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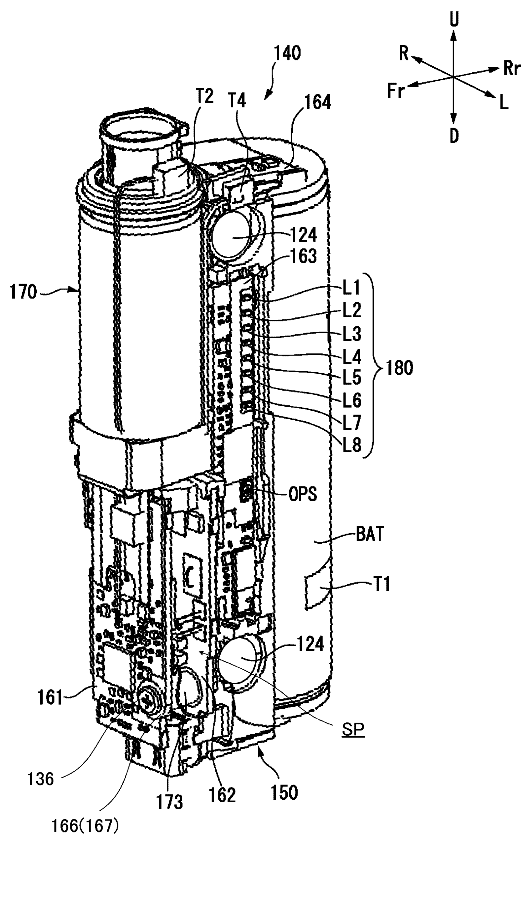
(54) **POWER SUPPLY UNIT OF AEROSOL GENERATING DEVICE**

(57) A power source unit (100) of an aerosol generating device includes: a power source (BAT); a heater connector (Cn) to which a heater configured to heat an aerosol source by consuming power supplied from the power source is connected; a first board 161; a second board 162 separate from the first board; a case (110) in which the power source, the heater connector, the first board, and the second board are housed; and a spacer 173 disposed between the first board and the second board and configured to hold the first board and the second board in parallel. A chassis 150 to which the first and second boards are attached may be disposed inside the case. A controller (MCU) may be disposed on the first board to control the supply of power from the power source to the heater connector.

FIG. 5



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Description

TECHNICAL FIELD

[0001] The present invention relates to a power source unit of an aeroslo generating device.

BACKGROUND ART

[0002] In a power source unit of an aerosol generating device, a plurality of boards may be disposed in a case.

[0003] For example, JP-T-2020-531015 discloses that a main circuit board is disposed inside an aerosol generating device along a longitudinal direction, and a sub-circuit board is disposed above the main circuit board along a horizontal direction.

[0004] However, when a plurality of boards are arranged adjacent to each other in the case, the boards may come into contact with each other depending on a fixing method thereof or a usage environment of a user, which may cause a short circuit.

SUMMARY OF INVENTION

[0005] The present invention provides a power source unit of an aerosol generating device capable of appropriately avoiding contact between boards in a case.

[0006] According to an aspect of the present invention, there is provided a power source unit of an aerosol generating device including: a power source; a heater connector to which a heater configured to heat an aerosol source by consuming power supplied from the power source is connected; a first board; a second board separate from the first board; a case in which the power source, the heater connector, the first board, and the second board are housed; and a spacer disposed between the first board and the second board and configured to hold the first board and the second board in parallel.

[0007] According to the aspect of the present invention, it is possible to appropriately avoid contact between the boards in the case.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

Fig. 1 is a perspective view of a non-combustion-type suction device.
Fig. 2 is a perspective view of the non-combustion-type suction device with a rod attached.
Fig. 3 is another perspective view of the non-combustion-type suction device.
Fig. 4 is an exploded perspective view of the non-combustion-type suction device.
Fig. 5 is a perspective view of an internal unit of the non-combustion-type suction device.
Fig. 6 is an exploded perspective view of the internal unit of Fig. 5.
Fig. 7 is a perspective view of the internal unit from which a power source and a chassis are removed.
Fig. 8 is another perspective view of the internal unit from which the power source and the chassis are removed.
Fig. 9 is a schematic diagram showing operation modes of the suction device.
Fig. 10 is a diagram showing a schematic configuration of an electric circuit of the internal unit.
Fig. 11 is a diagram showing an operation of the electric circuit in a sleep mode.
Fig. 12 is a diagram showing an operation of the electric circuit in an active mode.
Fig. 13 is a diagram showing an operation of the electric circuit in a heating initial setting mode.
Fig. 14 is a diagram showing an operation of the electric circuit at a time of heating of a heater in a heating mode.
Fig. 15 is a diagram showing an operation of the electric circuit at a time of detecting a temperature of the heater in the heating mode.
Fig. 16 is a diagram showing an operation of the electric circuit in a charging mode.
Fig. 17 is a view showing a primary surface of a receptacle-mounted board.
Fig. 18 is a view showing a secondary surface of the receptacle-mounted board.
Fig. 19 is a view showing a primary surface of an MCU-mounted board.
Fig. 20 is a view showing a secondary surface of the MCU-mounted board.
Fig. 21 is a cross-sectional view of the non-combustion-type suction device.
Fig. 22 is a perspective view of a spacer.

DESCRIPTION OF EMBODIMENTS

[0009] Hereinafter, a suction system according to an embodiment of an aerosol generating device in the present invention will be described with reference to the drawings. The suction system includes a non-combustion-type suction device 100 (hereinafter, also simply referred to as the "suction device 100") that is an embodiment of a power source unit of the present invention, and a rod 500 heated by the suction device 100. In the following description, a configuration in which the suction device 100 undetachably houses a heating unit will be described as an example. However, the heating unit may be configured to be detachable from the suction device 100. For example, a unit in which the rod 500 and the heating unit are integrated may be configured to be detachable from the suction device 100. That is, the power source unit of an aerosol generating device may not include the heating unit as a constituent element. The term "undetachable" refers to a mode in which detachment cannot be performed as long as intended use is intended. Alternatively, the heating unit may be configured by cooperation of an induction heating coil provided in the suction device 100 and a susceptor incorporated in the rod 500.

[0010] Fig. 1 is a perspective view showing an overall configuration of the suction device 100. Fig. 2 is a perspective view of the suction device 100 with the rod 500 attached. Fig. 3 is another perspective view of the suction device 100. Fig. 4 is an exploded perspective view of the suction device 100. In the following description, a three-dimensional space orthogonal coordinate system is described in which three directions orthogonal to each other are referred to as a front-rear direction, a left-right direction, and an up-down direction for the sake of convenience. In the drawings, Fr denotes a front side, Rr denotes a rear side, R denotes a right side, L denotes a left side, U denotes an upper side, and D denotes a lower side.

[0011] The suction device 100 is configured to generate aerosol containing flavor by heating the elongated, substantially cylindrical rod 500 (see Fig. 2) serving as an example of a flavor component generating base material having a filler containing an aerosol source, a flavor source, and the like.

<Flavor Component Generating Base Material (Rod)>

[0012] The rod 500 contains the filler containing the aerosol source that is heated at a predetermined temperature to generate the aerosol.

[0013] A type of the aerosol source is not particularly limited, and extraction substances from various natural products and/or constituent components thereof can be selected according to an intended use. The aerosol source may be a solid, or may be, for example, a polyhydric alcohol such as glycerin or propylene glycol, or a liquid such as water. The aerosol source may contain the flavor source such as a cigarette raw material that releases a flavor component by heating or an extract derived from the cigarette raw material. Gas to which the flavor component is added is not limited to the aerosol, and for example, invisible steam may be generated.

[0014] The filler of the rod 500 may contain cigarettes as the flavor source. A material of the cigarettes is not particularly limited, and known materials such as lamina and midbone can be used. The filler may contain one kind or two or more kinds of fragrances. A type of the fragrance is not particularly limited, and is preferably menthole from a viewpoint of imparting a good draft. The flavor source may contain a plant (for example, mint, Kampo, or herb) other than a cigarette. Depending on applications, the rod 500 may not include the flavor source.

<Overall Configuration of Non-Combustion-Type Suction Device>

[0015] Next, the overall configuration of the suction device 100 will be described with reference to Figs. 1 to 4. The suction device 100 includes a substantially rectangular parallelepiped case 110 having a front surface, a rear surface, a left surface, a right surface, an upper surface, and a lower surface. The case 110 includes a bottomed cylindrical case main body 112 in which the front surface, the rear surface, the upper surface, the lower surface, and the right surface are integrally formed, an outer panel 115 and an inner panel 118 that seal an opening 114 (see Fig. 4) of the case main body 112 and form the left surface, and a slider 119.

[0016] The inner panel 118 is fixed to the case main body 112 by a bolt 120. The outer panel 115 is fixed to the case main body 112 so as to cover an outer surface of the inner panel 118 by magnets 124 held by a chassis 150 (see Fig. 5), which will be described later, housed in the case main body 112. Since the outer panel 115 is fixed by the magnets 124, a user can replace the outer panel 115 in accordance with his or her preference.

[0017] The inner panel 118 is provided with two through holes 126 through which the magnets 124 penetrate. In the inner panel 118, a vertically long hole 127 and a circular round hole 128 are further provided between the two through holes 126 disposed in the up-down direction. The long hole 127 is for transmitting light emitted from eight light emitting diodes (LEDs) L1 to L8 incorporated in the case main body 112. A button-type operation switch OPS incorporated in the case main body 112 passes through the round hole 128. Accordingly, the user can detect the light emitted from the eight LEDs L1 to L8 via an LED window 116 of the outer panel 115. Further, the user can press down the operation switch OPS via a pressing portion 117 of the outer panel 115.

[0018] As shown in Fig. 2, an opening 132 into which the rod 500 can be inserted is provided in the upper surface of the case main body 112. The slider 119 is coupled to the case main body 112 so as to be movable in the front-rear direction between a position (see Fig. 1) where the opening 132 is closed and a position (see Fig. 2) where the opening 132 is opened. In Fig. 2, it should be noted that the slider 119 is transparent and only an outer shape of the slider 119 is indicated by a two-dot chain line in order to facilitate understanding.

[0019] The operation switch OPS is used to perform various operations of the suction device 100. For example, the user operates the operation switch OPS via the pressing portion 117 in a state in which the rod 500 is inserted into and attached to the opening 132 as shown in Fig. 2. Accordingly, the rod 500 is heated by a heating unit 170 (see Fig. 5) without being burned. When the rod 500 is heated, the aerosol is generated from the aerosol source contained in the rod 500, and the flavor of the flavor source contained in the rod 500 is added to the aerosol. The user can suction the aerosol containing the flavor by holding a suction port 502 of the rod 500 protruding from the opening 132 in mouth and suctioning.

[0020] As shown in Fig. 3, a charging terminal 134 that is electrically connected to an external power source such as an outlet or a mobile battery to receive power supply is provided in the lower surface of the case main body 112. In the present embodiment, the charging terminal 134 is a universal serial bus (USB) Type-C receptacle, and is not limited thereto. The charging terminal 134 is hereinafter also referred to as a receptacle RCP.

[0021] The charging terminal 134 may include, for example, a power receiving coil, and may be configured to receive electric power transmitted from the external power source in a non-contact manner. In this case, a power transmission (wireless power transfer) method may be an electromagnetic induction type, a magnetic resonance type, or a combination of the electromagnetic induction type and the magnetic resonance type. As another example, the charging terminal 134 can be connected to various USB terminals or the like, and may include the power receiving coil described above.

[0022] The configuration of the suction device 100 shown in Figs. 1 to 4 is merely an example. The suction device 100 can be configured in various forms such that the gas to which the flavor component is imparted is generated from the rod 500 by holding the rod 500 and applying an action such as heating, and the user can suction the generated gas.

<Internal Configuration of Non-Combustion-Type Suction Device>

[0023] An internal unit 140 of the suction device 100 will be described with reference to Figs. 5 to 8. Fig. 5 is a perspective view of the internal unit 140 of the suction device 100. Fig. 6 is an exploded perspective view of the internal unit 140 of Fig. 5. Fig. 7 is a perspective view of the internal unit 140 from which a power source BAT and the chassis 150 are removed. Fig. 8 is another perspective view of the internal unit 140 from which the power source BAT and the chassis 150 are removed.

[0024] The internal unit 140 housed in an internal space of the case 110 includes the chassis 150, the power source BAT, a circuit unit 160, the heating unit 170, a notification unit 180, and various sensors.

[0025] The chassis 150 includes a plate-shaped chassis main body 151 that is disposed substantially at a center of the internal space of the case 110 in the front-rear direction and extends in the up-down direction and the front-rear direction, a plate-shaped front-rear dividing wall 152 that is disposed substantially at the center of the internal space of the case 110 in the front-rear direction and extends in the up-down direction and the left-right direction, a plate-shaped up-down dividing wall 153 that extends forward from substantially a center of the front-rear dividing wall 152 in the up-down direction, a plate-shaped chassis upper wall 154 that extends rearward from upper edge portions of the front-rear dividing wall 152 and the chassis main body 151, and a plate-shaped chassis lower wall 155 that extends rearward from lower edge portions of the front-rear dividing wall 152 and the chassis main body 151. A left surface of the chassis main body 151 is covered with the inner panel 118 and the outer panel 115 of the case 110 described above.

[0026] In the internal space of the case 110, a heating unit housing region 142 is defined and formed in an upper front portion by the chassis 150, a board housing region 144 is defined and formed in a lower front portion, and a power source housing space 146 is defined and formed in a rear portion along the up-down direction.

[0027] The heating unit 170 housed in the heating unit housing region 142 is constituted by a plurality of cylindrical members, and the plurality of cylindrical members are concentrically arranged to form a cylindrical body as a whole. The heating unit 170 includes a rod housing portion 172 capable of housing a part of the rod 500 therein, and a heater HTR (see Figs. 10 to 16) that heats the rod 500 from an outer periphery or a center of the rod 500. It is preferable that a surface of the rod housing portion 172 and the heater HTR are insulated from each other by forming the rod housing portion 172 with a heat insulating material or providing the heat insulating material inside the rod housing portion 172. It is sufficient that the heater HTR is an element capable of heating the rod 500. The heater HTR is, for example, a heating element. Examples of the heating element include a heating resistor, a ceramic heater, and an induction heating type heater. As the heater HTR, for example, a heater having a positive temperature coefficient (PTC) characteristic in which a resistance value increases with an increase in temperature is preferably used. Alternatively, the heater HTR having a negative temperature coefficient (NTC) characteristic in which the resistance value decreases with the increase in temperature may be used. The heating unit 170 has a function of defining a flow path of air to be supplied to the rod 500 and a function of heating the rod 500. The case 110 is formed with a vent (not shown) through which the air flows in, and is configured such that the air can flow into the heating unit 170.

[0028] The power source BAT housed in the power source housing space 146 is a rechargeable secondary battery, an electric double layer capacitor, or the like, and is preferably a lithium ion secondary battery. An electrolyte of the power source BAT may one or a combination of a gel electrolyte, an electrolytic solution, a solid electrolyte, and an ionic liquid.

[0029] The notification unit 180 notifies various kinds of information such as a state of charge (SOC) indicating a charging state of the power source BAT, a preheating time at a time of suction, and a suction possible period. The notification unit 180 according to the present embodiment includes the eight LEDs L1 to L8 and a vibration motor M. The notification unit 180 may include a light emitting element such as the LEDs L1 to L8, may include a vibration element such as the vibration motor M, or may include a sound output element. The notification unit 180 may be a combination of two or more of the light emitting element, the vibration element, and the sound output element.

[0030] The various sensors include an intake sensor that detects a puff operation (suction operation) of the user, a power source temperature sensor that detects a temperature of the power source BAT, a heater temperature sensor that detects a temperature of the heater HTR, a case temperature sensor that detects a temperature of the case 110, a cover position sensor that detects a position of the slider 119, a panel detection sensor that detects attachment and detachment of the outer panel 115, and the like.

[0031] The intake sensor mainly includes, for example, a thermistor T2 disposed in the vicinity of the opening 132. The power source temperature sensor mainly includes, for example, a thermistor T1 disposed in the vicinity of the power source BAT. The heater temperature sensor mainly includes, for example, a thermistor T3 disposed in the vicinity of the heater HTR. As described above, the rod housing portion 172 is preferably insulated from the heater HTR. In this case, the thermistor T3 is preferably in contact with or close to the heater HTR inside the rod housing portion 172. When the heater HTR has the PTC characteristic or the NTC characteristic, the heater HTR itself may be used as the heater temperature sensor. The case temperature sensor mainly includes, for example, a thermistor T4 disposed in the vicinity of the left surface of the case 110. The cover position sensor mainly includes a Hall IC 14 (see Figs. 10 to 16) including a Hall element disposed in the vicinity of the slider 119. The panel detection sensor mainly includes a Hall IC 13 (see Figs. 10 to 16) including a Hall element disposed in the vicinity of an inner surface of the inner panel 118.

[0032] The circuit unit 160 includes four circuit boards, a plurality of integrate circuits (ICs), and a plurality of elements. The four circuit boards include an MCU-mounted board 161 on which a micro controller unit (MCU) 1 and a charging IC 2 to be described later are mainly disposed, a receptacle-mounted board 162 on which the charging terminal 134 is mainly disposed, an LED-mounted board 163 on which the operation switch OPS, the LEDs L1 to L8, and a communication IC 15 to be described later are disposed, and a Hall IC-mounted board 164 on which the Hall IC 14 to be described later including the Hall element constituting the cover position sensor is disposed.

[0033] The MCU-mounted board 161 and the receptacle-mounted board 162 are arranged parallel to each other in the board housing region 144. Specifically, the MCU-mounted board 161 and the receptacle-mounted board 162 are arranged such that respective element arrangement surfaces thereof are arranged along the left-right direction and the up-down direction, and the MCU-mounted board 161 is arranged in front of the receptacle-mounted board 162. The MCU-mounted board 161 and the receptacle-mounted board 162 are provided with openings 175 and 176 (see Figs. 17 to 20), respectively. The MCU-mounted board 161 and the receptacle-mounted board 162 are fixed to the chassis 150 with a bolt 136 in a state in which a spacer 173 is interposed between opening peripheral edge portions 166 and 168 of the opening portions 175 and 176.

[0034] Fig. 22 is a perspective view of the spacer 173.

[0035] As shown in Fig. 22, the spacer 173 includes a large diameter portion 191, a first small diameter portion 192a that is provided on one end side of the large diameter portion 191 and has a smaller diameter than that of the large diameter portion 191, a second small diameter portion 192b that is provided on the other end side of the large diameter portion 191 and has a smaller diameter than that of the large diameter portion 191, a first disk portion 193a that connects one end of the large diameter portion 191 and the first small diameter portion 192a, a second disk portion 193b that connects the other end of the large diameter portion 191 and the second small diameter portion 192b, and a through hole 194 that is formed across the first small diameter portion 192a, the large diameter portion 191, and the second small diameter portion 192b, and has a cylindrical shape as a whole. The first disk portion 193a and the second disk portion 193b are formed parallel to each other.

[0036] The bolt 136 is inserted through the opening 175 of the MCU-mounted board 161, the through hole 194 of the cylindrical spacer 173, and the opening 176 of the receptacle-mounted board 162, and is fixed to a board fixing portion 156 of the front-rear dividing wall 152 disposed between the MCU-mounted board 161 and the receptacle-mounted board 162 and the power source BAT in the front-rear direction with the spacer 173 interposed therebetween. At this time, the first small diameter portion 192a is fitted into and connected to the opening 175 of the MCU-mounted board 161, and the second small diameter portion 192b is fitted into and connected to the opening 176 of the receptacle-mounted board 162. Meanwhile, the first disk portion 193a comes into contact with the opening peripheral edge portion 166 (see Fig. 20) of a secondary surface 161b of the MCU-mounted board 161, and the second disk portion 193b comes into contact with the opening peripheral edge portion 168 (see Fig. 17) of a primary surface 162a of the receptacle-mounted board 162. Accordingly, the MCU-mounted board 161 and the receptacle-mounted board 162 are held in parallel by the spacer 173.

[0037] That is, the spacer 173 is a holding member that is disposed between the MCU-mounted board 161 and the receptacle-mounted board 162 and holds the MCU-mounted board 161 and the receptacle-mounted board 162 in parallel. In this way, by holding the two boards 161 and 162 arranged in the case 110 in parallel via the spacer 173, it is possible to prevent the boards 161 and 162 from coming into contact with each other and causing a short circuit. Further, the two boards 161 and 162 held in parallel can ensure an electrically safe region SP in the case 110, and the internal space of the case 110 can be effectively used. A width (a length in the front-rear direction) of the region SP is equal to a length of the large diameter portion 191 of the spacer 173. By fixing the MCU-mounted board 161 and the receptacle-mounted board 162 to the chassis 150 in the case 110, the two boards 161 and 162 can be held in a stable state. Further, since the front-rear dividing wall 152 of the chassis 150 is disposed between the MCU-mounted board 161 and the receptacle-mounted board 162 and the power source BAT, the power source BAT and the two boards 161 and 162 can be separated from each other, and heat of the power source BAT can be prevented from being transmitted to the boards 161 and 162.

[0038] The spacer 173 has conductivity, and grounds of the MCU-mounted board 161 and the receptacle-mounted board 162 are connected via the spacer 173. More specifically, the first small diameter portion 192a fitted into the opening 175 of the MCU-mounted board 161 is connected to the ground inside the MCU-mounted board 161, and the second small diameter portion 192b fitted into the opening 176 of the receptacle-mounted board 162 is connected to the ground inside the receptacle-mounted board 162. Accordingly, ground potentials of the MCU-mounted board 161 and the receptacle-mounted board 162 can be equalized, and supply of charging power and operating power and communication between the MCU-mounted board 161 and the receptacle-mounted board 162 can be stabilized. Further, since a volume of the spacer 173 can be freely set, a resistance can be reduced by making the spacer 173 thick and short.

[0039] For the sake of convenience, when surfaces of the MCU-mounted board 161 and the receptacle-mounted board 162 facing forward are defined as primary surfaces 161a and 162a, respectively, and surfaces opposite to the primary surfaces 161a and 162a are defined as secondary surfaces 161b and 162b, respectively, the secondary surface 161b of the MCU-mounted board 161 and the primary surface 162a of the receptacle-mounted board 162 face each other with a predetermined gap therebetween, thereby forming the electrically safe region SP described above. The primary surface 161a of the MCU-mounted board 161 faces the front surface of the case 110, and the secondary surface 162b of the receptacle-mounted board 162 faces the front-rear dividing wall 152 of the chassis 150.

[0040] The MCU-mounted board 161 and the receptacle-mounted board 162 are electrically connected to each other via a flexible wiring board 165. The flexible wiring board 165 that electrically connects the MCU-mounted board 161 and the receptacle-mounted board 162 connects FPC connection portions 231 and 232 of the MCU-mounted board 161 and the receptacle-mounted board 162 to each other (see Figs. 17 to 20). Elements and ICs mounted on the MCU-mounted board 161 and the receptacle-mounted board 162 will be described later.

[0041] The LED-mounted board 163 is disposed on a left side surface of the chassis main body 151 and between the two magnets 124 disposed in the up-down direction. An element arrangement surface of the LED-mounted board 163 is disposed along the up-down direction and the front-rear direction. In other words, the element arrangement surface of each of the MCU-mounted board 161 and the receptacle-mounted board 162 is orthogonal to the element arrangement surface of the LED-mounted board 163. In this way, the element arrangement surface of each of the MCU-mounted board 161 and the receptacle-mounted board 162 and the element arrangement surface of the LED-mounted board 163 are not limited to be orthogonal to each other, and preferably intersect with each other (are not parallel to each other). The vibration motor M constituting the notification unit 180 together with the LEDs L1 to L8 is fixed to a lower surface of the chassis lower wall 155 and is electrically connected to the MCU-mounted board 161.

[0042] The Hall IC-mounted board 164 is disposed on an upper surface of the chassis upper wall 154.

<Operation Mode of Suction Device>

[0043] Fig. 9 is a schematic diagram showing operation modes of the suction device 100. As shown in Fig. 9, the operation modes of the suction device 100 include a charging mode, a sleep mode, an active mode, a heating initial setting mode, a heating mode, and a heating completion mode.

[0044] The sleep mode is a mode in which power saving is achieved by mainly stopping power supply to electrical components necessary for heating control of the heater HTR.

[0045] The active mode is a mode in which most of functions other than heating control of the heater HTR are enabled. When the slider 119 is opened while the suction device 100 is operating in the sleep mode, the suction device 100 switches the operation mode to the active mode. When the slider 119 is closed or a non-operation time of the operation switch OPS reaches a predetermined time while the suction device 100 is operating in the active mode, the suction device 100 switches the operation mode to the sleep mode.

[0046] The heating initial setting mode is a mode in which an initial setting of control parameters and the like for starting heating control of the heater HTR is performed. When the suction device 100 detects an operation of the operation switch OPS while operating in the active mode, the suction device 100 switches the operation mode to the heating initial setting mode, and when the initial setting is finished, the suction device 100 switches the operation mode to the heating mode.

[0047] The heating mode is a mode in which the heating control (heating control for aerosol generation and heating control for temperature detection) of the heater HTR is executed. When the operation mode is switched to the heating mode, the suction device 100 starts the heating control of the heater HTR.

[0048] The heating completion mode is a mode in which processing (processing of storing a heating history or the like) of completing the heating control of the heater HTR is executed. When an energization time of the heater HTR or the number of times user suctions reaches an upper limit or the slider 119 is closed while the suction device 100 is operating in the heating mode, the suction device 100 switches the operation mode to the heating completion mode, and when the completion processing is completed, the suction device 100 switches the operation mode to the active mode. The suction device 100 switches the operation mode to the heating completion mode when a USB connection is made while operating in the heating mode, and when the completion processing is completed, switches the operation mode to the charging mode. As shown in Fig. 9, in this case, the operation mode may be switched to the active mode before the operation mode is switched to the charging mode. In other words, when the USB connection is made while the suction device 100 is operating in the heating mode, the suction device 100 may switch the operation mode in an order of the heating completion mode, the active mode, and the charging mode.

[0049] The charging mode is a mode in which the power source BAT is charged with power supplied from the external power source connected to the receptacle RCP. When the external power source is connected (USB-connected) to the receptacle RCP while the suction device 100 is operating in the sleep mode or the active mode, the suction device 100 switches the operation mode to the charging mode. When the charging of the power source BAT is completed or the connection between the receptacle RCP and the external power source is released while the suction device 100 is operating in the charging mode, the suction device 100 switches the operation mode to the sleep mode.

<Outline of Circuit of Internal Unit>

[0050] Fig. 10 is a diagram showing a schematic configuration of an electric circuit of the internal unit 140. Fig. 10 only shows main elements and ICs.

[0051] A wire indicated by a thick solid line in Fig. 10 is a wire (a wire connected to a ground provided in the internal unit 140) having the same potential as a reference potential (ground potential) of the internal unit 140, and this wire is hereinafter referred to as a ground line. In Fig. 10, electrical components obtained by chipping a plurality of circuit elements are indicated by rectangles, and reference numerals of various terminals are described inside the rectangles. A power source terminal VCC and a power source terminal VDD mounted on the chip indicate power source terminals on a high potential side, respectively. A power source terminal VSS and a ground terminal GND mounted on the chip are power source terminals on a low potential side (reference potential side), respectively. In the chipped electrical component, a difference between a potential of the power source terminal on the high potential side and a potential of the power source terminal on the low potential side is a power source voltage. The chipped electrical component executes various functions using the power source voltage.

[0052] The MCU-mounted board 161 is provided with, as main electric components, an MCU 1 that performs overall control of the entire suction device 100, the charging IC 2 that performs charging control of the power source BAT, a load switch (hereinafter, LSW) 3 configured by combining a capacitor, a resistor, a transistor, and the like, and a voltage dividing circuit Pc for USB connection detection.

[0053] The ground terminal GND of each of the charging IC 2 and the LSW 3 is connected to the ground line.

[0054] The LED-mounted board 163 is provided with, as main electric components, the Hall IC 13 including a Hall element constituting the panel detection sensor, the LEDs L1 to L8, the operation switch OPS, and the communication IC 15. The communication IC 15 is a communication module for communicating with an electronic device such as a smartphone. Each of the power source terminal VSS of the Hall IC 13 and the ground terminal GND of the communication IC 15 is connected to the ground line. The communication IC 15 and the MCU 1 can communicate with each other through a communication line LN. One end of the operation switch OPS is connected to the ground line, and the other end of the operation switch OPS is connected to a terminal P4 of the MCU 1.

[0055] The receptacle-mounted board 162 is provided with, as main electric components, a power source connector (in the drawing, the power source BAT connected to the power source connector is described) electrically connected to the power source BAT, a step-up DC/DC converter 9 (in the drawing, the step-up DC/DC 9 is described), a protection IC 10, an overvoltage protection IC 11, the receptacle RCP, switches S3 and S4 constituted by MOSFETs, an operational amplifier OP1, and a pair of (positive electrode side and negative electrode side) heater connectors Cn electrically connected to the heater HTR.

[0056] The two ground terminals GND of the receptacle RCP, the ground terminal GND of the step-up DC/DC converter 9, the power source terminal VSS of the protection IC 10, the ground terminal GND of the overvoltage protection IC 11, and a negative power source terminal of the operational amplifier OP1 are each connected to the ground line.

[0057] The Hall IC 14 including the Hall element constituting the cover position sensor is provided on the Hall IC-mounted board 164. The power source terminal VSS of the Hall IC 14 is connected to the ground line. An output terminal OUT of the Hall IC 14 is connected to a terminal P8 of the MCU 1. The MCU 1 detects opening and closing of the slider 119 based on a signal input to the terminal P8.

<Details of Circuit of Internal Unit>

[0058] Hereinafter, a connection relationship and the like of each of the electrical components will be described with reference to Fig. 10.

[0059] Two power input terminals V_{BUS} of the receptacle RCP are connected to an input terminal IN of the overvoltage protection IC 11 via a protection element such as a fuse Fs. When a USB plug is connected to the receptacle RCP and a USB cable including the USB plug is connected to the external power source, a USB voltage V_{USB} is supplied to two power input terminals V_{BUS} of the receptacle RCP.

[0060] The input terminal IN of the overvoltage protection IC 11 is connected to one end of a voltage dividing circuit Pa including a series circuit of two resistors. The other end of the voltage dividing circuit Pa is connected to the ground line. A connection point of the two resistors constituting the voltage dividing circuit Pa is connected to a voltage detection terminal OVLo of the overvoltage protection IC 11. When a voltage input to the voltage detection terminal OVLo is less than a threshold, the overvoltage protection IC 11 outputs a voltage input to the input terminal IN from the output terminal OUT. When the voltage input to the voltage detection terminal OVLo is equal to or higher than a threshold (overvoltage), the overvoltage protection IC 11 stops the voltage output from the output terminal OUT (cuts off the electrical connection between the LSW 3 and the receptacle RCP), thereby protecting the electrical components downstream of the overvoltage protection IC 11. The output terminal OUT of the overvoltage protection IC 11 is connected to an input terminal VIN of the LSW 3 and one end of the voltage dividing circuit Pc (the series circuit of two resistors) connected to the MCU 1. The other end of the voltage dividing circuit Pc is connected to the ground line. A connection point of the two resistors constituting the voltage dividing circuit Pc is connected to a terminal P17 of the MCU 1.

[0061] One end of a voltage dividing circuit Pf including a series circuit of two resistors is connected to the input terminal VIN of the LSW 3. The other end of the voltage dividing circuit Pf is connected to the ground line. A connection point of the two resistors constituting the voltage dividing circuit Pf is connected to a control terminal ON of the LSW 3. A collector terminal of a bipolar transistor S2 is connected to the control terminal ON of the LSW 3. An emitter terminal of the bipolar transistor S2 is connected to the ground line. A base terminal of the bipolar transistor S2 is connected to a terminal P19 of the MCU 1. When a signal input to the control terminal ON is a high level, the LSW 3 outputs a voltage input to the input terminal VIN from an output terminal VOUT. The output terminal VOUT of the LSW 3 is connected to an input terminal VBUS of the charging IC 2 and an anode of each of the LEDs L1 to L8.

[0062] The MCU 1 turns on the bipolar transistor S2 while the USB connection is not made. Accordingly, since the control terminal ON of the LSW 3 is connected to the ground line via the bipolar transistor S2, a low-level signal is input to the control terminal ON of the LSW 3.

[0063] The bipolar transistor S2 connected to the LSW 3 is turned off by the MCU 1 when the USB connection is made. When the bipolar transistor S2 is turned off, the USB voltage V_{USB} divided by the voltage dividing circuit Pf is input to the control terminal ON of the LSW 3. Therefore, when the USB connection is made and the bipolar transistor S2 is turned off, a high-level signal is input to the control terminal ON of the LSW 3. Accordingly, the LSW 3 outputs the USB voltage V_{USB} supplied from the USB cable from the output terminal VOUT. It should be noted that even when the USB connection is made in a state in which the bipolar transistor S2 is not turned off, since the control terminal ON of the LSW 3 is connected to the ground line via the bipolar transistor S2, the low-level signal continues to be input to the control terminal ON of the LSW 3 unless the MCU 1 turns off the bipolar transistor S2.

[0064] A positive electrode terminal of the power source BAT is connected to the power source terminal VDD of the protection IC 10, the input terminal VIN of the step-up DC/DC converter 9, and a charging terminal bat of the charging IC 2. Therefore, a power source voltage V_{BAT} of the power source BAT is supplied to the protection IC 10, the charging IC 2, and the step-up DC/DC converter 9. A resistor Ra, a switch Sa constituted by an MOSFET, and a switch Sb constituted by an MOSFET are connected in series in this order to a negative electrode terminal of the power source BAT. A current detection terminal CS of the protection IC 10 is connected to a connection point between the resistor Ra and the switch Sa. A control terminal of each of the switches Sa and Sb is connected to the protection IC 10.

[0065] The protection IC 10 acquires a value of a current flowing through the resistor Ra at a time of charging and discharging of the power source BAT from a voltage input to the current detection terminal CS, and when the current value is excessive (in a case of an overcurrent), the protection IC 10 performs opening and closing control of the switch Sa and the switch Sb to stop charging or discharging of the power source BAT, thereby protecting the power source BAT. More specifically, when the protection IC 10 acquires the excessive current value at the time of charging the power source BAT, the protection IC 10 stops the charging of the power source BAT by turning off the switch Sb. When the protection IC 10 acquires the excessive current value at the time of discharging the power source BAT, the protection IC 10 stops the discharging of the power source BAT by turning off the switch Sa. Further, when a voltage value of the power source BAT is abnormal (in a case of overcharge or overvoltage) from the voltage input to the power source terminal VDD, the protection IC 10 performs opening and closing control of the switch Sa and the switch Sb to stop charging or discharging of the power source BAT, thereby protecting the power source BAT. More specifically, when the protection IC 10 detects the overcharge of the power source BAT, the protection IC 10 stops the charging of the power source BAT by turning off the switch Sb. When the protection IC 10 detects the overdischarge of the power source BAT, the protection IC 10 stops the discharge of the power source BAT by turning off the switch Sa.

[0066] One end of a reactor Lc is connected to a switching terminal SW of the step-up DC/DC converter 9. The other end of the reactor Lc is connected to the input terminal VIN of the step-up DC/DC converter 9. The step-up DC/DC converter 9 steps up the input voltage by performing on and off control of a built-in transistor connected to the switching terminal SW, and outputs the stepped-up voltage from the output terminal VOUT. The input terminal VIN of the step-up DC/DC converter 9 constitutes a power source terminal on a high potential side of the step-up DC/DC converter 9. The step-up DC/DC converter 9 performs a step-up operation when a signal input to an enable terminal EN is at a high level. In the USB-connected state, the signal input to the enable terminal EN of the step-up DC/DC converter 9 may be controlled to a low level by the MCU 1. Alternatively, in the USB-connected state, the MCU 1 may not control the signal input to the enable terminal EN of the step-up DC/DC converter 9, thereby making a potential of the enable terminal EN indefinite.

[0067] The output terminal VOUT of the step-up DC/DC converter 9 is connected to a source terminal of a switch S4 constituted by a P-channel MOSFET. A gate terminal of the switch S4 is connected to a terminal P15 of the MCU 1. One end of a resistor Rs is connected to a drain terminal of the switch S4. The other end of the resistor Rs is connected to the heater connector Cn on a positive electrode side connected to one end of the heater HTR. A voltage dividing circuit Pb including two resistors is connected to a connection point of the switch S4 and the resistor Rs. A connection point of the two resistors constituting the voltage dividing circuit Pb is connected to a terminal P18 of the MCU 1. The connection point of the switch S4 and the resistor Rs is further connected to a positive power source terminal of the operational amplifier OP1.

[0068] A connection line of the output terminal VOUT of the step-up DC/DC converter 9 and the source terminal of the switch S4 is connected to a source terminal of the switch S3 constituted by a P-channel MOSFET. A gate terminal of the switch S3 is connected to a terminal P16 of the MCU 1. A drain terminal of the switch S3 is connected to a connection line of the resistor Rs and the heater connector Cn on the positive electrode side. In this way, a circuit including the switch S3 and a circuit including the switch S4 and the resistor Rs are connected in parallel between the output terminal VOUT of the step-up DC/DC converter 9 and the positive electrode side of the heater connector Cn. Since the circuit including the switch S3 does not include a resistor, the circuit including the switch S3 has a lower resistance than that of the circuit including the switch S4 and the resistor Rs.

[0069] The enable terminal EN of the step-up DC/DC converter 9 is connected to a terminal P14 of the MCU 1.

[0070] A non-inverting input terminal of the operational amplifier OP1 is connected to the connection line of the resistor Rs and the heater connector Cn on the positive electrode side. An inverting input terminal of the operational amplifier OP1 is connected to the heater connector Cn on a negative electrode side connected to the other end of the heater HTR and the ground line. One end of a resistor R4 is connected to an output terminal of the operational amplifier OP1. The other end of the resistor R4 is connected to a terminal P9 of the MCU 1.

[0071] The input terminal VBUS of the charging IC 2 is connected to the anode of each of the LEDs L1 to L8. Cathodes of the LEDs L1 to L8 are connected to the control terminals PD1 to PD8 of the MCU 1 via resistors for current limitation. That is, the LEDs L1 to L8 are connected in parallel to the input terminal VBUS. The LEDs L1 to L8 are configured to be operable by the USB voltage V_{USB} supplied from the USB cable connected to the receptacle RCP and the voltage supplied from the power source BAT via the charging IC 2. Transistors (switching elements) connected to the control terminals PD1 to PD8 and the ground terminal GND are incorporated in the MCU 1. The MCU 1 turns on the transistor connected to the control terminal PD1 to energize and turn on the LED L1, and turns off the transistor connected to the control terminal PD1 to turn off the LED L1. By switching on and off of the transistor connected to the control terminal PD1 at a high speed, a luminance and a light emission pattern of the LED L1 can be dynamically controlled. The LEDs L2 to L8 are similarly controlled to be turned on by the MCU 1.

[0072] The charging IC 2 has a charging function of charging the power source BAT based on the USB voltage V_{USB} input to the input terminal VBUS. The charging IC 2 acquires a charging current or a charging voltage of the power source BAT from a terminal or a wiring (not shown), and performs the charging control of the power source BAT (power supply control from the charging terminal bat to the power source BAT) based on the acquired charging current or the charging voltage.

[0073] The charging IC 2 further includes a V_{BAT} power path function and an OTG function. The V_{BAT} power path function is a function of outputting, from an output terminal SYS, a system power source voltage Vcc0 that is substantially the same as the power source voltage V_{BAT} input to the charging terminal bat. The OTG function is a function of outputting, from the input terminal VBUS, a system power source voltage Vcc4 obtained by stepping up the power source voltage V_{BAT} input to the charging terminal bat. ON/OFF of the OTG function of the charging IC 2 is controlled by the MCU 1 through serial communication using the communication line LN. In the OTG function, the power source voltage V_{BAT} input to the charging terminal bat may be output from the input terminal VBUS as it is. In this case, the power source voltage V_{BAT} and the system power source voltage Vcc4 are substantially the same. It should be noted that in order to perform the serial communication, a plurality of signal lines such as a data line for data transmission and a clock line for synchronization are required, and only one signal line is shown in Figs. 10 to 16 for simplification.

[0074] The output terminal SYS of the charging IC 2 is connected to the power source terminal VDD of the MCU 1, the power source terminal VDD of the Hall IC 13, the power source terminal VCC of the communication IC 15, the power source terminal VDD of the Hall IC 14, and a series circuit (a series circuit of a resistor and a capacitor) connected to the operation switch OPS. A charge enable terminal CE (-) of the charging IC 2 is connected to a terminal P22 of the MCU 1 via a resistor. In order to stabilize the voltage supplied to these power source terminals, a voltage regulator may be connected to the output terminal SYS of the charging IC 2.

[0075] The output terminal OUT of the Hall IC 13 is connected to a terminal P3 of the MCU 1. When the outer panel 115 is detached, a low-level signal is output from the output terminal OUT of the Hall IC 13. The MCU 1 determines whether the outer panel 115 is attached based on the signal input to the terminal P3.

[0076] The LED-mounted board 163 is provided with a series circuit (a series circuit of a resistor and a capacitor) connected to the operation switch OPS. The series circuit is connected to a power source line that connects the output terminal SYS of the charging IC 2 to the power source terminal VDD of the MCU 1, the power source terminal VDD of the Hall IC 13, the power source terminal VDD of the Hall IC 14, and the power source terminal VCC of the communication IC 15. A connection point of the resistor and the capacitor of the series circuit is connected to the terminal P4 of the MCU 1 and the operation switch OPS. In a state in which the operation switch OPS is not pressed, the operation switch OPS is not conducted, and the signal input to the terminal P4 of the MCU 1 is a high level due to the voltage output from the output terminal SYS of the charging IC 2. When the operation switch OPS is pressed down and the operation switch OPS is conductive, the signal input to the terminal P4 of the MCU 1 is a low level because the MCU 1 is connected to the ground line. The MCU 1 detects an operation of the operation switch OPS based on the signal input to the terminal P4.

<Operations for Each of Operation Modes of Suction Device>

[0077] Hereinafter, operations of the electric circuit shown in Fig. 10 will be described with reference to Figs. 11 to 16. Fig. 11 is a diagram showing an operation of the electric circuit in the sleep mode. Fig. 12 is a diagram showing an operation of the electric circuit in the active mode. Fig. 13 is a diagram showing an operation of the electric circuit in the heating initial setting mode. Fig. 14 is a diagram showing an operation of the electric circuit at a time of heating of the heater HTR in the heating mode. Fig. 15 is a diagram showing an operation of the electric circuit at a time of detecting a temperature of the heater HTR in the heating mode. Fig. 16 is a diagram showing an operation of the electric circuit in the charging mode. In each of Figs. 11 to 16, among the terminals of the chipped electrical components, the terminals surrounded by dashed ellipse indicate the terminals to and from which the power source voltage V_{BAT}, the USB voltage V_{USB}, the system power source voltage, and the like are input or output.

[0078] In any operation mode, the power source voltage V_{BAT} is input to the power source terminal VDD of the protection IC 10, the input terminal VIN of the step-up DC/DC converter 9, and the charging terminal bat of the charging IC 2.

<Sleep Mode: Fig. 11>

[0079] The MCU 1 enables the V_{BAT} power path function of the charging IC 2, and disables the OTG function and the charging function. Since the USB voltage V_{USB} is not input to the input terminal VBUS of the charging IC 2, the V_{BAT} power path function of the charging IC 2 is effective. Since a signal for enabling the OTG function is not output from the MCU 1 to the charging IC 2 through the communication line LN, the OTG function is disabled. Therefore, the charging IC 2 generates the system power source voltage Vcc0 from the power source voltage V_{BAT} input to the charging terminal bat, and outputs the generated system power source voltage Vcc0 from the output terminal SYS. The system power source voltage Vcc0 output from the output terminal SYS is input to the power source terminal VDD of the MCU 1, the power source terminal VDD of the Hall IC 13, the power source terminal VCC of the communication IC 15, and the power source terminal VDD of the Hall IC 14. The system power source voltage Vcc0 is set to be lower than the USB voltage V_{USB} input from the external power source to the power source input terminal V_{USB} at the time of charging.

[0080] In this way, in the sleep mode, since the OTG function of the charging IC 2 is stopped, the power supply to the LEDs L1 to L8 is stopped.

<Active Mode: Fig. 12>

[0081] The MCU 1 activates the OTG function of the charging IC 2 via the communication line LN when the signal input to the terminal P8 is the high level and the MCU 1 detects that the slider 119 is opened from the sleep mode state of Fig. 11. Accordingly, the charging IC 2 outputs, from the input terminal VBUS, the system power source voltage Vcc4 obtained by stepping up the power source voltage V_{BAT} input from the charging terminal bat. The system power source voltage Vcc4 output from the input terminal VBUS is supplied to the LEDs L1 to L8.

<Heating Initial Setting Mode: Fig. 13>

[0082] When the signal input to the terminal P4 is a low level (the operation switch OPS is pressed) from the state of Fig. 12, the MCU 1 performs various settings necessary for the heating, and then inputs a high level enable signal from the terminal P14 to the enable terminal EN of the step-up DC/DC converter 9. Accordingly, the step-up DC/DC converter 9 outputs a drive voltage V_{bst} obtained by stepping up the power source voltage V_{BAT}

from the output terminal VOUT. The drive voltage V_{bst} is supplied to the switches S3 and S4. In this state, the switches S3 and S4 are turned off. Thereafter, the operation mode is shifted to the heating mode.

<Heating of Heater in Heating Mode: Fig. 14>

[0083] In the state of Fig. 13, the MCU 1 starts switching control of the switch S3 connected to the terminal P16 and switching control of the switch S4 connected to the terminal P15. These switching controls may be automatically started when the heating initial setting mode described above is completed, or may be started by further pressing the operation switch OPS. Specifically, as shown in Fig. 14, the MCU 1 performs the heating control of turning on the switch S3, turning off the switch S4, supplying the drive voltage V_{bst} to the heater HTR, and performing the heating of the heater HTR for generating the aerosol, and as shown in Fig. 15, performs temperature detection control of turning off the switch S3, turning on the switch S4, and detecting the temperature of the heater HTR.

<Heater Temperature Detection in Heating Mode: Fig. 15>

[0084] As shown in Fig. 15, at a time of the temperature detection control, the drive voltage V_{bst} is input to the positive power source terminal of the operational amplifier OP1 and is also input to the voltage dividing circuit Pb. The voltage divided by the voltage dividing circuit Pb is input to the terminal P18 of the MCU 1. The MCU 1 acquires the voltage of the positive power source terminal of the operational amplifier OP1 at the time of the temperature detection control based on the voltage input to the terminal P18.

[0085] During the temperature detection control, the drive voltage V_{bst} is supplied to the series circuit of the resistor Rs and the heater HTR. Then, a voltage V_{heat} obtained by dividing the drive voltage V_{bst} by the resistor Rs and the heater HTR is input to the non-inverting input terminal of the operational amplifier OP1. The operational amplifier OP1 amplifies and outputs a difference between the voltage input to the inverting input terminal and the voltage V_{heat} input to the non-inverting input terminal.

[0086] The output signal of the operational amplifier OP1 is input to the terminal P9 of the MCU 1. The MCU 1 acquires the temperature of the heater HTR based on the signal input to the terminal P9, the voltage of the positive power source terminal of the operational amplifier OP1 acquired based on the input voltage of the terminal P18, and a known electrical resistance value of the resistor Rs.

<Charging Mode: Fig. 16>

[0087] Fig. 16 shows a case where the USB connection is made in the sleep mode. When the USB connection is made, the USB voltage V_{USB} is input to the input terminal VIN of the LSW 3 via the overvoltage protection IC 11. The USB voltage V_{USB} is also supplied to the voltage dividing circuit Pf connected to the input terminal VIN of the LSW 3. Since the bipolar transistor S2 is turned on immediately after the USB connection is made, the signal input to the control terminal ON of the LSW 3 remains at the low level. The USB voltage V_{USB} is also supplied to the voltage dividing circuit Pc connected to the terminal P17 of the MCU 1, and the voltage divided by the voltage dividing circuit Pc is input to the terminal P17. The MCU 1 detects the USB connection based on the voltage input to the terminal P17. The voltage dividing circuit Pc is configured to make the voltage input to the terminal P17 equal to or lower than the system power source voltage Vcc0 input to the power source terminal VDD of the MCU 1.

[0088] When the MCU 1 detects that the USB connection is made, the MCU 1 turns off the bipolar transistor S2 connected to the terminal P19. When a low-level signal is input to the gate terminal of the bipolar transistor S2, the USB voltage V_{USB} divided by the voltage dividing circuit Pf is input to the control terminal ON of the LSW 3. Accordingly, the high-level signal is input to the control terminal ON of the LSW 3, and the LSW 3 outputs the USB voltage V_{USB} from the output terminal VOUT. The USB voltage V_{USB} output from the LSW 3 is input to the input terminal VBUS of the charging IC 2. The USB voltage V_{USB} output from the LSW 3 is supplied as it is to the LEDs L1 to L8 as the system power source voltage Vcc4.

[0089] When the MCU 1 detects that the USB connection is made, the MCU 1 further outputs a low-level enable signal from the terminal P22 to the charge enable terminal CE (-) of the charging IC 2. Accordingly, the charging IC 2 enables the charging function of the power source BAT, and starts charging the power source BAT with the USB voltage V_{USB} input to the input terminal VBUS. At this time, the MCU 1 does not perform the heating of the heater HTR for generating the aerosol while the switch S3 and the switch S4 are turned off. In other words, when the MCU 1 detects that the USB connection is made based on the voltage input to the terminal P17, the MCU 1 prohibits the supply of power from the power source BAT to the heater connector Cn. Accordingly, it is possible to avoid power consumption from the power source BAT at the time of charging.

[Receptacle-Mounted Board]

[0090] Fig. 17 is a diagram showing the primary surface 162a of the receptacle-mounted board 162. The primary surface 162a of the receptacle-mounted board 162 is a surface on one side of the region SP formed by the two boards 161 and 162 held in parallel.

[0091] On the primary surface 162a of the receptacle-mounted board 162 extending in the up-down direction, the heater connector Cn is disposed in the vicinity of an upper end portion, the receptacle RCP is disposed at a lower end portion, and the reactor Lc of the step-up DC/DC converter 9 is disposed between the heater connector Cn and the receptacle RCP.

[0092] In the vicinity of the receptacle RCP, a battery connector 222 on a positive electrode side (hereinafter, referred to as a positive electrode side battery connector 222) is disposed on a right side, and the opening 176 into which the second small diameter portion 192b of the spacer 173 is fitted is disposed on a left side. Further, on a left side of the reactor Lc, a battery connector 224 on a negative electrode side (hereinafter, referred to as a negative electrode side battery connector 224) and power source temperature detection connectors 234 connected to the thermistor T1 constituting the power source temperature sensor are disposed. A positive electrode side power source bus bar 236 (see Figs. 7 and 8) extending from the positive electrode terminal of the power source BAT is connected to the positive electrode side battery connector 222, and a negative electrode side power source bus bar 238 (see Figs. 7 and 8) extending from the negative electrode terminal of the power source BAT is connected to the negative electrode side battery connector 224.

[0093] The receptacle RCP is disposed at the lower end portion of the receptacle-mounted board 162, and the opening 176 to which the spacer 173 and the receptacle-mounted board 162 are connected is closer to the lower end portion side with respect to the upper end portion. That is, in the receptacle-mounted board 162 extending in the up-down direction, the receptacle RCP and the opening 176 are disposed close to the same side (lower end side in the present embodiment) in the up-down direction. In the vicinity of a path through which the power supplied from the external power source passes, noise due to the current may be generated, and by providing the spacer 173 which is not affected by the noise in the vicinity of the path, a board area of the receptacle-mounted board 162 can be effectively utilized. Accordingly, since an increase in the size of the receptacle-mounted board 162 can be prevented, a cost and a size of the power source unit of the aerosol generating device can be reduced.

[0094] Fig. 18 is a diagram showing the secondary surface 162b of the receptacle-mounted board 162. On the secondary surface 162b of the receptacle-mounted board 162, the overvoltage protection IC 11 is disposed below the opening 176, and the protection IC 10, the operational amplifier OP1, and the step-up DC/DC converter 9 are disposed above the opening 176 in this order from below.

[MCU-Mounted Board]

[0095] Fig. 19 is a diagram showing the primary surface 161a of the MCU-mounted board 161. On the primary surface 161a of the MCU-mounted board 161 extending in the up-down direction, heater temperature detection connectors 240 to which the thermistor T3 constituting the heater temperature sensor is connected via a conductive wire are disposed at an upper end portion, and the charging IC 2 is disposed below the heater temperature detection connectors 240. Further, the opening 175 into which the first small diameter portion 192a of the spacer 173 is fitted is disposed at a position corresponding to the opening 176 of the receptacle-mounted board 162, and the MCU 1 is disposed in the vicinity of the opening 175.

[0096] The MCU 1 is disposed on the lower side of the MCU-mounted board 161, and the opening 175 to which the spacer 173 and the MCU-mounted board 161 are connected is closer to the lower end portion side with respect to the upper end portion. That is, in the MCU-mounted board 161 extending in the up-down direction, the MCU 1 and the opening 175 are disposed close to the same side (the lower end side in the present embodiment) in the up-down direction. Here, the opening peripheral edge portion 166 around the opening 175 of the MCU-mounted board 161 is an insulating portion 167, and a bolt head of the bolt 136 for fixing the MCU-mounted board 161 and the receptacle-mounted board 162 to the chassis 150 comes into contact with the opening peripheral edge portion 166. The electrical connection between the head of the bolt 136 and the opening peripheral edge portion 166 of the MCU-mounted board 161 is cut off by the insulating portion 167. By disposing the MCU 1 in the vicinity of the insulating portion 167 of the MCU-mounted board 161, the noise entering the MCU 1 can be reduced.

[0097] By disposing the MCU 1 on the MCU-mounted board 161 with respect to the receptacle-mounted board 162 on which the receptacle RCP is disposed, since the MCU 1 is separated from the receptacle RCP, the MCU 1 is less likely to be affected by static electricity or the like that may enter from the receptacle RCP. Accordingly, the operation of the suction device 100 can be made more stable.

[0098] Fig. 20 is a diagram showing the secondary surface 161b of the MCU-mounted board 161. The secondary surface 161b of the MCU-mounted board 161 is a surface on the other side of the region SP formed by the two boards 161 and 162 held in parallel.

[0099] On the secondary surface 161b of the MCU-mounted board 161, a motor connector 226 to which the vibration motor M is connected via a conductive wire is disposed above the opening 175, and case temperature detection connectors 228 to which the thermistor T4 constituting the case temperature sensor is connected via a conductive wire and intake air detection connectors 230 to which the thermistor T2 constituting the intake sensor is connected via a conductive wire are disposed above the motor connector 226.

[0100] Fig. 21 is a cross-sectional view of the suction device 100.

[0101] In this way, a plurality of elements and ICs are mounted on the primary surface 161a and the secondary surface 161b of the MCU-mounted board 161 and the primary surface 162a and the secondary surface 162b of the receptacle-mounted board 162. As shown in Fig. 21, in the region SP formed by the primary surface 162a of the receptacle-mounted board 162 and the secondary surface 161b of the MCU-mounted board 161 held in parallel, the reactor Lc connected to the receptacle RCP and the step-up DC/DC converter 9 is disposed as described above. In Fig. 21, a reference numeral 300 denotes a heat diffusion member that dissipates heat generated by the step-up DC/DC converter 9 or the like.

[0102] By disposing the receptacle RCP having a relatively large volume in the region SP between the receptacle-mounted board 162 and the MCU-mounted board 161, the board area can be effectively utilized. Accordingly, the cost and the size of the suction device 100 can be reduced.

[0103] In general, the size of the reactor Lc connected to the step-up DC/DC converter 9 increases in accordance with the current output from the step-up DC/DC converter 9. In the suction device 100, since the heater HTR is a component having the largest power consumption, the reactor Lc is likely to be larger than the step-up DC/DC converter 9 itself. By disposing the reactor Lc having a large volume in the region SP between the receptacle-mounted board 162 and the MCU-mounted board 161, it is possible to prevent the reactor Lc from protruding to the outside.

[0104] Although the embodiments are described above with reference to the drawings, it is needless to say that the present invention is not limited to such examples. It will be apparent to those skilled in the art that various changes and modifications may be conceived within the scope of the claims. It is also understood that the various changes and modifications belong to the technical scope of the present invention. Further, constituent elements in the embodiments described above may be combined freely within a range not departing from the spirit of the present invention.

[0105] For example, in the above-described embodiment, the spacer 173 has the cylindrical shape, but the present invention is not limited thereto, and the spacer 173 may have a tubular shape as long as there is the through hole 194 through which the bolt 136 is inserted.

[0106] At least the following matters are described in the present description. Corresponding constituent elements or the like in the above-described embodiments are shown in parentheses. However, the present invention is not limited thereto.

(1) A power supply unit of an aeroslo generating device (non-combustion-type suction device 100) includes:

a power source (power source BAT);
a heater connector (heater connectors Cn) to which a heater (heater HTR) configured to heat an aerosol source by consuming power supplied from the power source is connected;
a first board (MCU-mounted board 161);
a second board (receptacle-mounted board 162) separate from the first board;
a case (case 110) in which the power source, the heater connector, the first board, and the second board are housed; and
a spacer (spacer 173) disposed between the first board and the second board and configured to hold the first board and the second board in parallel.

[0107] According to (1), by holding the two boards arranged in the case in parallel via the spacer, it is possible to prevent the boards from coming into contact with each other and causing a short circuit. Further, an electrically safe region can be ensured in the case by the two boards held in parallel, and the space in the case can be effectively utilized.

[0108] (2) The power source unit of the aerosol generating device according to claim (1) further includes: a chassis (chassis 150) disposed inside the case, in which
the first board and the second board are fixed to the chassis.

[0109] According to (2), by fixing the first board and the second board to the chassis in the case, the two boards can be held in a stable state.

[0110] (3) The power supply unit of an aerosol generating device according to (2), in which
at least a part (front-rear dividing wall 152) of the chassis is disposed between the power source and the first board and the second board.

[0111] According to (3), it is possible to separate the power source from the first board and the second board, and it is possible to prevent the heat of the power source from being transmitted to the first board and the second board.

[0112] (4) The power supply unit of an aerosol generating device according to (2) or (3), in which

the spacer has a cylindrical shape having a through hole (through hole 194),
the first board and the second board have openings (openings 175 and 176), respectively, and
the first board and the second board are fixed to the chassis in a state where the spacer is sandwiched between the first board and the second board by a bolt (bolt 136) inserted through the through hole and the openings.

[0113] According to (4), the cost of the power source unit of the aerosol generating device can be reduced by using the bolts having high versatility.

[0114] (5) The power supply unit of an aerosol generating device according to (4), in which
an opening peripheral edge portion (opening peripheral edge portion 166) of the first board in contact with a head

of the bolt includes an insulating portion (insulating portion 167).

[0115] According to (5), the electrical connection between the head of the bolt and the opening peripheral edge portion of the first board is cut off by the insulating portion.

[0116] (6) The power supply unit of an aerosol generating device according to (5) further includes:

a controller (MCU 1) disposed on the first board and configured to be capable of controlling supply of power from the power source to the heater connector, in which
the first board extends in a predetermined direction (up-down direction),
the controller is provided on one end side (lower side) in the predetermined direction, and
a portion (opening 175) where the spacer and the first board are connected to each other is closer to the one end side with respect to the other end side (upper side) in the predetermined direction.

[0117] According to (6), by disposing the controller in the vicinity of the insulating portion of the first board, noise entering the controller can be reduced.

[0118] (7) The power supply unit of an aerosol generating device according to any one of (1) to (6), in which

the spacer has conductivity, and
connects a ground of the first board and a ground of the second board with each other.

[0119] According to (7), by connecting the grounds of the two boards via the spacer, the ground potentials of the two grounds can be equalized, and the supply and communication of the charging power and the operating power between the IC of the first board and the IC of the second board can be stabilized. Further, since the volume of the spacer can be freely set, the resistance can be reduced by increasing the volume of the spacer.

[0120] (8) The power supply unit of an aerosol generating device according to any one of (1) to (7) further includes:

a receptacle (receptacle RCP) capable of being electrically connected to an external power source, in which
the receptacle is disposed between the first board and the second board.

[0121] According to (8), since the receptacle having a relatively large volume is disposed in the space defined by the two boards held in parallel, the board area can be effectively utilized. Accordingly, the cost and the size of the power source unit of the aerosol generating device can be reduced.

[0122] (9) The power supply unit of an aerosol generating device according to (8), in which

the second board extends in the predetermined direction (up-down direction),
the receptacle is disposed on one end side (lower side) of the second board in the predetermined direction, and
a portion (opening 176) where the spacer and the second board are connected to each other is closer to the one end side with respect to the other end side (upper side) in the predetermined direction.

[0123] In the vicinity of the path through which the power supplied from the external power source passes, noise due to the current may be generated. According to (9), the spacer that is not affected by noise is provided in the vicinity of the path, thereby effectively utilizing the board area of the second board. Accordingly, since an increase in the size of the second board can be prevented, the cost and the size of the power source unit of the aerosol generating device can be reduced.

[0124] (10) The power supply unit of an aerosol generating device according to any one of (1) to (9) further includes:

a voltage conversion IC (step-up DC/DC converter 9) including an input terminal (input terminal VIN) connected to the power source and an output terminal (output terminal VOUT) connected to the heater connector; and
a reactor (reactor Lc) connected to the voltage conversion IC, in which
the reactor is disposed between the first board and the second board.

[0125] The size of the reactor connected to the voltage conversion IC increases in accordance with the current output from the voltage conversion IC. In the aerosol generating device, since the heater is a component having the largest power consumption, the reactor is likely to be larger than the voltage conversion IC itself. According to (10), by disposing the reactor having a large volume between the first board and the second board, it is possible to prevent the reactor from protruding to the outside.

Claims

1. A power source unit of an aerosol generating device comprising:

a power source;
a heater connector to which a heater configured to heat an aerosol source by consuming power supplied from the power source is connected;
a first board;
a second board separate from the first board;
a case in which the power source, the heater connector, the first board, and the second board are housed; and

a spacer disposed between the first board and the second board and configured to hold the first board and the second board in parallel.

2. The power source unit of an aerosol generating device according to claim 1, further comprising:

a chassis disposed inside the case, wherein the first board and the second board are fixed to the chassis.

3. The power source unit of an aerosol generating device according to claim 2, wherein at least a part of the chassis is disposed between the power source and the first board and the second board.

4. The power source unit of an aerosol generating device according to claim 2 or 3, wherein:

the spacer has a cylindrical shape having a through hole;
the first board and the second board have openings, respectively; and
the first board and the second board are fixed to the chassis in a state in which the spacer is sandwiched between the first board and the second board by a bolt inserted through the through hole and the openings.

5. The power supply unit of an aeroslo generating device according to claim 4, wherein an opening peripheral edge portion of the first board in contact with a head of the bolt includes an insulating portion.

6. The power source unit of an aerosol generating device according to claim 5, further comprising: a controller disposed on the first board and configured to control supply of power from the power source to the heater connector, wherein:

the first board extends in a predetermined direction;
the controller is provided on one end side in the predetermined direction; and
a portion where the spacer and the first board are connected to each other is closer to the one end side with respect to the other end side in the predetermined direction.

7. The power source unit of an aerosol generating device according to any one of claims 1 to 6, wherein:

the spacer has conductivity; and
connects a ground of the first board and a ground of the second board with each other.

8. The power source unit of an aerosol generating device according to any one of claims 1 to 7, further comprising:

a receptacle configured to be electrically connected to an external power source, wherein the receptacle is disposed between the first board and the second board.

9. The power source unit of an aerosol generating device according to claim 8, wherein:

the second board extends in the predetermined direction;
the receptacle is disposed on one end side of the second board in the predetermined direction; and
a portion where the spacer and the second board are connected to each other is closer to the one end side with respect to the other end side in the predetermined direction.

10. The power source unit of an aerosol generating device according to any one of claims 1 to 9, further comprising:

a voltage conversion IC including an input terminal connected to the power source and an output terminal connected to the heater connector; and
a reactor connected to the voltage conversion IC, wherein
the reactor is disposed between the first board and the second board.

FIG. 1

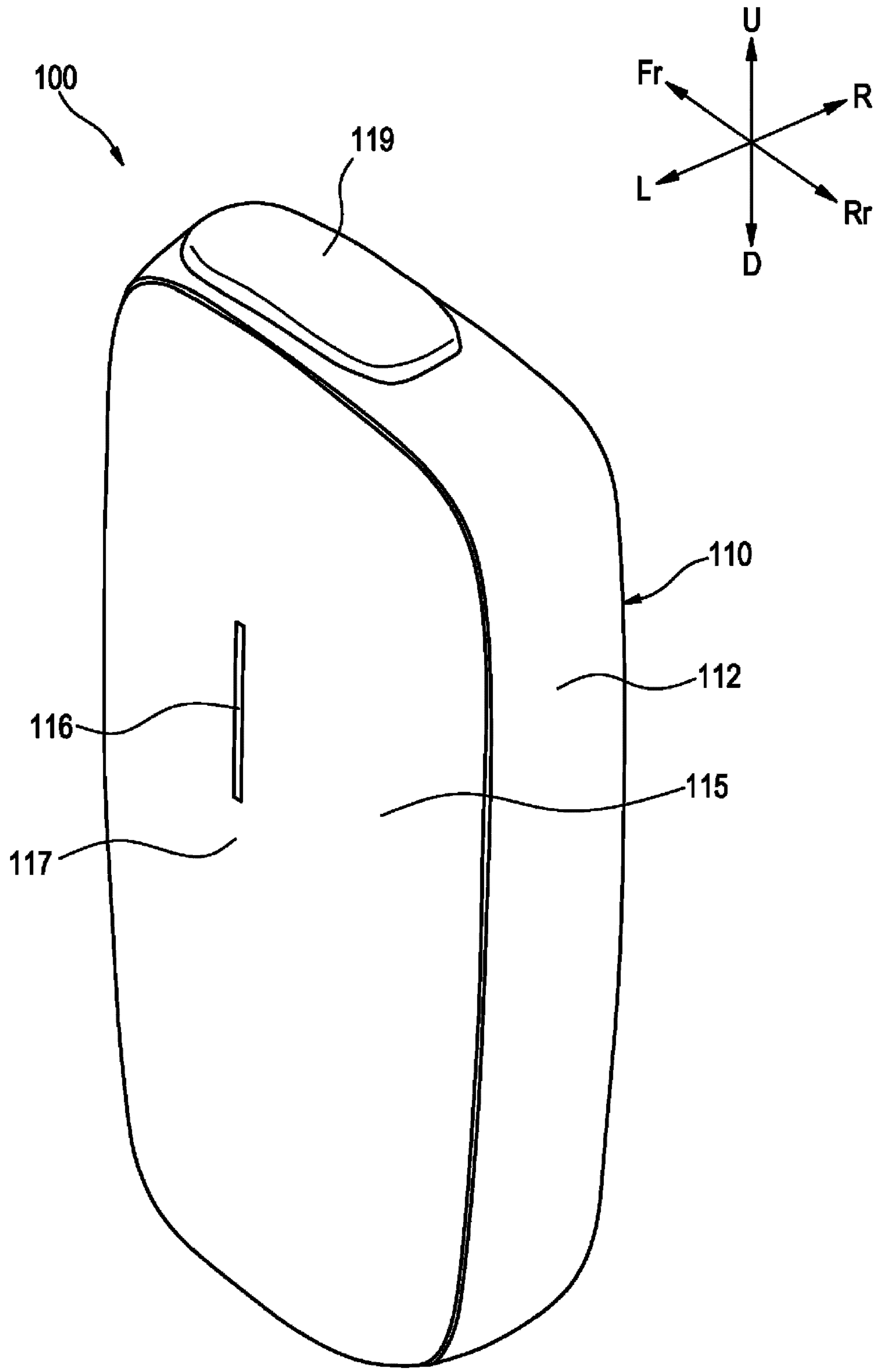


FIG. 2

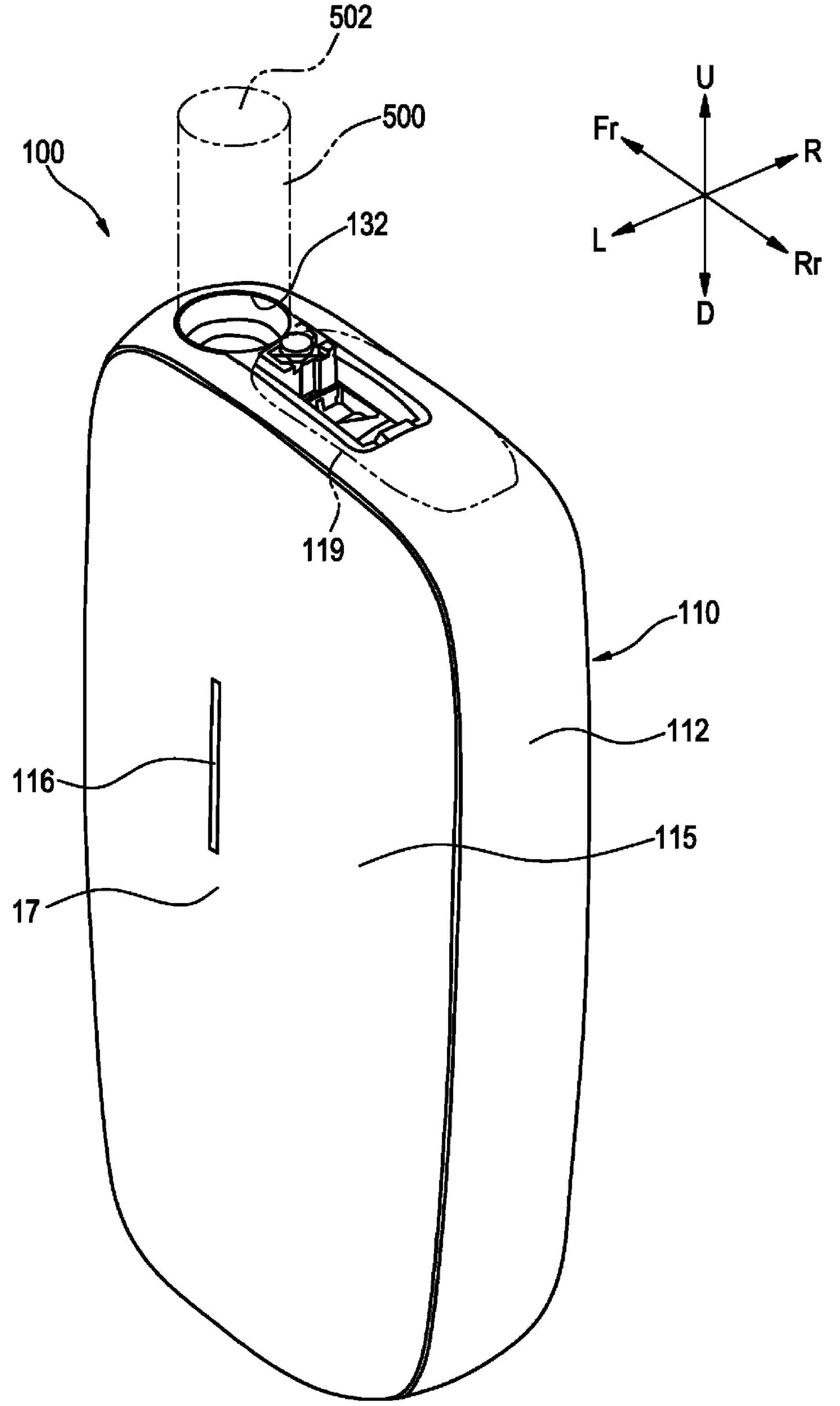


FIG. 3

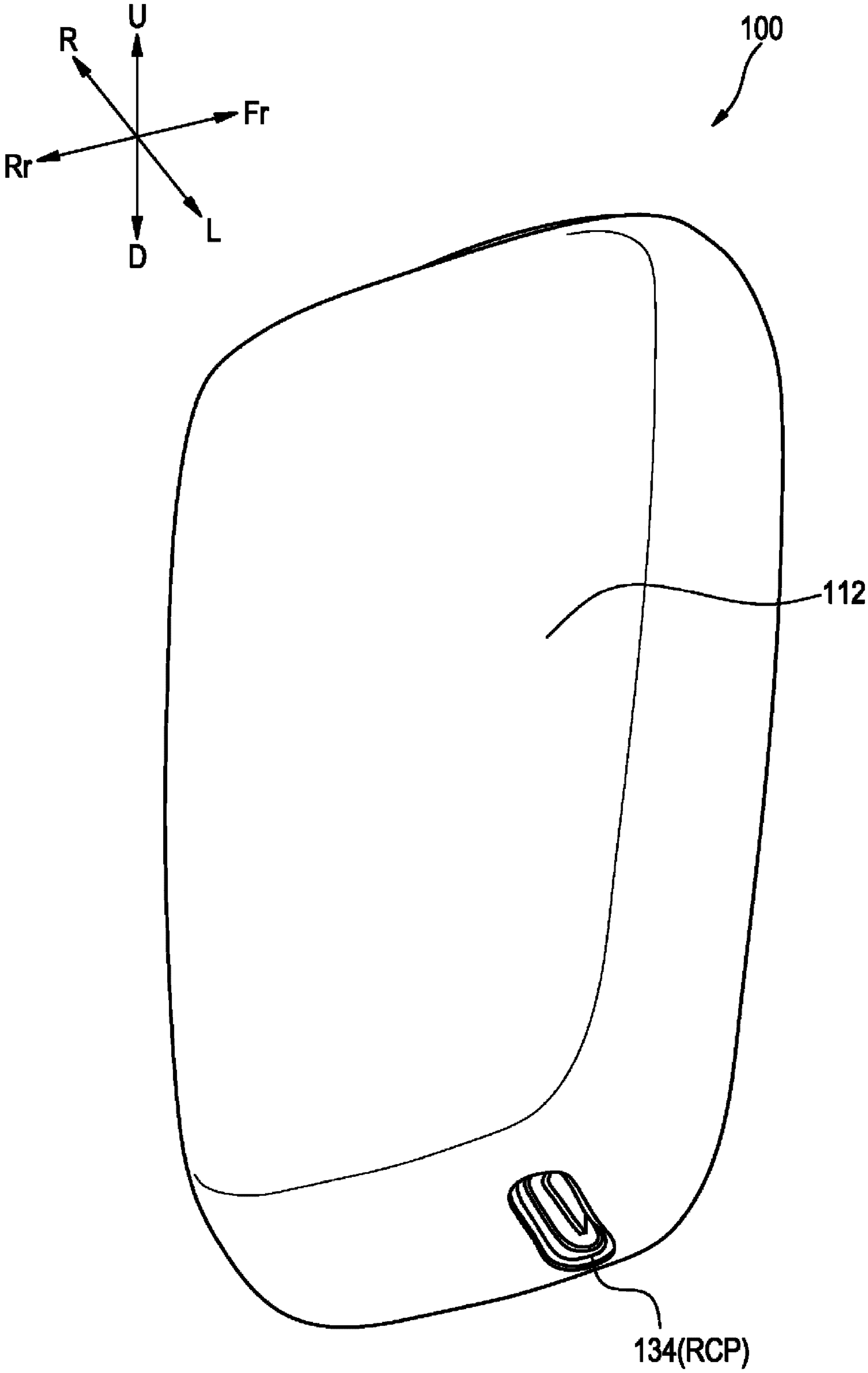


FIG. 4

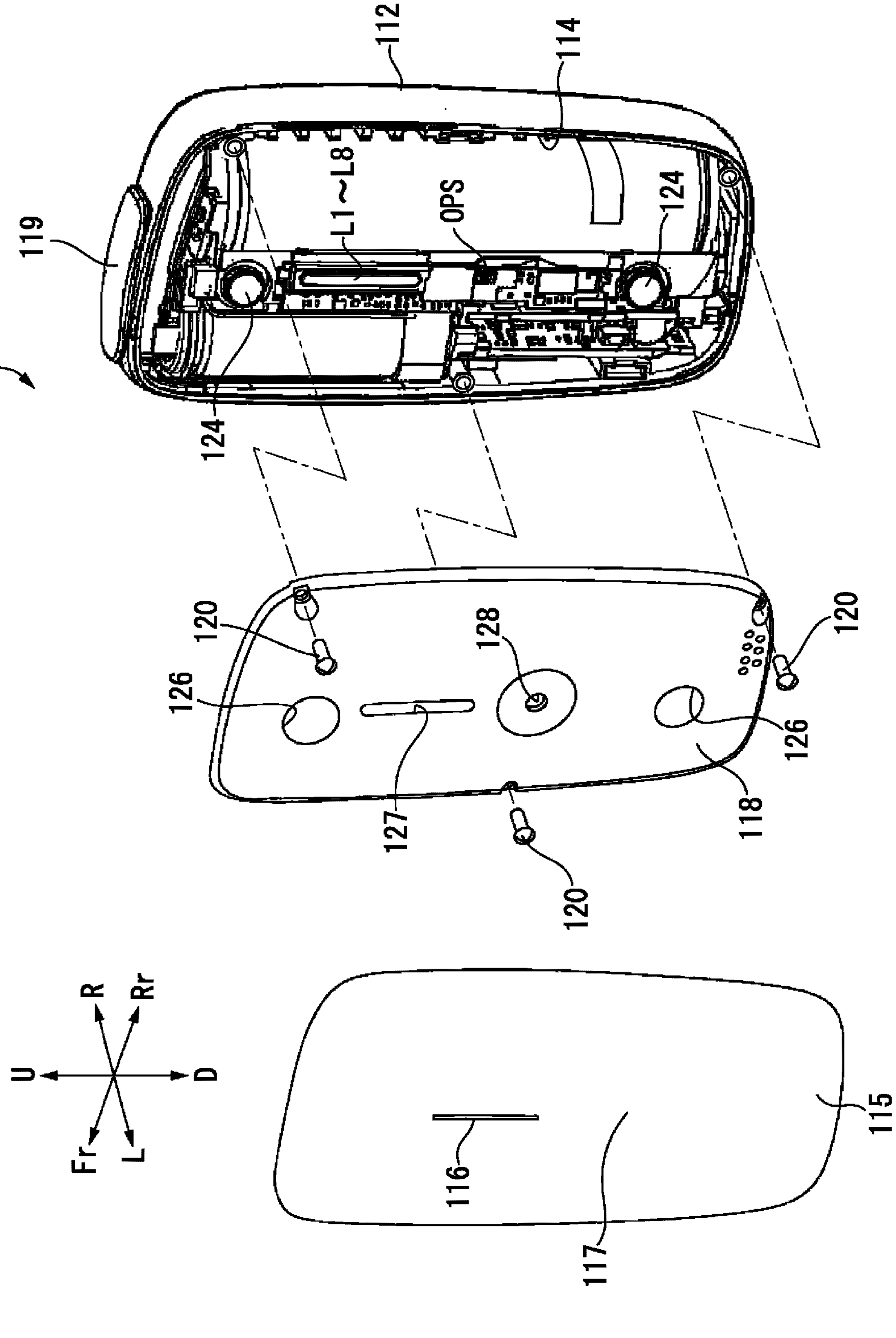
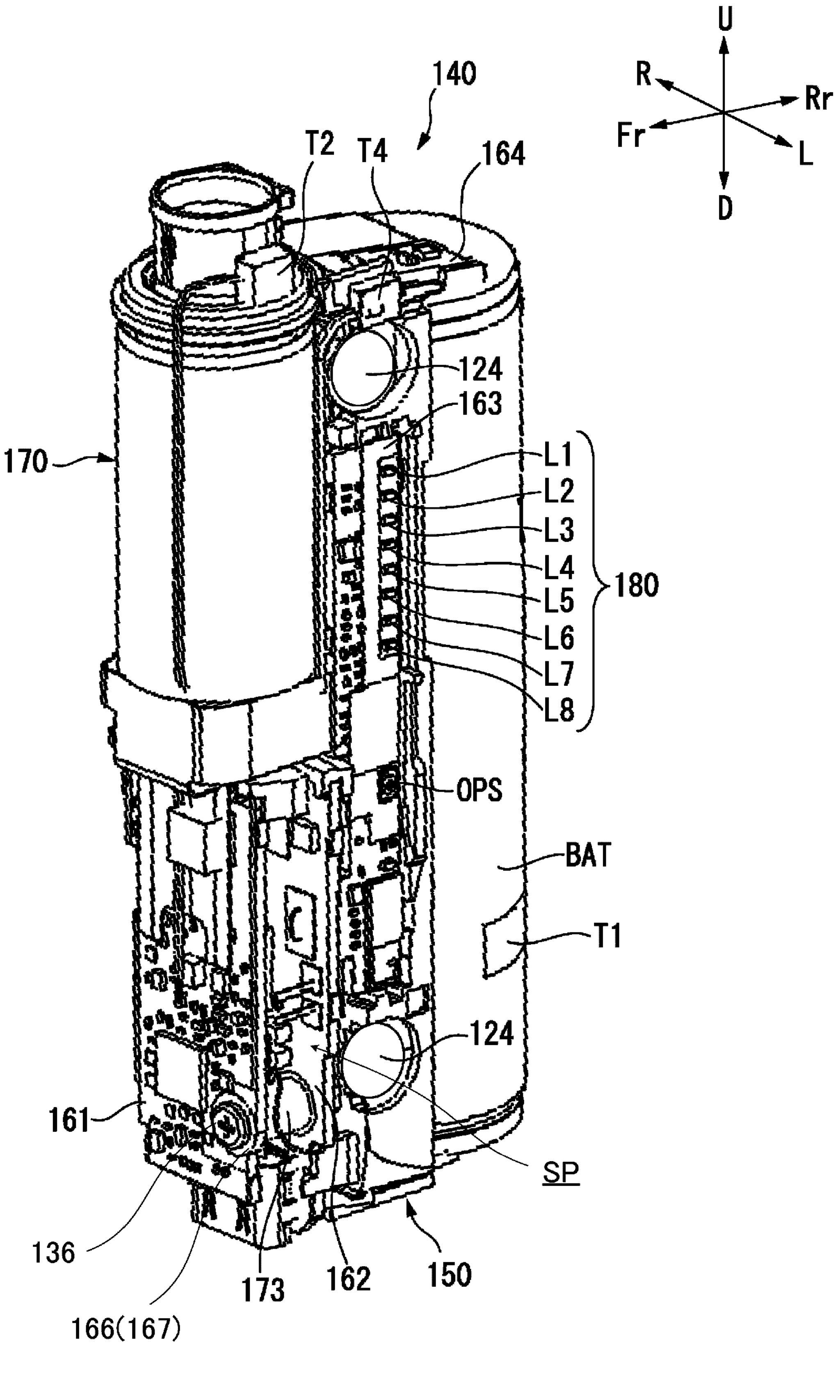

100
112
114
119
L1~L8
OPS
124
124
120
120
120
126
126
127
128
118
115
116
117
U
D
R
Rr
Fr
L

FIG. 5



140
T2
T4
164
U
R
Rr
Fr
L
D
124
163
170
L1
L2
L3
L4
L5
L6
L7
L8
180
OPS
BAT
T1
124
161
SP
136
173
162
150
166(167)

FIG. 6

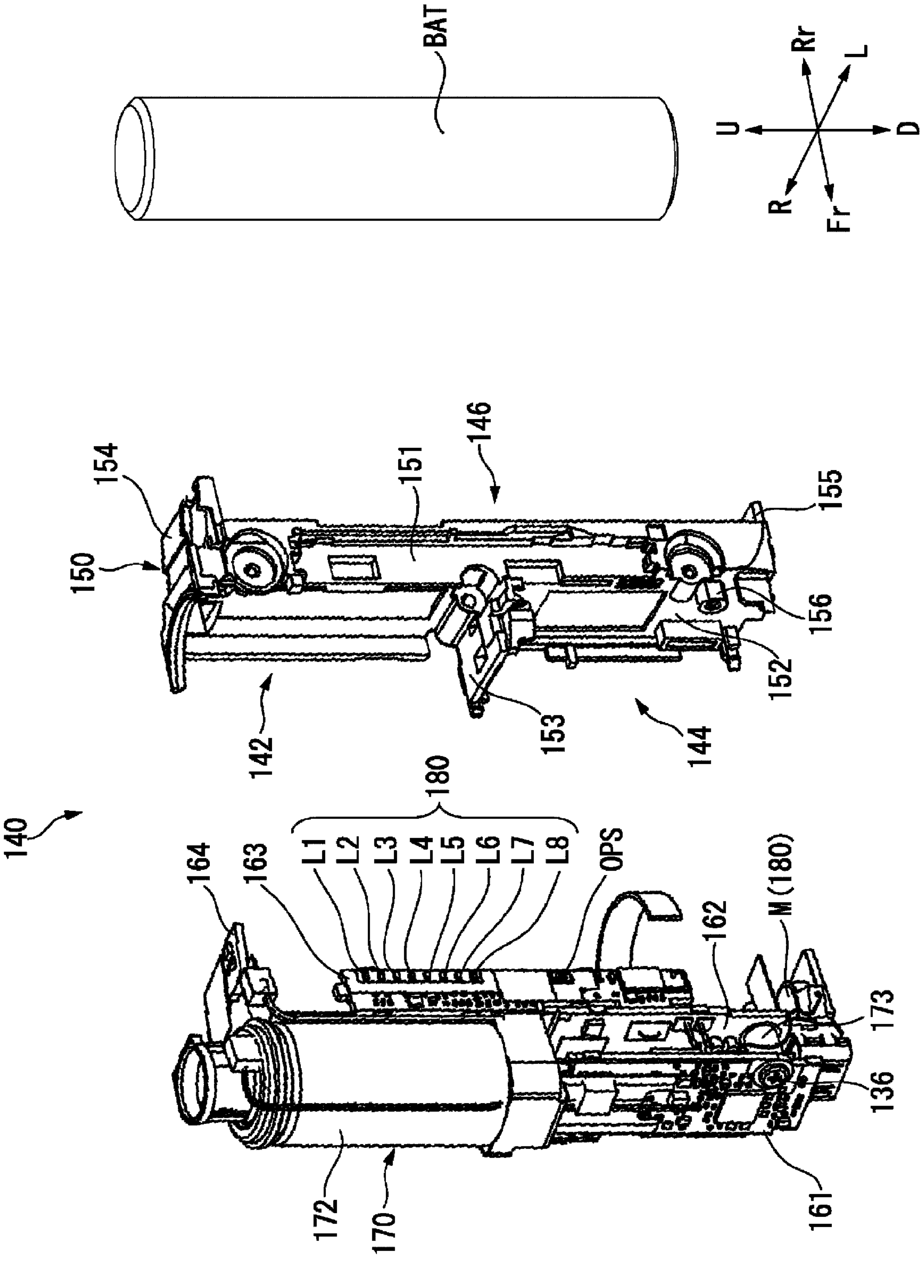

BAT
Rr
L
U
D
R
Fr
146
154
151
155
150
156
152
142
153
144
140
180
164
163
L1
L2
L3
L4
L5
L6
L7
L8
OPS
162
M(180)
173
136
172
170
161

FIG. 7

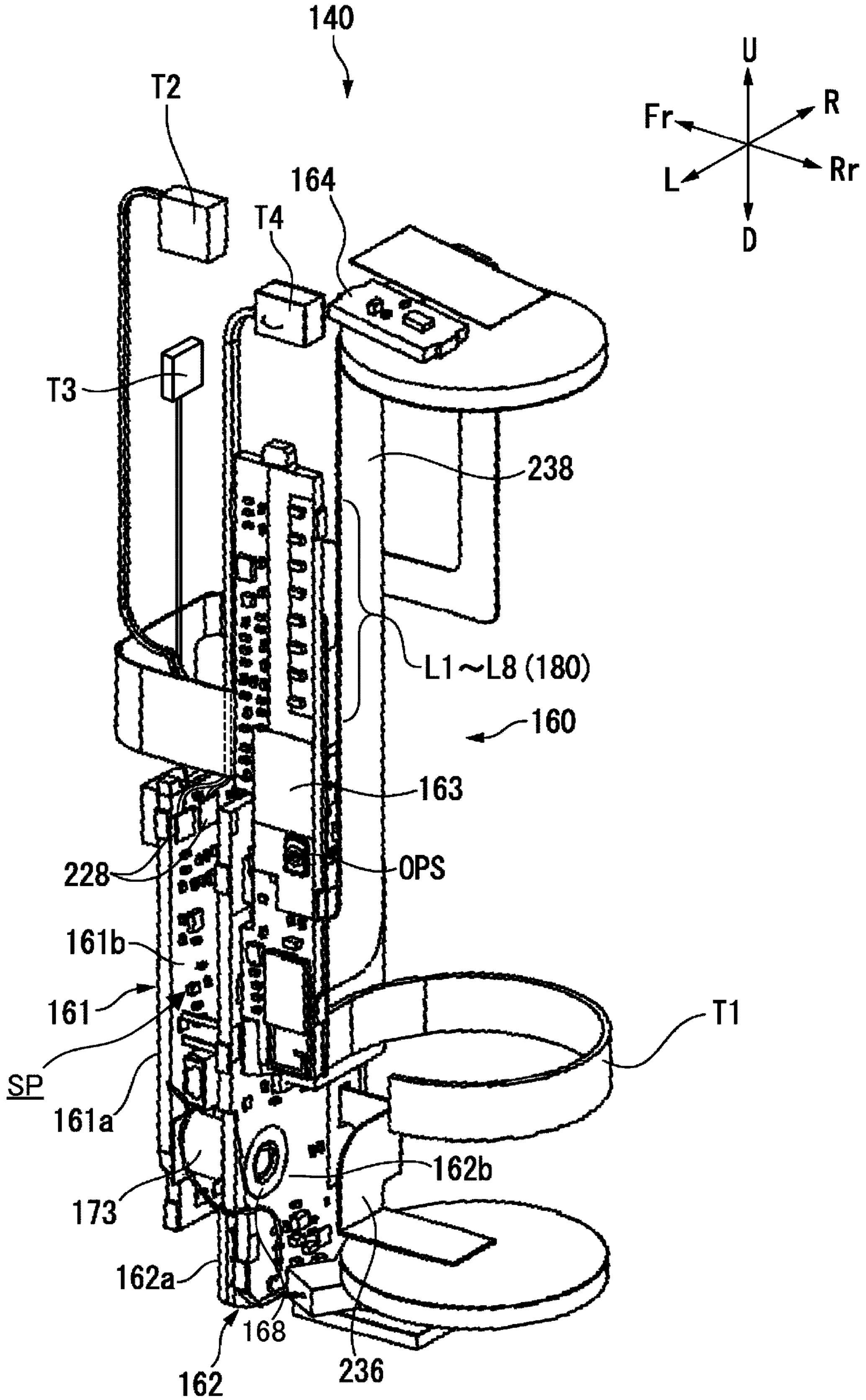
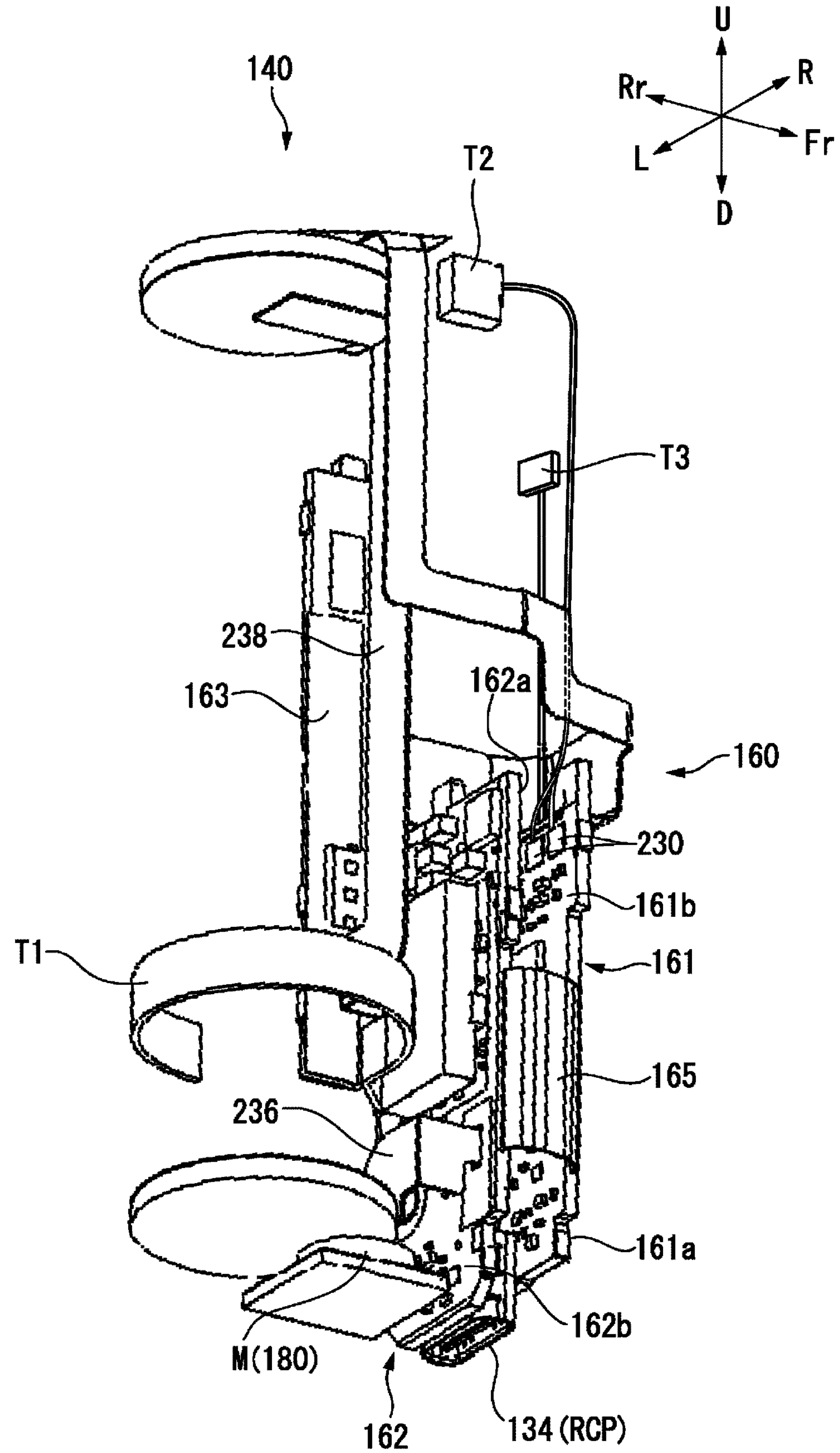

140
T2
T3
T4
164
U
R
Fr
L
Rr
D
238
L1～L8 (180)
160
163
OPS
228
161b
161
SP
161a
173
162a
162
168
236
162b
T1

FIG. 8



140
U
D
R
L
Rr
Fr
T2
T3
238
163
162a
160
230
161b
161
T1
165
236
161a
162b
M(180)
162
134 (RCP)

FIG. 9

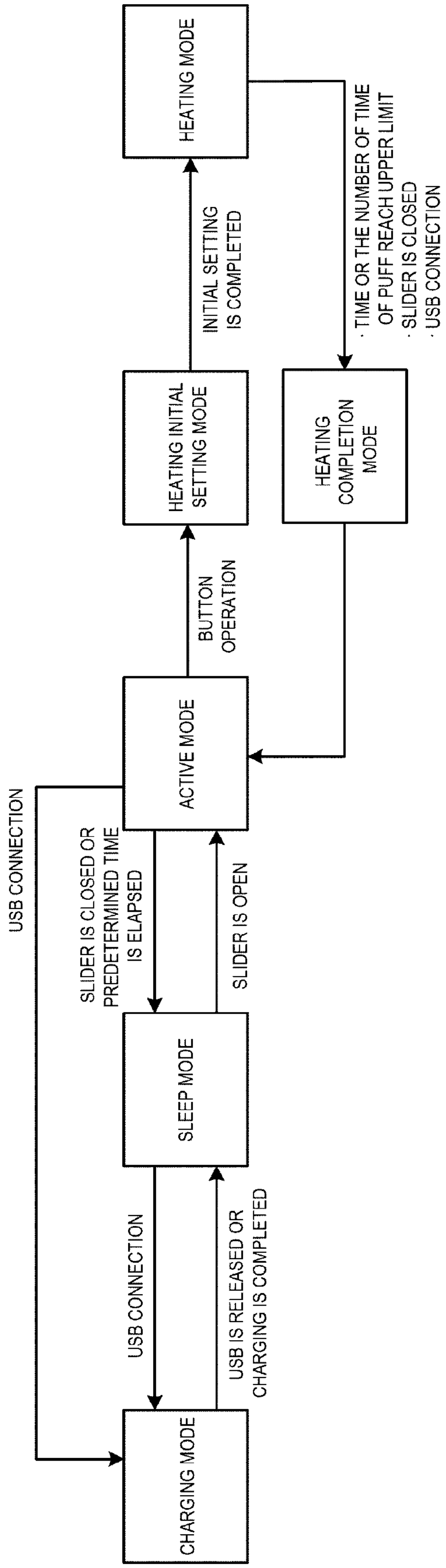
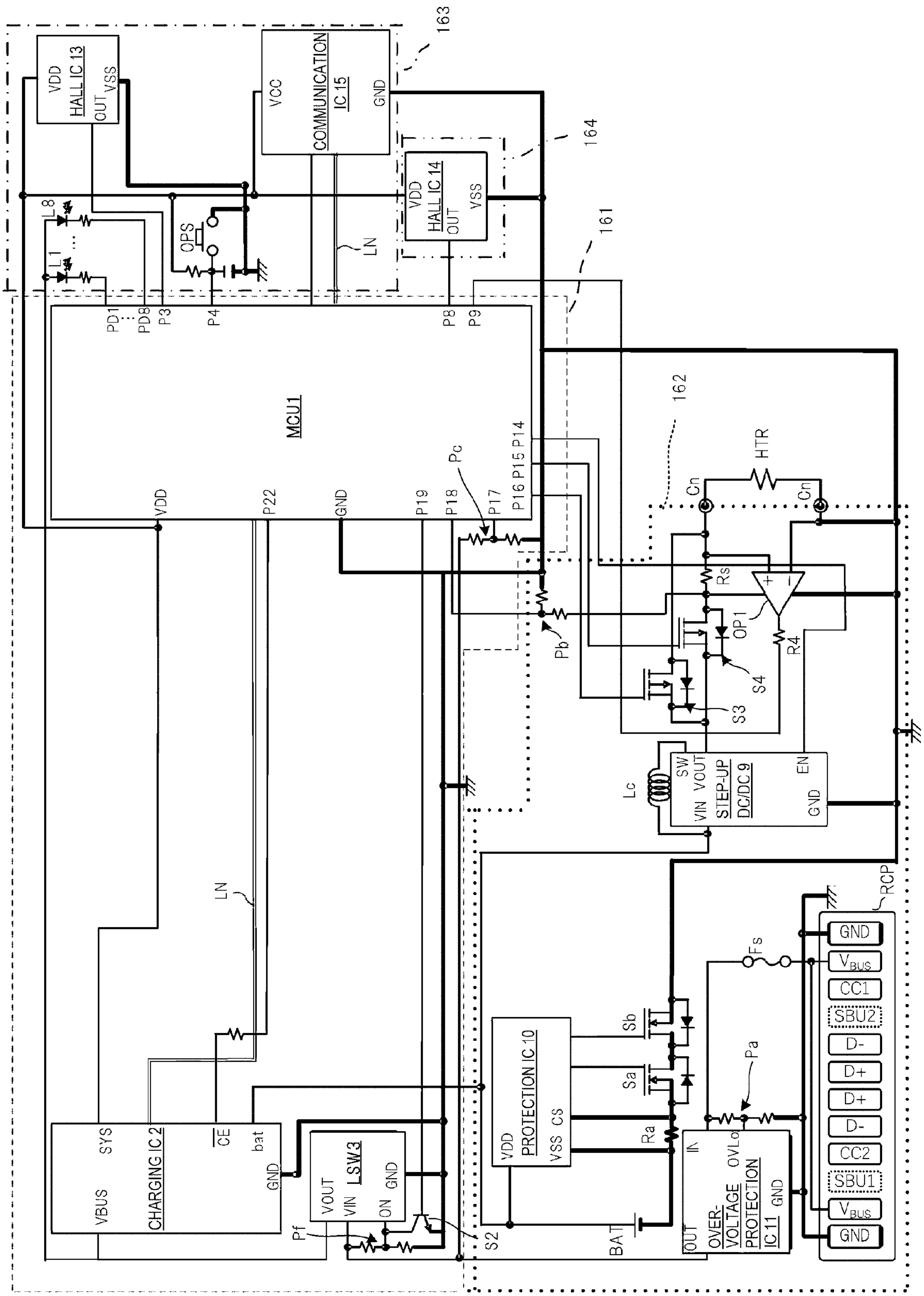
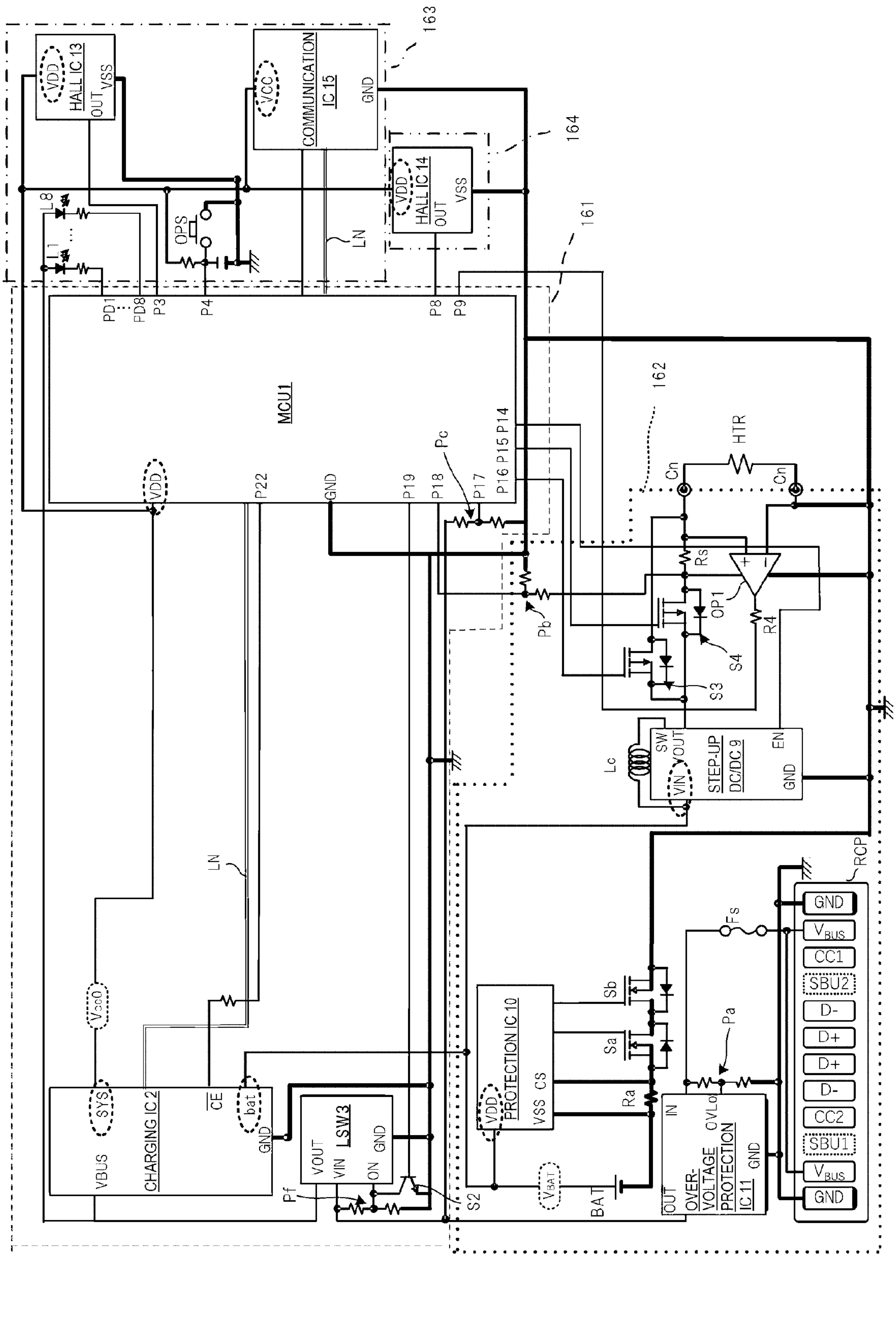

CHARGING MODE
SLEEP MODE
ACTIVE MODE
HEATING INITIAL SETTING MODE
HEATING MODE
HEATING COMPLETION MODE
USB CONNECTION
USB IS RELEASED OR CHARGING IS COMPLETED
SLIDER IS CLOSED OR PREDETERMINED TIME IS ELAPSED
SLIDER IS OPEN
USB CONNECTION
BUTTON OPERATION
INITIAL SETTING IS COMPLETED
· TIME OR THE NUMBER OF TIME OF PUFF REACH UPPER LIMIT
· SLIDER IS CLOSED
· USB CONNECTION

FIG. 10

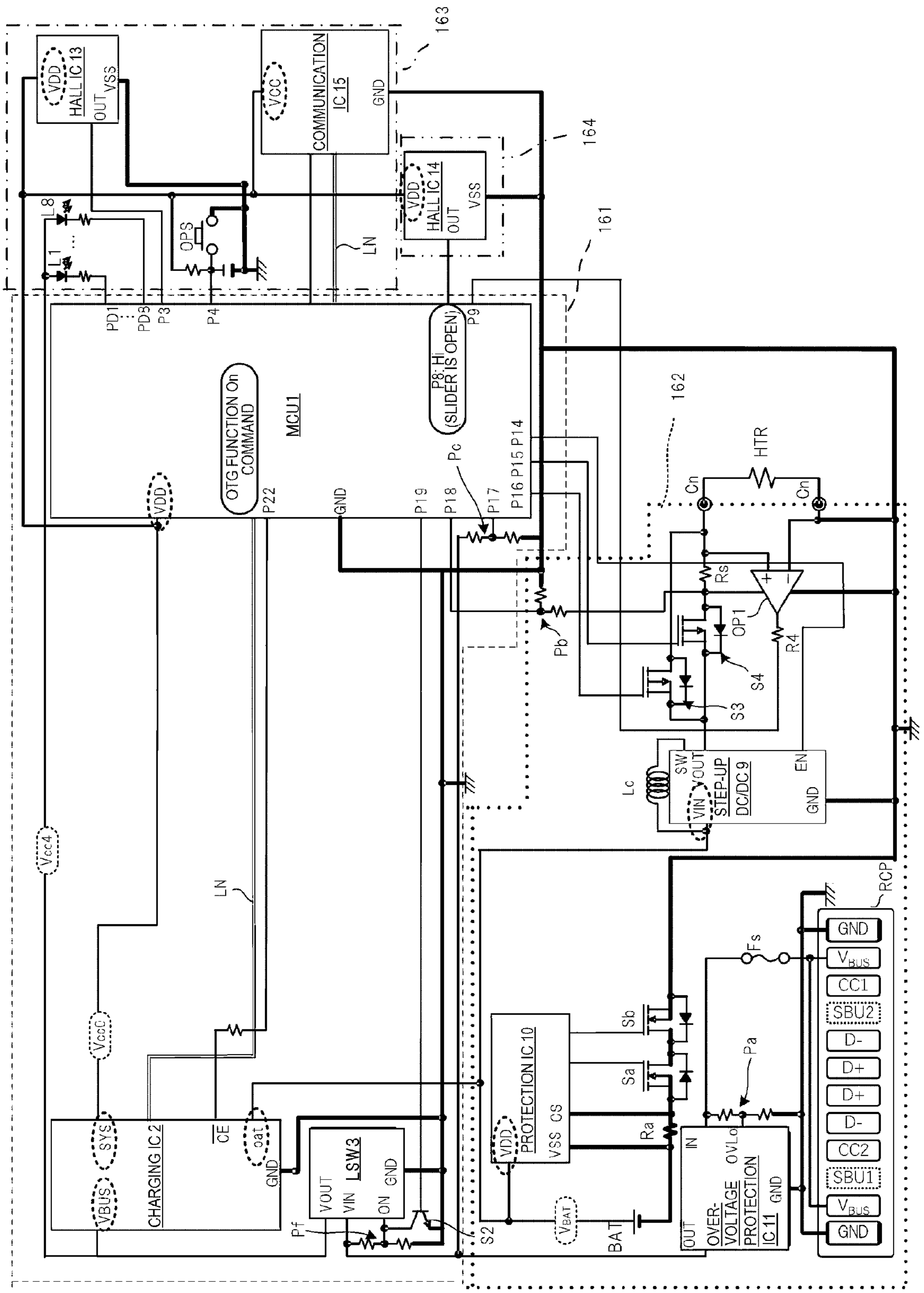

163
164
161
162
HALL IC 13
VDD
OUT
VSS
COMMUNICATION IC 15
VCC
GND
HALL IC 14
L1
L8
OPS
LN
MCU1
PD1
PD8
P3
P4
P8
P9
P14
P15
P16
P17
P18
P19
GND
P22
VDD
Pc
Pb
Cn
HTR
Rs
OP1
R4
S3
S4
Lc
SW
VOUT
VIN
STEP-UP DC/DC 9
EN
RCP
GND
VBUS
CC1
SBU2
D-
D+
CC2
SBU1
Fs
Pa
Sa
Sb
Ra
PROTECTION IC 10
CS
VSS
IN
OVLo
OUT
OVER-VOLTAGE PROTECTION IC 11
BAT
CHARGING IC 2
SYS
CE
bat
LSW 3
ON
S2
Pf



163
164
161
162
HALL IC 13
VDD
OUT
VSS
COMMUNICATION IC 15
VCC
GND
HALL IC 14
L8
L1
OPS
LN
PD1
PD8
P3
P4
P8
P9
MCU1
VDD
P22
GND
P19
P18
P17
P16
P15
P14
Pc
Pb
Cn
HTR
Rs
OP1
R4
S4
S3
Lc
SW
VOUT
VIN
STEP-UP DC/DC 9
EN
RCP
GND
V_{BUS}
CC1
SBU2
D-
D+
CC2
SBU1
Fs
Pa
Sb
Sa
Ra
PROTECTION IC 10
CS
VSS
IN
OVLo
OVER-VOLTAGE PROTECTION IC 11
OUT
BAT
V_{BAT}
S2
CHARGING IC 2
VBUS
SYS
CE
bat
V_{CC0}
LSW3
VOUT
VIN
ON
Pf

FIG. 11

FIG. 12


163
164
161
162
HALL IC 13
VDD
OUT
VSS
COMMUNICATION
IC 15
VCC
GND
HALL IC 14
L1
L8
OPS
LN
PD1
PD8
P3
P4
P9
P8: Hi
(SLIDER IS OPEN)
OTG FUNCTION On
COMMAND
MCU1
P22
GND
P19
P18
P17
P16
P15
P14
Pc
Pb
HTR
Cn
Rs
OP1
R4
S3
S4
Lc
SW
VOUT
VIN
STEP-UP
DC/DC 9
EN
Vcc4
VccC
CHARGING IC 2
VBUS
SYS
CE
Bat
LSW3
Pf
ON
S2
PROTECTION IC 10
CS
Sa
Sb
Ra
BAT
OVER-
VOLTAGE
PROTECTION
IC 11
IN
OUT
OVLo
Pa
Fs
RCP
CC1
SBU2
D-
D+
CC2
SBU1

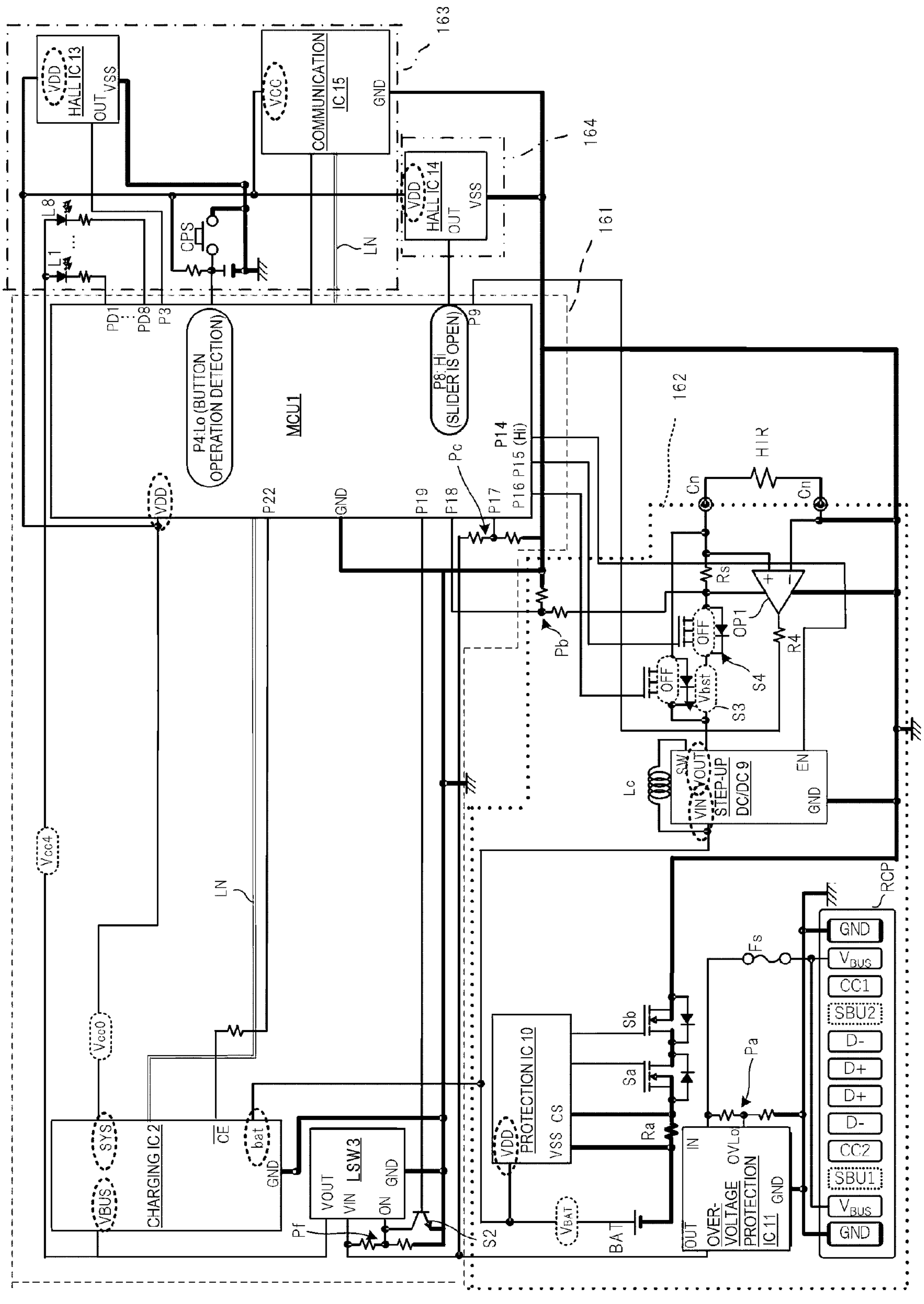
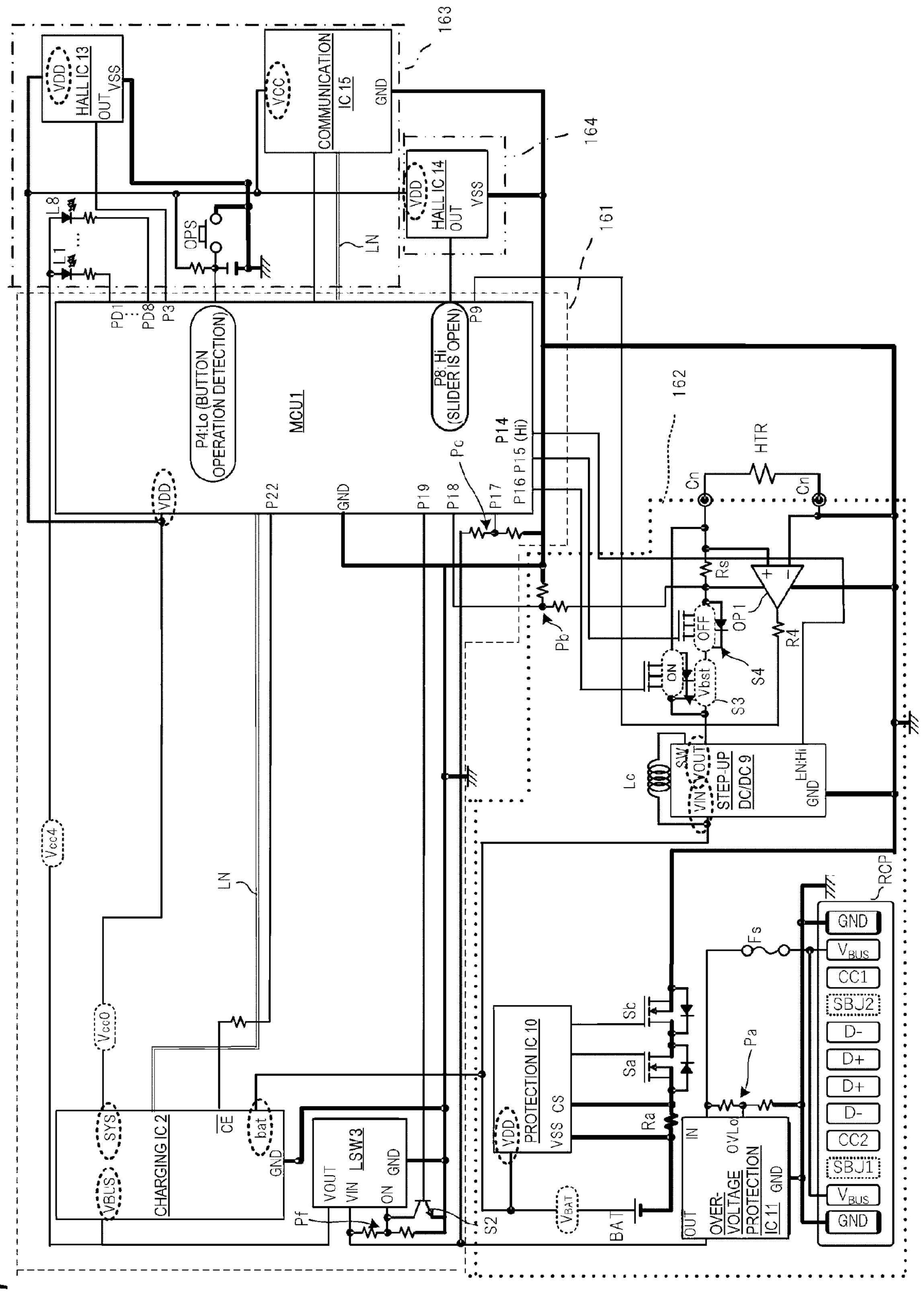

HALL IC 13
VDD
OUT
VSS
COMMUNICATION IC 15
VCC
GND
163
HALL IC 14
164
161
162
CPS
L1
L8
LN
PD1
PD8
P3
P4:Lo (BUTTON OPERATION DETECTION)
P8: Hi (SLIDER IS OPEN)
P9
MCU1
P14
P15 (Hi)
P16
P17
P18
P19
P22
Pc
Pb
Cn
HIR
Rs
OP1
R4
S3
S4
Vbst
OFF
Lc
STEP-UP DC/DC 9
SW
VOUT
VIN
EN
Vcc4
Vcc0
CHARGING IC 2
SYS
VBUS
CE
bat
LSW3
ON
Pf
S2
PROTECTION IC 10
CS
Sa
Sb
Ra
BAT
VBAT
OVER-VOLTAGE PROTECTION IC 11
IN
OUT
OVLo
Pa
Fs
RCP
GND
CC1
SBU2
D-
D+
CC2
SBU1

FIG. 13



163
164
161
162
HALL IC 13
VDD
OUT
VSS
COMMUNICATION IC 15
VCC
GND
HALL IC 14
VDD
OUT
VSS
L1
L8
OPS
LN
PD1
PD8
P3
P4:Lo (BUTTON OPERATION DETECTION)
P8: Hi (SLIDER IS OPEN)
P9
MCU1
VDD
P22
GND
P19
P18
P17
P16 P15 (Hi)
P14
Pc
Pb
Cn
HTR
Rs
OP1
R4
ON
OFF
Vbst
S3
S4
Lc
SW
VOUT
VIN
STEP-UP DC/DC 9
EN·Hi
GND
Vcc4
Vcc0
CHARGING IC 2
VBUS
SYS
CE
bat
GND
LSW 3
VOUT
VIN
ON
GND
Pf
S2
PROTECTION IC 10
VDD
VSS
CS
Sa
Sc
Ra
VBAT
BAT
OVER-VOLTAGE PROTECTION IC 11
IN
OVLo
OUT
GND
Pa
Fs
RCP
GND
VBUS
CC1
SBJ2
D-
D+
D+
D-
CC2
SBJ1
VBUS
GND

FIG. 14

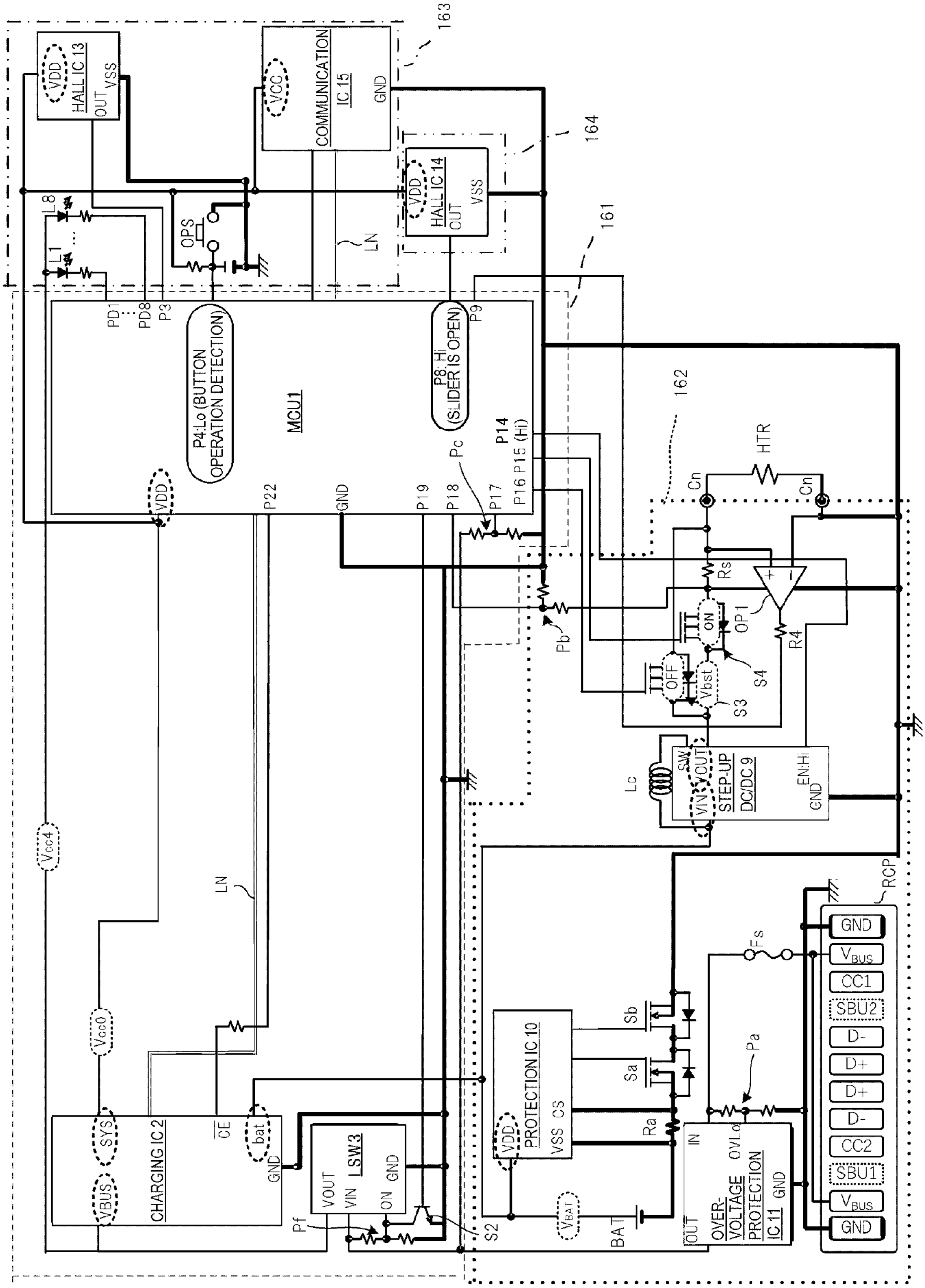
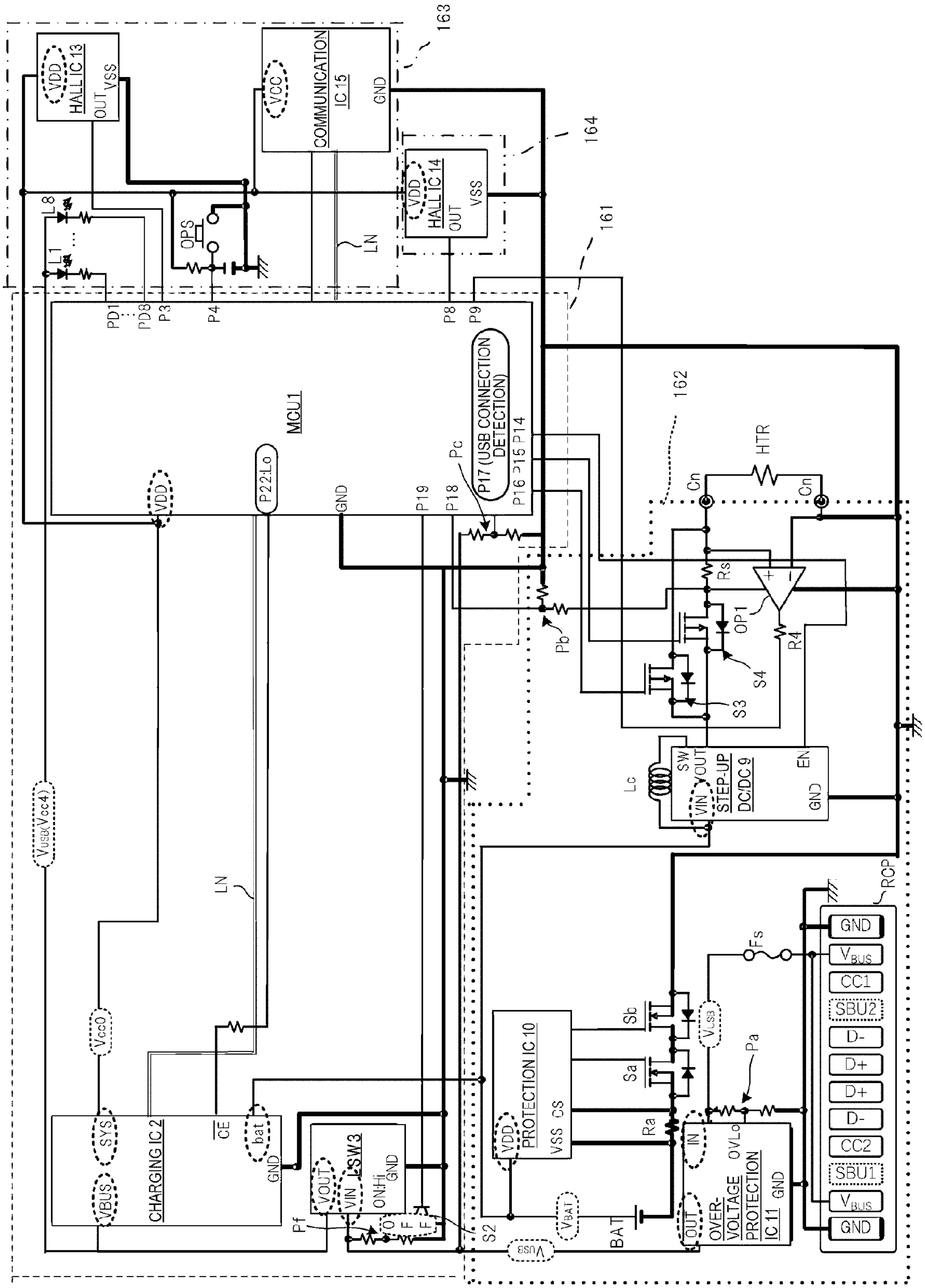

163
164
161
162
HALL IC 13
COMMUNICATION IC 15
HALL IC 14
MCU1
P4:Lo (BUTTON OPERATION DETECTION)
P8: Hi (SLIDER IS OPEN)
OPS
LN
HTR
Rs
OP1
R4
S3
S4
Lc
STEP-UP DC/DC 9
EN:Hi
Vcc4
Vcc0
CHARGING IC 2
LSW3
PROTECTION IC 10
Sa
Sb
Ra
Fs
Pa
Pb
Pc
Pf
S2
BAT
OVER-VOLTAGE PROTECTION IC11
RCP
GND
CC1
SBU2
D-
D+
CC2
SBU1

FIG. 15



163
COMMUNICATION IC 15
VCC
GND
VDD
HALL IC 13
OUT VSS
164
VDD
HALL IC 14
OUT
VSS
161
L8
L1
OPS
LN
PD1
PD8
P3
P4
P8
P9
MCU1
P17 (USB CONNECTION DETECTION)
P14
P15
P16
P18
P19
GND
P22:Lo
VDD
Pc
162
HTR
Cn
Cn
Rs
OP1
R4
Pb
S3
S4
Lc
SW
VOUT
VIN
STEP-UP DC/DC 9
EN
GND
RCP
GND
VBUS
CC1
SBU2
D-
D+
D+
D-
CC2
SBU1
VBUS
GND
Fs
VUSB(Vcc4)
Vcc0
LN
Sb
Sa
Pa
PROTECTION IC 10
VDD
VSS
CS
Ra
IN
OVLo
OVER-VOLTAGE PROTECTION IC 11
GND
OUT
BAT
VBAT
VUSB
S2
CHARGING IC 2
VBUS
SYS
CE
bat
GND
LSW 3
VOUT
VIN
ON:Hi
GND
Pf
OFF

FIG. 16

FIG. 17

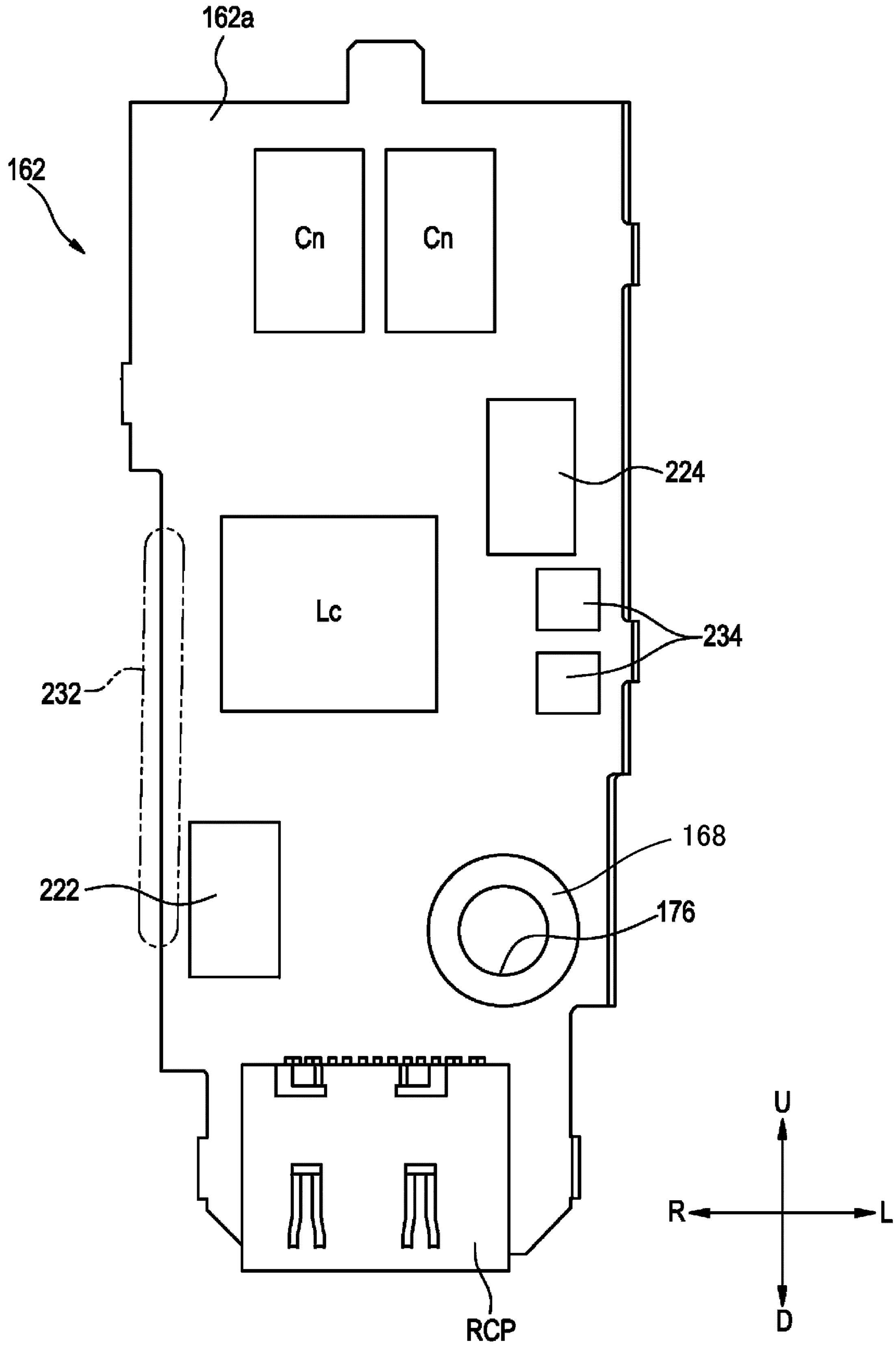


FIG. 18

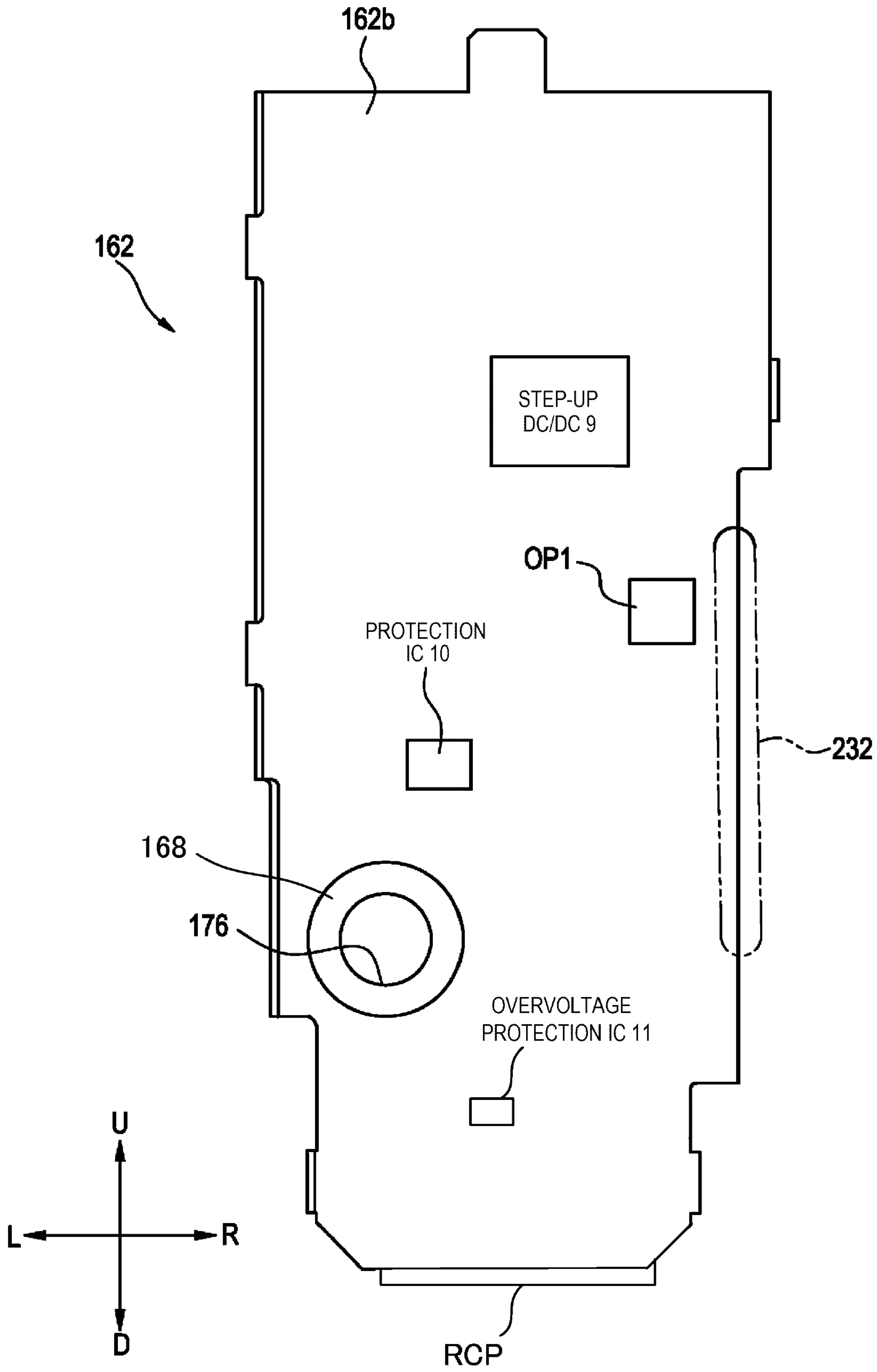

162b
162
STEP-UP
DC/DC 9
OP1
PROTECTION
IC 10
232
168
176
OVERVOLTAGE
PROTECTION IC 11
U
L
R
D
RCP

FIG. 19

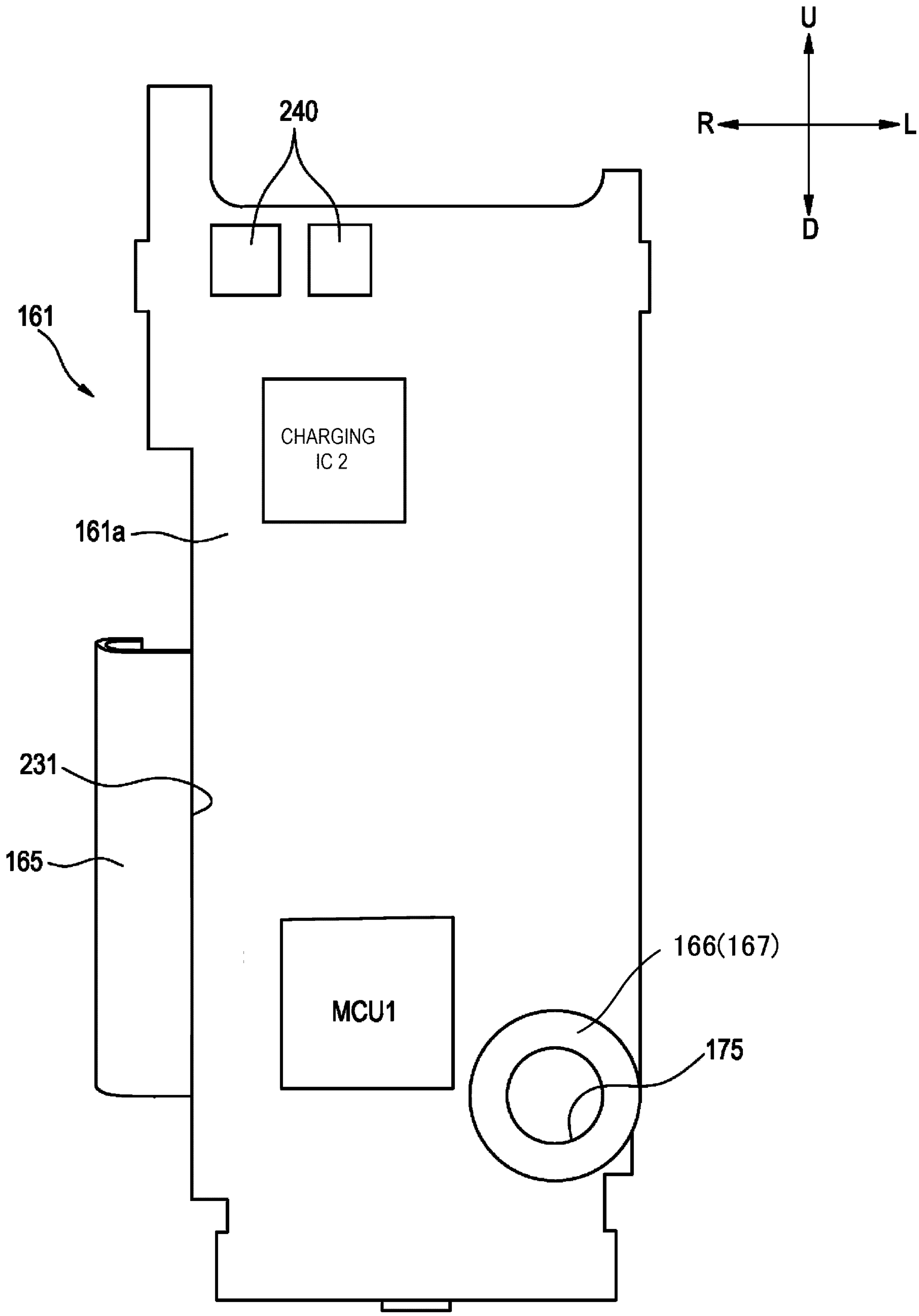


FIG. 20

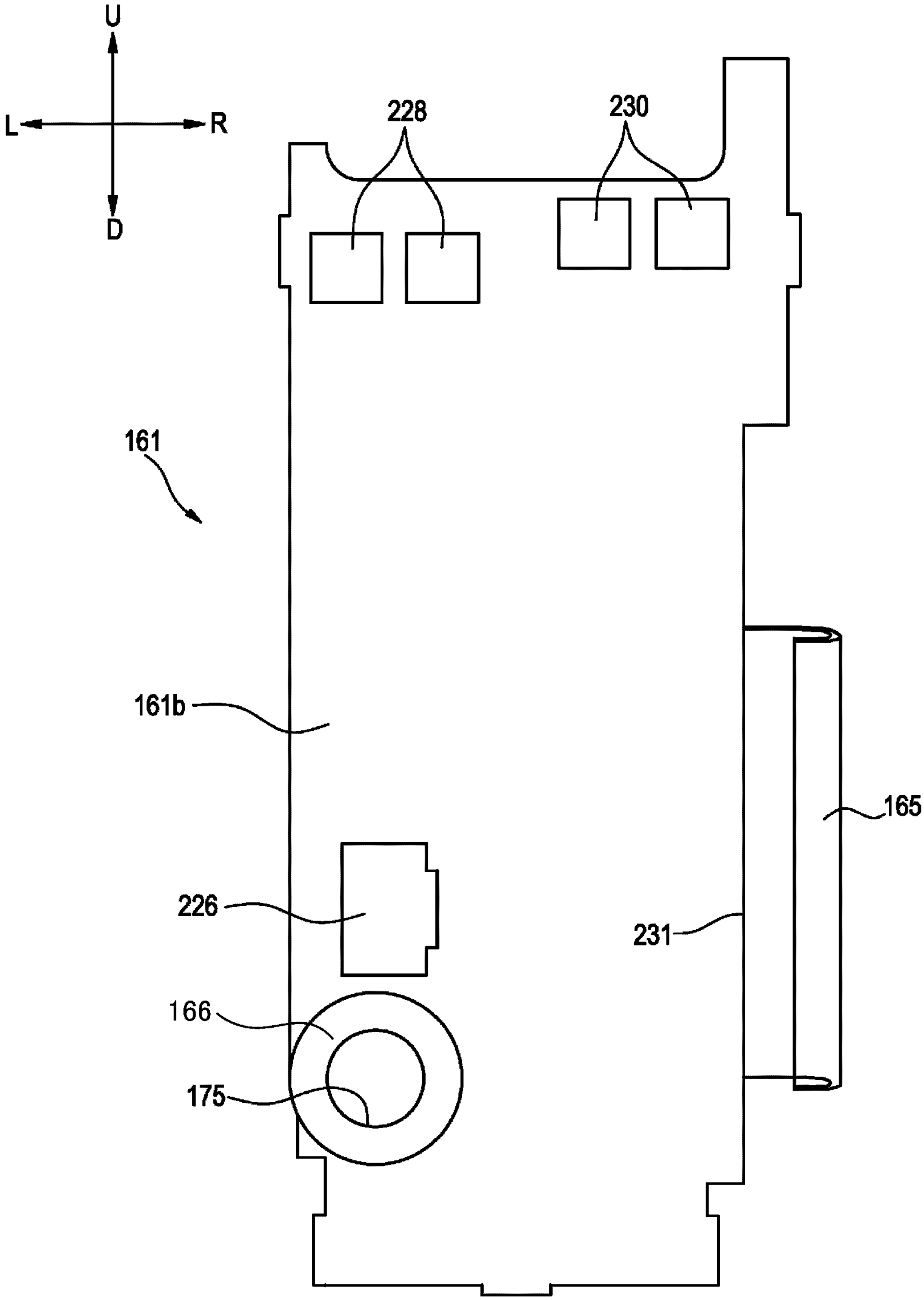


FIG. 21

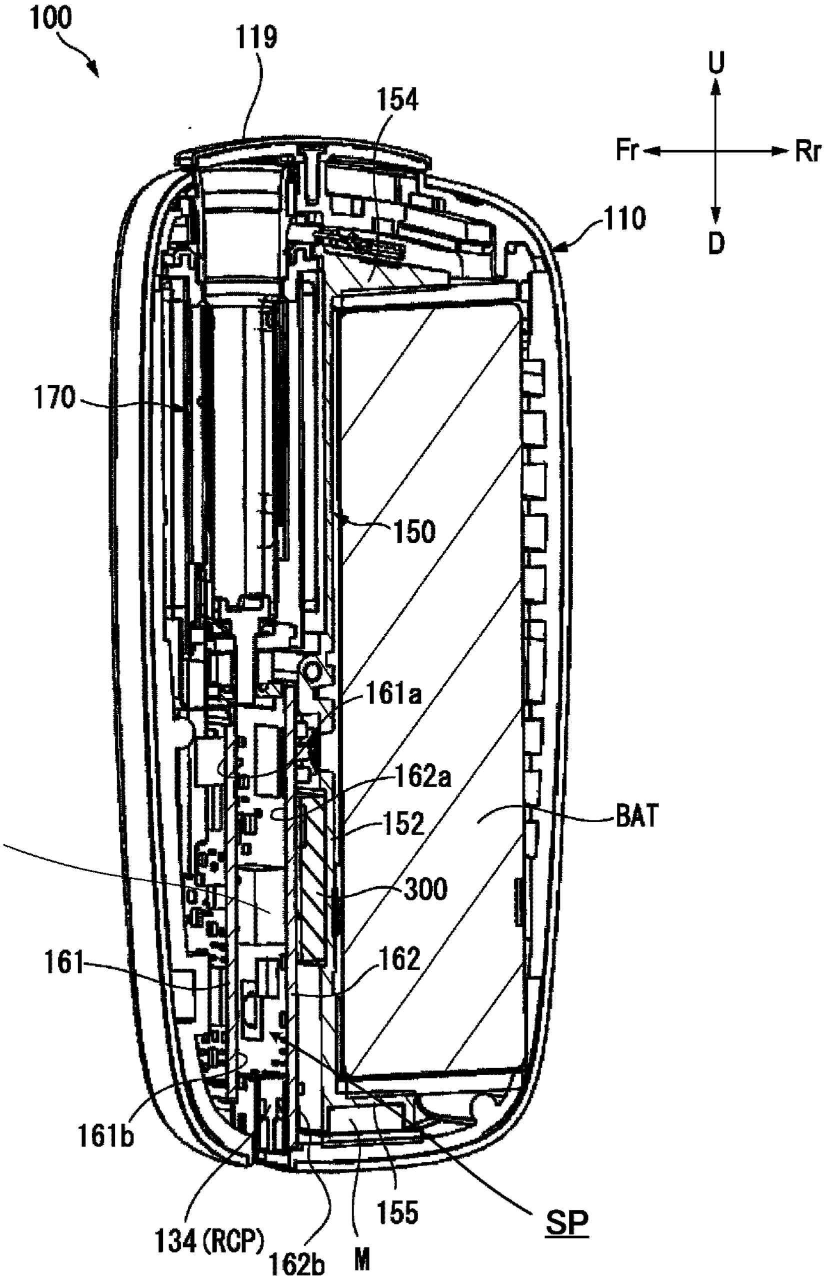
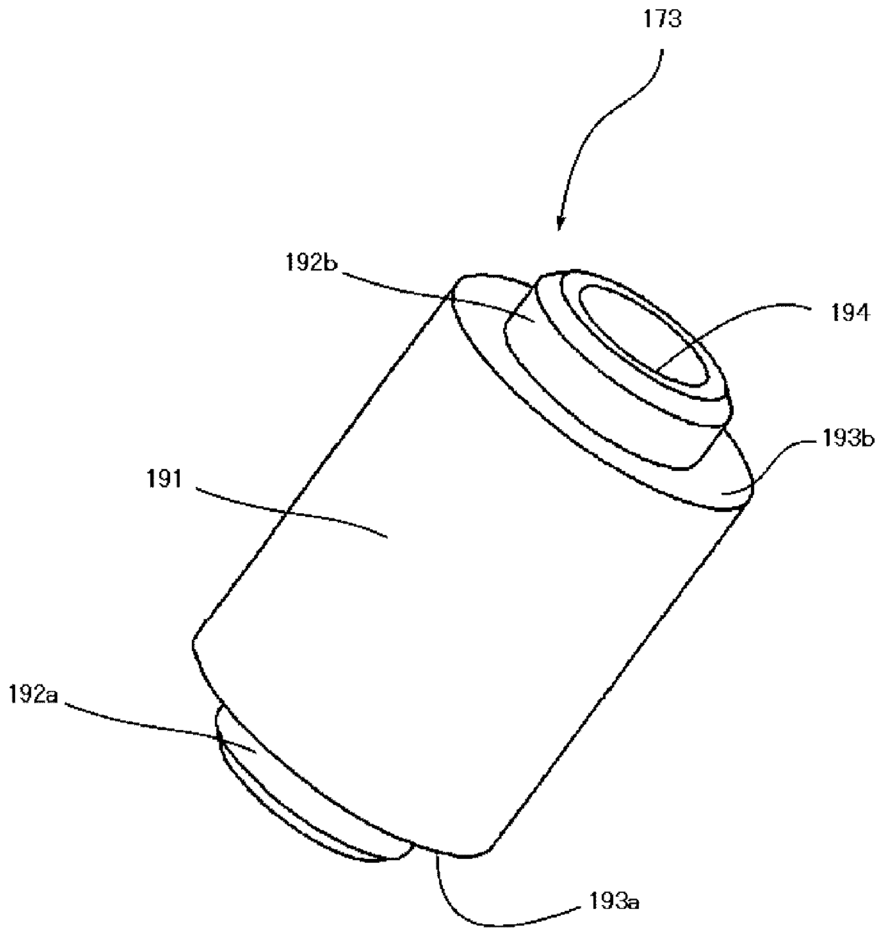

100
119
154
U
Fr
Rr
D
110
170
150
161a
162a
152
BAT
Lc
300
161
162
161b
155
SP
134 (RCP)
162b
M

FIG. 22



Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 2271

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	WO 2020/199217 A1 (NICOVENTURES TRADING LTD [GB]) 8 October 2020 (2020-10-08) * page 9, line 8 - page 11, line 26; figures 5,6 * * page 20, line 14 - page 21, line 3 *	1-10	INV. A24F40/40 H05K1/14 ADD. A61M15/06
X	JP 2020 065543 A (JAPAN TOBACCO INC) 30 April 2020 (2020-04-30) * paragraph [0019] - paragraph [0054]; figures 1-6 *	1-10	
A	GB 2 559 683 A (SHENZHEN IVPS TECH CO LTD [CN]) 15 August 2018 (2018-08-15) * paragraph [0040] - paragraph [0060]; figure 2 *	1-10	
A	CN 208 941 042 U (SHENZHEN ZHONGDAAN TECH CO LTD) 7 June 2019 (2019-06-07) * abstract; figure 1 *	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

A24F
H05K
A61M

The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	29 September 2022	Dobbs, Harvey

CATEGORY OF CITED DOCUMENTS

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EP 22 17 2271

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29-09-2022

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		JP 2022528877 A	16-06-2022
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		GB 2559683 A	15-08-2018
CN 208941042 U	07-06-2019	NONE	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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