies. Thus, the coil **156** makes it possible to charge the capacitor **158** and to transmit digital information using amplitude modulation.

A capacitor **162** and a resistor **164** connected in parallel and a diode **166** forms a detector used to detect amplitude modulated digital information. A filter circuit is formed by a resistor **168** connected in series with a resistor **170** connected in series with a capacitor **172** connected in series with the resistor **168** via ground, and a capacitor **174**, one terminal of which is connected between the resistors **168**, **170** and the other terminal of which is connected between the diode **166** and the circuit formed by the capacitor **162** and resistor **164**. The filter circuit is used to filter out undesired low and high frequencies. The detected and fil-

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tered signals are fed to an implanted microprocessor **176** that decodes the digital information and controls the motor **128** via an H-bridge **178** comprising transistors **180, 182, 184** and **186**. The motor **128** can be driven in two opposite directions by the H-bridge **178**.

The microprocessor **176** also monitors the amount of stored energy in the storage capacitor **158**. Before sending signals to activate the motor **128**, the microprocessor **176** checks whether the energy stored in the storage capacitor **158** is enough. If the stored energy is not enough to perform the requested operation, the microprocessor **176** waits for the received signals to charge the storage capacitor **158** before activating the motor **128**.

What is claimed is:

1. A food intake restriction apparatus for an obese patient, comprising:

an operable restriction device adapted to be implanted in the patient to engage the stomach or esophagus to form an upper pouch of the stomach and a restricted stoma opening in the stomach or esophagus,

an accumulator adapted to be implanted in the patient for supplying energy for the operation of said restriction device to vary the restriction of the stoma opening, said accumulator being chargeable from outside the patient's body,

a control device operable from outside the patient's body for controlling said accumulator to supply energy,

a source of energy external to the patient's body and capable of releasing wireless energy, and

an implantable energy transfer device adapted to transfer said wireless energy into an energy form suited for charging said accumulator,

wherein said control device is adapted to control said external source of energy to release said wireless energy.

2. The apparatus according to claim 1, wherein said control device controls said restriction device.

3. The apparatus according to claim 2, wherein said control device comprises an internal control unit adapted to be implanted in the patient for controlling said restriction device.

4. The apparatus according to claim 3, wherein said internal control unit is programmable.

5. The apparatus according to claim 4, wherein said control device comprises an external control unit outside the patient's body, said internal control unit being programmable by said external control unit.

6. The apparatus according to claim 5, wherein said external control unit loads said internal control unit with data in accordance with a loading mode only authorized for a doctor.

7. The apparatus according to claim 5, wherein said external control unit controls said internal control unit in accordance with a doctor mode only authorized for a doctor.

8. The apparatus according to claim 5, wherein said external control unit controls said internal control unit in accordance with a patient mode permitted for the patient.

9. The apparatus according to claim 4, wherein said internal control unit is programmable for controlling said restriction device over time.

10. The apparatus according to claim 9, wherein said internal control unit controls said restriction device over time in accordance with an activity schedule program.

11. The apparatus according to claim 9, wherein said internal control unit comprises a microprocessor.

12. The apparatus according to claim 1, further comprising an operation device adapted to be implanted in the

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patient for operating said restriction device, wherein said control device controls said operation device to operate said restriction device.

13. The apparatus according to claim 12, wherein said operation device comprises hydraulic means and at least one valve for controlling a fluid flow in said hydraulic means.

14. The apparatus according to claim 13, wherein said control device comprises a wireless remote control for controlling said valve.

15. The apparatus according to claim 12, wherein said restriction device comprises hydraulic means and said operation device comprises a reservoir forming a fluid chamber with a variable volume connected to said hydraulic means, and said operation device distributes fluid from said chamber to said hydraulic means by reduction of the volume of said chamber and withdraws fluid from said hydraulic means to said chamber by expansion of the volume of said chamber.

16. The apparatus according to claim 12, wherein said operation device comprises a motor.

17. The apparatus according to claim 16, wherein said motor comprises a rotary motor, and said control device controls said rotary motor to rotate a desired number of revolutions.

18. The apparatus according to claim 16, wherein said motor comprises a linear motor.

19. The apparatus according to claim 16, wherein said motor comprises a hydraulic or pneumatic fluid motor, and said control device controls said fluid motor.

20. The apparatus according to claim 16, wherein said motor comprises an electric motor having electrically conductive parts made of plastics.

21. The apparatus according to claim 12, wherein said control device releases electric energy from said accumulator.

22. The apparatus according to claim 12, wherein said control device shifts polarity of said released energy to reverse said operation device.

23. The apparatus according to claim 12, wherein said operation device comprises an electric motor and said released energy comprises electric energy.

24. The apparatus according to claim 12, wherein said restriction device is operable to perform a reversible function.

25. The apparatus according to claim 24, further comprising a reversing device adapted to be implanted in the patient for reversing said function performed by said restriction device.

26. The apparatus according to claim 25, wherein said control device controls said reversing device to reverse said function performed by said restriction device.

27. The apparatus according to claim 26, wherein said reversing device comprises a switch.

28. The apparatus according to claim 27, wherein said switch is operable by said released energy.

29. The apparatus according to claim 28, wherein said control device controls the operation of said switch by shifting polarity of said released energy supplied to said switch.

30. The apparatus according to claim 27, wherein said switch comprises an electric switch and said accumulator supplies electric energy for the operation of said switch.

31. The apparatus according to claim 27, wherein said operation device comprises a motor, and said reversing device reverses said motor.

32. The apparatus according to claim 25, wherein said reversing device comprises hydraulic means including a

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

33. The apparatus according to claim 25, wherein said reversing device comprises a mechanical reversing device.

34. The apparatus according to claim 33, wherein said mechanical reversing device comprises a switch.

35. The apparatus according to claim 33, wherein said reversing device comprises a gear box.

36. The apparatus according to claim 12, wherein said restriction device comprises hydraulic means and said operation device comprises a pump for pumping a fluid in said hydraulic means.

37. The apparatus according to claim 36, wherein said operation device comprises a motor for driving said pump.

38. The apparatus according to claim 37, wherein said operation device comprises a fluid conduit between said pump and said hydraulic means of said restriction device, and a reservoir for fluid, said reservoir forming part of said conduit.

39. The apparatus according to claim 38, hydraulic means, pump and conduit are devoid of any non-return valve.

40. The apparatus according to claim 39, wherein said reservoir forms a fluid chamber with a variable volume, and said pump distributes fluid from said chamber to said hydraulic means of said restriction device by reduction of the volume of said chamber and withdraws fluid from said hydraulic means to said chamber by expansion of the volume of said chamber.

41. The apparatus according to claim 1, wherein said control device controls said external source of energy to release electromagnetic energy.

42. The apparatus according to claim 1, wherein said control device controls said external source of energy to release kinetic energy.

43. The apparatus according to claim 1, wherein said control device controls said external source of energy to release non-magnetic energy.

44. The apparatus according to claim 1, wherein said control device controls said external source of energy to release non-electromagnetic energy.

45. The apparatus according to claim 1, wherein said control device controls said external source of energy to release non-kinetic energy.

46. The apparatus according to claim 1, wherein said control device controls said external source of energy to release non-thermal energy.

47. The apparatus according to claim 1, further comprising a battery adapted to be implanted in the patient for supplying electric energy to electric energy consuming components of the apparatus adapted to be implanted in the patient.

48. The apparatus according to claim 1, further comprising a stabilizer adapted to be implanted in the patient for stabilizing the energy released from said accumulator.

49. The apparatus according to claim 48, wherein the energy released from said accumulator comprises electric energy and said stabilizer comprises a capacitor.

50. The apparatus according to claim 49, wherein said 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.

51. The apparatus according to claim 1, wherein said restriction device is operable to perform a reversible function.

52. The apparatus according to claim 51, further comprising a reversing device adapted to be implanted in the patient for reversing said function performed by said restriction device.

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53. The apparatus according to claim 52, wherein said control device controls said reversing device to reverse said function performed by said restriction device.

54. The apparatus according to claim 52, wherein said reversing device comprises hydraulic means including a valve for shifting the flow direction of a fluid in said hydraulic means.

55. The apparatus according to claim 52, wherein said reversing device comprises a mechanical reversing device.

56. The apparatus according to claim 55, wherein said mechanical reversing device comprises a switch.

57. The apparatus according to claim 55, wherein said mechanical reversing device comprises a gear box.

58. The apparatus according to claim 52, wherein said reversing device comprises a switch.

59. The apparatus according to claim 58, wherein said switch of said reversing device is operable by electric energy released from said battery.

60. The apparatus according to claim 59, wherein said control device controls the operation of said switch of said reversing device by shifting polarity of said released electric energy supplied to said switch of said reversing device.

61. The apparatus according to claim 58, wherein said switch of said reversing device comprises an electric switch.

62. The apparatus according to claim 52, further comprising a motor adapted to be implanted in the patient for operating said restriction device, wherein said reversing device reverses said motor.

63. The apparatus according to claim 1, further comprising at least one sensor adapted to be implanted in the patient for sensing at least one physical parameter of the patient.

64. The apparatus according to claim 63, wherein said control device controls said restriction device in response to signals from said sensor.

65. The apparatus according to claim 64, wherein said control device comprises an internal control unit adapted to be implanted in the patient and directly controlling said restriction device in response to signals from said sensor.

66. The apparatus according to claim 64, wherein said control device comprises an external control unit outside the patient's body and controlling said restriction device in response to signals from said sensor.

67. The apparatus according to claim 66, wherein said external control unit directly controls said restriction device in response to signals from said sensor.

68. The apparatus according to claim 66, wherein said external control unit stores information on said physical parameter sensed by said sensor and is manually operated to control said restriction device based on said stored information.

69. The apparatus according to claim 63, further comprising at least one sender adapted to be implanted in the patient for sending information on said physical parameter sensed by said sensor.

70. The apparatus according to claim 1, further comprising an external data communicator outside the patient's body and an internal data communicator adapted to be implanted in the patient for communicating with said external communicator, wherein said internal communicator feeds data related to the patient back to said external communicator or said external communicator feeds data to said internal communicator.

71. The apparatus according to claim 70, wherein said internal communicator feeds data related to said restriction device.

72. The apparatus according to claim 70, wherein said internal communicator feeds data related to at least one physical signal of the patient.

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73. The apparatus according to claim 1, further comprising a switch adapted to be implanted in the patient for directly or indirectly switching said energy released from said accumulator.

74. The apparatus according to claim 1, wherein said restriction device controls the size of said stoma opening.

75. The apparatus according to claim 74, wherein said restriction device steplessly controls the size of the stoma opening.

76. The apparatus according to claim 1, wherein said control device releases energy from said accumulator in a non-mechanical manner.

77. The apparatus according to claim 1, further comprising a pressure sensor for directly or indirectly sensing the pressure in the patient's stomach.

78. The apparatus according to claim 77, wherein said control device controls said restriction device in response to signals from said pressure sensor.

79. The apparatus according to claim 1, further comprising an energy transfer device adapted to be implanted in the patient, wherein said control device releases electric energy from said accumulator and said energy transfer device transfers said electric energy into kinetic energy for operation of said restriction device.

80. The apparatus according to claim 79, wherein said restriction device is directly operated with said kinetic energy, as said energy transfer device transfers said electric energy into kinetic energy.

81. The apparatus according to claim 79, further comprising a capacitor adapted to be implanted in the patient for stabilizing said electric energy released by said control device.

82. The apparatus according to claim 1, wherein said restriction device is non-inflatable.

83. The apparatus according to claim 1, wherein said control device releases energy for a determined time period.

84. The apparatus according to claim 1, wherein said control device releases energy in a determined number of energy pulses.

85. The apparatus according to claim 1, wherein said control device comprises a wireless remote control transmitting at least one wireless control signal for controlling said restriction device.

86. The apparatus according to claim 85, wherein said remote control is capable of obtaining information on the condition of said restriction device and to control said restriction device in response to said information.

87. The apparatus according to claim 85, wherein said wireless remote control comprises at least one external signal transmitter or transceiver and at least one internal signal receiver or transceiver adapted to be implanted in the patient.

88. The apparatus according to claim 85, wherein said wireless remote control comprises at least one external signal receiver or transceiver and at least one internal signal transmitter or transceiver adapted to be implanted in the patient.

89. The apparatus according to claim 85, wherein said remote control is capable of sending information related to said restriction device from inside the patient's body to the outside thereof.

90. The apparatus according to claim 89, wherein said remote control controls said restriction device in response to said information.

91. The apparatus according to claim 85, wherein said remote control transmits a carrier signal for carrying said control signal.



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92. The apparatus according to claim 91, wherein said carrier signal is frequency, amplitude or frequency and amplitude modulated.

93. The apparatus according to claim 91, wherein said carrier signal is digital, analog or digital and analog.

94. The apparatus according to claim 91, wherein said control signal used with said carrier signal is frequency, amplitude or frequency and amplitude modulated.

95. The apparatus according to claim 85, wherein said 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.

96. The apparatus according to claim 85, wherein said control signal comprises an electric, magnetic or electric and magnetic field.

97. The apparatus according to claim 85, wherein said control signal is digital, analog or digital and analog.

98. The apparatus according to claim 97, wherein said remote control transmits an electromagnetic carrier wave signal for carrying said digital or analog control signal.

99. The apparatus according to claim 85, wherein said control signal is transmitted in pulses by said wireless remote control.

100. The apparatus according to claim 1, wherein said control device releases energy from said accumulator in a non-invasive manner.

101. A method of treating morbid obesity comprising:  
implanting an operable restriction device in a patient in engagement with the stomach or esophagus to form an upper pouch of the stomach and a restricted stoma opening in the stomach or esophagus,  
implanting an accumulator for energizing the restriction device,  
implanting an energy transfer device,  
providing an external source of energy,  
controlling the external source of energy to release wireless energy,  
transferring the wireless energy by the energy transfer device into storable energy,  
charging the implanted accumulator with the storable energy, and  
controlling the accumulator to release energy for use in connection with the operation of the restriction device including to vary the restriction of the stoma opening.

102. A method of treating morbid obesity, comprising the steps of:

placing at least two laparoscopic trocars in an obese patient's body,  
inserting a dissecting tool through the trocars and dissecting an area of the stomach or esophagus,  
implanting an operable restriction device in the dissected area in engagement with the stomach or esophagus to form an upper pouch and a restricted stoma opening in the stomach or esophagus,  
implanting an accumulator and an energy transfer device in the patient,  
providing an external source of energy,  
controlling the external source of energy to release wireless energy,  
transferring the wireless energy by the energy transfer device into storable energy,

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charging the implanted accumulator with the storable energy, and

controlling the accumulator to release energy for use in connection with the operation of the restriction device including to vary the restriction of the stoma opening.

103. A food intake restriction apparatus for an obese patient, comprising:

an operable restriction device adapted to be implanted in the patient to engage the stomach or esophagus to form an upper pouch of the stomach and a restricted stoma opening in the stomach or esophagus,

a rechargeable battery adapted to be implanted in the patient for supplying electric energy for the operation of said restriction device,

a switch adapted to be implanted in the patient for switching on and off the electric energy of said battery to thereby disconnect said battery from energy consuming components of the apparatus,

a control device operable from outside the patient's body for controlling said switch to release electric energy from said battery to operate said restriction device to vary the restriction of the stoma opening,

a source of energy external to the patient's body and capable of releasing wireless energy, and

an energy transfer device adapted to be implanted in the patient for transferring said wireless energy into electric energy for charging said battery,  
wherein said control device controls said external source of energy to release said wireless energy.

104. The apparatus according to claim 103, further comprising an energy transfer device adapted to be implanted in the patient for transferring the energy supplied by said battery into a different energy form.

105. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into electromagnetic energy.

106. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into kinetic energy.

107. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into thermal energy.

108. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into non-magnetic energy.

109. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into non-electromagnetic energy.

110. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into non-kinetic energy.

111. The apparatus according to claim 104, wherein said control device controls said energy transfer device to transfer the energy supplied by said battery into non-thermal energy.

112. The apparatus according to claim 104, wherein said control device controls said energy transfer device in a mechanical manner.

113. The apparatus according to claim 104, wherein said control device controls said energy transfer device in a non-mechanical manner.

114. The apparatus according to claim 103, further comprising an energy storage device adapted to be implanted in



the patient for storing said wireless energy supplied from said external source of energy.

115. The apparatus according to claim 114, wherein said energy storage device comprises an accumulator.

116. The apparatus according to claim 115, wherein said accumulator comprises an electric accumulator.

117. The apparatus according to claim 116, wherein said electric 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.

118. The apparatus according to claim 103, wherein said control device controls said external source of energy to release electromagnetic energy.

119. The apparatus according to claim 103, wherein said control device controls said external source of energy to release magnetic energy.

120. The apparatus according to claim 103, wherein said control device controls said external source of energy to release kinetic energy.

121. The apparatus according to claim 103, wherein said control device controls said external source of energy to release non-magnetic energy.

122. The apparatus according to claim 103, wherein said control device controls said external source of energy to release non-electromagnetic energy.

123. The apparatus according to claim 103, wherein said control device controls said external source of energy to release non-kinetic energy.

124. The apparatus according to claim 103, wherein said control device controls said external source of energy to release non-thermal energy.

125. The apparatus according to claim 103, further comprising an energy transfer device adapted to be implanted in the patient for transferring the electric energy supplied by said battery into a different energy form.

126. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into magnetic energy.

127. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into electromagnetic energy.

128. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into kinetic energy.

129. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into thermal energy.

130. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into non-magnetic energy.

131. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into non-electromagnetic energy.

132. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into non-kinetic energy.

133. The apparatus according to claim 125, wherein said control device controls said energy transfer device to transfer the electric energy supplied by said battery into non-thermal energy.

134. The apparatus according to claim 125, wherein said control device controls said energy transfer device in a mechanical manner.

135. The apparatus according to claim 125, wherein said control device controls said energy transfer device in a non-mechanical manner.

136. The apparatus according to claim 103, wherein said control device comprises an internal control unit adapted to be implanted in the patient for controlling said restriction device.

137. The apparatus according to claim 136, wherein said internal control unit is programmable.

138. The apparatus according to claim 137, wherein said control device comprises an external control unit outside the patient's body, said internal control unit being programmable by said external control unit.

139. The apparatus according to claim 138, wherein said external control unit loads said internal control unit with data in accordance with a loading mode only authorized for a doctor.

140. The apparatus according to claim 138, wherein said external control unit controls said internal control unit in accordance with a doctor mode only authorized for a doctor.

141. The apparatus according to claim 138, wherein said external control unit controls said internal control unit in accordance with a patient mode permitted for the patient.

142. The apparatus according to claim 137, wherein said internal control unit is programmable for controlling said restriction device over time.

143. The apparatus according to claim 142, wherein said internal control unit controls said restriction device over time in accordance with an activity schedule program.

144. The apparatus according to claim 142, wherein said internal control unit comprises a microprocessor.

145. The apparatus according to claim 103, further comprising an operation device adapted to be implanted in the patient for operating said restriction device, wherein said control device controls said operation device to operate said restriction device.

146. The apparatus according to claim 145, wherein said operation device comprises a hydraulic device and at least one valve for controlling a fluid flow in said hydraulic device.

147. The apparatus according to claim 146, wherein said control device comprises a wireless remote control for controlling said valve.

148. The apparatus according to claim 145, wherein said restriction device comprises a hydraulic device and said operation device comprises a reservoir forming a fluid chamber with a variable volume connected to said hydraulic device, and said operation device distributes fluid from said chamber to said hydraulic device by reduction of the volume of said chamber and withdraws fluid from said hydraulic device to said chamber by expansion of the volume of said chamber.

149. The apparatus according to claim 103, further comprising at least one sensor adapted to be implanted in the patient for sensing at least one physical parameter of the patient.

150. The apparatus according to claim 149, wherein said control device controls said restriction device in response to signals from said sensor.

151. The apparatus according to claim 150, wherein said control device comprises an internal control unit adapted to be implanted in the patient and directly controlling said restriction device in response to signals from said sensor.

152. The apparatus according to claim 150, wherein said control device comprises an external control unit outside the

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patient's body and controlling said restriction device in response to signals from said sensor.

153. The apparatus according to claim 152, wherein said external control unit directly controls said restriction device in response to signals from said sensor.

154. The apparatus according to claim 152, wherein said external control unit stores information on said physical parameter sensed by said sensor and is manually operated to control said restriction device based on said stored information.

155. The apparatus according to claim 149, further comprising at least one sender adapted to be implanted in the patient for sending information on said physical parameter sensed by said sensor.

156. The apparatus according to claim 103, further comprising an external data communicator outside the patient's body and an internal data communicator adapted to be implanted in the patient for communicating with said external communicator, wherein said internal communicator feeds data related to the patient back to said external communicator or said external communicator feeds data to said internal communicator.

157. The apparatus according to claim 156, wherein said internal communicator feeds data related to said restriction device.

158. The apparatus according to claim 156, wherein said internal communicator feeds data related to at least one physical signal of the patient.

159. The apparatus according to claim 103, wherein said restriction device is adapted to control the size of said stoma opening.

160. The apparatus according to claim 103, wherein said restriction device steplessly controls the size of the stoma opening.

161. The apparatus according to claim 103, further comprising a pressure sensor for directly or indirectly sensing the pressure in the patient's stomach.

162. The apparatus according to claim 161, wherein said control device controls said restriction device in response to signals from said pressure sensor.

163. The apparatus according to claim 103, further comprising an energy transfer device adapted to be implanted in the patient, wherein said control device releases electric energy from said battery and said energy transfer device transfers said electric energy into kinetic energy for operation of said restriction device.

164. The apparatus according to claim 163, wherein said restriction device is directly operated with said kinetic energy, as said energy transfer device transfers said electric energy into kinetic energy.

165. The apparatus according to claim 163, further comprising a capacitor adapted to be implanted in the patient for stabilizing said electric energy released by said control device.

166. The apparatus according to claim 103, wherein said restriction device is non-inflatable.

167. The apparatus according to claim 103, wherein said control device releases energy for a determined time period.

168. The apparatus according to claim 103, wherein said control device releases energy in a determined number of energy pulses.

169. The apparatus according to claim 103, wherein said control device comprises a wireless remote control transmitting at least one wireless control signal for controlling said restriction device.

170. The apparatus according to claim 169, wherein said remote control is capable of obtaining information on the

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condition of said restriction device and to control said restriction device in response to said information.

171. The apparatus according to claim 169, wherein said wireless remote control comprises at least one external signal transmitter or transceiver and at least one internal signal receiver or transceiver adapted to be implanted in the patient.

172. The apparatus according to claim 169, wherein said wireless remote control comprises at least one external signal receiver or transceiver and at least one internal signal transmitter or transceiver adapted to be implanted in the patient.

173. The apparatus according to claim 169, wherein said remote control is capable of sending information related to said restriction device from inside the patient's body to the outside thereof.

174. The apparatus according to claim 173, wherein said remote control controls said restriction device in response to said information.

175. The apparatus according to claim 169, wherein said remote control transmits a carrier signal for carrying said control signal.

176. The apparatus according to claim 175, wherein said carrier signal is frequency, amplitude or frequency and amplitude modulated.

177. The apparatus according to claim 175, wherein said carrier signal is digital, analog or digital and analog.

178. The apparatus according to claim 175, wherein said control signal used with said carrier signal is frequency, amplitude or frequency and amplitude modulated.

179. The apparatus according to claim 169, wherein said 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.

180. The apparatus according to claim 169, wherein said control signal comprises an electric, magnetic or electric and magnetic field.

181. The apparatus according to claim 169, wherein said control signal is digital, analog or digital and analog.

182. The apparatus according to claim 181, wherein said remote control transmits an electromagnetic carrier wave signal for carrying said digital or analog control signal.

183. The apparatus according to claim 169, wherein said control signal is transmitted in pulses by said wireless remote control.

184. The apparatus according to claim 103, wherein said control device releases energy from said battery in a non-invasive manner.

185. The apparatus according to claim 103, further comprising a source of energy external to the patient's body and capable of releasing wireless energy, and wherein said control device controls said external source of energy to release said wireless energy to control said switch.

186. The apparatus according to claim 103, wherein said battery has a life-time of at least 10 years.

187. The apparatus according to claim 103, wherein said control device controls said restriction device.

188. The apparatus according to claim 187, further comprising an operation device adapted to be implanted in the patient for operating said restriction device, wherein said battery powers said operation device and said control device controls said operation device to operate said restriction device.

189. The apparatus according to claim 188, wherein said operation device comprises a motor.

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**190.** The apparatus according to claim **189**, wherein said motor comprises a rotary motor, and said control device controls said rotary motor to rotate a desired number of revolutions.

**191.** The apparatus according to claim **189**, wherein said motor comprises a hydraulic or pneumatic fluid motor, and said control device controls said fluid motor.

**192.** The apparatus according to claim **189**, wherein said motor comprises a casing of electrically conductive plastics.

**193.** The apparatus according to claim **188**, wherein said control device shifts polarity of said released electric energy to reverse said operation device.

**194.** The apparatus according to claim **188**, wherein said operation device comprises an electric motor.

**195.** The apparatus according to claim **188**, wherein said restriction device comprises hydraulic means, and said operation device comprises a pump for pumping a fluid in said hydraulic means and a motor for driving said pump.

**196.** The apparatus according to claim **188**, wherein said restriction device comprises hydraulic means, and said operation device comprises a pump for pumping a fluid in said hydraulic means and a motor for driving said pump.

**197.** The apparatus according to claim **196**, wherein said operation device comprises a fluid conduit between said pump and said hydraulic means of said restriction device, and a reservoir for fluid, said reservoir forming part of said conduit.

**198.** The apparatus according to claim **197**, wherein said hydraulic means, pump and conduit are devoid of any non-return valve.

**199.** The apparatus according to claim **197**, wherein said reservoir forms a fluid chamber with a variable volume, and said pump distributes fluid from said chamber to said hydraulic means of said restriction device by reducing the volume of said chamber and withdraws fluid from said hydraulic means to said chamber by expanding the volume of said chamber.

**200.** A method of treating morbid obesity comprising:

implanting an operable restriction device in a patient in engagement with the stomach or esophagus to form an upper pouch of the stomach and a restricted stoma opening in the stomach or esophagus,

implanting a battery for energizing the restriction device,

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implanting a switch for switching the power of the implanted battery,

implanting an energy transfer device,

providing an external source of energy,

controlling the external source of energy to release wireless energy,

transferring the wireless energy by the energy transfer device into an energy form suited for operating the switch, and

using the transferred wireless energy to operate the switch to release electric energy from the battery for use in connection with the operation of the restriction device including to vary the restriction of the stoma opening.

**201.** A method of treating morbid obesity, comprising the steps of:

placing at least two laparoscopic trocars in an obese patient's body,

inserting a dissecting tool through the trocars and dissecting an area of the stomach or esophagus,

implanting an operable restriction device in the dissected area in engagement with the stomach or esophagus to form an upper pouch and a restricted stoma opening in the stomach or esophagus,

implanting a battery for energizing the restriction device, implanting a switch for switching the power of the implanted battery,

implanting an energy transfer device,

providing an external source of energy,

controlling the external source of energy to release wireless energy,

transferring the wireless energy by the energy transfer device into an energy form suited for operating the switch,

using the transferred wireless energy to operate the implanted switch to release electric energy from the battery for use in connection with the operation of the restriction device including to vary the restriction of the stoma opening.

\* \* \* \* \*

专利名称(译)	控制食物摄入限制		
公开(公告)号	<a href="#">US6461293</a>	公开(公告)日	2002-10-08
申请号	US09/503149	申请日	2000-02-11
[标]申请(专利权)人(译)	OBTECH医疗		
申请(专利权)人(译)	OBTECH医药股份公司		
当前申请(专利权)人(译)	OBTECH医药股份公司		
[标]发明人	FORSELL PETER		
发明人	FORSELL, PETER		
IPC分类号	A61F2/00 A61F2/02 A61F5/00 A61B17/12 A61B17/135 A61B17/00 A61N1/378 A61N1/372 A61B A61B19/00 A61F A61N A61F2/04		
CPC分类号	A61F2/0036 A61F2/004 A61F5/0003 A61B17/1355 A61B2017/00017 A61B2017/00539 A61B2019/464 A61F2250/0001 A61N1/3787 A61B2090/064		
审查员(译)	刨, KEVIN		
优先权	60/148345 1999-08-12 US		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

#### 摘要(译)

食物摄入限制装置和方法包括并使用植入患者体内并且与胃或食道接合以在胃或食道中形成受限制的造口开口的可操作限制装置。提供了用于激励限制装置的能量源，以及用于从患者体外释放来自能量源的能量的控制装置。释放的能量与限制装置的操作结合使用，以改变造口开口的尺寸，以允许或基本上防止食物通过。

