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(54) Title: MEDICAL DEVICE COMPRISING A REMOTE CONTROL

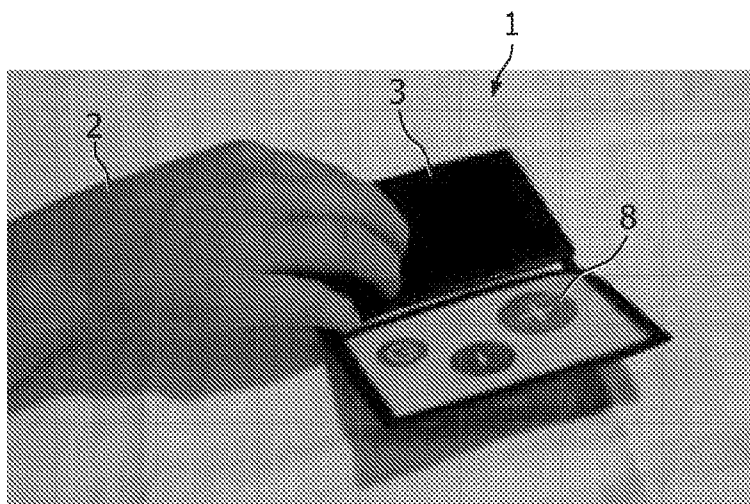


FIG. 1

(57) Abstract: Medical device (11) comprising a remote control (1, 30, 40) having a flat foldable sheath (3, 41), with a display (10, 37, 46), an input interface (7, 34, 35, 47, 52), and an antenna (33, 51). The sheath (3, 41) encases a power module (38, 48), a central control unit (31, 49) and wireless communication circuitry (32). The remote control (1, 40) can have the shape of a pocket size bill fold, having two or more panels (42, 43, 44) connected at their adjacent edges by a flexible interconnect (45).

Medical device comprising a remote control

FIELD OF THE INVENTION

The present invention relates to a medical device comprising a remote control. The medical device can, e.g., be a wearable, ingestible or implantable drug delivery and/or monitoring systems. The invention also relates to a remote control arranged for use with such a medical device.

BACKGROUND OF THE INVENTION

A wide variety of medical devices is used for drug delivery and/or for the purpose of diagnosis or for monitoring physiological parameters.

For the management of some diseases such as diabetes and Parkinson's disease, medication has to be administered very frequently. For these diseases, electronic medication pumps can be used to optimize the treatments and to increase the patient compliance and comfort. Examples of these pumps are wearable drug delivery systems such as insulin pumps and transdermal drug delivery systems, implantable pumps and pumps that can be taken in oral form, so-called electronic pills.

For other types of diseases, medical devices are used to monitor certain physiological parameters, e.g. heart-signals (ECG) or blood glucose levels.

These personal medical devices are for example located inside the body, implanted or ingested, or worn on the skin underneath the clothing. The patient or a caregiver needs to be able to access information from these devices, e.g. current drug delivery rate, device status, blood glucose level, etc., and/or control the settings of these devices, e.g. increase or decrease the medication flux.

US 2007/0233051 discloses a remote control for a drug delivery system. The disclosed remote control is voluminous and therefore it is difficult for a patient to carry it with him the whole day. Moreover, the remote control offers a relatively complex user interface.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a medical device with a remote control that can be carried in an unobtrusive way and that is easy to understand and to use.

The object of the invention is achieved with a medical device comprising a remote control having a foldable sheath with a display, an input interface, and an antenna, the sheath encasing at least one power module for feeding power to a central control unit operatively connected to the display and the input interface, and wireless communication circuitry for communication between the antenna and the central control unit. The object of the invention is also achieved with a remote control arranged for use with such a medical device. This way, the remote control can be folded and easily be carried by the user, e.g., in a pocket of clothing.

The control unit is used to process data and to transmit data among elements in the remote control. The wireless communication circuitry is coupled to the microprocessor control unit and used to convert wireless signals to data and data to wireless signals. The antenna is coupled to the wireless communication circuitry and receives or transmits the wireless signals. The input interface is coupled to the control unit, and enables users to input data.

To enhance the possibility of folding the remote control, flexible components can be used, e.g., components that can be curved around a radius of 2 cm or less while keeping their functionality. The display can for example be a flexible display. Suitable flexible displays are for example flexible monochrome or color electrophoretic displays (passive or active matrix). With active matrix electrophoretic displays the amount of interconnects is reduced and the number of addressable pixels is higher. This results in high contrast and bistability, which reduces power consumption and allows information to be displayed even when the used battery is empty or when the driver electronics is damaged. Alternatively, flexible LCD displays can be used. Suitable LCD displays include STN LCD (passive or active matrix) and PDLC (active matrix) displays and cholesteric texture LCD's, which typically have a simple construction and show a high contrast and bistability. Electrowetting displays (passive or active matrix) can also be used, e.g., displays based on HEOS technology on flexible substrates. Such displays can offer high contrast and bright color display. Flexible OLED's form another group of suitable displays.

The input interface can also be flexible, e.g. a flexible keyboard, such as an elastomer bubble keyboard. The input interface can for example comprise a set of control buttons and / or a flexible keyboard. For the convenience of older patients or patients

suffering from visual and / or motor dysfunctions, a small number of large buttons can be used, such as a number of 1 – 4 buttons having a surface area of 1 cm² or more. The buttons can for example be color coded and / or have different shapes to make it easier for the patient to recognize the functions of the various buttons.

5 The power module can for example be a solid-state polymer stabilized Li:ion battery. Such batteries can be provided in any suitable shape and are foldable and rechargeable.

 Optionally, the remote control may have the shape of a pocket size bill fold. This makes it easier for the user to carry the remote control with him all day. The remote
10 control can for example comprise two or more panels each connected to an adjacent panel by a flex foil interconnection, which can be metal coated.

 To prevent unintentional activation of the input interface, the remote control can comprise an open-close detector arranged to lock the input interface when the remote control is folded and to unlock the user interface when the remote control is unfolded. When
15 the open-close detector detects that the remote control is folded, the input interface is locked. As soon as the open-close detector detects that the remote control is unfolded, the input interface is reactivated and unlocked.

 To save energy, the remote control can for example comprise a hibernating module for setting the remote control in a hibernating mode activated by folding the remote
20 control, and deactivated by unfolding it.

 The medical device according to the invention can for example comprise a drug delivery unit with a drug reservoir, a nozzle, a pump for transporting drug from the reservoir to the nozzle, a central processing unit for controlling the pump, a power module for supplying power to the pump and an antenna for signal exchange with the remote control.
25 Such a drug delivery unit can for instance be implantable or ingestible. Alternatively, the drug delivery unit can comprise a wearable member, such as a fastening band or a garment, holding the drug delivery device in the right position for effective drug delivery to a patient.

 Additionally, or alternatively, the medical device can comprise a monitoring unit with a sensor for monitoring a physiological parameter in a patient, such as heart signals
30 or blood glucose levels. Such a monitoring unit can also be implantable, ingestible or wearable, as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be elucidated with reference to the figures wherein:

Fig. 1 shows a half unfolded remote control for a medical device according to the present invention in use;

5 Fig. 2 shows the remote control of Figure 1 unfolded;

Fig. 3 shows schematically a further possible embodiment of a medical device according to the present invention;

Fig. 4 shows schematically a further possible embodiment of a remote control of a medical device according to the invention.

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DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 shows a remote control 1 for a medical device according to the present invention, being unfolded by the hand of a user 2. The medical device can for example be an electronic pill or implantate for drug delivery or the like. The remote control 1
15 comprises a flat foldable sheath 3 and has the shape and size of a pocket size bill fold. Within the sheath 3 is an antenna, a flexible power module, wireless communication circuitry and circuitry for internal communication between the functional parts of the remote control 1. The remote control 1 comprises three panels 4, 5, 6 which are covered when the remote control 1 is folded and which form the upper side of the remote control when unfolded, as
20 shown in Figure 2. The first panel 4 shows an input interface 7 comprising a set of control buttons 8. The second panel 5 shows a set of buttons 9 for browsing on a flexible display 10 on the third panel 6.

The display 10 shows information to the user 2, e.g., a patient or his caregiver, such as a medical doctor or nurse. Using the buttons 9, the user 2 can browse through the
25 information shown on the display 10. In response to the displayed information, the user 2 can use buttons 8 for data input, e.g. a command for increasing or decreasing a dose of a drug to be administered.

Figure 3 is a block diagram of a medical device 11 according to the present invention. The medical device 11 comprises an implantable or ingestible drug delivery device
30 20 and a foldable remote control 30.

The remote control 30 includes a central control unit 31, a wireless communication circuitry 32, an antenna 33, a keyboard module 34, a function key module 35, an open-close detector 36, a display 37, a power module 38 for the supply of power to the various parts of the remote control 30, and a hibernating module 39. The keyboard module 34

and the function key module 35 form an input interface. The central control unit 31 is provided to process data and control the data transmission among the various parts of the foldable remote control 30. The wireless communication circuitry 32 is coupled to the central control unit 31 and converts signals into data and data into signals. The wireless module 32 can for example be a Bluetooth®, infrared, near-field communication, ultra wide band, or IEEE 802.11 module. The antenna 33 is coupled to the wireless communication circuitry 32 and receives or transmits wireless signals. If the wireless communication circuitry 32 is an infrared module, the antenna 33 can be a light emitting diode (LED). The keyboard module 34 is linked to the central control unit 31 and enables users to input data. The function key module 35 is coupled to the central control unit 31 as well and enables input of control signals. The open-close detector 36 is also coupled to the central control unit 31 and detects if the foldable remote control 30 is open or folded. When the remote control 30 is folded, central control unit 31 deactivates the keyboard module 34, the function key module 35 and the display 37, while the hibernating module 39 sets the remote control 30 in a hibernating mode.

The drug delivery device 20 comprises a housing 21 encasing a drug reservoir 22. The housing 21 comprises a dispensing nozzle 23. Within the housing 21 is a pump 24 for transporting an amount of the drug from the drug reservoir 22 to the nozzle 23. The drug delivery device 20 further contains a central processing unit 25 and an antenna 26 for receiving control signals from the remote control 30 and for returning data signals to the remote control 30. A communication module 27 processes received signals from the antenna 26 to data sent to the central processing unit 25. The drug delivery device 20 further contains a sensor 28 for monitoring a physiological parameter. Data from the sensor 28 and from the antenna 26 can initiate the central processing unit 25 to control the pump 24 and to initiate or stop drug delivery at a certain delivery rate. A power module 29, such as a battery, is included in the drug delivery device 20 to deliver the required power to the pump 24 and the other parts of the drug delivery device 20.

Figure 4 shows a further possible embodiment of a remote control 40 for a medical device according to the invention. The remote control 40 is of the bill fold type having a sheath 41 divided into three flexible panels 42, 43, 44. In other embodiments, two, four or even more of such panels can be used. The middle panel 43 is connected at its two opposite longitudinal sides to adjacent panels 42 and 44 respectively by metal coated flexible interconnects 45. The left panel 42 comprises a flexible display 46, such as a flexible electrophoretic active matrix display. The middle panel 43 comprises an elastomer bubble

keyboard 47 and a flexfoil section 48 encasing a flexible battery 49 and a control unit 50. Embedded in the right panel 44 is an antenna 51 extending along the edges of the panel 44. The right panel 44 is provided with three function keys 52.

5 While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude
10 other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. Medical device (11) comprising a remote control (1, 30, 40) comprising a flat foldable sheath (3, 41), with a display (10, 37, 46), an input interface (7, 34, 35, 47, 52), and an antenna (33, 51), the sheath (3, 41) encasing at least one power module (38, 48) for feeding power to a central control unit (31, 49) operatively connected to the display (10, 37, 46) and the input interface, and wireless communication circuitry (32) for communication between the antenna and the central control unit (1, 30, 40).

2. Medical device according to claim 1 wherein the input interface comprises a set of control buttons (8, 9, 34, 35, 52).

3. Medical device according to claim 1 wherein the remote control (1, 40) has the shape of a pocket size bill fold.

4. Medical device according to claim 3 wherein the remote control (40) comprises two or more panels (42, 43, 44) connected at their adjacent edges by a flexible interconnect (45).

5. Medical device according to claim 1 wherein the display is a flexible display (10, 46).

6. Medical device according to claim 1 wherein the remote control (30) comprises an open-close detector (46) arranged to lock the input interface when the remote control is folded and to unlock the user interface when the remote control is unfolded.

7. Medical device according to claim 1 wherein the remote control comprises a hibernating module (39) for setting the remote control (30) in a hibernating mode activated by folding the remote control, and deactivated by unfolding it.

8. Medical device according to claim 1 wherein the medical device comprises a drug delivery unit (20) with a drug reservoir (22), a nozzle (23), a pump (24) for transporting drug from the reservoir to the nozzle, a central processing unit (25) for controlling the pump, a power module (29) for supplying power to the pump and an antenna (26) for signal exchange with the remote control (30).
9. Medical device according to claim 8 wherein the drug delivery unit is implantable.
10. Medical device according to claim 8 wherein the drug delivery unit is ingestible.
11. Medical device according to claim 8 wherein the drug delivery unit comprises a wearable member.
12. Medical device according to claim 1 wherein the medical device comprises a monitoring unit with a sensor for monitoring a physiological parameter in a patient.
13. Medical device according to claim 12 wherein the monitoring unit is an implantable.
14. Medical device according to claim 12 wherein the monitoring unit is ingestible.
15. Remote control arranged for use with a medical device according to any one of the preceding claims.

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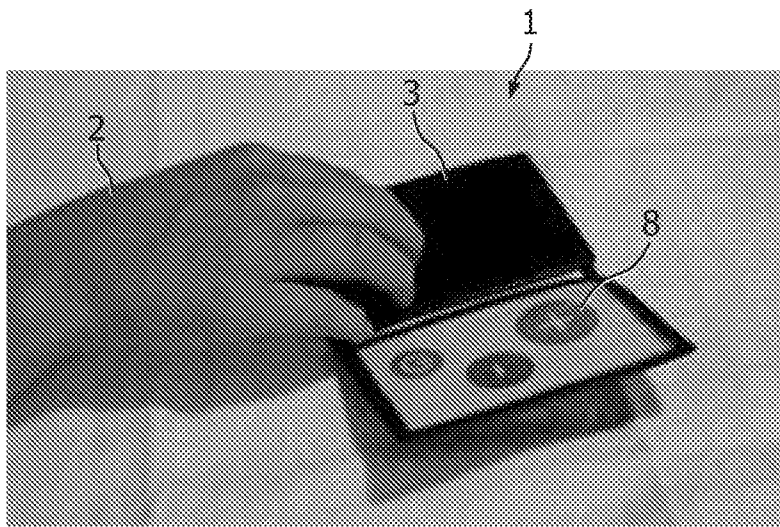


FIG. 1

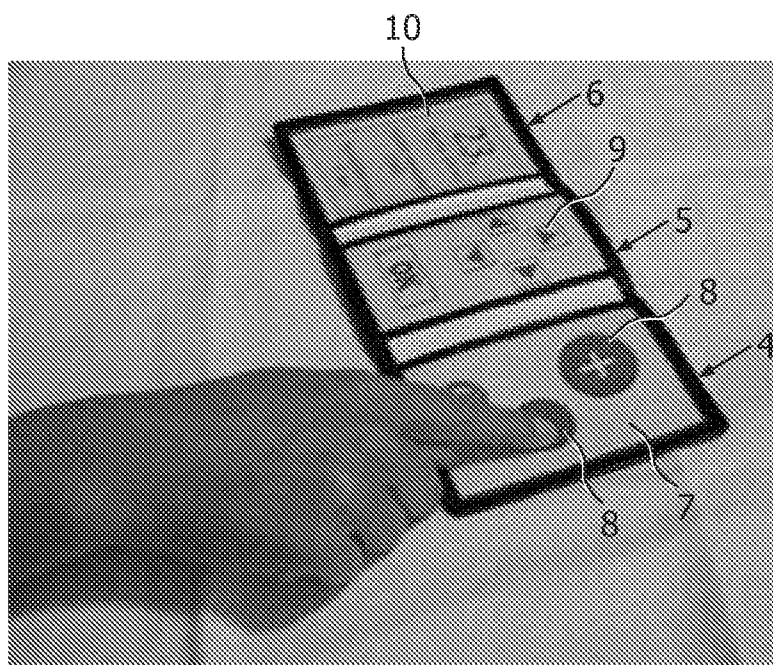


FIG. 2

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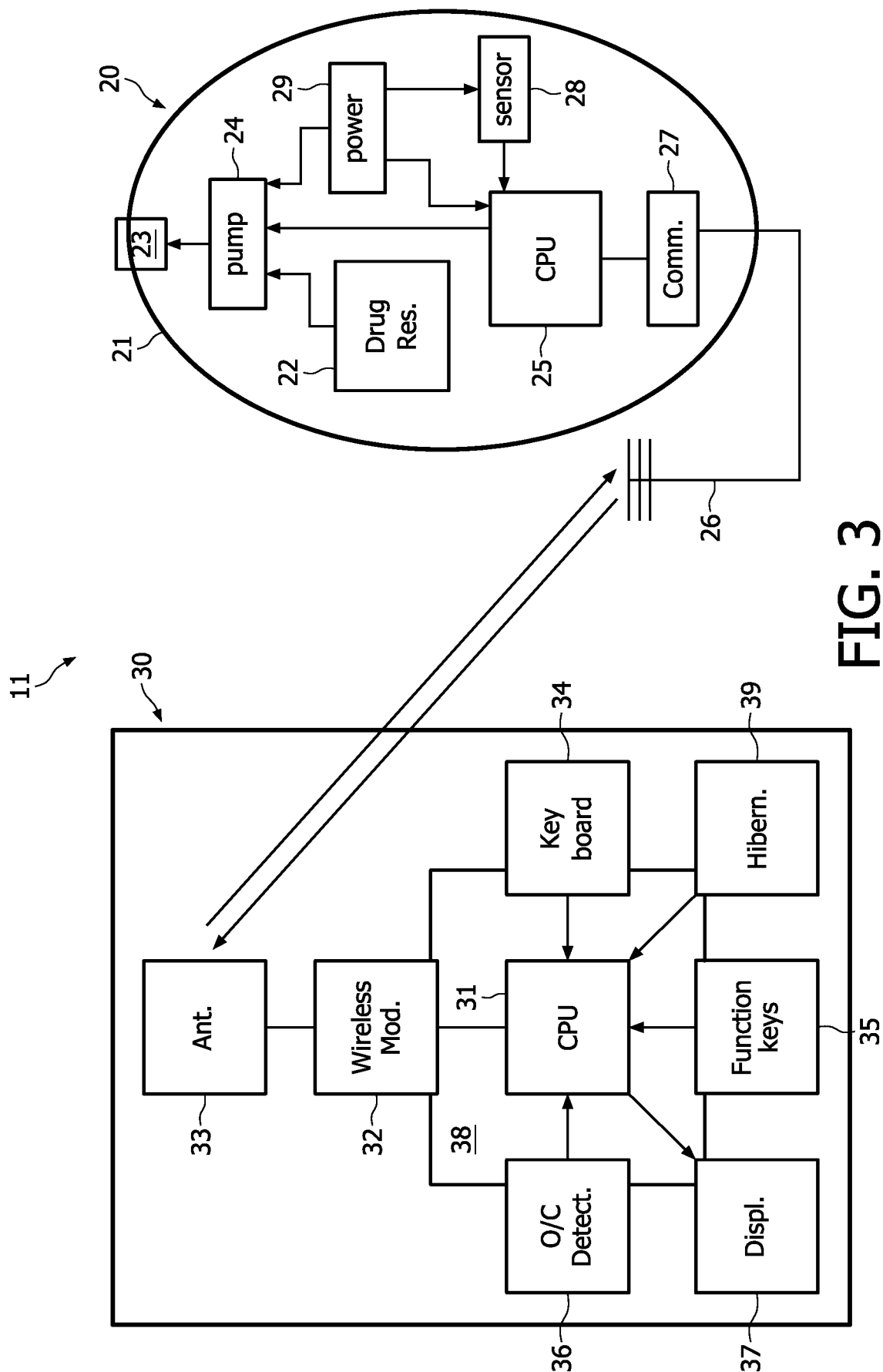


FIG. 3

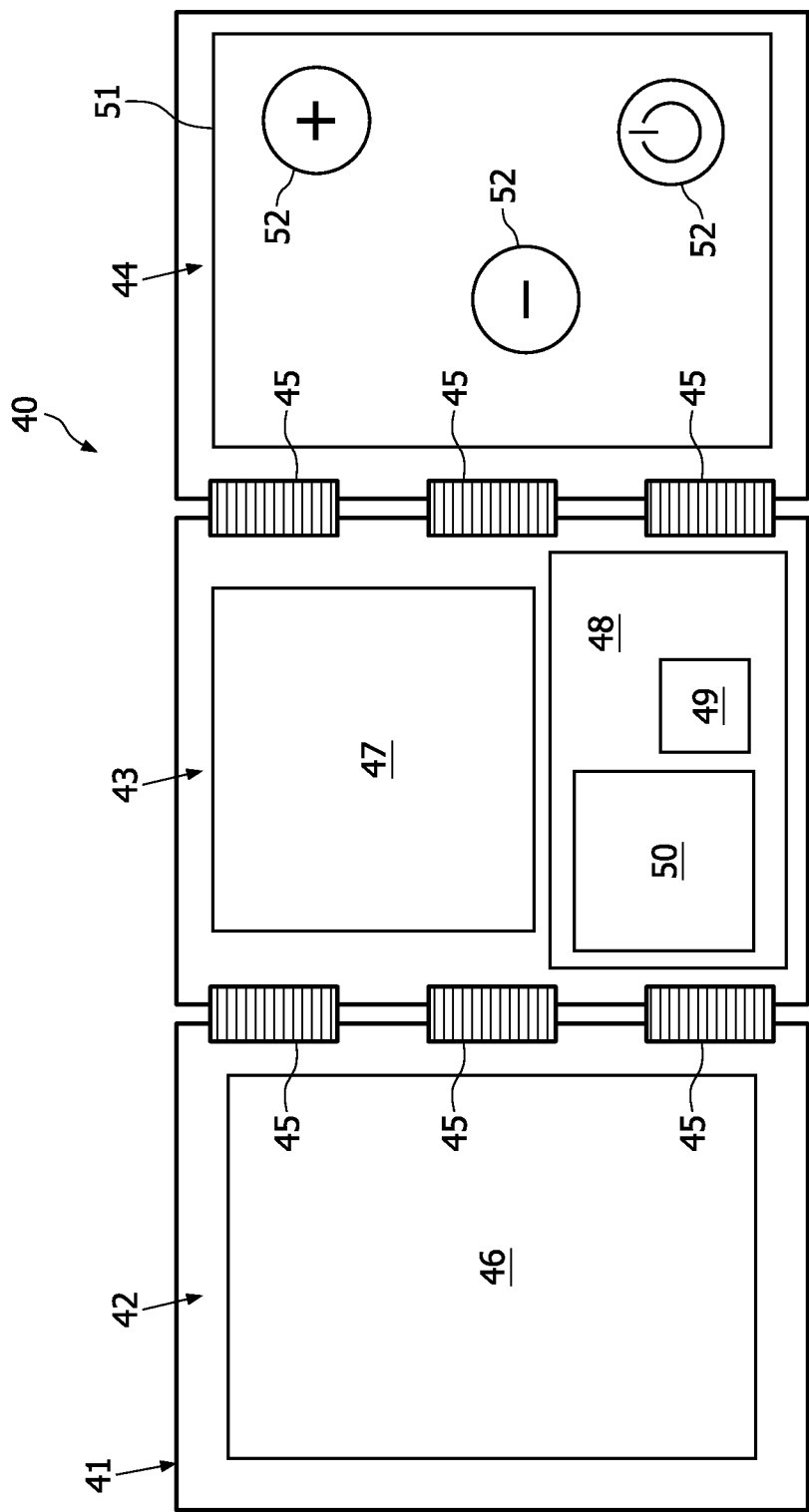


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2009/053029

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/142

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/051139 A2 (INSULET CORP [US]) 3 May 2007 (2007-05-03) the whole document -----	1-15
X	JP 11 250761 A (INAX CORP) 17 September 1999 (1999-09-17) the whole document -----	15
A		1-14
A	EP 1 406 427 A2 (NIPPON ELECTRIC CO [JP]) 7 April 2004 (2004-04-07) the whole document -----	1-15
X	US 2004/037051 A1 (HAGIWARA YASUJI [JP] ET AL) 26 February 2004 (2004-02-26) the whole document -----	15
A		1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

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O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007051139	A2	03-05-2007	NONE
JP 11250761	A	17-09-1999	NONE
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