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(54) **POWER CONTROL DEVICE OF ELECTRONIC MUSICAL INSTRUMENT**

(57) When a first state signal is outputted from a latch circuit while a lid is open, a power control circuit turns off electricity supply to a main control unit based on the first state signal. On the other hand, when a second state signal is outputted from the latch circuit when the electricity supply to the main control unit is off, the power control circuit turns on the electricity supply to the main control unit based on the second state signal. Therefore,

while the lid is open, even after the electricity supply to the main control unit is turned off in response to no operation being performed over the predetermined time, by operation of the second switch, the second state signal is outputted from the latch circuit. Thus, the electricity supply to the main control unit can be turned on without temporarily closing the open lid.

[ON state caused by opening of a keyboard lid]

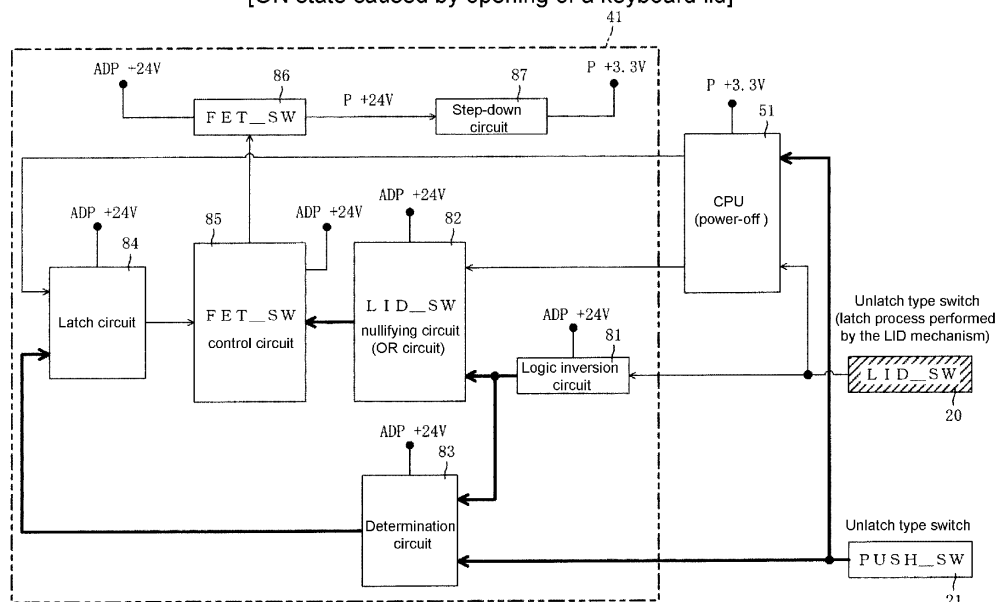


FIG. 4

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates to a power control device of an electronic musical instrument, particularly to a power control device that allows a function of turning on/off power in conjunction with opening and closing of a lid of an electronic musical instrument to suitably coexist with a function of automatically turning off the power when no operation is performed over a predetermined period.

Description of Related Art

[0002] Patent Literature 1 describes an electronic keyboard instrument whose power is switched between on and off in response to opening and closing of a lid (hereinafter "keyboard lid") that covers a keyboard.

[Prior Art Literature]

[Patent Literature]

[0003] [Patent Literature 1] Japanese Patent No. 4962148

SUMMARY OF THE INVENTION

[Problems to Be Solved by the Invention]

[0004] In Patent Literature 1, the function (hereinafter "automatic power-off function") of automatically turning off the power when no operation is performed over a certain period is not taken into account. If the automatic power-off function is loaded into the electronic musical instrument whose power is turned on/off by opening and closing of the keyboard lid, when the automatic power-off function causes a power-off while the keyboard lid is open, to turn on the power again, it will be necessary to close the open keyboard lid temporarily and then open it again. However, performing the closing operation of the keyboard lid takes time and is not smart.

[0005] The invention has been made in view of the aforementioned matters and provides a power control device that allows a function of turning on/off power in conjunction with opening and closing of a lid of an electronic musical instrument to suitably coexist with the automatic power-off function.

[Solution to the Problems and Effect of the Invention]

[0006] In order to achieve the above purpose, according to the power control device of a technical solution of the invention, when electricity supply to a main control unit including an electricity-operated control processor is off, a power control circuit turns on the electricity supply

to the main control unit based on a signal outputted from a first switch in response to opening of the lid. In the case where the electricity supply to the main control unit is on, when the electricity supply to the main control unit is turned off based on a signal outputted from a third switch in response to no operation being performed over a predetermined time, a latch circuit holds a first state signal for turning off the electricity supply to the main control unit. On the other hand, when a signal for turning on the electricity supply to the main control unit is outputted from a second switch due to operation of the second switch, the latch circuit holds, in place of the first state signal, a second state signal for turning on the electricity supply to the main control unit.

[0007] When the first state signal is outputted from the latch circuit while the lid is open, the power control circuit turns off the electricity supply to the main control unit based on the first state signal. On the other hand, when the second state signal is outputted from the latch circuit in the case where the electricity supply to the main control unit is off, the power control circuit turns on the electricity supply to the main control unit based on the second state signal.

[0008] Therefore, while the lid is open, even after the electricity supply to the main control unit is turned off in response to no operation being performed over the predetermined time, by operation of the second switch, the second state signal is outputted from the latch circuit. Thus, the electricity supply to the main control unit can be turned on without temporarily closing the open lid. Accordingly, the function of turning on/off the power in conjunction with opening and closing of the lid of the electronic musical instrument can suitably coexist with the automatic power-off function.

[0009] According to the power control device of a second technical solution, in addition to the effects accomplished by the aforementioned technical solution, the following effects are achieved. When the signal for turning off the electricity supply to the main control unit is outputted from the first switch or the second switch in response to the closing of the lid or the operation of the second switch while the electricity supply to the main control unit is on, the control processor executes a delay process that delays output of the signal for turning off the electricity supply to the main control unit as long as a period for storing, in a non-volatile memory contained in the main control unit, content of a volatile memory contained in the main control unit. Then, in response to output of the signal for turning off the electricity supply to the main control unit from the control processor, the power control circuit turns off the electricity supply to the main control unit. Therefore, it can be prevented that the electricity supply to the main control unit is immediately turned off in response to a signal output from the first switch or the second switch and that the content stored in the volatile memory is lost.

[0010] According to the power control device of a third technical solution, in addition to the effects accomplished

by the aforementioned technical solutions, the following effects are achieved. During the execution of the delay process, the control processor executes a first output process outputting a signal that nullifies the turn-off of the electricity supply to the main control unit. Over a period while the signal is being outputted by the first output process, a first nullifying circuit nullifies the signal that is for turning off the electricity supply to the main control unit and that is outputted from the first switch in response to the closing of the lid. Therefore, a period from when the lid is closed until when the electricity supply to the main control unit is turned off can be delayed by a period of time delayed. Accordingly, it can be prevented that the electricity supply to the main control unit is immediately turned off in response to the signal output from the first switch and that the content stored in the volatile memory is lost.

[0011] According to the power control device of a fourth technical solution, in addition to the effects accomplished by the aforementioned technical solutions, the following effects are achieved. When the signal for turning off the electricity supply to the main control unit is outputted from the second switch in response to the operation of the second switch while the electricity supply to the main control unit is on, the control processor, after executing the delay process, executes a second output process outputting the signal for turning off the electricity supply to the main control unit to the latch circuit. Therefore, a period from when the second switch is operated until when the first state signal is outputted from the latch circuit to turn off the electricity supply to the main control unit can be delayed by a period of time delayed. Accordingly, it can be prevented that the electricity supply to the main control unit is immediately turned off in response to the signal output from the second switch and that the content stored in the volatile memory is lost.

[0012] According to the power control device of a fifth technical solution, in addition to the effects accomplished by the aforementioned technical solutions, the following effects are achieved. The second switch is a switch covered by the lid in a closed state of the lid and exposed in an open state of the lid. When the lid is closed, a second nullifying circuit nullifies the signal outputted from the second switch due to the operation of the second switch. Therefore, even if the second switch is unintentionally operated in the closed state of the lid, turn-on of the electricity supply to the main control unit thereby caused can be prevented.

[0013] According to the power control device of a sixth technical solution, when the lid is open, the second nullifying circuit outputs a signal having the same level as that of the signal supplied from the second switch.

[0014] According to the power control device of a seventh technical solution, the first nullifying circuit outputs, to the power control circuit, a signal corresponding to a level of the signal supplied from the first switch or the control processor, and the power control circuit turns on or off the electricity supply to the main control unit based

on the signal outputted from the latch circuit and the signal outputted from the first nullifying circuit.

[0015] According to the power control device of an eighth technical solution, when the signal outputted from the latch circuit has a second level and the signal outputted from the first nullifying circuit has a first level, the power control circuit turns on the electricity supply to the main control unit.

[0016] According to the power control device of a ninth technical solution, when the electricity supply to the main control unit is turned off based on the signal outputted from the third switch, or when the lid is opened, the power is on and the second switch is operated, the power control circuit changes the signal to be outputted from the latch circuit from the second level to the first level so as to turn off the electricity supply to the main control unit.

[0017] According to the power control device of a tenth technical solution, when the power is turned off by the closing of the lid, the power control circuit changes the signal to be outputted from the first nullifying circuit from the first level to the second level so as to turn off the electricity supply to the main control unit.

[0018] According to the power control device of an eleventh technical solution, the latch circuit outputs the signal having the first level to the power control circuit when the electricity supply to the main control unit is turned off based on the signal outputted from the third switch or when the lid is opened, the power is on, and the second switch is operated, and outputs the signal having the second level to the power control circuit when the signal for turning on the electricity supply to the main control unit is outputted from the second switch due to the operation of the second switch; the first nullifying circuit outputs the signal having the first level to the power control circuit when the lid is opened to turn on the power or while the lid is open, and outputs the signal having the second level to the power control circuit when the lid is closed to turn off the power; and the power control circuit outputs the signal for turning on the electricity supply to the main control unit when the signal supplied from the latch circuit has the second level and the signal supplied from the first nullifying circuit has the first level, and outputs the signal for turning off the electricity supply to the main control unit when the signal supplied from the latch circuit has the first level or the signal supplied from the first nullifying circuit has the second level.

[0019] According to the power control device of a twelfth technical solution, the first nullifying circuit is configured as an OR circuit.

[0020] According to the power control device of a thirteenth technical solution, the power control device further includes a logic inversion circuit that inverts a state of the signal supplied from the first switch and supplies it to the first nullifying circuit and the second nullifying circuit respectively.

[0021] According to the power control device of a fourteenth technical solution, in addition to the effects accomplished by the aforementioned technical solutions,

the following effects are achieved. The second switch is an unlatch type switch. Thus, while the lid is open, when the electricity supply to the main control unit is turned off in response to no operation being performed over the predetermined time, there is no need to operate the second switch once to return it to the off state and then operate it to turn it on again. Therefore, the electronic musical instrument can be activated in a smart manner.

[0022] According to the power control device of a fifteenth technical solution, in addition to the effects accomplished by the aforementioned technical solutions, the following effects are achieved. The lid is a keyboard lid that covers a keyboard when in the closed state and exposes the keyboard when in the open state. Thus, the electricity supply to the main control unit can be turned on by the act of opening the keyboard lid in order to use the keyboard. Therefore, an electronic keyboard instrument can be activated in a smart manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a perspective diagram of an electronic keyboard instrument to which a power control device according to an embodiment of the invention is applied.

FIGs. 2A and 2B show an internal configuration of an instrument main body.

FIG. 3 is a block diagram showing an electric configuration of the electronic keyboard instrument.

FIG. 4 is a block diagram for explaining power control performed by a power control unit.

FIG. 5 is a block diagram for explaining power control performed by the power control unit.

FIG. 6 is a block diagram for explaining power control performed by the power control unit.

FIG. 7 is a block diagram for explaining power control performed by the power control unit.

FIG. 8 is a block diagram for explaining power control performed by the power control unit.

FIG. 9 is a block diagram for explaining power control performed by the power control unit.

FIG. 10 is a block diagram for explaining power control performed by the power control unit.

FIG. 11 is a block diagram for explaining power control performed by the power control unit.

FIG. 12 is a flowchart showing a power control process executed by a CPU.

DESCRIPTION OF THE EMBODIMENTS

[0024] Preferred embodiments of the invention are explained hereinafter with reference to the accompanying drawings. FIG. 1 is a perspective diagram of an electronic keyboard instrument 1 to which a power control device according to an embodiment of the invention is applied. As shown in FIG. 1, the electronic keyboard instrument

1 includes an instrument main body 2 and a leg portion 3 supporting the instrument main body 2. Moreover, the left-right direction of the electronic keyboard instrument 1 is defined based on a direction in which a player looks at the keyboard instrument 1, and the front-back direction is defined by taking the player side of the keyboard instrument 1 as the "front."

[0025] The instrument main body 2 mainly includes a shelf 4 (see FIGs. 2A and 2B) supported by the leg portion 3, a side board 5 disposed upright on both sides of the shelf 4, a top board 6 disposed between the side boards 5, a front board 7 suspended on the front side of the top board 6, a back board 8 (see FIGs. 2A and 2B) suspended on the back side of the top board 6, and a keyboard lid 9 arranged below the front board 7.

[0026] The keyboard lid 9 in a closed state is arranged across the left and right side boards 5 in a substantially horizontal manner, thereby covering a keyboard 10 that includes white keys 10a and black keys 10b, and so on.

The keyboard lid 9 can be accommodated in an internal space 30 (see FIGs. 2A and 2B) of the instrument main body 2 by being slid toward the front board 7. Accordingly, the keyboard lid 9 in the closed state can be opened. The keyboard lid 9 is equivalent to a lid of the invention.

[0027] Moreover, the electronic keyboard instrument 1 in FIG. 1 shows when the keyboard lid 9 is in an open state. The keyboard lid 9 in the open state exposes the keyboard 10, a wooden clapper 11 provided on both left and right sides of the keyboard 10, and an operation panel 25. A user can give a performance using the keyboard 10 exposed by opening the keyboard lid 9.

[0028] On the operation panel 25, a manipulator 23 (see FIG. 3) or an indicator 24 (see FIG. 3) is provided. The manipulator 23 includes a knob, or a slider, or a button or the like by which the user inputs various instructions. The indicator 24 is for indicating various information and is, e.g., a liquid crystal display (LCD). The user, while checking the content indicated by the indicator 24, properly operates the manipulator 23, and can thereby perform user setting (e.g., timbre information) or status setting (e.g., volume setting) of the electronic keyboard instrument 1 or the like if necessary.

[0029] In addition, on the operation panel 25, a push switch (hereinafter "PUSH_SW") 21 for turning on or off electricity supply to a main control unit 42 (see FIG. 3) is provided. The PUSH_SW 21 is equivalent to a second switch of the invention. As described above, the operation panel 25 is exposed by opening the keyboard lid 9. Thus, the PUSH_SW 21 is a switch that can be operated in the open state of the keyboard lid 9. The PUSH_SW 21 is configured as an unlatch type switch.

[0030] Next, opening and closing of the keyboard lid 9 are explained with reference to FIGs. 2A and 2B. FIGs. 2A and 2B show an internal configuration of the instrument main body 2. Moreover, FIGs. 2A and 2B show a state of the internal configuration in the vicinity of the left side board 5 as viewed from the right side. More specifically, FIG. 2A shows the internal configuration of the

instrument main body 2 in the closed state of the keyboard lid 9, while FIG. 2B shows the internal configuration of the instrument main body 2 in the open state of the keyboard lid 9.

[0031] As shown in FIG. 2A, in the keyboard lid 9 in the closed state, a dropping portion 12 close to or abutting against an upper surface of a keyslip 22 so as to cover the wooden clapper 11 and a front end surface of the keyboard 10 is provided downward from a front end portion. A guide pin 13 is provided on both left and right sides (i.e., in the direction perpendicular to the paper surface of FIG. 2A) of a front end of the dropping portion 12. Meanwhile, a pinion 17 is rotatably attached to both left and right sides of a back end of the keyboard lid 9. The pinion 17 is a member that engages with a later-described rack 15.

[0032] In the instrument main body 2, a front guide groove 14 and the rack 15 are provided on the inside of each of the left and right side boards 5. Both the front guide groove 14 and the rack 15 are formed along the front-back direction (the left-right direction in FIG. 2A) of the instrument main body 2. The rack 15 is located more backward in the instrument main body 2 than the front guide groove 14.

[0033] The front guide groove 14 is a recessed rail that guides the moving guide pin 13. Meanwhile, the rack 15 is a member that engages with the pinion 17. The rack 15 is arranged on an upper surface of an attachment member 16 fixed to each of the left and right side boards 5.

[0034] By the guide pin 13 being guided along the front guide groove 14 and the pinion 17 moving on the rack 15, the keyboard lid 9 can be moved in the front-back direction. When the keyboard lid 9 in the closed state is moved backward, the keyboard lid 9 is accommodated in the internal space 30 of the instrument main body 2. Accordingly, as shown in FIG. 2B, the keyboard lid 9 is opened.

[0035] On the inside of the left rack 15, a lid switch (hereinafter "LID_SW") 20 for turning on or off electricity supply to the main control unit 42 (see FIG. 3) is provided. The LID_SW 20 is equivalent to a first switch of the invention. The LID_SW 20 is fixed to the left attachment member 16 (the attachment member 16 illustrated in FIGs. 2A and 2B). The LID_SW 20 is configured as an unlatch type switch. Moreover, the LID_SW 20 may not only be provided on the left side but may be provided on the right side, and may also be provided on both left and right sides.

[0036] A shaft portion 18 is inserted into the left and right pinions 17. An actuator 19 that operates the LID_SW 20 when the keyboard lid 9 is closed is provided on the side of the right pinion 17 on the shaft portion 18. When the keyboard lid 9 is open, as shown in FIG. 2B, the actuator 19 presses a lever portion of the LID_SW 20 and thereby operates the LID_SW 20. While the keyboard lid 9 is open, the lever portion of the LID_SW 20 remains pressed by the actuator 19. As described above, the

LID_SW 20 is configured as an unlatch type switch, and while the keyboard lid 9 is open, the LID_SW 20 maintains a state of being operated by a mechanism of the keyboard lid 9.

[0037] In the electronic keyboard instrument 1 of the present embodiment, by opening and closing of the keyboard lid 9, the LID_SW 20 is operated, and thereby the electricity supply to the main control unit 42 (see FIG. 3) including a CPU 51 and so on can be turned on or off. Hereinafter, turning on electricity supply to the main control unit 42 is referred to as "turning on power," and turning off the electricity supply is referred to as "turning off the power."

[0038] On the other hand, the electronic keyboard instrument 1 has an automatic power-off function. According to the electronic keyboard instrument 1 of the present embodiment, when the power is turned off by actuation of the automatic power-off function while the keyboard lid 9 is open, without performing a closing operation of the keyboard lid 9, the power can be turned on again by operation of the PUSH_SW 21. The details thereof are described later. Due to such configuration, the function of turning on/off the power in conjunction with opening and closing of the keyboard lid 9 can suitably coexist with the automatic power-off function.

[0039] FIG. 3 is a block diagram showing an electric configuration of the electronic keyboard instrument 1. As shown in FIG. 3, the electronic keyboard instrument 1 includes a power control unit 41 and the main control unit 42. By connecting a power plug 71 to a commercial power source (not illustrated), AC current supplied from the commercial power source is converted to DC current by an AC adapter 72 and inputted to the electronic keyboard instrument 1. The main control unit 42 is operated by the DC current inputted from the AC adapter 72. The power control unit 41 is a circuit that controls whether or not to apply the DC current inputted from the AC adapter 72 to the main control unit 42 (i.e., on/off of the power).

[0040] The main control unit 42 is a circuit that realizes main functions such as a musical sound control function of the electronic keyboard instrument 1. The main control unit 42 is equivalent to a main control unit of the invention. The main control unit 42 includes the CPU 51, a ROM 52, a RAM 53, a flash memory 54, a sound source 55, and an input/output port (hereinafter "I/O") 56. The elements 51 to 56 are connected to one another through a bus line 57. The bus line 57 is connected to the keyboard 10, the LID_SW 20, the PUSH_SW 21, the manipulator 23 and the indicator 24. The electronic keyboard instrument 1 also includes a digital-to-analog converter (DAC) 58. The DAC 58 is connected to the sound source 55 and also to an amplifier 61 provided outside the electronic keyboard instrument 1.

[0041] The CPU 51 is a central control unit that controls each portion of the electronic keyboard instrument 1 in accordance with fixed value data or control programs stored in the ROM 52 or the RAM 23. The ROM 52 is an unrewritable non-volatile memory. The ROM 52 stores a

control program executed by the CPU 51, or the fixed value data (not illustrated) referred by the CPU 51 when the control program is executed, etc. The CPU 51 is equivalent to a control processor of the invention.

[0042] In addition, when no operation has been performed on the electronic keyboard instrument 1 over a certain period, the CPU 51 outputs a signal for actuating the automatic power-off function. The details thereof are described later. Therefore, the CPU 51 is equivalent to a third switch of the invention.

[0043] The RAM 53 is a rewritable volatile memory. The RAM 53 is equivalent to a volatile memory of the invention. Therefore, stored content in the RAM 53 is erased when the power is turned off. The RAM 53 temporarily stores various data upon execution of the control program by the CPU 51.

[0044] In addition, the user setting such as timbre information or the status setting (e.g., volume setting, or brightness setting of the indicator 24, etc.) of the electronic keyboard instrument 1, or the like, which is stored in the flash memory 54, is copied from the flash memory 54 to the RAM 53. When the user changes the user setting or the status setting by operating the manipulator 23, the user setting or the status setting copied to the RAM 53 is rewritten as a setting value after the change.

The flash memory 54 is a rewritable non-volatile memory. The flash memory 54 is equivalent to a non-volatile memory of the invention. Therefore, stored content in the flash memory 54 is not erased even if the power is turned off. The flash memory 54 stores non-volatile memory such as the user setting or the status setting and so on. When an event occurs in which the power is turned off when the keyboard lid 9 is closed or when the automatic power-off function is actuated, or the like, the electronic keyboard instrument 1 stores, in the flash memory 54, the user setting or the status setting that has been stored in the RAM 53 before the power is turned off. The details thereof are described later.

[0045] The sound source 55 is configured as a sampling sound source having a built-in waveform memory (not illustrated) that stores a sound source waveform. When the key 10a or 10b of the keyboard 10 is pressed, the sound source 55 reads, from the waveform memory, waveform data corresponding to a sound production instruction that corresponds to the pressed key 10a or 10b and that is supplied from the CPU 51, and generates a musical sound corresponding to the read waveform data and the user setting such as timbre information. The musical sound generated by the sound source 55 is supplied to the DAC 58 to be converted to an analog signal, amplified by the amplifier 61, and emitted from a speaker 62. On the other hand, when the key 10a or 10b is no longer pressed, the sound source 55 stops the musical sound being generated. Accordingly, the musical sound that was being emitted from the speaker 62 is muffled.

[0046] The I/O 56 is connected to the power control unit 41. By input of the DC current supplied from the power control unit 41 to the main control unit 42 through the

I/O 56, the elements such as the CPU 51 and so on that constitute the main control unit 42 operate.

[0047] The power control unit 41 is connected to the LID SW 20 and the PUSH_SW 21. The power control unit 41 controls the on/off of the power (i.e., the on/off of the electricity supply to the main control unit 42) in response to output from the switches 20 and 21. In addition, when the CPU 51 actuates the automatic power-off function, the power control unit 41 turns off the power in response to output from the CPU 51.

[0048] Next, the configuration of the power control unit 41 is explained with reference to FIGs. 4 to 11. FIGs. 4 to 11 are block diagrams for explaining power control performed by the power control unit 41. Moreover, in FIGs. 4 to 11, the I/O 56 interposed between the power control unit 41 and the CPU 51 is omitted from description.

[0049] The power control unit 41 includes a logic inversion circuit 81, a LID_SW nullifying circuit 82, a determination circuit 83, a latch circuit 84, a FET_SW control circuit 85, a FET_SW 86, and a step-down circuit 87. These circuits 81 to 86 are operated by a +24 V adapter voltage (ADP +24 V) applied by the AC adapter 72.

[0050] The logic inversion circuit 81 is a circuit that inverts and outputs a state of a signal supplied from the LID_SW 20. That is, when the signal supplied from the LID_SW 20 is in a HIGH state, the logic inversion circuit 81 inverts the signal to a LOW state and outputs the same. On the other hand, when the signal supplied from the LID_SW 20 is in the LOW state, the logic inversion circuit 81 inverts the signal to the HIGH state and outputs the same.

[0051] In the present embodiment, when the keyboard lid 9 is closed (i.e., when the LID_SW 20 is not being operated), the LID_SW 20 outputs a HIGH signal. On the other hand, when the keyboard lid 9 is open (i.e., when the LID_SW 20 maintains the state of being operated by the actuator 19), the LID_SW 20 outputs a LOW signal. Consequently, when the keyboard lid 9 is closed, the logic inversion circuit 81 outputs a LOW signal; when the keyboard lid 9 is open, the logic inversion circuit 81 outputs a HIGH signal. The signal outputted from the logic inversion circuit 81 is supplied to the LID_SW nullifying circuit 82 and the determination circuit 83 respectively.

[0052] The LID_SW nullifying circuit 82 is a circuit that temporarily nullifies, according to a signal supplied from the CPU 51, the signal supplied from the logic inversion circuit 81 in response to the closing of the keyboard lid 9. The LID_SW nullifying circuit 82 is equivalent to a first nullifying circuit of the invention. The LID_SW nullifying circuit 82 is configured as an OR circuit. Consequently, when any of the signal supplied from the logic inversion circuit 81 and the signal supplied from the CPU 51 is a HIGH signal, the LID_SW nullifying circuit 82 outputs a HIGH signal. On the other hand, when both the signal supplied from the logic inversion circuit 81 and the signal supplied from the CPU 51 are LOW signals, the LID_SW nullifying circuit 82 outputs a LOW signal.

[0053] When the keyboard lid 9 is closed, both the signal supplied from the logic inversion circuit 81 and the signal supplied from the CPU 51 will be LOW signals. Therefore, when the keyboard lid 9 is closed to turn off the power, the LID_SW nullifying circuit 82 outputs a LOW signal. On the other hand, in other cases, i.e., when the keyboard lid 9 is opened to turn on the power or while the keyboard lid 9 is open, the LID_SW nullifying circuit 82 outputs a HIGH signal. The signal outputted from the LID_SW nullifying circuit 82 is supplied to the FET_SW control circuit 85.

[0054] When the keyboard lid 9 is closed, while the LID_SW nullifying circuit 82 outputs a LOW signal, the CPU 51, after outputting a HIGH signal over a predetermined data storage period, switches to LOW. The details thereof are described later. Consequently, after the keyboard lid 9 has been closed, the LID_SW nullifying circuit 82 nullifies the LOW signal outputted from the logic inversion circuit 81 by outputting a HIGH signal over the data storage period. Accordingly, the power-off based on the closing of the keyboard lid 9 can be delayed as long as the data storage period.

[0055] The determination circuit 83 is a circuit that outputs a signal supplied from the PUSH_SW 21 in response to the state of the keyboard lid 9. The determination circuit 83 is equivalent to a second nullifying circuit of the invention. When the keyboard lid 9 is open, the determination circuit 83 outputs a signal in the same state as the signal supplied from the PUSH_SW 21. On the other hand, when the keyboard lid 9 is closed, the determination circuit 83 nullifies the signal supplied from the PUSH_SW 21 in response to operation of the PUSH_SW 21.

[0056] In the present embodiment, the PUSH_SW 21 outputs a HIGH signal when not being operated. On the other hand, the PUSH_SW 21 outputs a LOW signal when the PUSH_SW 21 is operated. Consequently, in the open state of the keyboard lid 9, when the PUSH_SW 21 is not being operated, the determination circuit 83 outputs a HIGH signal similar to that supplied from the PUSH_SW 21. On the other hand, in the open state of the keyboard lid 9, when the PUSH_SW 21 is operated, the determination circuit 83 outputs a LOW signal similar to that supplied from the PUSH_SW 21.

[0057] In addition, in the closed state of the keyboard lid 9, when the PUSH_SW 21 is operated, the determination circuit 83 nullifies the LOW signal supplied from the PUSH_SW 21 and outputs a HIGH signal. In this way, in the closed state of the keyboard lid 9, a signal output corresponding to operation of the PUSH_SW 21 is nullified. Thus, even if the PUSH_SW 21 is unintentionally operated in the closed state of the keyboard lid 9 (including a state in which the keyboard lid 9 is opened to an extent without operating the LID_SW 20), such situation can be ignored.

[0058] On the other hand, in the closed state of the keyboard lid 9, when the PUSH_SW 21 is not being operated, the determination circuit 83 outputs a HIGH signal similar to that supplied from the PUSH_SW 21. The signal

outputted from the determination circuit 83 is supplied to the latch circuit 84.

[0059] The latch circuit 84 is a circuit that latches a state in which the power is turned on/off by operation of the PUSH_SW 21 or actuation of the automatic power-off function. The latch circuit 84 is equivalent to a latch circuit of the invention. When the signal supplied from the CPU 51 is a HIGH signal, the latch circuit 84 switches a signal that has been latched to the LOW state to the HIGH state. Accordingly, the latch circuit 84 outputs a HIGH signal.

[0060] On the other hand, when the signal supplied from the determination circuit 83 is a LOW signal and the signal supplied from the CPU 51 is a LOW signal, the latch circuit 84 switches a signal that has been latched to the HIGH state to the LOW state. Accordingly, the latch circuit 84 outputs a LOW signal. In addition, when the signal supplied from the determination circuit 83 is a HIGH signal and the signal supplied from the CPU 51 is a LOW signal, the latch circuit 84 holds a LOW signal.

[0061] When the PUSH_SW 21 is operated in order to turn off the power during operation of the CPU 51, the CPU 51, after outputting a LOW signal over the predetermined data storage period, switches the signal to the HIGH state. The details thereof are described later. In addition, when the automatic power-off function is actuated due to no operation being performed over a certain time during operation of the CPU 51, similarly to when the PUSH_SW 21 is operated, the CPU 51, after outputting a LOW signal over the predetermined data storage period, switches the signal to the HIGH state.

[0062] Consequently, the latch circuit 84 latches and outputs a LOW signal during a period from when the PUSH_SW 21 is operated or when the automatic power-off function is actuated until when the data storage period passes. Then, after the data storage period has passed, the latch circuit 84 latches and outputs a HIGH signal. The signal outputted from the latch circuit 84 is supplied to the FET_SW control circuit 85. When a HIGH signal is outputted from the latch circuit 84, the FET_SW control circuit 85 controls the power to be off. The details thereof are described later.

[0063] On the other hand, in the open state of the keyboard lid 9, when the PUSH_SW 21 is operated, the determination circuit 83 outputs a LOW signal. Consequently, in response to the fact that a LOW signal is supplied from the determination circuit 83 when the power is off, the latch circuit 84 switches a signal that has been latched to the HIGH state to the LOW state. In this case, the FET_SW control circuit 85 controls the power to be off by switching the signal outputted from the latch circuit 84 to the LOW state. The details thereof are described later.

[0064] Consequently, when the power is turned off in response to operation of the PUSH_SW 21 or actuation of the automatic power-off function, a HIGH signal is outputted from the latch circuit 84. On the other hand, in other cases, i.e., when the power is turned on by operation of the PUSH_SW 21 or while the power is on, a LOW

signal is outputted from the latch circuit 84.

[0065] The FET_SW control circuit 85 is a circuit that controls a FET switch (hereinafter "FET_SW") 86 based on a signal supplied from the LID_SW nullifying circuit 82 and a signal supplied from the latch circuit 84. The FET_SW control circuit 85 is equivalent to a power control circuit of the invention. Moreover, FET is an abbreviation of field-effect transistor.

[0066] When the signal supplied from the latch circuit 84 is a LOW signal and the signal supplied from the LID_SW nullifying circuit 82 is a HIGH signal, the FET_SW control circuit 85 outputs a LOW signal. When the output from the FET_SW control circuit 85 is in the LOW state, the FET_SW 86 is turned on. As a result, a 3.3 V system voltage (P +3.3 V) stepped-down from a +24 V internal voltage (P +24 V) by the step-down circuit 87 is outputted. The system voltage is a voltage for causing the main control unit 42 to operate. That is, by output of the system voltage from the step-down circuit 87, the power is turned on.

[0067] One situation in which the signal supplied from the latch circuit 84 is a LOW signal and the signal supplied from the LID_SW nullifying circuit 82 is a HIGH signal is that the keyboard lid 9 is open and the automatic power-off function is not in operation. Another situation is that the PUSH_SW 21 is operated when the power is off. Consequently, in these situations, the power is turned on. Therefore, when the power is turned off by actuation of the automatic power-off function in the open state of the keyboard lid 9, by operation of the PUSH_SW 21, the power can be turned on again.

On the other hand, when the signal supplied from the latch circuit 84 is a HIGH signal, the FET_SW control circuit 85 outputs a HIGH signal. When the signal supplied from the LID_SW nullifying circuit 82 is a LOW signal, the FET_SW control circuit 85 also outputs a HIGH signal. When the output from the FET_SW control circuit 85 is in the HIGH state, the FET_SW 86 is turned off. As a result, the system voltage for causing the main control unit 42 to operate is not outputted. In other words, the power is turned off.

[0068] The situation in which the signal supplied from the latch circuit 84 is a HIGH signal is that a HIGH signal is outputted from the CPU 51 due to passage of the data storage period after the PUSH_SW 21 is operated or after the automatic power-off function is actuated. On the other hand, the situation in which the signal supplied from the LID_SW nullifying circuit 82 is a LOW signal is that the keyboard lid 9 is closed. Therefore, in these situations, the power is turned off.

[0069] FIG. 4 is a block diagram of a case where the power is turned on by opening of the keyboard lid 9. Moreover, in FIGs. 4 to 11, an arrow in thick solid line indicates a HIGH signal. On the other hand, an arrow in thin solid line indicates a LOW signal.

[0070] As shown in FIG. 4, in response to the opening of the keyboard lid 9, the LID_SW 20 outputs a LOW signal. Accordingly, the logic inversion circuit 81 outputs

a HIGH signal. Since the power is off, the CPU 51 does not operate. Consequently, the LID_SW nullifying circuit 82 outputs a HIGH signal.

[0071] Meanwhile, since the PUSH_SW 21 is not being operated, the PUSH_SW 21 outputs a HIGH signal. As described above, since the logic inversion circuit 81 outputs a HIGH signal, the determination circuit 83 outputs a HIGH signal. Since the CPU 51 does not operate, the latch circuit 84 outputs a LOW signal due to the supply of the HIGH signal from the determination circuit 83.

[0072] As a result, since the FET_SW control circuit 85 is supplied with a LOW signal from the latch circuit 84 and a HIGH signal from the LID_SW nullifying circuit 82, the FET_SW control circuit 85 outputs a LOW signal. Accordingly, the FET_SW 86 is turned on, and the system voltage is outputted from the step-down circuit 87. That is, the power is turned on, so that the main control unit 42 operates.

[0073] FIGs. 5 and 6 are block diagrams of cases where the power is turned off by actuation of the automatic power-off function while the keyboard lid 9 is open. More specifically, FIG. 5 illustrates the case during the data storage period, and FIG. 6 illustrates the case after the data storage period has passed.

[0074] Because the keyboard lid 9 is open, as shown in FIG. 5, the LID_SW 20 outputs a LOW signal. Consequently, the logic inversion circuit 81 outputs a HIGH signal. The CPU 51 outputs a LOW signal to the LID_SW nullifying circuit 82. Consequently, the LID_SW nullifying circuit 82 outputs a HIGH signal.

[0075] Meanwhile, since the PUSH_SW 21 is not being operated, the PUSH_SW 21 outputs a HIGH signal. Accordingly, the determination circuit 83 outputs a HIGH signal. After the automatic power-off function is actuated and during the data storage period, the CPU 51 outputs a LOW signal to the latch circuit 84. Consequently, the latch circuit 84 outputs a LOW signal.

[0076] As a result, since the FET_SW control circuit 85 is supplied with a LOW signal from the latch circuit 84 and a HIGH signal from the LID_SW nullifying circuit 82, the FET_SW control circuit 85 outputs a LOW signal. Accordingly, the FET_SW 86 is turned on. Consequently, since the system voltage is continuously outputted from the step-down circuit 87, the main control unit 42 continues to operate.

[0077] When the data storage period passes, as shown in FIG. 6, the CPU 51 outputs a HIGH signal to the latch circuit 84. Consequently, the latch circuit 84 outputs a HIGH signal. As a result, the FET_SW control circuit 85 outputs a HIGH signal. Accordingly, the FET_SW 86 is turned off, and the power is turned off.

[0078] FIG. 7 is a block diagram of a case where the power is turned on by operation of the PUSH_SW 21. Since the PUSH_SW 21 is a switch that can be operated in the open state of the keyboard lid 9, in such case, the keyboard lid 9 is open. Consequently, as shown in FIG. 7, the LID_SW 20 outputs a LOW signal. Accordingly, the logic inversion circuit 81 outputs a HIGH signal. Since

the power is off, the CPU 51 does not operate. Consequently, the LID_SW nullifying circuit 82 outputs a HIGH signal due to the supply of the HIGH signal from the logic inversion circuit 81.

[0079] Meanwhile, since the PUSH_SW 21 is operated, the PUSH_SW 21 outputs a LOW signal. As described above, since the logic inversion circuit 81 outputs a HIGH signal, the determination circuit 83 outputs a LOW signal. Since the CPU 51 does not operate, the latch circuit 84 outputs a LOW signal due to the supply of the LOW signal from the determination circuit 83.

[0080] As a result, since the FET_SW control circuit 85 is supplied with a LOW signal from the latch circuit 84 and a HIGH signal from the LID_SW nullifying circuit 82, the FET_SW control circuit 85 outputs a LOW signal. Accordingly, the FET_SW 86 is turned on, and the power is turned on, so that the main control unit 42 operates.

[0081] FIGs. 8 and 9 are block diagrams of cases where the power is turned off by closing of the keyboard lid 9. More specifically, FIG. 8 illustrates the case during the data storage period, and FIG. 9 illustrates the case after the data storage period has passed.

[0082] As shown in FIG. 8, in response to the closing of the keyboard lid 9, the LID_SW 20 outputs a HIGH signal. Accordingly, the logic inversion circuit 81 outputs a LOW signal. After the keyboard lid 9 has been closed and during the data storage period, the CPU 51 outputs a HIGH signal to the LID_SW nullifying circuit 82. Consequently, the LID_SW nullifying circuit 82 outputs a HIGH signal.

[0083] Meanwhile, since the PUSH_SW 21 is not being operated, the PUSH_SW 21 outputs a HIGH signal. Accordingly, the determination circuit 83 outputs a LOW signal. The CPU 51 outputs a LOW signal to the latch circuit 84. Consequently, the latch circuit 84 outputs a LOW signal.

[0084] As a result, since the FET_SW control circuit 85 is supplied with a LOW signal from the latch circuit 84 and a HIGH signal from the LID_SW nullifying circuit 82, the FET_SW control circuit 85 outputs a LOW signal. Accordingly, the FET_SW 86 is turned on. Consequently, since the system voltage is continuously outputted from the step-down circuit 87, the main control unit 42 continues to operate.

[0085] When the data storage period passes, as shown in FIG. 9, the CPU 51 outputs a LOW signal to the LID_SW nullifying circuit 82. Consequently, the LID_SW nullifying circuit 82 outputs a LOW signal. Accordingly, the FET_SW control circuit 85 outputs a HIGH signal. Accordingly, the FET_SW 86 is turned off, and the power is turned off.

[0086] FIGs. 10 and 11 are block diagrams of cases where the power is turned off by operation of the PUSH_SW 21. More specifically, FIG. 10 illustrates the case during the data storage period, and FIG. 11 illustrates the case after the data storage period has passed.

[0087] In such case, because the keyboard lid 9 is open, as shown in FIG. 10, the LID_SW 20 outputs a

LOW signal. Consequently, the logic inversion circuit 81 outputs a HIGH signal. The CPU 51 outputs a LOW signal to the LID_SW nullifying circuit 82. Consequently, the LID_SW nullifying circuit 82 outputs a HIGH signal.

[0088] Meanwhile, since the PUSH_SW 21 is operated, the PUSH_SW 21 outputs a LOW signal. Accordingly, the determination circuit 83 outputs a LOW signal. After the PUSH_SW 21 is operated and during the data storage period, the CPU 51 outputs a LOW signal to the latch circuit 84. Consequently, the latch circuit 84 outputs a LOW signal.

[0089] As a result, since the FET_SW control circuit 85 is supplied with a LOW signal from the latch circuit 84 and a HIGH signal from the LID_SW nullifying circuit 82, the FET_SW control circuit 85 outputs a LOW signal. Accordingly, the FET_SW 86 is turned on. Consequently, since the system voltage is continuously outputted from the step-down circuit 87, the main control unit 42 continues to operate.

[0090] When the data storage period passes, as shown in FIG. 11, the CPU 51 outputs a HIGH signal to the latch circuit 84. Consequently, the latch circuit 84 outputs a HIGH signal. As a result, the FET_SW control circuit 85 outputs a HIGH signal. Accordingly, the FET_SW 86 is turned off, and the power is turned off.

[0091] FIG. 12 is a flowchart showing a power control process executed by the CPU 51 of the electronic keyboard instrument 1. This process is a process that controls the state of the signals outputted by the CPU 51 to the LID_SW nullifying circuit 82 and to the latch circuit 84 respectively when the power is on. This process is started in response to turn-on of the power and supply of electricity to the CPU 51, and the CPU 51 executes this process while the power is on.

[0092] The CPU 51 outputs a HIGH signal to the LID_SW nullifying circuit 82, and outputs a LOW signal to the latch circuit 84 (S1). The CPU 51 determines whether a HIGH signal is received from the LID_SW 20 (S2). If determining that a HIGH signal is received from the LID_SW 20 (S2: Yes), the CPU 51 moves to the process in S4.

[0093] If determining that no HIGH signal is received from the LID_SW 20 (S2: No), the CPU 51 determines whether a LOW signal is received from the PUSH_SW 21 (S10). If determining that a LOW signal is received from the PUSH_SW 21 (S10: Yes), the CPU 51 moves to the process in S4.

[0094] If determining that no LOW signal is received from the PUSH_SW 21 (S10: No), the CPU 51 starts the time counting of a period (hereinafter "standby period") during which actuation of the automatic power-off function is awaited (S11) and then determines whether any operation has been performed (S12). If determining that an operation has been performed (S12: Yes), the CPU 51 clears the standby period (S14), and moves the process to S2. On the other hand, if determining that no operation has been performed (S12: No), the CPU 51 determines whether the standby period has passed (S13).

[0095] In the process in S13, if determining that the standby period has not passed (S13: No), the CPU 51 moves the process to S2. Moreover, in this case, once (S2: No) and (S10: No) are passed through, the time counting of the standby period in the process in S11 is started again. Therefore, if the time counting of the standby period has already been started by the process in the previous S11 and keeps going on, it goes without saying that the process in the next S11 is skipped. On the other hand, if determining that the standby period has passed (S13: Yes), the CPU 51 moves to the process in S4.

[0096] In this way, if determining that a HIGH signal is received from the LID_SW 20 (S2: Yes), or if determining that a LOW signal is received from the PUSH_SW 21 (S10: Yes), or if determining that the standby period has passed (S13: Yes), the CPU 51 moves to the process in S4.

[0097] In the process in S4, the CPU 51 stores, in the flash memory 54, the stored content in the RAM 53 (S4), and waits until such storage is completed (S5: No). That is, the power remains on until the storage is completed.

[0098] If the storage is completed (S5: Yes), the CPU 51 determines whether a LID (keyboard lid 9) is closed, i.e., whether a HIGH signal is received from the LID_SW 20 (S6). If determining that the LID (keyboard lid 9) is closed, i.e., that a HIGH signal is received from the LID_SW 20 (S6: Yes), the CPU 51 outputs a LOW signal to the LID_SW nullifying circuit 82 (S7) to turn off the power (S9), so as to end this process. On the other hand, if determining that the LID (keyboard lid 9) is not closed, i.e., that no HIGH signal is received from the LID_SW 20 (S6: No), the CPU 51 outputs a HIGH signal to the latch circuit 84 (S8) to turn off the power (S9), so as to end this process.

[0099] In the flowchart shown in FIG. 12, the process in S5 executed by the CPU 51 is equivalent to a delay process of the invention. The process in S1 executed by the CPU 51 is equivalent to a first output process of the invention. The process in S8 executed by the CPU 51 is equivalent to a second output process of the invention.

[0100] According to the electronic keyboard instrument 1 of the present embodiment, when the automatic power-off function is actuated while the keyboard lid 9 is open, the FET_SW control circuit 85 turns off the power (i.e., turns off the electricity supply to the main control unit 42) based on a HIGH signal outputted from the latch circuit 84. On the other hand, when a LOW signal is outputted from the latch circuit 84 in the case where the power is off, the FET_SW control circuit 85 turns on the power based on the LOW signal.

[0101] Consequently, when the power is off, by operation of the PUSH_SW 21, the signal of the latch circuit 84 can be inverted to the LOW state. Thus, while the keyboard lid 9 is open, even after the power is turned off (i.e., the electricity supply to the main control unit 42 is turned off) by the automatic power-off function, by operation of the PUSH_SW 21, the power can be turned on. Since the power can be turned on again without tempo-

rarily closing the open keyboard lid 9, the electronic keyboard instrument 1 can be activated in a smart manner. In this way, the function of turning on/off the power in conjunction with opening and closing of the keyboard lid 9 can suitably coexist with the automatic power-off function.

[0102] In addition, by provision of the automatic power-off function, the CPU 51 does not operate during the standby period while the electronic keyboard instrument 1 is not being operated, and electricity (standby electricity) consumed during the standby period can be reduced. On the other hand, when the power is off, operation of the LID_SW 20 or operation of the PUSH_SW 21 according to opening of the keyboard lid 9 is detected by the power control unit 41 that is actuated with lower standby electricity. Thus, in view of this, contribution is made to reduction in the standby electricity.

[0103] The configuration in which operation of the LID_SW 20 or operation of the PUSH_SW 21 is detected by the power control unit 41 has the following problem. Because the operation of the LID_SW 20 or the operation of the PUSH_SW 21 according to closing of the keyboard lid 9 performed when the power is on is immediately detected by the power control unit 41, and the power is immediately turned off, the content that was stored in the RAM 53, such as timbre information or the like, is lost.

[0104] With respect to this, according to the electronic keyboard instrument 1 of the present embodiment, when operation of the LID_SW 20 or operation of the PUSH_SW 21 according to opening of the keyboard lid 9 is performed when the power is on, the CPU 51 delays output of a signal for turning off the power until the data storage period passes, and thus loss of the stored content in the RAM 53 can be prevented.

[0105] The above illustrates the invention on the basis of the embodiment. However, it is easily understood that the invention is not limited to any of the above embodiments, and various modifications or alterations may be made without departing from the spirit of the invention.

[0106] For example, the numerical values mentioned in the above embodiments are merely examples, and it is of course possible that other numerical values are suitably used. The data storage period is not necessarily 5 seconds, but may have a suitable length. Similarly, the standby period is not necessarily 10 minutes, but may have a suitable length. Moreover, the data storage period and the standby period may have a variable length set by the user.

[0107] In the above embodiments, an electronic musical instrument equipped with the power control device of the invention is exemplified by the electronic keyboard instrument 1 having a configuration in which the power can be turned on/off in response to opening and closing of the keyboard lid 9. The invention is applicable not only to a keyboard instrument like the electronic keyboard instrument 1, but also to any electronic musical instrument having a configuration in which the power can be turned on/off in response to opening and closing of a lid. For

example, if a synthesizer provided with a lid that covers an operation panel has a configuration in which the power can be turned on/off in response to opening and closing of the lid, the invention is also applicable to the synthesizer.

[0108] In the above embodiments, when the power is turned off by actuation of automatic power-off function or closing of the keyboard lid 9, or the like, the stored content in the RAM 53 is stored in the flash memory 54. However, such storage may not be performed. In that case, the process of the CPU 51 inverting the state of an output signal during or after the data storage period, i.e., the processes in S7 and S8, is no longer needed. In addition, the LID_SW nullifying circuit 82 is also no longer needed.

[0109] In the above embodiments, when the power is turned off by actuation of automatic power-off function or closing of the keyboard lid 9, or the like, a destination to store the stored content in the RAM 53 is exemplified by the flash memory 54 that is built in the electronic keyboard instrument 1. However, the destination may be various non-volatile memories (e.g., a USB-connected flash memory or hard disk, etc.) detachably connected to the electronic keyboard instrument 1.

[0110] In the above embodiments, the determination circuit 83 is provided to which a signal outputted from the PUSH_SW 21 and a signal outputted from the logic inversion circuit 81 are supplied. However, the determination circuit 83 may not be provided, and the signal outputted from the PUSH_SW 21 and the signal outputted from the logic inversion circuit 81 may be supplied to the latch circuit 84.

[0111] In the above embodiments, when the power is off, operation of the LID_SW 20 or operation of the PUSH_SW 21 according to opening of the keyboard lid 9 is detected by the power control unit 41. This may be replaced with a configuration in which a power supply for supplying electricity to the CPU 51 is separately provided, thereby supplying electricity to the CPU 51 in response to operation of the LID_SW 20 or the PUSH_SW 21, and the thus actuated CPU 51 performs power control of other circuits. Alternatively, electricity may be constantly supplied to the CPU 51, and operation of the LID_SW 20 or the PUSH_SW 21 may be monitored.

[0112] In the above embodiment, the LID_SW 20 is provided inside the instrument main body 2. When the keyboard lid 9 is open, the actuator 19 operates the LID_SW 20; when the keyboard lid 9 is closed, the actuator 19 separates from the LID_SW 20 to cancel the operation. However, the LID_SW 20 can be disposed in various positions. For example, the LID_SW 20 can be provided on the wooden clapper 11. In such case, the keyboard lid is of a type that rotates about a rotating shaft. When the keyboard lid is closed, the operation is performed by the keyboard lid pushing the LID_SW 20; when the keyboard lid is open, the operation is canceled by the keyboard lid separating from the LID_SW 20.

[0113] In the above embodiments, the PUSH_SW 21 is an unlatch type switch. However, the PUSH_SW 21

can also be a latch type switch. However, if the PUSH_SW 21 is a latch type switch, after the power is turned off by the automatic power-off function, it will be necessary to operate the PUSH_SW 21 once to return it to the off state and then operate it to turn it on again. In contrast, because such operation is unnecessary for an unlatch type switch, the electronic keyboard instrument 1 can be activated in a smart manner.

[0114] In the above embodiments, the PUSH_SW 21 is provided in a position exposed by opening the keyboard lid 9. However, the PUSH_SW 21 may be provided in a position that is exposed regardless of opening and closing of the keyboard lid 9. In addition, there may be a foot switch or the like connected to the electronic keyboard instrument 1 by a cable.

[0115] In the above embodiments, the cases where the switches such as the LID_SW 20 or the circuits such as the LID_SW nullifying circuit 82 output a HIGH signal or a LOW signal in each situation have been explained. However, the invention is not limited thereto. That is, the switches or the circuits may be configured to output signals opposite to those explained in the above embodiments. Namely, in the case mentioned above where a HIGH signal is outputted, a LOW signal may be outputted, and in the case mentioned above where a LOW signal is outputted, a HIGH signal may be outputted. With such configuration, the same effects as the above embodiments can still be obtained.

[0116] The features described according to the above embodiments or the aforementioned variants may also be implemented in proper combination.

Claims

1. A power control device of an electronic musical instrument, comprising:

a main control unit (42), comprising an electricity-operated control processor (51);
an openable and closable lid (9);
a first switch (20), in response to opening and closing of the lid (9), outputting a signal for turning on or off electricity supply to the main control unit (42);
a second switch (21), in response to an operation irrelevant to the opening and closing of the lid (9), outputting a signal for turning on the electricity supply to the main control unit (42);
a third switch (51), when the electricity supply to the main control unit (42) is on, outputting a signal for turning off the electricity supply to the main control unit (42) under a condition that no operation is performed over a predetermined time;
a power control circuit (85), in response to the opening of the lid (9) when the electricity supply to the main control unit (42) is off, turning on the

- electricity supply to the main control unit (42) based on the signal outputted from the first switch (20); and
 a latch circuit (84), while holding a first state signal for turning off the electricity supply to the main control unit (42) when the electricity supply to the main control unit (42) is turned off based on the signal outputted from the third switch (51), holding, in place of the first state signal, a second state signal for turning on the electricity supply to the main control unit (42) when the signal for turning on the electricity supply to the main control unit (42) is outputted from the second switch (21) due to operation of the second switch (21), wherein
 when the first state signal is outputted from the latch circuit (84) while the lid (9) is open, the power control circuit (85) turns off the electricity supply to the main control unit (42) based on the first state signal, and when the second state signal is outputted from the latch circuit (84) when the electricity supply to the main control unit (42) is off, the power control circuit (85) turns on the electricity supply to the main control unit (42) based on the second state signal.
2. The power control device of claim 1, wherein the second switch (21) outputs a signal for turning off the electricity supply to the main control unit (42) in response to the operation irrelevant to the opening and closing of the lid (9);
 the main control unit (42) further comprises a volatile memory (53) and a non-volatile memory (52, 54);
 when the signal for turning off the electricity supply to the main control unit (42) is outputted from the first switch (20) or the second switch (21) in response to the closing of the lid (9) or the operation of the second switch (21) while the electricity supply to the main control unit (42) is on, the control processor (51) executes a delay process that delays output of the signal for turning off the electricity supply to the main control unit (42) as long as a period for storing content of the volatile memory (53) in the non-volatile memory (52, 54); and
 in response to the signal for turning off the electricity supply to the main control unit (42) being outputted from the control processor (51), the power control circuit (85) turns off the electricity supply to the main control unit (42).
 3. The power control device of claim 2, wherein during execution of the delay process, the control processor (51) executes a first output process outputting a signal that nullifies the turn-off of the electricity supply to the main control unit (42); and wherein the power control device comprises a first nullifying circuit (82) that, over a period while the signal is being outputted by the first output process, nullifies the signal that is for turning off the electricity supply to the main control unit (42) and that is outputted from the first switch (20) in response to the closing of the lid (9).
 4. The power control device of claim 2 or 3, wherein the second switch (21) outputs the signal for turning off the electricity supply to the main control unit (42) in response to the operation irrelevant to the opening and closing of the lid (9); and
 when the signal for turning off the electricity supply to the main control unit (42) is outputted from the second switch (21) in response to the operation of the second switch (21) while the electricity supply to the main control unit (42) is on, the control processor (51), after executing the delay process, executes a second output process outputting the signal for turning off the electricity supply to the main control unit (42) to the latch circuit (84).
 5. The power control device of any one of claims 1 to 4, wherein the second switch (21) is a switch covered by the lid (9) in a closed state of the lid (9) and exposed in an open state of the lid (9); and wherein the power control device comprises a second nullifying circuit (83) that, when the lid (9) is closed, nullifies the signal outputted from the second switch (21) due to the operation of the second switch (21).
 6. The power control device of claim 5, wherein when the lid (9) is open, the second nullifying circuit (83) outputs a signal having the same level as that of the signal supplied from the second switch (21).
 7. The power control device of claim 5, wherein the first nullifying circuit (82) outputs, to the power control circuit (85), a signal corresponding to a level of the signal supplied from the first switch (20) or the control processor (51); and
 the power control circuit (85) turns on or off the electricity supply to the main control unit (42) based on the signal outputted from the latch circuit (84) and the signal outputted from the first nullifying circuit (82).
 8. The power control device of claim 7, wherein when the signal outputted from the latch circuit (84) has a second level and the signal outputted from the first nullifying circuit (82) has a first level, the power control circuit (85) turns on the electricity supply to the main control unit (42).
 9. The power control device of claim 7, wherein when the electricity supply to the main control unit (42) is turned off based on the signal outputted from the third switch (51), or when the lid (9) is opened, the power is on and the second switch (21) is operated, the power control circuit (85) changes the signal

nal to be outputted from the latch circuit (84) from the second level to the first level so as to turn off the electricity supply to the main control unit (42).

10. The power control device of claim 7, wherein
when the power is turned off by the closing of the lid (9), the power control circuit (85) changes the signal to be outputted from the first nullifying circuit (82) from the first level to the second level so as to turn off the electricity supply to the main control unit (42). 5 10
11. The power control device of claim 7, wherein
the latch circuit (84) outputs the signal having the first level to the power control circuit (85) when the electricity supply to the main control unit (42) is turned off based on the signal outputted from the third switch (51) or when the lid (9) is opened, the power is on, and the second switch (21) is operated, and outputs the signal having the second level to the power control circuit (85) when the signal for turning on the electricity supply to the main control unit (42) is outputted from the second switch (21) due to the operation of the second switch (21); 15 20
the first nullifying circuit (82) outputs the signal having the first level to the power control circuit (85) when the lid (9) is opened to turn on the power or while the lid (9) is open, and outputs the signal having the second level to the power control circuit (85) when the lid (9) is closed to turn off the power; and 25
the power control circuit (85) outputs the signal for turning on the electricity supply to the main control unit (42) when the signal supplied from the latch circuit (84) has the second level and the signal supplied from the first nullifying circuit (82) has the first level, and the power control circuit (85) outputs the signal for turning off the electricity supply to the main control unit (42) when the signal supplied from the latch circuit (84) has the first level or the signal supplied from the first nullifying circuit (82) has the second level. 30 35 40
12. The power control device of any one of claims 3 to 11, wherein the first nullifying circuit (82) is configured as an OR circuit.
13. The power control device of any one of claims 5 to 12, further comprising a logic inversion circuit (81) that inverts a state of the signal supplied from the first switch (20) and supplies it to the first nullifying circuit (82) and the second nullifying circuit (83) respectively. 45 50
14. The power control device of any one of claims 1 to 13, wherein the second switch (21) is an unlatch type switch. 55
15. The power control device of any one of claims 1 to 13, wherein
the electronic musical instrument is an electronic

keyboard instrument (1) having a keyboard (10); and the lid (9) is a keyboard lid (9) that covers the keyboard (10) when in the closed state and exposes the keyboard (10) when in the open state.

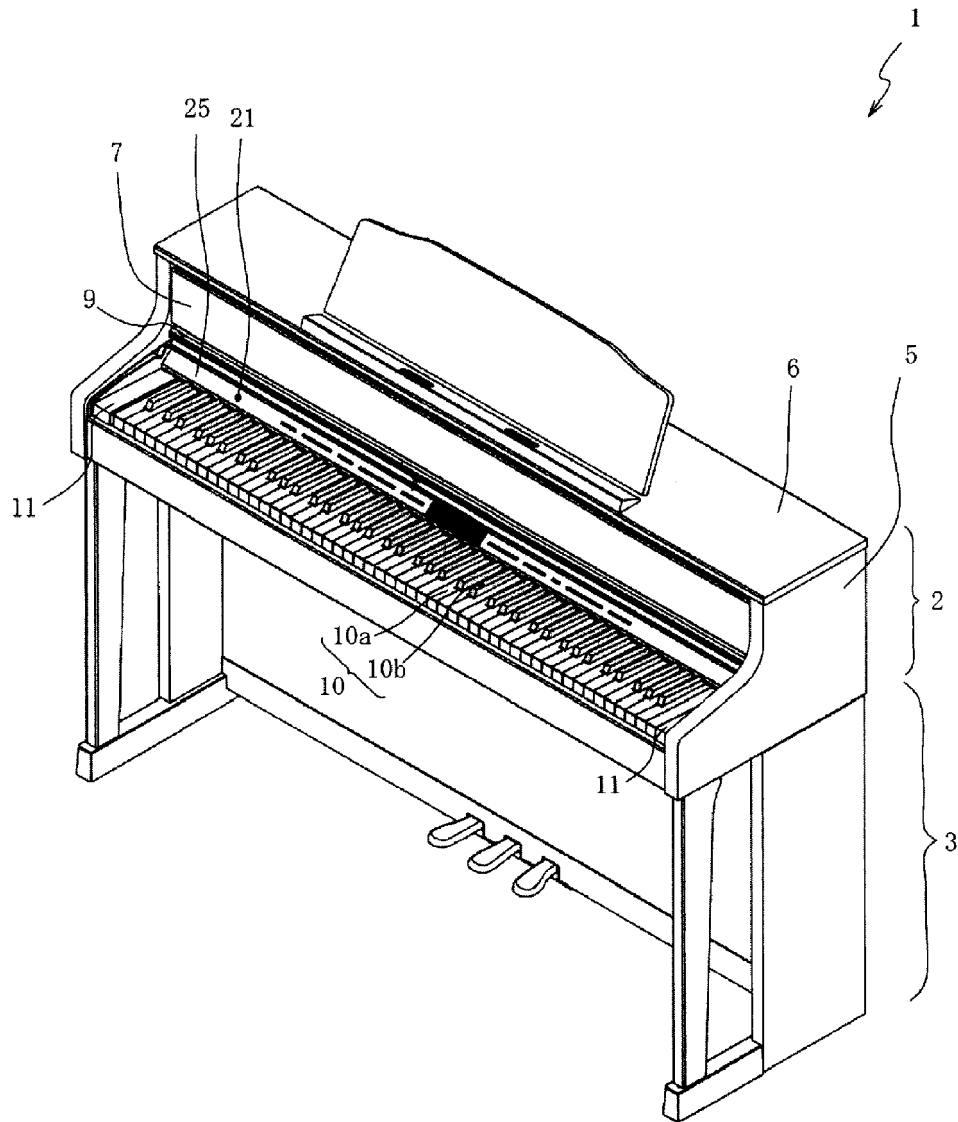


FIG. 1

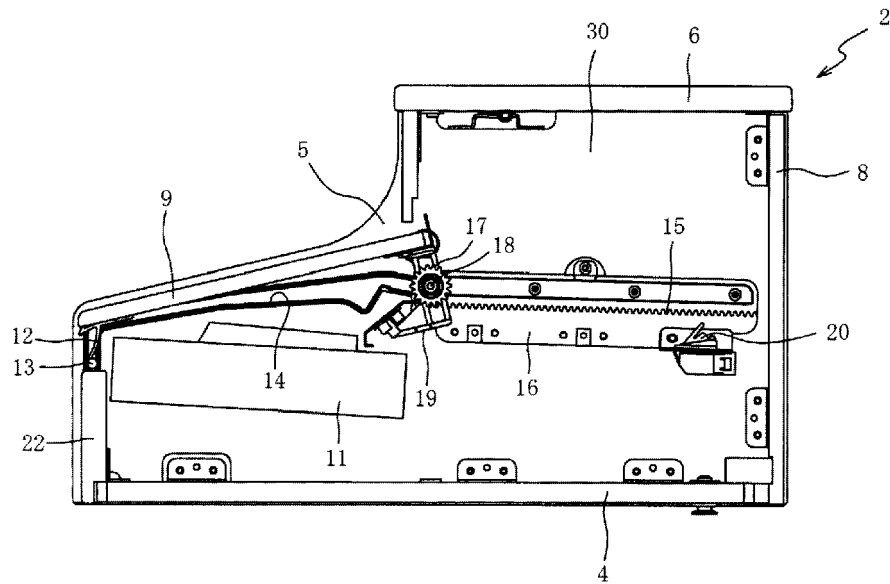


FIG. 2A

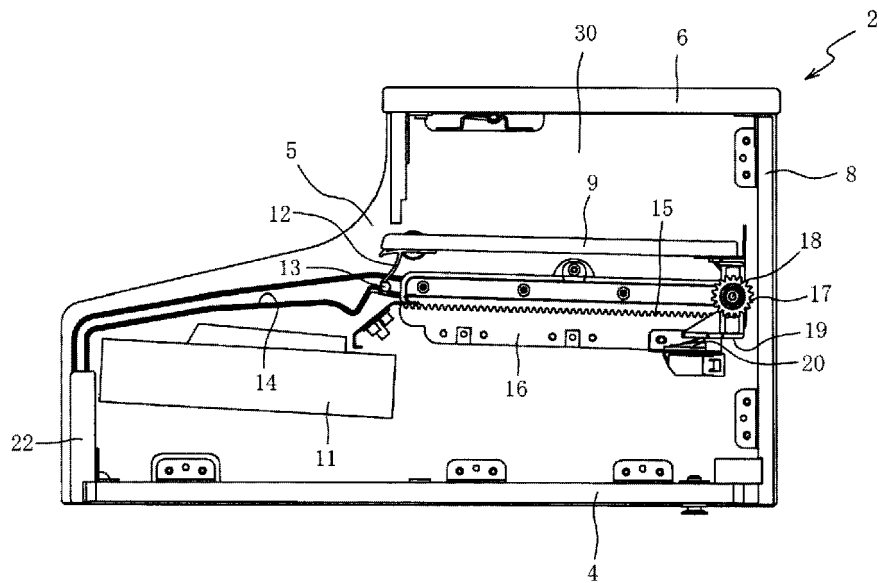


FIG. 2B

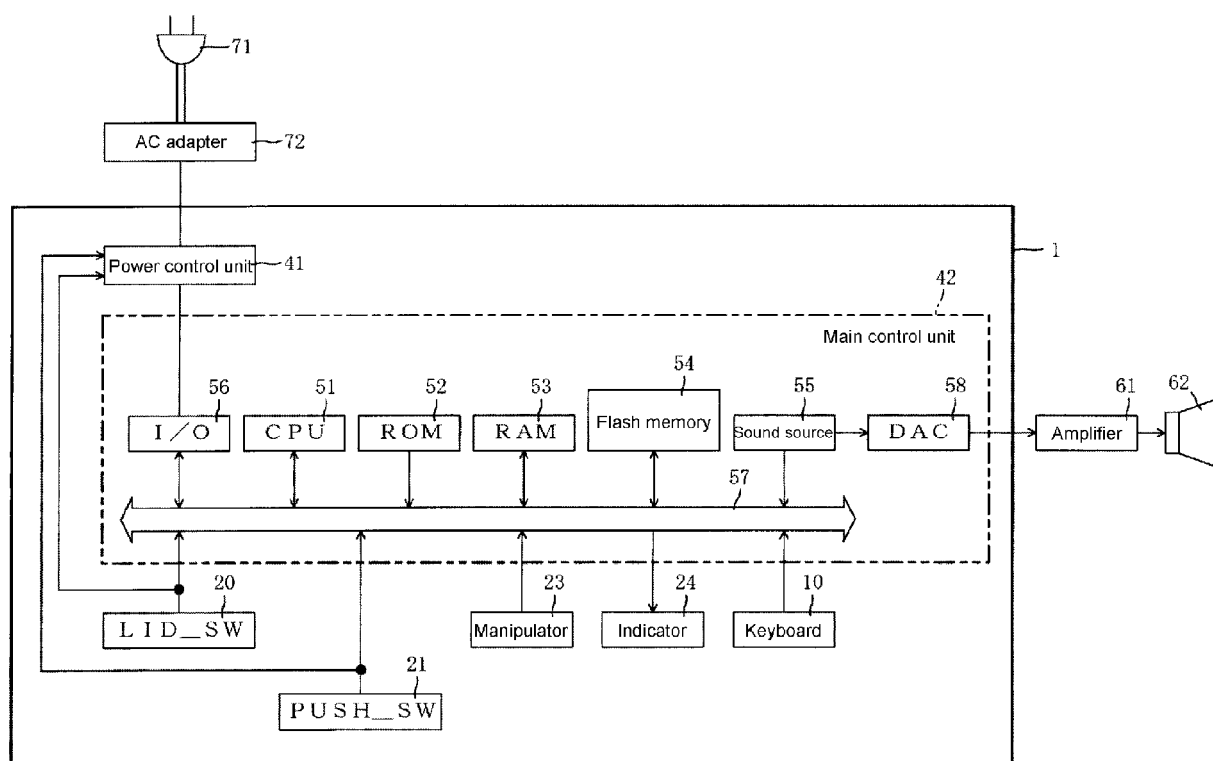


FIG. 3

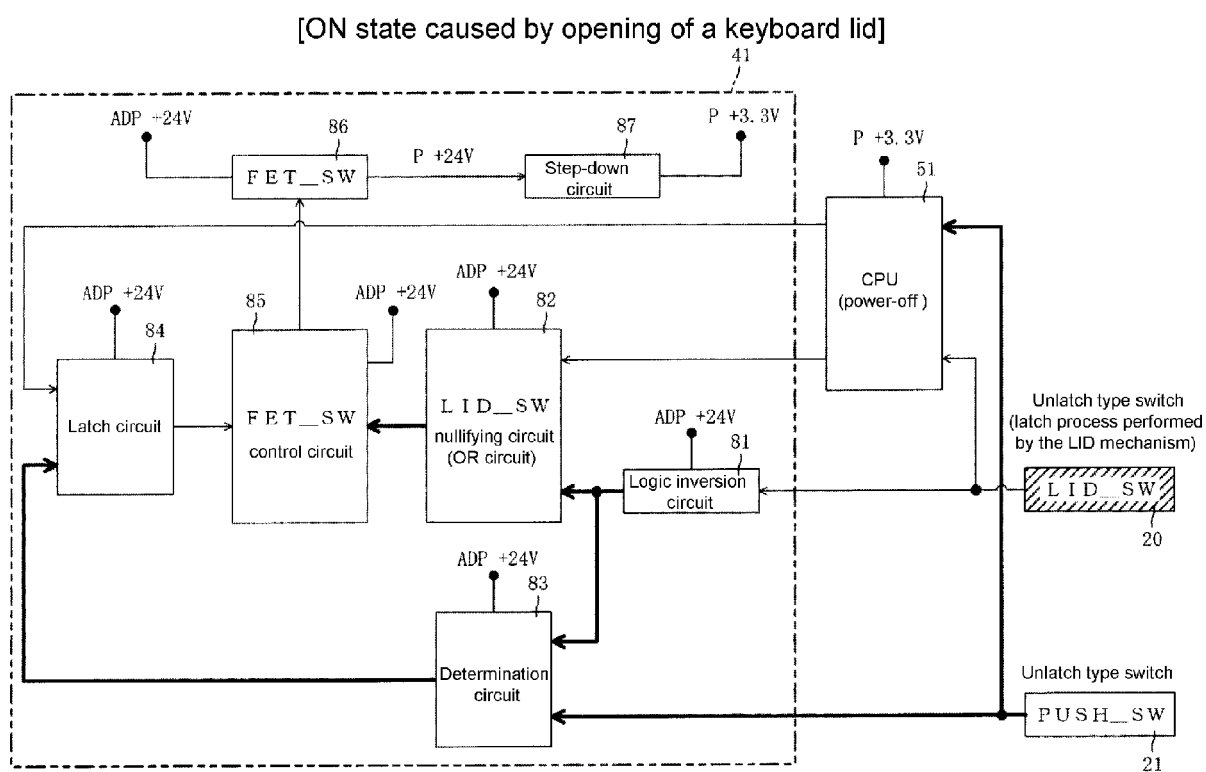


FIG. 4

[OFF state caused by an automatic power-off function (during a data storage period)]

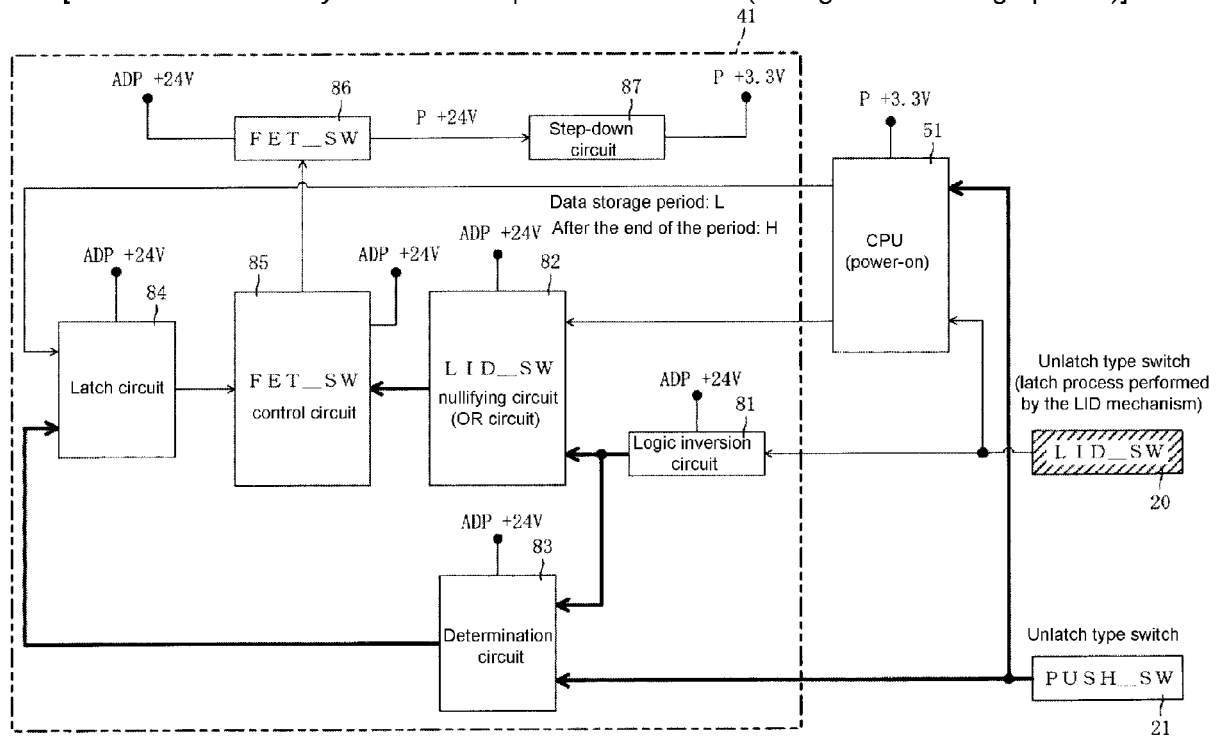


FIG. 5

[OFF state caused by the automatic power-off function (after the end of the data storage period)]

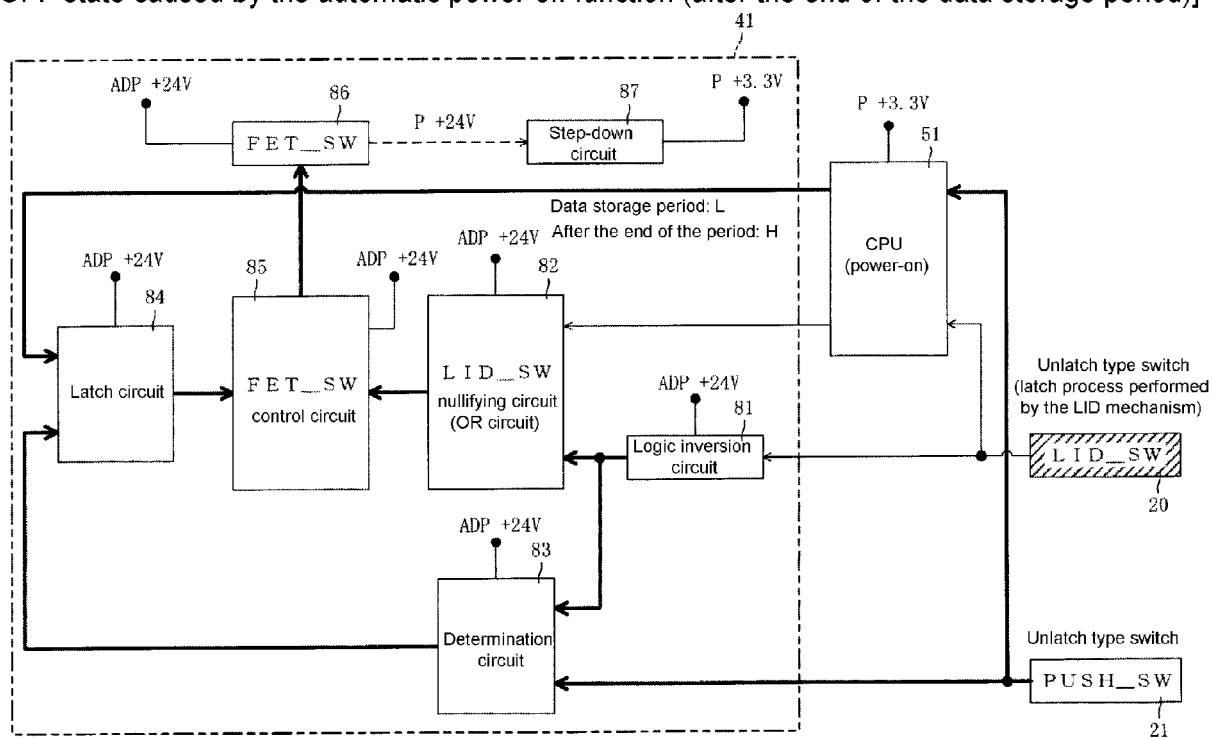


FIG. 6

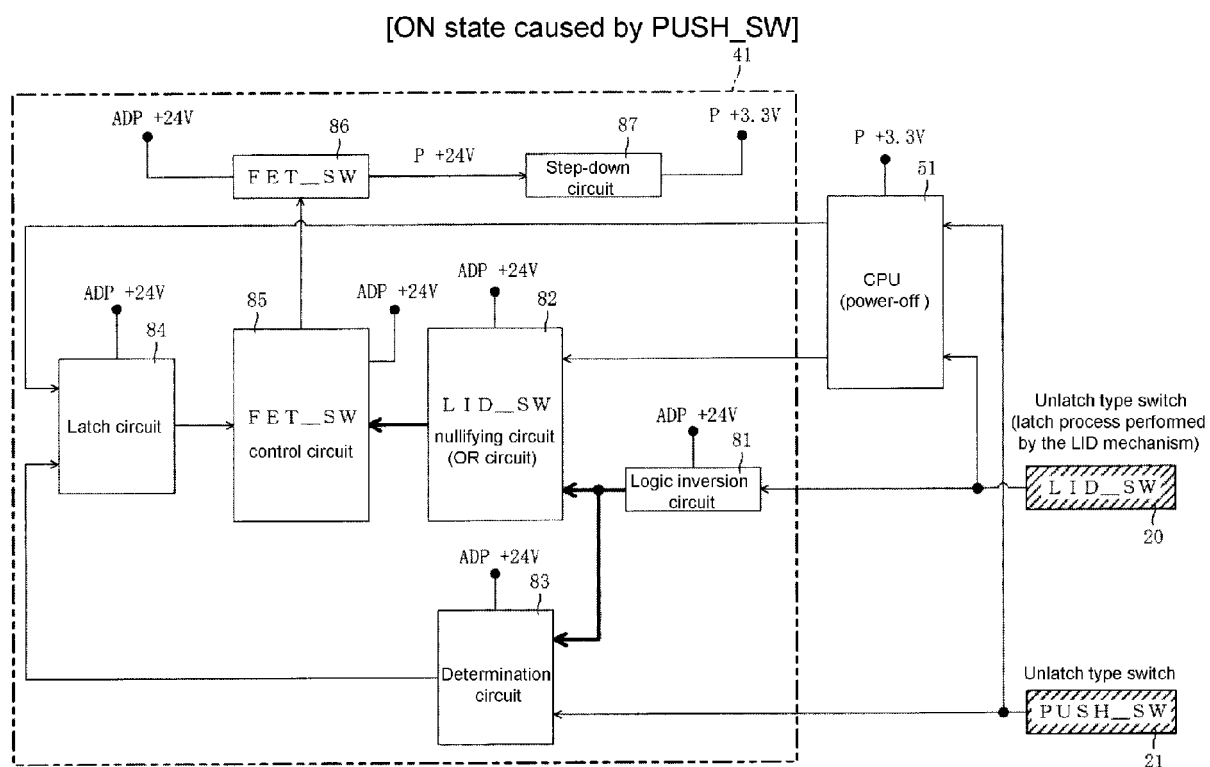


FIG. 7

[OFF state caused by closing of the keyboard lid (during a data storage period)]

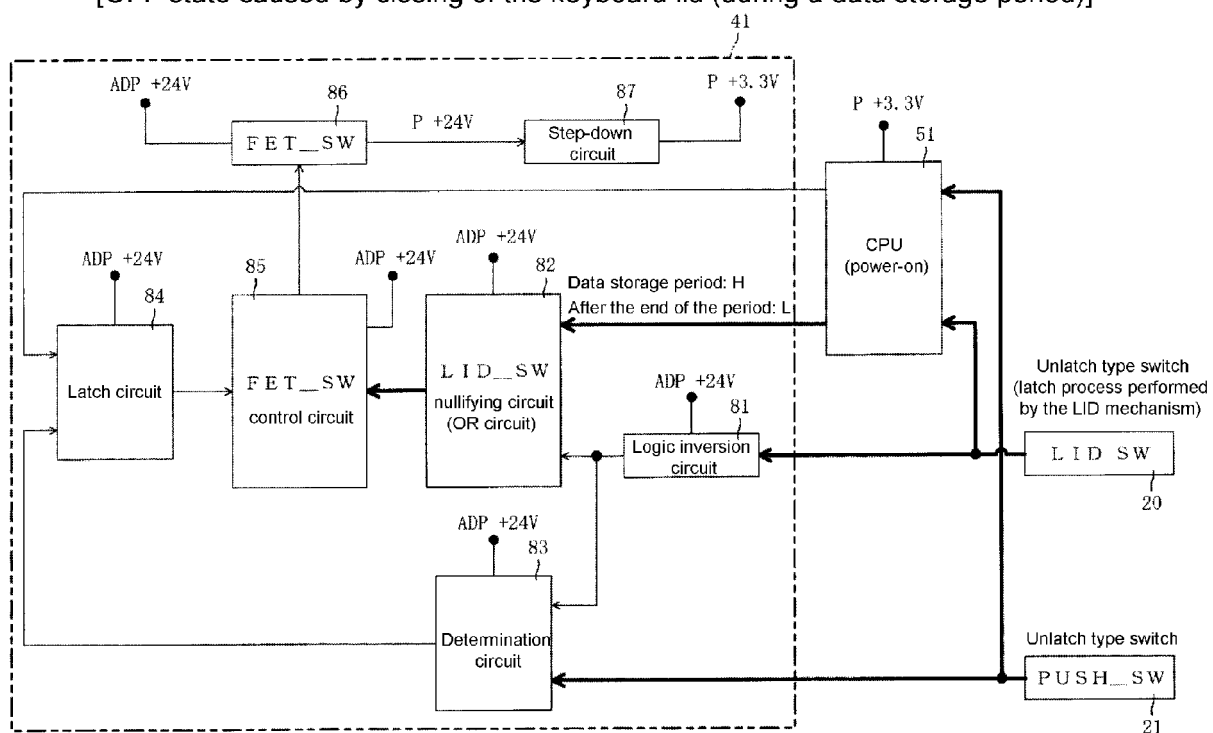


FIG. 8

[OFF state caused by closing of the keyboard lid (after the end of the data storage period)]

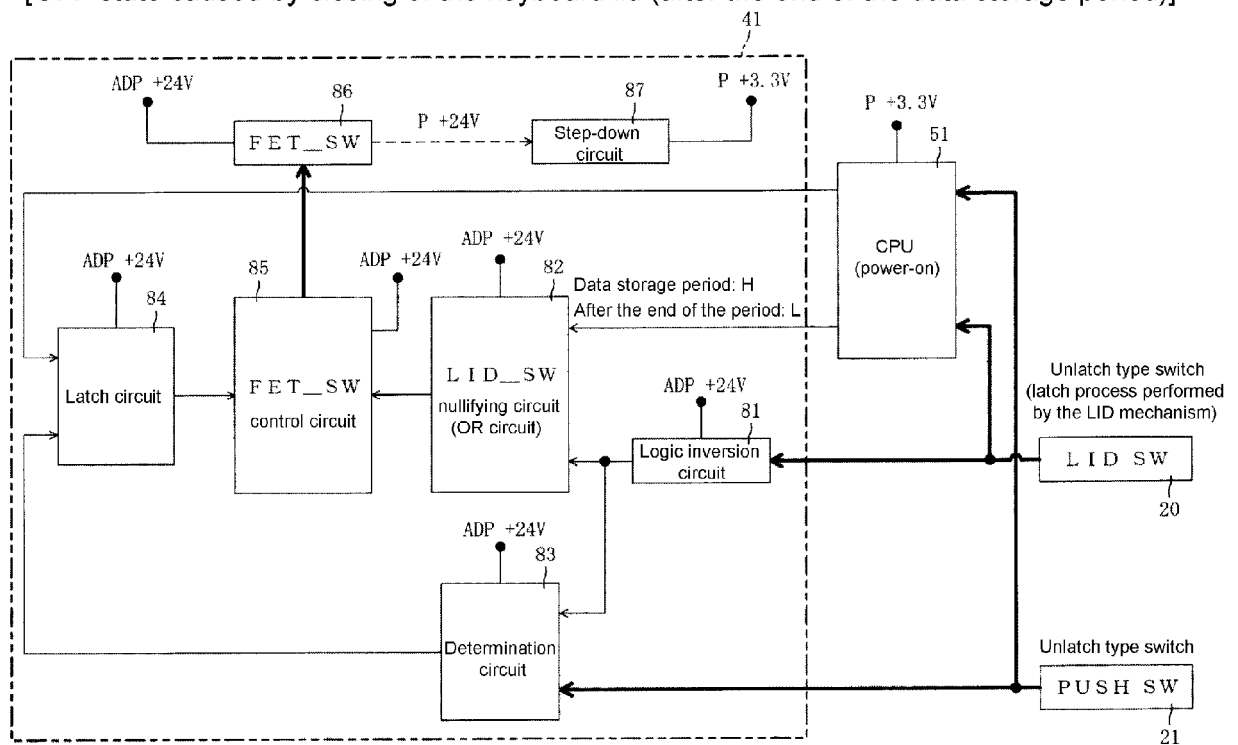


FIG. 9

[OFF state caused by PUSH_SW (during the data storage period)]

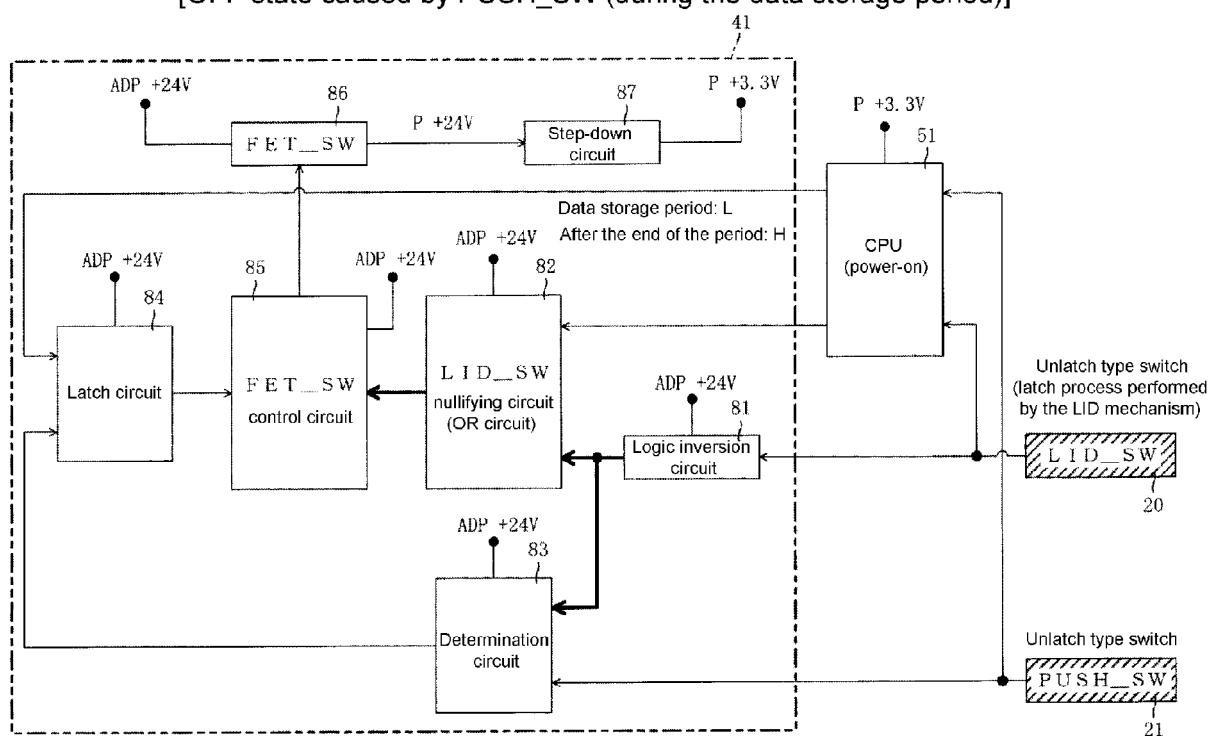


FIG. 10

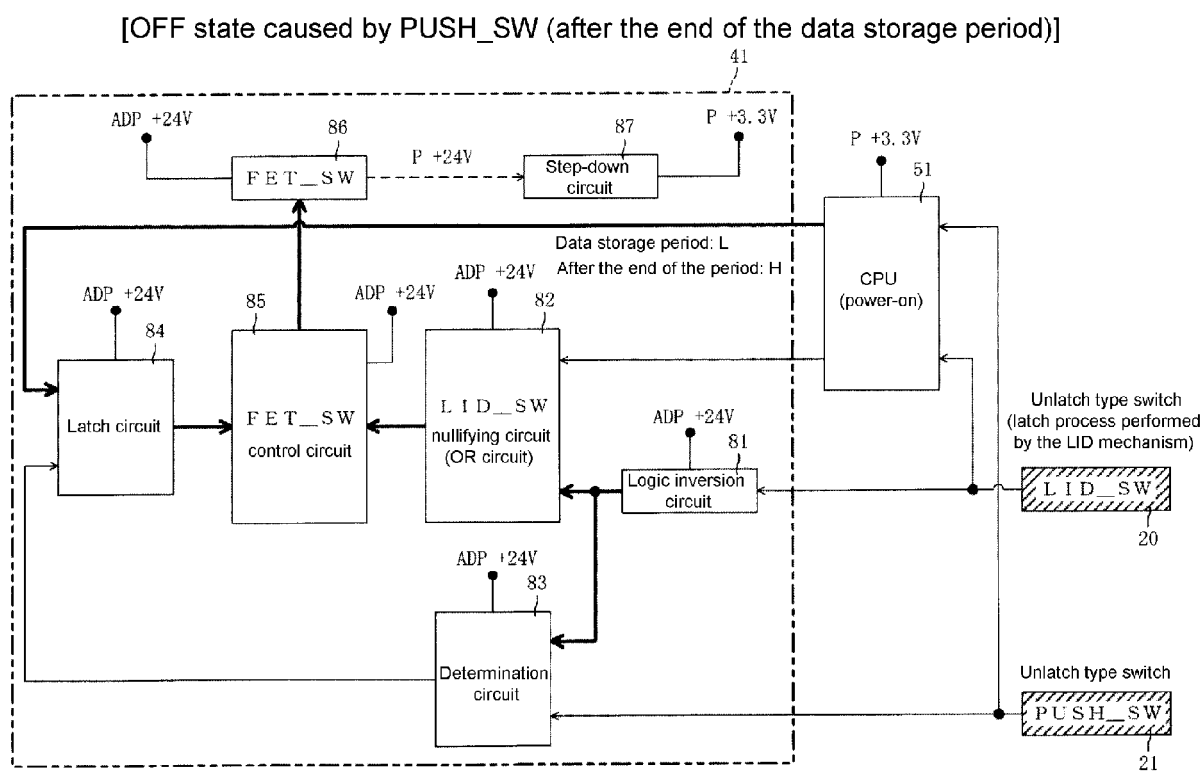


FIG. 11

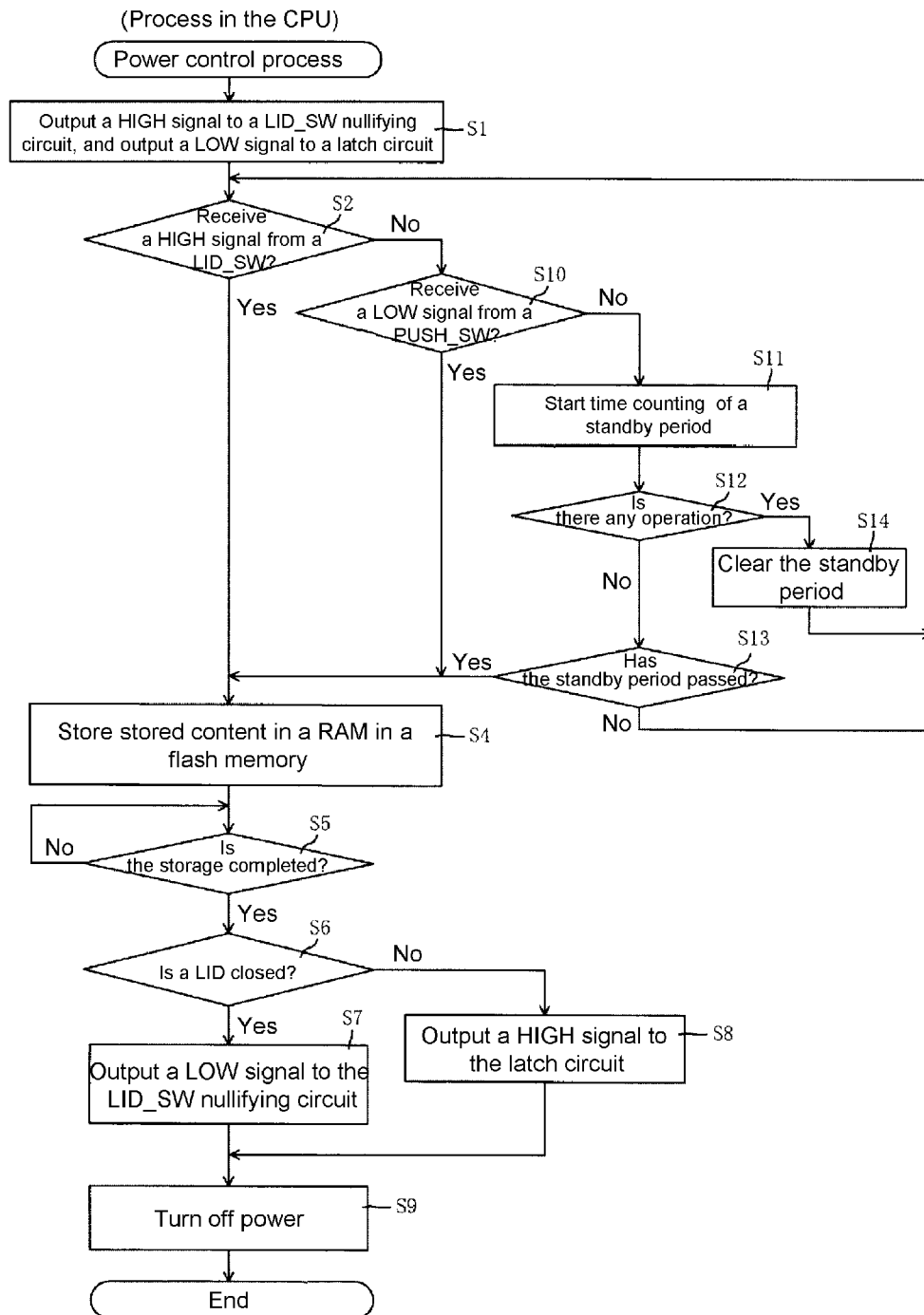


FIG. 12



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