



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.05.2019 Bulletin 2019/19

(51) Int Cl.:
G08C 17/00 (2006.01)

(21) Application number: **17199747.1**

(22) Date of filing: **02.11.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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(54) **REMOTE CONTROL DEVICE AND METHOD OF OPERATION**

(57) A remote control device (200) for transmitting control commands (120) to an external device (131) comprises a plurality of sockets (250) and a controller (210). Each socket (250) is constructed and arranged to receive a button (230) having an electrical resistance. The controller (210) is configured to detect, when a button (230) is inserted into one of the sockets (250), the electrical resistance of the inserted button (230) and determine,

from the detected electrical resistance, a control command associated with the inserted button (230). The controller (210) then assigns the determined control command to the socket (250) into which the inserted button (230) was inserted such that the determined control command is transmitted to the external device (131) in response to the inserted button (230) being pressed.

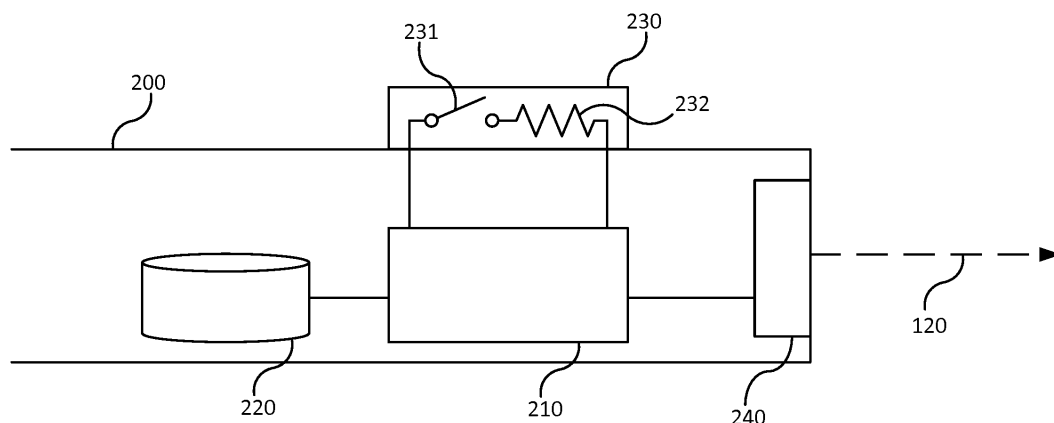


Figure 2

Description

Technical Field

[0001] The present disclosure relates to a remote control device and method of operating a remote control device.

Background

[0002] A remote control device (or more simply "remote control") is a device for remotely controlling one or more external electronic devices such as a television, set top box, air-conditioning unit, games console, etc. A user is able to control the electronic device using the remote control by pressing one or more buttons of the remote control which cause the remote control to transmit one or more command signals to the electronic device. For example, a user may turn a television on by pressing an "on" button on a remote control, in response to which the remote control transmits a control signal to the television causing the television to turn on. A plurality of buttons is usually provided on the remote control which have specifically designated functions.

[0003] Remote controls typically transmit command signals to the electronic device using wireless communications (e.g. infrared, Bluetooth, etc.), but may alternatively be connected to the electronic device via a wired connection, in which cases commands signals are sent via the wired connection.

[0004] Known remote controls use a matrix scanning method to determine which button has been pressed. The buttons are connected to a grid of wires. Pressing a button activates a unique pair of wires, allowing a processor to determine which button was pressed and transmit the appropriate control command to the external electronic device.

Summary

[0005] According to a first aspect disclosed herein, there is provided a remote control device for transmitting control commands to an external device, the remote control device comprising: a plurality of sockets, each socket being constructed and arranged to receive a button having an electrical resistance; and a controller configured to: detect, when a button is inserted into one of the sockets, the electrical resistance of the inserted button; determine, from the detected electrical resistance, a control command associated with the inserted button; and transmit the determined control command associated with the inserted button to the external device in response to the inserted button being pressed.

[0006] In an example, the controller is configured to detect the electrical resistance of the inserted button in response to the button being pressed.

[0007] In an example, the remote control device comprises a data storage for storing associations between

electrical resistances and control commands; and the controller is configured to determine the control command associated with the inserted button by accessing the data storage.

[0008] In an example, the sockets and controller are connected via wired connections such that when two or more inserted buttons are pressed the electrical resistance detected by the controller is an effective electrical resistance of the two or more inserted buttons.

[0009] In an example, the controller is configured to determine the electrical resistance of the inserted button in response to the button being inserted.

[0010] In an example, the controller is configured to assign the determined control command to the socket into which the inserted button was inserted such that the determined control command is transmitted to the external device in response to the inserted button being pressed.

[0011] In an example, the remote control device comprises a first plurality of sockets constructed and arranged to receive a first type of button, and a second plurality of sockets constructed and arranged to receive a second type of button.

[0012] In an example, each socket comprises a magnet arranged to hold a button in the socket.

[0013] According to a second aspect disclosed herein, there is provided a remote control device according to the first aspect and a plurality of buttons, at least some of the buttons having different electrical resistances detectable by the controller of the remote control device.

[0014] According to a third aspect disclosed herein, there is provided a method of transmitting control commands from a remote control device to an external device, the method comprising: detecting, when a button having an electrical resistance is inserted into one of a plurality of sockets of the remote control device, the electrical resistance of the inserted button; determining, from the detected electrical resistance, a control command associated with the inserted button; and transmitting the determined control command associated with the inserted button to the external device in response to the inserted button being pressed.

Brief Description of the Drawings

[0015] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically operation of an electronic device via a remote control in accordance with examples described herein;

Figure 2 shows schematically a remote control in accordance with examples described herein;

Figure 3 illustrates an example data structure for

holding associations between resistance values and control commands;

Figures 4A and 4B show schematically two example buttons;

Figure 5 shows schematically an example remote control having a plurality of sockets for receiving a plurality of buttons;

Figures 6A and 6B illustrate insertion of a button into a socket of the remote control; and

Figure 7 is a circuit diagram showing example electronic circuitry of the remote control in accordance with examples described herein.

Detailed Description

[0016] Figure 1 shows a schematic diagram of an example system 100 in which a user 110 operates a remote control 200 in order to control an electronic device 131. In this example the electronic device 131 is a television, but other electronic devices may be controlled such as an air-conditioning unit, a set top box, a games console, etc.

[0017] To control the electronic device 131, the user 110 presses a button on the remote control 200 which causes the remote control 200 to transmit a control signal 120 to a receiver 130 of the electronic device 131. Although shown as an external receiver 130 in Figure 1, receivers for receiving control signals from remote controls are typically integrated into the electronic device itself.

[0018] In any case, the remote control 200 is provided with a plurality of buttons each with a specific function. The user 110 chooses a button to press based on a desired control function the user 110 wishes to implement (e.g. turning the electronic device 131 on). The buttons may be provided with markings indicating the respective control function to the user 110 to aid the user 110 in finding the desired button.

[0019] In known remote controls, the function of a particular button is associated with the location of the button on the remote. In examples described herein, the function of a button is tied to the button itself, allowing buttons to be moved around the remote control while maintaining their particular functionality.

[0020] As a specific example, the remote control 200 may be a keyboard. In known keyboards, one can remove and swap letters, but the functionality remains static. That is, if the "T" and "K" keys are swapped, pressing the "T" key will type a "K"; the functionality remains unchanged. In examples described herein, however, the "T" key can be moved to any location on the keyboard and will still function as a "T" key (e.g. will still type "T" in response to being pressed).

[0021] Figure 2 shows a schematic diagram of an ex-

ample remote control 200 in accordance with embodiments described herein. The remote control 200 comprises a controller 210, a memory 220, and a transmitter 240. In this example, only a single button 230 is shown for the purposes of explanation. The button 230 has already been inserted into a socket of the remote control 200. The process for doing so is described in more detail below.

[0022] The button 230 comprises a switch 231 and a resistor 232. The switch 231 and resistor 232 are connected in series to two legs (described below) of the button 230. The legs are, in the inserted position as shown in Figure 2, electrically connected to the controller 210.

[0023] The controller 210 comprises one or more processors configured to perform the functionality described herein. The controller 210 is operably coupled to each of the memory 220 and transmitter 240. As mentioned above, the controller 210 is also operably coupled to the button 230 (when the button 230 is inserted).

[0024] The memory 220 comprises one or more data storage devices for storing data. The memory 220 is accessible by the controller 210 to at least perform read operations. That is, the controller 210 is able to read data from memory 220, though in other examples the controller 210 may also be able to write data to memory 220.

[0025] The transmitter 240 comprises one or more wired or wireless interfaces for transmitting control signals. An example of a wireless interface is an infrared interface configured to output data via an infrared signal. Other examples include Bluetooth, WiFi, etc. An example of a wired interface is an Ethernet interface. In any case, the transmitter 240 is configured to receive control signals from the controller 210 and output the control commands as one or more control signals for receipt by a receiver 130 of an external electronic device 131 as described above in relation to Figure 1.

[0026] When the button 230 is pressed, switch 231 closes, completing the circuit through the button 230 to the controller 210. A resistance value of the resistor 232 will affect measurable electrical properties (e.g. voltage or current) on the now closed circuit. The controller 210 is configured to measure such a property and determine a resistance value of the resistor 232 from the measured property. For example, the controller 210 may measure the voltage (V) and current (I) on the circuit and determine the resistance as $R=V/I$ according to Ohm's law.

[0027] The controller 210 is configured to determine a control command associated with the determined resistance value. This may involve accessing memory 220 to identify the control command in a lookup table storing associations between resistance values and control commands. An example of such a lookup table is shown in Figure 3.

[0028] The lookup table 300 (or other data structure) holds an association between resistance values 310 and control commands 320. The controller 210 accesses the lookup table 300 to identify the control command 320 associated with the determined resistance value of the

resistor 232. For example, if the resistor 232 is a 2000Ω resistor, the controller 210 will calculate this based on measuring the voltage and/or current and then identify, using the lookup table 300, that the button 230 which was pressed is a "menu" button. In response to identifying the appropriate control command 320, the controller 210 sends the control command 320 to the transmitter 240. The control command 320 is then transmitted by the transmitter 240 for reception by a receiver 130 of the external electronic device 131 as one or more control signals 120.

[0029] Figure 4A shows a button 230 in accordance with a first example described herein. The button 230 is cylindrical in shape, though other shapes are possible, such as cuboids. The button 230 is able to fit in at least two sockets of the remote control 200 (as described below).

[0030] In some examples, two or more types of buttons may be provided which can each fit in a respective two or more types of socket. That is, different sets of buttons may be provided which are the same shape within a set and different between sets. The remote control 200 may also comprise some fixed buttons which cannot be moved by the user 110. For example, character keys (buttons) and function keys (buttons) for insertion into sockets on a keyboard may be shaped such that the character keys can only fit into designated character key sockets and the function keys can only fit into designated function key sockets. In such examples, the user 110 still has freedom to place each type of key wherever desired within a restricted range. As another example, the remote control 200 may be a games controller. In this case, one section of the games controller may have sockets for receiving "movement" buttons (up, down, left, right, etc.) and another section of the games controller may have sockets for receiving "action" buttons (shoot, reload, etc.)

[0031] Returning to Figure 4A, the button 230 has a front face (outwardly facing when inserted in the remote control 200) and a back face (inwardly facing, so not in view, when inserted in the remote control 200). The back face has two legs 231a-b for inserting into a socket of the remote control 200. When inserted, the legs 231a-b operably couple the button 230 to the remote control 200. An example of how this works was given above in relation to Figure 2. In this example, the front face has markings 232 indicating the user 110 the functionality associated with that button 230.

[0032] Figure 4B shows a second example button 230. This button 230 is similar to the button 230 in Figure 4A, but the two legs 231a-b are arcuate in cross-section instead of being elongate pins. This allows for a better and more stable connection between the inserted button 230 and the remote control 200.

[0033] Figure 5 shows schematically a top view of a remote control 200. The remote control 200 has a transmitter 240, as before, for transmitting control signals 120 to a receiver 130 of an electronic device 131. In this example, the remote control 200 has a plurality of sockets

250 for receiving buttons. Specifically, thirty-nine sockets 250 are shown, arranged in thirteen rows of three.

[0034] A plurality of buttons 230 are shown next to the remote control 200 (i.e. not inserted into sockets 250 of the remote control 200). At least one socket 250 is constructed to be able to receive two or more buttons 230. In this example, each socket 250 can receive any button 230.

[0035] Each socket 250 comprises two electrical contacts 251a-b arranged to each contact a respective leg 231a-b of a button 230 when the button 230 is inserted into the socket 250. The electrical contacts 251a-b thereby provide a connection between the internal circuitry of the remote control 200 and each button 230 (when inserted). The contacts 251a-b may also be arranged to hold the button 230 in place, e.g. using friction or a locking mechanism (see Figure 6A and 6B). Alternatively or additionally, the sockets 250 may comprise a magnet arranged to hold a button 230 in place such that an electrical connection is maintained between the electrical contacts 251a-b and the legs 231a-b. In such cases, the buttons 230 may be constructed of a ferromagnetic material such as ferritic stainless steel, or may comprise a magnet of their own, or both.

[0036] Each button 230 is configured to initiate sending of a different control command to the electronic device 131. Each button 230 may therefore be provided with a unique marking 232 such as a symbol indicating its functionality to the user 110.

[0037] Because each button 230 can be inserted into any socket in this example, the user 110 is able to reconfigure the arrangement of buttons 230 on the remote control 200 at will. For example, the user 110 may place buttons 230 which the user 110 frequently uses in sockets 250 near the lower end of the remote control 250, to make them easier and more convenient to operate when the user 110 is holding the remote control 200.

[0038] Many remote controls are designed to be held by a single hand. As most people are right-handed, the layout of buttons on such a remote control may be designed with a right-handed user in mind. A left-handed user may therefore find such a remote control cumbersome or difficult to operate.

[0039] Aspects disclosed herein address this as the user 110 can simply reposition the buttons 230 as desired. This is achieved by having the functionality of the button 230 (i.e. what control command is triggered by pressing that button) follow the button 230 itself, rather than being assigned to a specific location on the remote control 200 (a specific socket 250).

[0040] As described above in relation to Figures 2 and 3, each button 230 comprises an internal resistor 232, with each button's (or type of button's) internal resistor 232 having a different resistance. There is a unique mapping between resistance values 310 and control commands 320, e.g. stored in memory 220. When a button 230 is pressed, the controller 210 measures the resistance value 310, looks up the corresponding control com-

mand 320, and transmits it via the transmitter 240. This processes is independent of where on the remote control the pressed button 230 is located (i.e. into which socket 250 the pressed button 230 is inserted).

[0041] The buttons 230 may be manufactured with a consistent resistance value 310 for each control command 320. An advantage of this is that if the user 110 loses or breaks one or more of the buttons 230, the user 110 is able to buy replacement buttons 230 which require no setup: they will automatically function as intended in the remote 200 due to the resistance value 310 being associated with a known control command 320.

[0042] In an alternative example, the controller 210 measures the resistance value 310 in response to a button 230 being inserted into a socket 250 (e.g. for the first time). The controller 210 then identifies the control command 320 corresponding to that resistance value 310 (e.g. using lookup table 300), and stores an associated between the socket 250 into which the button 230 was inserted and the identified control command 320. In this example, the controller 210 does not need to measure the resistance value 310 every time the button 230 is pressed, as the functionality (control command 320) is associated directly with that socket 250.

[0043] Figures 6A and 6B illustrate insertion of a button 230 into a socket 350. The button 230 is in this example is of the same type illustrated in Figure 4B, with arcuate shape legs to provide a greater contact area between the legs 231a-b of the button 230 and the socket 250. In this example, the electrical contacts 251a-b for connecting to the legs 231a-b of the button 230 comprise holes for receiving a respective leg. The socket 250 is constructed and arranged to lock the legs 231a-b into the holes when turned. That is, the button 230 can be locked into the socket 250 by, after placing each leg 231a-b in a respective hole, turning the button 230 (e.g. clockwise) about its longitudinal axis as shown in Figure 6B.

[0044] Figure 7 is a circuit diagram showing schematically an example circuitry of the remote control 200 into which three buttons 230a-c have been inserted. Each button 230a-c comprises a respective switch 231a-c and internal resistor 232a-c in a manner described above in relation to Figure 2.

[0045] In this example arrangement, one leg of each button 230a-c is connected to an input voltage VCC. The other legs of each button 230a-c are connected to each other and to ground GND via reference resistor 262. The controller 210 is connected to each button 230a-c between the reference resistor 262 and the buttons 230a-c themselves, in a potential divider arrangement in which the resistors 232a-c of each button 230 are connected in parallel.

[0046] In this arrangement, closing a switch 231a-c (by pressing the respective button 230) forms a potential divider circuit having input voltage VCC, internal resistor 232a-c of the pressed button 230 as one resistor, and reference resistor 262 as the other. The output voltage is measurable by the controller 210. Hence, when a but-

ton 230a-c is pressed, the controller 210 is able to determine the resistance value of the internal resistor 232a-c of the pressed button 230a-c by measuring the output voltage. To perform such a calculation, the controller 210 requires values of the input voltage VCC and the resistance of the reference resistor 262. These values can be stored in memory 220.

[0047] If multiple buttons 230a-c are pressed at the same time, the output voltage measured by the controller 210 may be different from an output voltage resulting from any single one of the buttons 230a-c having been pressed. In such cases, the controller 210 may calculate a resistance value as normal, but the resistance value calculated will correspond to an effective resistance of all pressed buttons 230 connected in parallel. This effective resistance value may also be assigned to a control command, in the manner described above, thus allowing for additional functionality.

[0048] In an example, an analogue-to-digital converter (ADC) is used to identify buttons 230. As mentioned earlier, known remote controls use a matrix scanning method for button readings because of the cost of components and to save space on a printed circuit board (PCB). According to aspects described herein, on the other hand, resistors are embedded inside the each button 230 which are therefore moved with the buttons to new socket locations whenever the user relocates the buttons. Use of an ADC is more suitable for this application.

[0049] In an example, the controller 210 (e.g. a processor or a microcontroller unit) is in low power mode or in power down state most of the time and consumes little power. When a button 230 is pressed, an analogue comparator generates a signal to wake up the controller 210. The analogue comparator may be in the controller 210, or may be an off-chip peripheral.

[0050] The reference signal of the analogue comparator may be connected to an internal voltage reference of the controller 210, but may also be provided externally. When the analogue comparator raises an interrupt signal, the controller 210 wakes up and reads the analogue value (electrical resistance) of the button 230. The controller 210 may be capable of both ADC and analogue comparison on a single pin so as not to require an external trace. If controller 210 is in power down state, an external analogue comparator or the button signal may power it on using a reset pin or a power management integrated circuit (PMIC).

[0051] In an example, the interrupt system can perform digital switching via a component such as transistor, internally or externally. When no button is pressed on the remote control, the pin is pulled down to ground signal, and after a button 230 is pressed, there is a voltage drop on the internal resistor of the button 230 and the pulldown resistor. The connection of these resistors is associated with a voltage value. The circuit is designed to that threshold. Hence, when the interrupt signal is received, the controller 210 wakes up and reads the analogue value of the button 230. Other methods to wake up the controller 210

are possible.

[0052] The remote control 200 may also comprise one or more de-bouncing circuits, electrical filters (such as R-C filter, glitch filter, hysteresis-band, etc.) or digital filters (software filters, etc.).

[0053] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0054] Reference is made herein to data storage for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0055] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0056] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope

of the invention, which is defined in the claims.

Claims

1. A remote control device for transmitting control commands to an external device, the remote control device comprising:
 - a plurality of sockets, each socket being constructed and arranged to receive a button having an electrical resistance; and
 - a controller configured to:
 - detect, when a button is inserted into one of the sockets, the electrical resistance of the inserted button;
 - determine, from the detected electrical resistance, a control command associated with the inserted button; and
 - transmit the determined control command associated with the inserted button to the external device in response to the inserted button being pressed.
2. A remote control device according to claim 1, wherein the controller is configured to detect the electrical resistance of the inserted button in response to the button being pressed.
3. A remote control device according to claim 1 or claim 2, comprising a data storage for storing associations between electrical resistances and control commands; wherein the controller is configured to determine the control command associated with the inserted button by accessing the data storage.
4. A remote control device according to any of claims 1 to 3, wherein the sockets and controller are connected via wired connections such that when two or more inserted buttons are pressed the electrical resistance detected by the controller is an effective electrical resistance of the two or more inserted buttons.
5. A remote control device according to any of claims 1 to 4, wherein the controller is configured to determine the electrical resistance of the inserted button in response to the button being inserted.
6. A remote control device according to claim 5, wherein the controller is configured to assign the determined control command to the socket into which the inserted button was inserted such that the determined control command is transmitted to the external device in response to the inserted button being pressed.

7. A remote control device according to any of claims 1 to 6, wherein the remote control device comprises a first plurality of sockets constructed and arranged to receive a first type of button, and a second plurality of sockets constructed and arranged to receive a second type of button. 5
8. A remote control device according to any of claims 1 to 7, wherein each socket comprises a magnet arranged to hold a button in the socket. 10
9. A remote control device according to any of claims 1 to 8 and a plurality of buttons, at least some of the buttons having different electrical resistances detectable by the controller. 15
10. A method of transmitting control commands from a remote control device to an external device, the method comprising: 20
- detecting, when a button having an electrical resistance is inserted into one of a plurality of sockets of the remote control device, the electrical resistance of the inserted button;
- determining, from the detected electrical resistance, a control command associated with the inserted button; and 25
- transmitting the determined control command associated with the inserted button to the external device in response to the inserted button being pressed. 30

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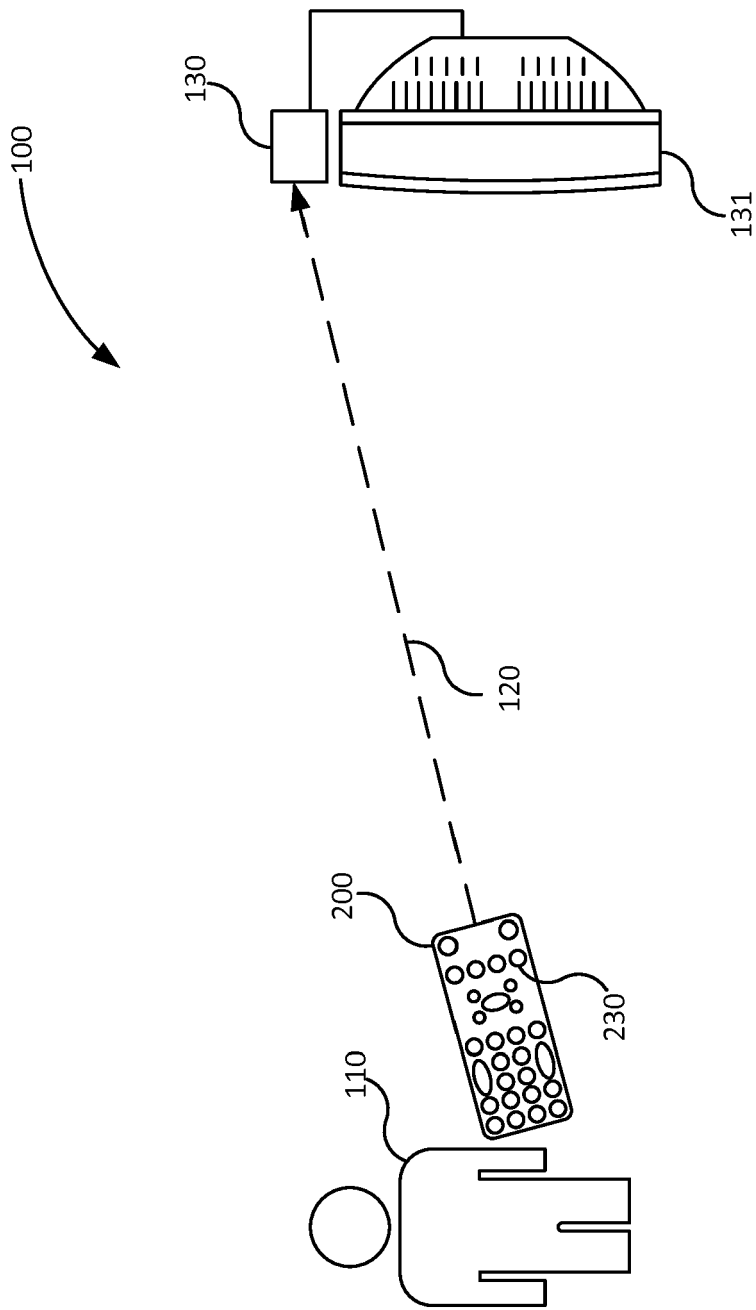


Figure 1

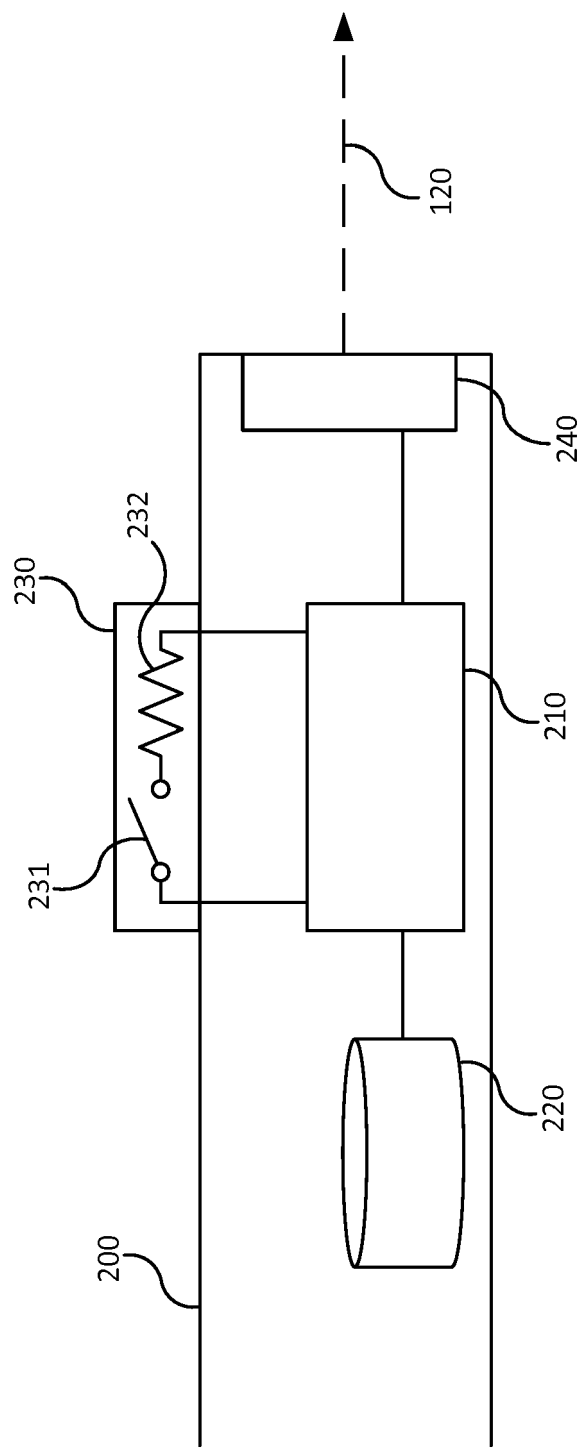
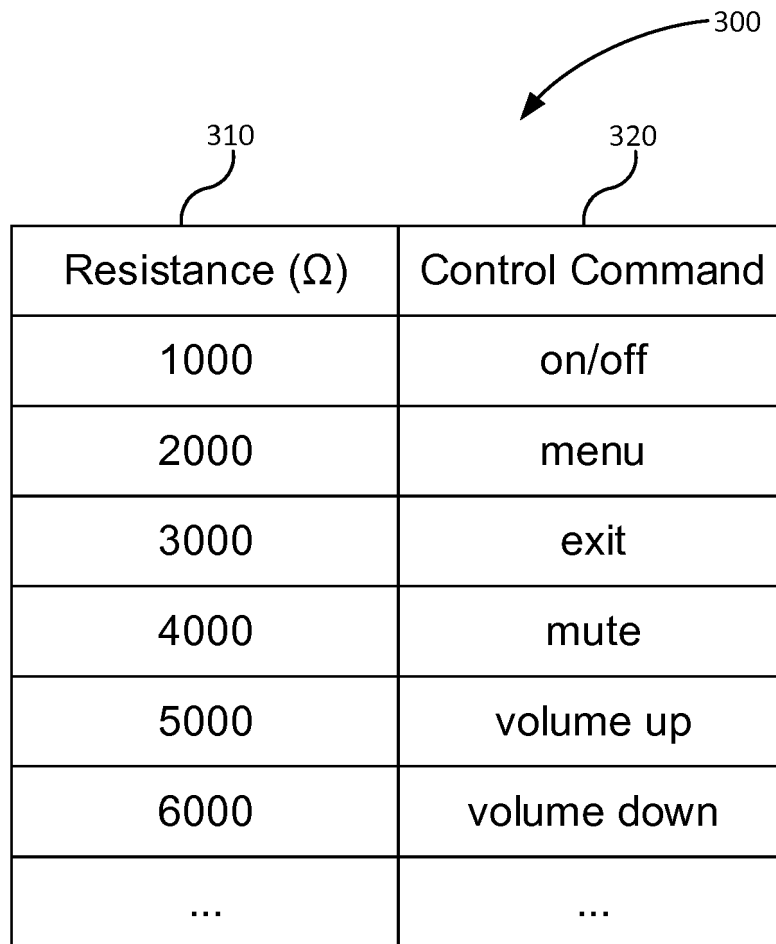


Figure 2



The diagram shows a table with two columns. A curved arrow labeled '300' points from the top right towards the table. A label '310' is connected by a line to the first column header 'Resistance (Ω)'. A label '320' is connected by a line to the second column header 'Control Command'.

Resistance (Ω)	Control Command
1000	on/off
2000	menu
3000	exit
4000	mute
5000	volume up
6000	volume down
...	...

Figure 3

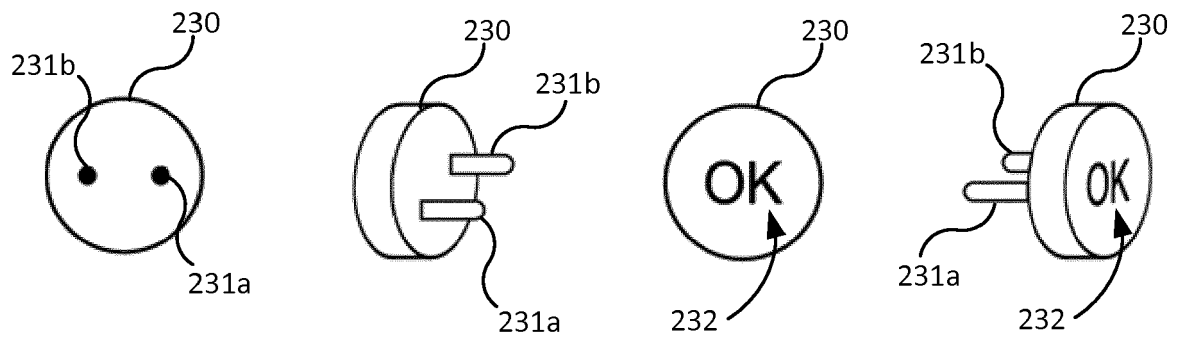


Figure 4A

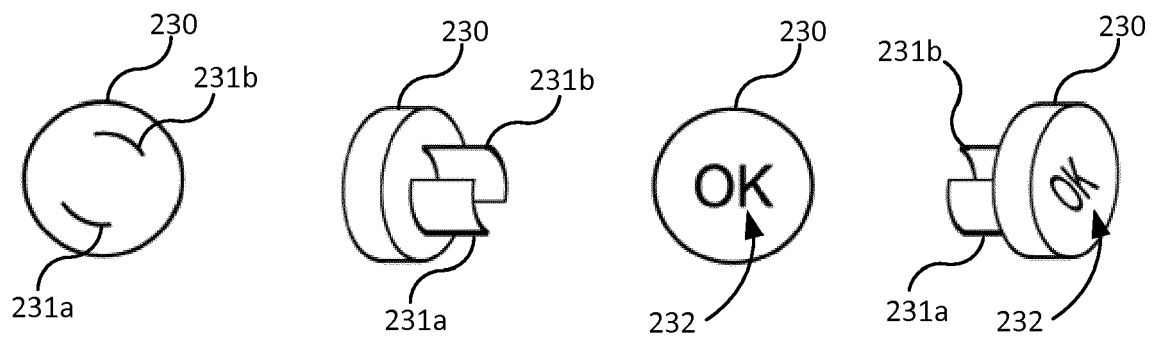


Figure 4B

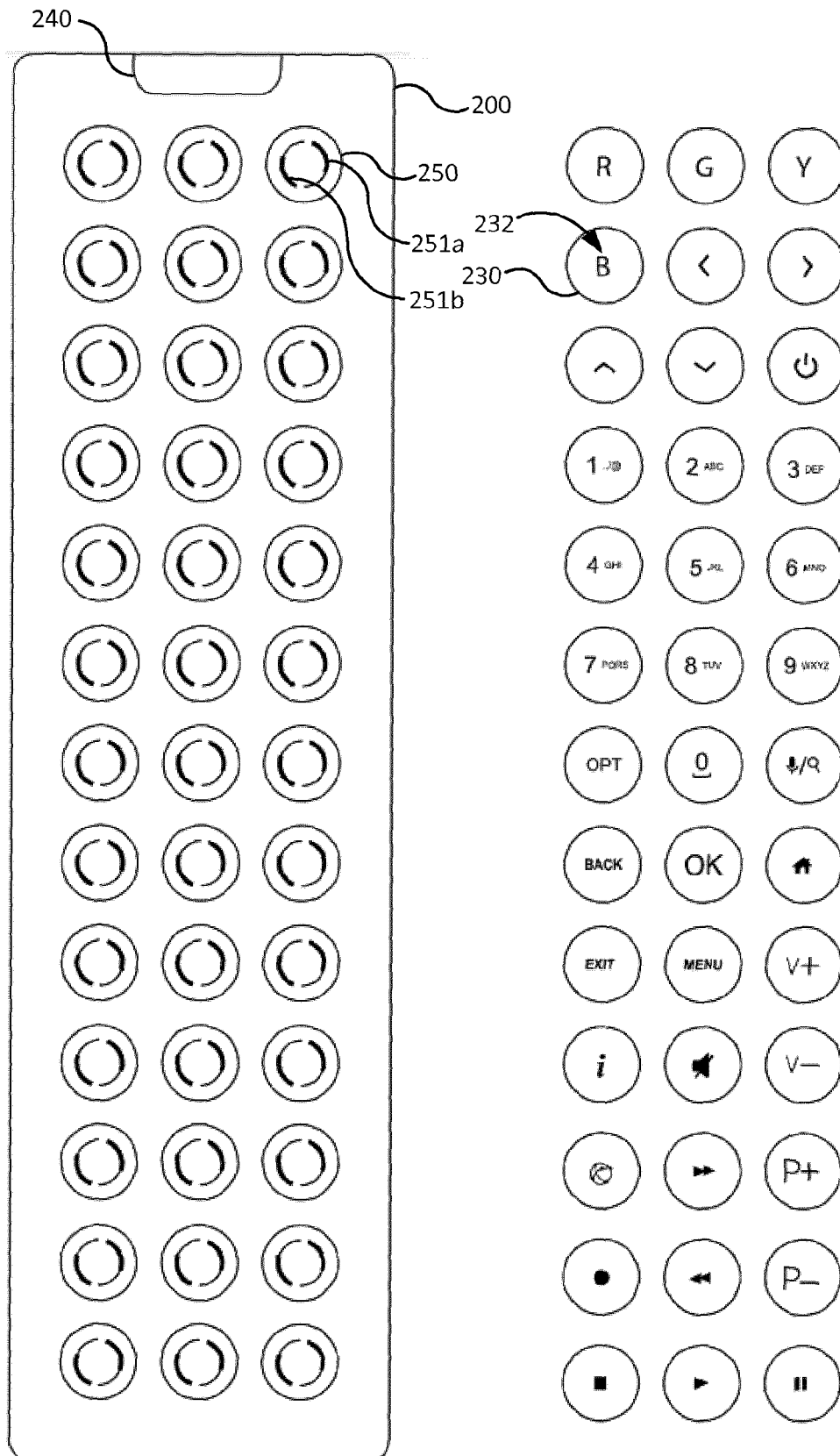


Figure 5

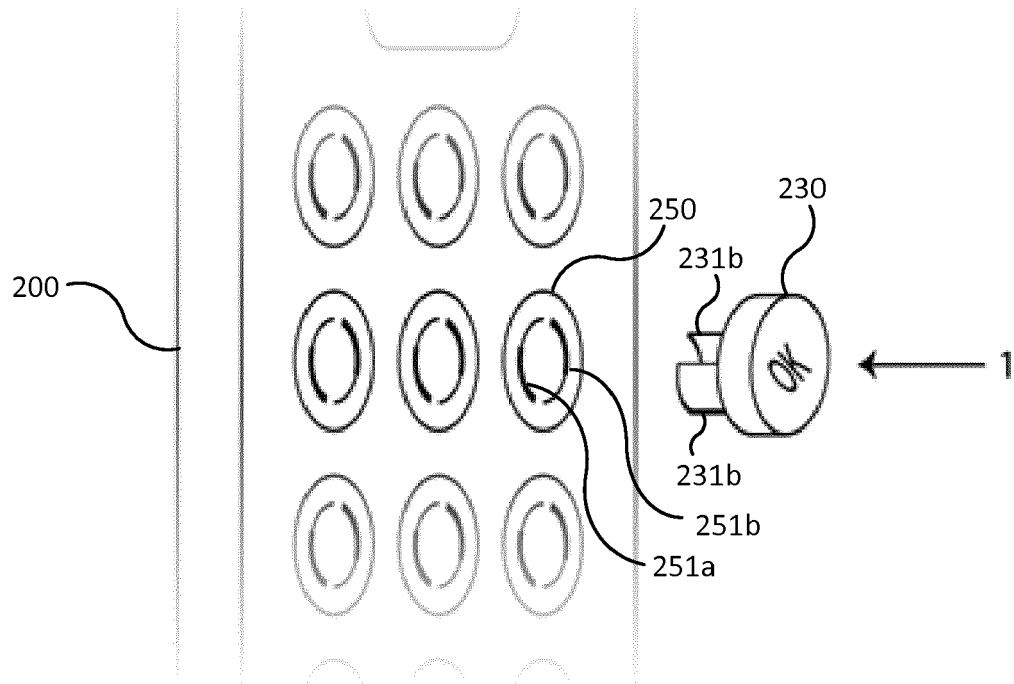


Figure 6A

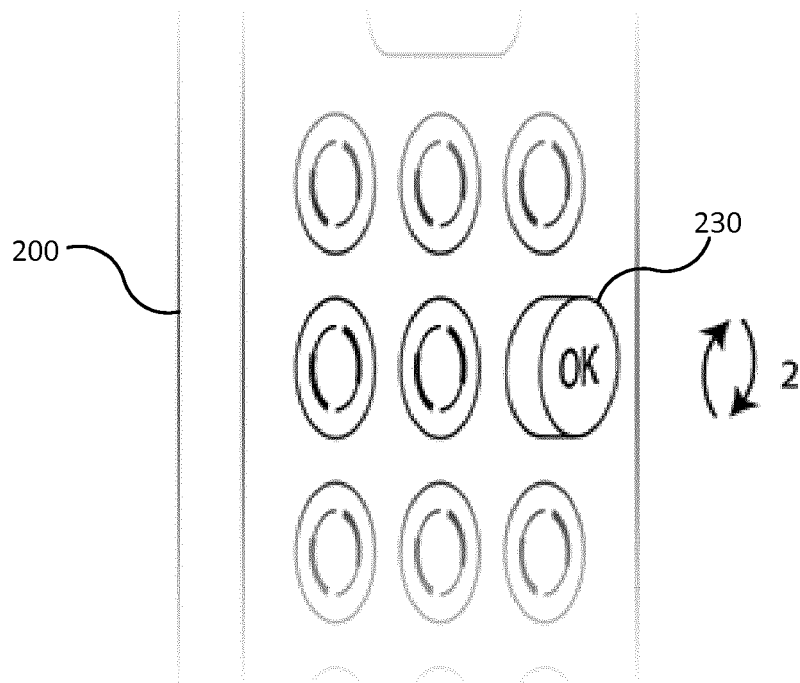


Figure 6B

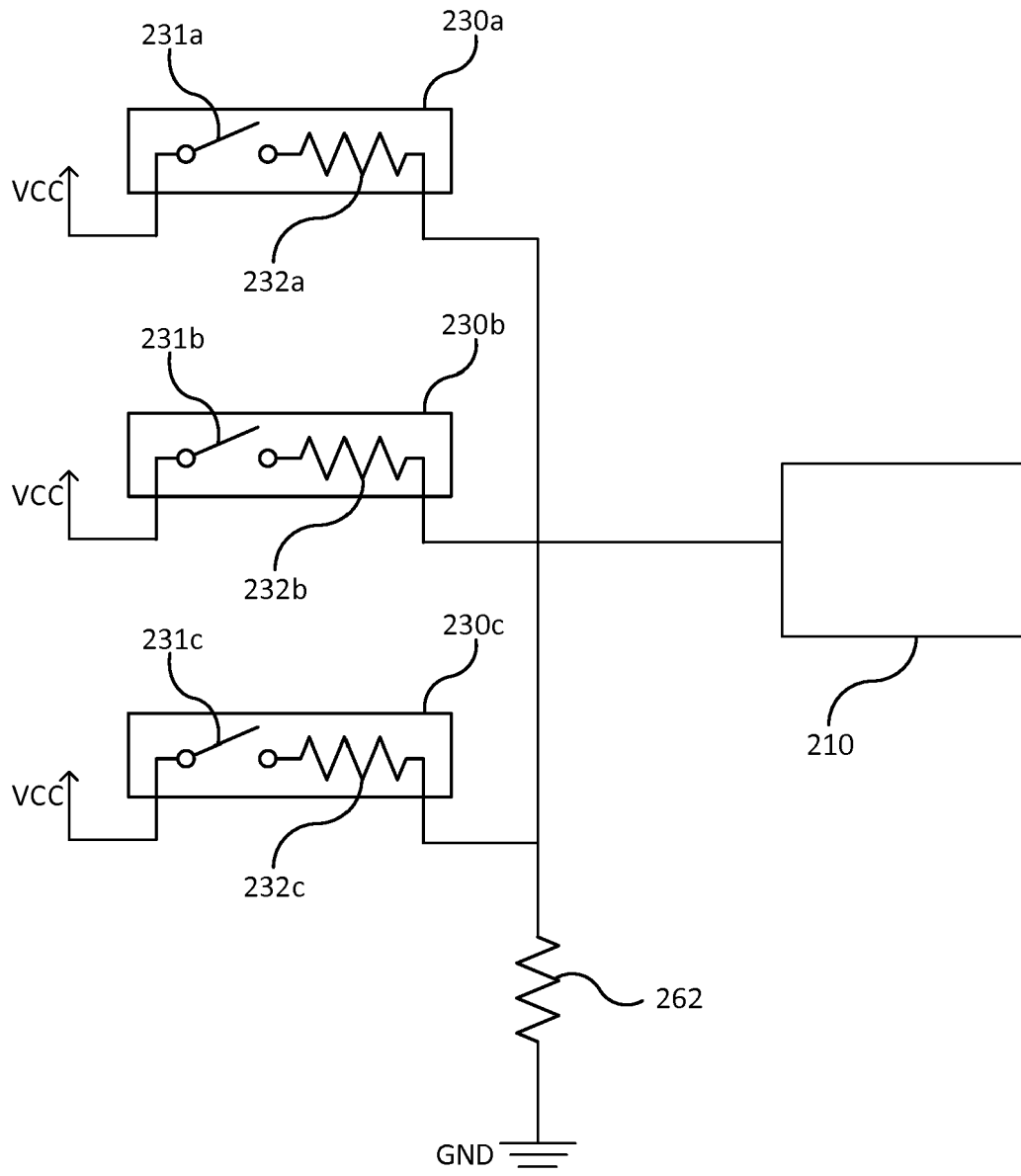


Figure 7



EUROPEAN SEARCH REPORT

Application Number
EP 17 19 9747

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 729 222 A (IGGULDEN JERRY [US] ET AL) 17 March 1998 (1998-03-17) * column 3, line 65 - column 5, line 53 * * column 9, line 35 - line 43 * -----	1-10	INV. G08C17/00
			TECHNICAL FIELDS SEARCHED (IPC)
			G08C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 April 2018	Examiner Pham, Phong
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

18-04-2018

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