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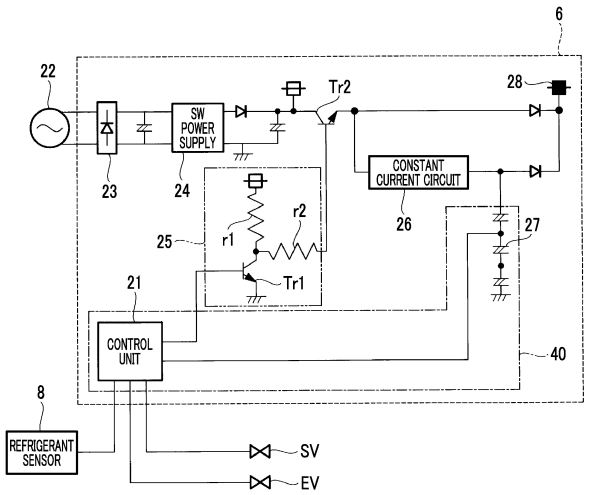
(54) CONTROL DEVICE, CUT-OFF VALVE CIRCUIT PROVIDED WITH CONTROL DEVICE, AIR-CONDITIONING DEVICE PROVIDED WITH CONTROL DEVICE, AND CONTROL METHOD

(57) The present invention provides: a control device that can improve energy efficiency; a cut-off valve circuit device provided with the control device; an air-conditioning device provided with the control device; and a control method. This control device (40) is provided with: a power storage unit (27) that is charged by an external power source (22); and a control unit (21) that controls power supplied from the external power source or the power storage unit. If power is being supplied from the external power source and the amount of charge in the power storage unit is equal to or greater than a prescribed amount, the control unit uses the power charged in the power storage unit to control loads (EV, SV) connected to the outside.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a control device, a shut-off valve circuit provided with the control device, an air-conditioning device provided with the control device, and a control method.

Background Art

[0002] In the related art, in an air-conditioning device provided with a shut-off valve that shuts off the flow of a refrigerant, the shut-off valve has been controlled using power supplied from an external power supply.

[0003] PTL 1 discloses that in an air-conditioning device provided with an external power supply, a shut-off valve, and a power storage unit that is charged by the external power supply, when the supply of the external power supply is stopped, the shut-off valve is operated using power from the power storage unit to shut off the flow of a refrigerant.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2020-134005

Summary of Invention

Technical Problem

[0005] However, when the power supply from an external power supply as described in PTL 1 is maintained for a long period of time, for example, the power storage unit is only charged by the external power supply, and the power charged in the power storage unit is not used to control the shut-off valve, resulting in a problem of wasted power consumption when the power storage unit is in a standby state.

[0006] The present disclosure has been made in consideration of the above circumstances, and an object of the present disclosure is to provide a control device that can improve energy efficiency, a shut-off valve circuit provided with the control device, an air-conditioning device provided with the control device, and a control method.

Solution to Problem

[0007] A control device according to an aspect in some embodiments of the present disclosure includes: a power storage unit that is charged by an external power supply; and a control unit that controls power supplied from the external power supply or the power storage unit, and when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, the control unit drives a load connected to an outside using the power charged in the power storage unit.

[0008] A shut-off valve circuit according to an aspect in some embodiments of the present disclosure includes the above-described control device.

[0009] An air-conditioning device according to an aspect in some embodiments of the present disclosure includes the above-described control device.

[0010] A control method according to an aspect in some embodiments of the present disclosure includes: a step of charging a power storage unit that is charged by an external power supply; and a control step of controlling power supplied from the external power supply or the power storage unit, and in the control step, when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, control is performed such that a load connected to an outside is driven using the power charged in the power storage unit.

Advantageous Effects of Invention

[0011] According to the present disclosure, it is possible to reduce standby power consumption and improve energy efficiency by consuming the power charged in the power storage unit in accordance with predetermined conditions.

Brief Description of Drawings

[0012]

Fig. 1 is a schematic configuration diagram of an air-conditioning system in which a control device according to an embodiment of the present disclosure is used.

Fig. 2 is a circuit diagram showing an outline of a shut-off valve kit according to an embodiment of the present disclosure.

Fig. 3 is a diagram showing an example of a hardware configuration of a control unit according to an embodiment of the present disclosure.

Fig. 4 is a table showing the state of a shut-off valve with respect to operating conditions of an air-conditioning device according to an embodiment of the present disclosure.

Description of Embodiments

[0013] A control device and a control method according to an embodiment of the present disclosure will be described below with reference to the drawings.

[0014] Fig. 1 is a schematic configuration diagram of an air-conditioning device in which a control device according to an embodiment of the present disclosure is used. The air-conditioning device 1 includes an outdoor unit 2,

an outdoor unit power supply 3, a shut-off valve kit 6, a plurality of indoor units 4 (4-1 to 4-3), and an indoor unit power supply 5. The indoor units 4 are connected in parallel to the outdoor unit 2. Each indoor unit 4 is capable of electric communication with a remote control 7 (7-1 to 7-3) that inputs operation commands to the corresponding indoor unit 4. Each indoor unit 4 is capable of electric communication with a refrigerant sensor 8 (8-1 to 8-3) that detects leakage of the refrigerant flowing inside the corresponding indoor unit 4.

[0015] For convenience, Fig. 1 illustrates a configuration in which three indoor units 4 are connected to one outdoor unit 2; however, the number of installed outdoor units 2 and the number of connected indoor units 4 are not limited.

[0016] The outdoor unit 2 and each indoor unit 4 are connected via the shut-off valve kit 6, a liquid refrigerant pipe 10, and a gas refrigerant pipe 11, and refrigerant is transported in both directions. The outdoor unit 2 and the indoor unit 4 are connected by an electric communication line, and are capable of communication in both directions. The indoor unit 4 and the shut-off valve kit 6 are connected by an electric communication line, and are capable of communication in both directions.

[0017] The outdoor unit 2 includes, for example, a compressor (not shown) that compresses and sends out the refrigerant, a four-way valve (not shown) that switches a circulation direction of the refrigerant, an outdoor heat exchanger (not shown) that exchanges heat between the refrigerant and the outside air, an outdoor fan (not shown), an accumulator (not shown) provided in the suction side pipe of the compressor for the purpose of gas-liquid separation of the refrigerant, etc., and an outdoor unit control device (not shown). Power for operating the outdoor unit 2 is supplied from the outdoor unit power supply 3.

[0018] The indoor unit 4 includes an indoor heat exchanger (not shown), an indoor fan (not shown), an electronic expansion valve (not shown), an indoor unit control device (not shown), and the like. Power for operating the indoor unit 4 is supplied from the indoor unit power supply 5.

[0019] The operating conditions of the indoor unit 4 are controlled by an indoor unit control device based on commands input by a user using a remote control 7.

[0020] The outdoor unit control device and the indoor unit control device are configured to be able to transmit and receive information to and from each other, and control the air-conditioning device 1 while transmitting and receiving information. The outdoor unit control device controls, for example, the rotation speed of the compressor and the rotation speed of the outdoor fan. The indoor unit control device controls, for example, the rotation speed of the indoor fan and the valve opening degree of the electronic expansion valve. The operation of an air-conditioning device is well known and therefore will not be described in detail.

[0021] The shut-off valve kit 6 is connected to the outdoor unit 2 and the indoor unit 4 via the liquid refrigerant pipe 10 and the gas refrigerant pipe 11. The shut-off valve kit 6 switches between opening and closing of each valve that shuts off the flow of refrigerant flowing through the gas refrigerant pipe 11 or the liquid refrigerant pipe 10 based on the operating conditions of the air-conditioning device 1. The operating conditions of the air-conditioning device 1 are, for example, a comprehensive determination of cooling operation, heating operation, the temperature of the refrigerant circulating within the air-conditioning device 1, and the presence or absence of a refrigerant leak.

[0022] The refrigerant sensors 8 are provided in the respective indoor units 4 and detect whether or not refrigerant is leaking inside the indoor unit 4 or in the installation environment of the indoor unit 4. Specifically, as an example, when the concentration of the refrigerant inside the indoor unit 4 is greater than a predetermined amount, the refrigerant sensor 8 detects that refrigerant is leaking into the indoor unit 4.

[0023] The refrigerant sensor 8 is specifically a leakage sensor. The refrigerant sensor 8 may be any means capable of detecting a refrigerant leak, and may use any method of a mechanical method, an electrical method, or an optical method.

(Configuration of Shut-off Valve Kit)

[0024] Fig. 2 is a circuit diagram showing an outline of a shut-off valve kit according to an embodiment of the present disclosure.

[0025] The shut-off valve kit 6 includes a control unit 21 which controls the supplied power and controls the drive of the electrically connected actuator, an external power supply 22, a rectification circuit 23, a SW power supply 24, a switching circuit 25, a transistor Tr2, a constant current circuit 26, a power storage unit 27, and a driving power supply 28.

[0026] The shut-off valve kit 6 switches between opening and closing of an electric valve (electronic expansion valve) EV and a solenoid valve SV, which are shut-off valves that shut off the flow of refrigerant circulating through the outdoor unit 2 and each indoor unit 4. When switching between opening and closing the solenoid valve SV and the electric valve EV shown in Fig. 1, the shut-off valve kit 6 determines whether to use any of the power charged in the power storage unit 27 and the power supplied from the external power supply 22, based on the amount of charge in the power storage unit 27.

[0027] The control unit 21 switches ON/OFF of a switching circuit 25 (described later) based on the presence or absence of power supply from the external power supply 22 (described later) and the amount of charge in the power storage unit 27 (described later). The control unit 21 switches a power source for driving the control unit 21 by switching ON/OFF of the switching circuit 25.

[0028] The control unit 21 is capable of electric com-

munication with the power storage unit 27, and the control unit 21 detects the amount of charge in the power storage unit 27. The control unit 21 is connected to be capable of electric communication with electronic devices such as sensors or actuators outside the shut-off valve kit 6.

[0029] The control unit 21 can switch the open/closed states of the electric valve EV and the solenoid valve SV using the power charged in the power storage unit 27, which will be described later. Here, as shown in Fig. 2, a configuration including the control unit 21 and the power storage unit 27 is referred to as a control device 40.

[0030] Fig. 3 is a diagram showing an example of a hardware configuration of the control unit 21 according to an embodiment of the present disclosure.

[0031] The control unit 21 is a computer system and includes, for example, a CPU 31, a read only memory (ROM) 32 for storing programs and the like executed by the CPU 31, a random access memory (RAM) 33 that functions as a work area when each program is executed, a hard disk drive (HDD) 34 as a large-capacity storage device, and a communication unit 35 for connecting to a network or the like. As the large-capacity storage device, other storage devices such as a solid-state drive (SSD) may also be used. Each of these units is connected via a bus 38.

[0032] The control unit 21 may include an input unit including a keyboard and a mouse, or a display unit including a liquid crystal display device for displaying data.

[0033] Referring back to Fig. 2, the external power supply 22 is a power source that supplies power to the shut-off valve kit 6. The shut-off valve kit 6 includes a driving power supply 28 for driving the control unit 21, and the control unit 21 is driven using the power supplied to the driving power supply 28. When the amount of charge in the power storage unit 27 described below is less than a predetermined amount, the power storage unit 27 is charged with the power supplied from the external power supply 22.

[0034] The rectification circuit 23 is connected in parallel to the external power supply 22 and rectifies the AC voltage supplied from the external power supply 22. For example, the rectification circuit 23 is configured with a bridge rectification circuit using rectifier diodes, and performs full-wave rectification on the AC voltage supplied from the external power supply 22. The rectification method may be other rectification methods such as half-wave rectification. A smoothing capacitor for suppressing pulsating components in the output of the rectification circuit 23 is connected in parallel to a SW power supply 24 (described later) in the output line of the rectification circuit 23.

[0035] The SW power supply 24 is a power supply that stabilizes the output of a DC voltage converted from an AC voltage by controlling the duty ratio of a switching element. The SW power supply 24 may include, for example, a DC/DC converter, a switching regulator including an oscillator, and a voltage dividing resistor.

[0036] A rectifier diode and a smoothing capacitor are connected to the output side of the SW power supply 24.

[0037] The switching circuit 25 is a circuit that switches the ON/OFF of the transistor Tr1, which functions as a switch, based on a control signal output from the control unit 21. When ON/OFF of the transistor Tr1 of the switching circuit 25 is switched, ON/OFF of the transistor Tr2 included in the shut-off valve kit 6 is switched. In this way, the switching circuit 25 performs switching control of the power source that supplies power to the driving power supply 28 (described later) via the control unit 21.

[0038] Resistors r1 and r2 in Fig. 2 are elements for preventing breakdowns in the transistors Tr1 and Tr2, respectively, and for adjusting the voltages applied to the transistors Tr1 and Tr2.

[0039] The emitter side of the transistor Tr2 is connected in parallel to a path connected to the constant current circuit 26 and a path connected to the driving power supply 28. A rectifier diode is connected to each path to prevent current from flowing in the reverse direction.

[0040] The constant current circuit 26 is connected to the emitter side of the transistor Tr2, and supplies a constant current to the power storage unit 27. The constant current circuit 26 is configured using, for example, a three-terminal regulator IC, and generates a constant current.

[0041] The power storage unit 27 is connected between the output side of the constant current circuit 26 and the rectifier diode.

[0042] The power storage unit 27 is an element that stores power. When the amount of charge in the power storage unit 27 is less than a predetermined amount, the power storage unit 27 charges the power supplied from the external power supply 22. When the charged amount is equal to or greater than a predetermined amount, the battery becomes a power source that supplies power to the driving power supply 28 for driving the control unit 21 under the control to be described below. The power storage unit 27 is capable of electric communication with the control unit 21, and the amount of charge in the power storage unit 27 is detected by the control unit 21.

[0043] Specifically, the power storage unit 27 is, for example, a supercapacitor (electric double layer capacitor). Supercapacitors have the characteristic that they can be fully charged in a short time and do not deteriorate easily even when repeatedly charged and discharged. Alternatively, the power storage unit 27 may be a secondary battery such as a metal hydride battery, a lithium battery, or a lithium ion battery, thereby increasing the power storage capacity.

[0044] The driving power supply 28 is a power supply that supplies power for driving the control unit 21. When the amount of charge in the power storage unit 27 is less than a predetermined amount, the driving power supply 28 drives the control unit 21 using the power supplied from the external power supply 22. When the amount of charge in the power storage unit 27 is equal to or greater

than a predetermined amount, the driving power supply 28 drives the control unit 21 using the power supplied from the power storage unit 27.

(Switching Control of Power Source)

[0045] When the amount of charge in the power storage unit 27 is less than a predetermined amount, the control unit 21 stops outputting the control signal to the base of the transistor Tr1. At this time, the power storage unit 27 is charged with the power supplied from the external power supply 22 via the constant current circuit 26.

[0046] The driving power supply 28 for driving the control unit 21 is supplied with power from the external power supply 22.

[0047] When the amount of charge in the power storage unit 27 is equal to or greater than a predetermined amount, the control unit 21 outputs a control signal to the base of the transistor Tr1.

[0048] When a control signal is input to the base of the transistor Tr1, the switch of the transistor Tr1 enters an ON state, and the current flowing from the collector of the transistor Tr1 does not flow to the transistor Tr2 but flows to the emitter of the transistor Tr1.

[0049] When the switch of the transistor Tr1 is in the ON state, no voltage is applied to the base of the transistor Tr2. That is, the switch of the transistor Tr2 enters an OFF state.

[0050] When the switch of the transistor Tr2 is in the OFF state, a supply path for supplying power from the external power supply 22 to the driving power supply 28 for driving the control unit 21 is shut off.

[0051] As a result, when the switch of transistor Tr1 is in the ON state, the driving power supply 28 for driving the control unit 21 is not supplied with power from the external power supply 22, but is driven by the supply with the power charged in the power storage unit 27. The control unit 21 can control the drive of actuators such as shut-off valves provided outside the shut-off valve kit 6 by using the power charged in the power storage unit 27 even when power is not supplied from the external power supply 22.

[0052] Then, the control unit 21 is driven using the power charged in the power storage unit 27 until the amount of charge in the power storage unit 27 falls below a predetermined amount.

[0053] When the amount of charge in the power storage unit 27 falls below a predetermined amount, the control unit 21 stops outputting the control signal to the base of the transistor Tr1.

[0054] When no control signal is input to the base of the transistor Tr1, the switch of the transistor Tr1 enters an OFF state, and the current flowing from the power supply connected to the collector side of the transistor Tr1 does not flow to the emitter of the transistor Tr1 but flows to the base of the transistor Tr2.

[0055] When the switch of the transistor Tr1 is in the OFF state, a voltage is applied to the base of the transistor Tr2. That is, the switch of the transistor Tr2 enters an ON state.

[0056] When the switch of the transistor Tr2 is in the ON state, a supply path for supplying power from the external power supply 22 to the driving power supply 28 for driving the control unit 21 is connected.

[0057] In this way, the driving power supply 28 for driving the control unit 21 switches whether to supply power from the external power supply 22 or the power storage unit 27 depending on the amount of charge in the power storage unit 27.

[0058] This allows the power charged in the power storage unit 27 to be used under predetermined conditions, thereby making power consumption more efficient and reducing running costs.

(Use of Shut-off Valve Kit in Air-Conditioning Device)

[0059] Next, control of switching between opening and closing of the electric valve EV and the solenoid valve SV provided in the air-conditioning device 1 using the shut-off valve kit 6 will be described with reference to Fig. 4. Fig. 4 is a table showing the state of the shut-off valves (the electric valve EV and the solenoid valve SV) with respect to operating conditions of the air-conditioning device 1.

[0060] The control unit 21 provided in the shut-off valve kit 6 specifically switches between opening and closing of each valve, namely, the electric valve EV provided in the liquid refrigerant pipe 10 provided in the air-conditioning device 1 and the solenoid valve SV provided in the gas refrigerant pipe 11, based on the operating state of the air-conditioning device 1 or the amount of charge in the power storage unit 27. This controls the flow of refrigerant circulating through the refrigerant circuit of the air-conditioning device 1.

[0061] When an indoor unit group 100 is operating, the power source for controlling the opening and closing of the electric valve EV and the solenoid valve SV is switched based on the amount of charge in the power storage unit 27. In the example of Fig. 4, when the amount of charge in the power storage unit 27 is equal to or greater than a predetermined amount (the capacitor charging voltage is equal to or greater than 6 [V]), the electric valve EV and the solenoid valve SV use the power charged in the power storage unit 27 to bring the electric valve EV and the solenoid valve SV into an open state. When the amount of charge in the power storage unit 27 is less than a predetermined amount (the capacitor charging voltage is less than 6 [V]), the electric valve EV and the solenoid valve SV are brought into a closed state. When the amount of charge in the power storage unit 27 is less than a predetermined amount, the power storage unit 27 is charged with the power supplied from the external power supply 22 via the constant current circuit 26.

[0062] In an indoor unit group 200 having the same

configuration as the indoor unit group 100, a liquid refrigerant pipe 10 and a gas refrigerant pipe 11 connecting between the outdoor unit 2 and the shut-off valve kit 6 of the indoor unit group 100 each branch off between the electric valve EV or the solenoid valve SV and the outdoor unit, and are connected to the indoor unit group 200. In this way, the liquid refrigerant pipe 10 and the gas refrigerant pipe 11 connected to the outdoor unit branch off, allowing refrigerant to circulate between each indoor unit 4 and the outdoor unit 2 in each of the indoor unit groups 100 and 200.

[0063] In a case in which the electric valve EV and the solenoid valve SV are in the open state, when the indoor unit group 200 performs cooling operation, the flow of refrigerant circulating between the outdoor unit and the indoor unit group 100 and the flow of refrigerant circulating between the outdoor unit and the indoor unit group 200 mix, causing a phenomenon in which the refrigerant flows back into the compressor of the outdoor unit (liquid back), which may damage the compressor of the outdoor unit.

[0064] At this time, in order to prevent the refrigerant from flowing back into the compressor of the outdoor unit, the control unit 21 provided in the shut-off valve kit 6 of the indoor unit group 100 switches the electric valve EV and the solenoid valve SV to a closed state.

[0065] The control unit 21 detects the amount of charge in the power storage unit 27, and when the amount of charge in the power storage unit 27 is equal to or greater than a predetermined amount, the control unit 21 controls the switching circuit 25 to supply the power charged in the power storage unit 27 to the driving power supply 28. When power is supplied from the power storage unit 27 to the driving power supply 28, the control unit 21 can switch the electric valve EV and the solenoid valve SV to a closed state.

[0066] The control unit 21 detects the amount of charge in the power storage unit 27, and when the amount of charge in the power storage unit 27 is less than a predetermined amount, the power charged in the power storage unit 27 is not used, and the control unit 21 controls the switching circuit 25 to supply the power supplied from the external power supply 22 to the driving power supply 28. When power is supplied from the external power supply 22 to the driving power supply 28, the control unit 21 switches the electric valve EV and the solenoid valve SV to a closed state. During that time, the power storage unit 27 is charged with the power supplied from the external power supply 22 until the charged amount reaches or exceeds a predetermined amount.

[0067] In this way, the control unit 21 can switch whether to perform the opening and closing control of the electric valve EV and the solenoid valve SV using any of the external power supply 22 and the power storage unit 27 as the power source, depending on the operating conditions of the other indoor unit group 200 and the amount of charge in the power storage unit 27. This reduces the standby power consumption of the power storage unit 27 when the power storage unit 27 is fully charged, thereby making it possible to improve the efficiency of power consumption.

(Switching Control of Shut-Off Valve When Refrigerant Leak is Detected)

[0068] The plurality of indoor units 4 of the indoor unit group 100 each include the refrigerant sensor 8 corresponding to each indoor unit 4. Each refrigerant sensor 8 detects the presence or absence of a refrigerant leak inside the corresponding indoor unit 4 or in the installation environment of each indoor unit 4.

[0069] Each refrigerant sensor 8 outputs a detection result of a refrigerant leak inside the corresponding indoor unit 4 or in the installation environment of the indoor unit 4 to the indoor unit 4. Then, the indoor unit 4 corresponding to the refrigerant sensor 8 that detected the refrigerant leak outputs a notification that the refrigerant leak has been detected to the control unit 21 of the shut-off valve kit 6.

[0070] When the control unit 21 receives a notification that a refrigerant leak has been detected inside the indoor unit 4 or in the installation environment of the indoor unit 4, the control unit 21 detects the amount of charge in the power storage unit 27, and when the amount of charge in the power storage unit 27 is equal to or greater than a predetermined amount, the control unit 21 controls the switching circuit 25 to supply the power charged in the power storage unit 27 to the driving power supply 28. When power is supplied from the power storage unit 27 to the driving power supply 28, the control unit 21 can switch the electric valve EV and the solenoid valve SV to a closed state.

[0071] When the control unit 21 receives a notification that a refrigerant leak has been detected inside the indoor unit 4 or in the installation environment of the indoor unit 4, the control unit 21 detects the amount of charge in the power storage unit 27, and when the amount of charge in the power storage unit 27 is less than a predetermined amount, the control unit 21 controls the switching circuit 25 to supply power supplied from the external power supply 22 to the driving power supply 28 without using the power charged in the power storage unit 27. When power is supplied from the external power supply to the driving power supply 28, the control unit 21 switches the electric valve EV and the solenoid valve SV to a closed state. During that time, the power storage unit 27 is charged with the power supplied from the external power supply 22 until the charged amount reaches or exceeds a predetermined amount.

[0072] In this way, when the control unit 21 detects a refrigerant leak inside the indoor unit 4 or in the installation environment of the indoor unit 4 by the refrigerant sensor 8, the control unit 21 can switch whether to perform the opening and closing control of the electric valve EV and the solenoid valve SV using any of the external power supply 22 and the power storage unit 27 as the

power source, depending on the amount of charge in the power storage unit 27. This reduces the standby power consumption when the power storage unit 27 is fully charged, thereby making it possible to improve the efficiency of power consumption.

[0073] Regarding the positions at which the electric valve EV and the solenoid valve SV are provided, in the above-described embodiment, they are provided in the liquid refrigerant pipe 10 and the gas refrigerant pipe 11 between the outdoor unit and the shut-off valve kit 6, respectively. However, the present disclosure is not limited to this example, and the electric valve EV and the solenoid valve SV may be provided in positions close to each indoor unit 4 side in the liquid refrigerant pipe 10 and the gas refrigerant pipe 11 between each indoor unit 4 and the shut-off valve kit 6.

[0074] Although the present disclosure has been described above using the embodiments, the technical scope of the present disclosure is not limited to the scope described in the above embodiments. Various modifications or improvements can be made to the above-described embodiments without departing from the gist of the invention, and such modifications or improvements are also included in the technical scope of the present disclosure. The above embodiments may be combined as appropriate.

[0075] According to a first aspect of the present disclosure, there is provided a control device (40) including: a power storage unit (27) that is charged by an external power supply (22); and a control unit (21) that controls power supplied from the external power supply or the power storage unit, in which when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, the control unit drives a load (EV, SV) connected to an outside using the power charged in the power storage unit.

[0076] With the control device according to the present disclosure, the control unit can consume the power charged in the power storage unit when a voltage equal to or greater than a predetermined amount is charged in the power storage unit, even in a state in which power is being supplied from an external power supply, thereby reducing standby power consumption and improving energy efficiency.

[0077] The state in which power is being supplied from an external power supply refers to, for example, a state in which power equal to or greater than a predetermined percentage of a preset maximum rated value is being supplied from the external power supply.

[0078] According to a second aspect of the present disclosure, in the control device (40) according to the first aspect, the power storage unit is a supercapacitor.

[0079] When the power storage unit is a supercapacitor, it is possible to completely discharge it, so that the remaining amount of charge can be accurately measured by measuring between the terminals of the power storage unit. Since supercapacitors do not deteriorate much even when repeatedly charged and discharged, it is possible to reduce the frequency of maintenance of a system provided with the control device.

[0080] According to a third aspect of the present disclosure, in the control device (40) according to the first or second aspect, the load is a shut-off valve that is disposed in an inter-unit pipe connecting a refrigerant circuit of an indoor unit and an outdoor unit, and that shuts off a flow of a refrigerant between the refrigerant circuit and the outdoor unit, and when the amount of charge in the power storage unit is equal to or greater than the predetermined amount in a state in which the power is being supplied from the external power supply, the control unit controls an open/closed state of the shut-off valve using the power charged in the power storage unit.

[0081] Even in a state in which power is being supplied from an external power supply, when the amount of charge in the power storage unit is equal to or greater than a predetermined amount, the control unit prioritizes using the power charged in the power storage unit, thereby making it possible to improve the efficiency of power consumption of the system.

[0082] When the control device is provided in an air conditioner and the air conditioner is in cooling operation, the control unit can close the shut-off valve by using the power charged in the power storage unit. This prevents mist-like refrigerant from flowing back inside the pipe connecting the refrigerant circuit of the indoor unit and the outdoor unit, reducing a likelihood of breakdowns in equipment such as the indoor unit, the outdoor unit, and the compressor provided in the outdoor unit.

[0083] A fourth aspect of the present disclosure, the control device (40) according to any one of the first to third aspects further includes a refrigerant detection unit that detects a refrigerant leak, and when the refrigerant detection unit detects a refrigerant leak, the control unit controls the shut-off valve to a closed state using the power charged in the power storage unit.

[0084] When the refrigerant detection unit detects a refrigerant leak, the control unit can control the shut-off valve to a closed state using the power charged in the power storage unit. This makes it possible to quickly stop a refrigerant leak regardless of whether or not power is being supplied from an external power supply, thereby suppressing breakdown of the control device or the occurrence of fire accidents.

[0085] According to a fifth aspect of the present disclosure, there is provided a shut-off valve circuit (6) including the control device according to any one of the first to fourth aspects.

[0086] According to a sixth aspect of the present disclosure, there is provided an air-conditioning device (1) including the control device according to any one of the first to fourth aspects.

[0087] According to a seventh aspect of the present disclosure, there is provided a control method including: a step of charging a power storage unit that is charged by an external power supply; and a control step of controlling

power supplied from the external power supply or the power storage unit, in which in the control step, when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, control is performed such that a load connected to an outside is driven using the power charged in the power storage unit.

Reference Signs List

[0088]

1: air-conditioning device
2: outdoor unit
3: outdoor unit power supply
4: indoor unit
5: indoor unit power supply
6: shut-off valve kit (shut-off valve circuit)
7: remote control
8: refrigerant sensor
10: liquid refrigerant pipe
11: gas refrigerant pipe
21: control unit
22: external power supply
23: rectification circuit
24: SW power supply
25: switching circuit
26: constant current circuit
27: power storage unit
28: driving power supply
31: CPU
32: ROM
33: RAM
34: hard disk drive
35: communication unit
38: bus
40: control device
100, 200: indoor unit group
EV: electric valve
SV: solenoid valve
Tr1, Tr2: transistor
r1, r2: resistor

Claims

1. A control device comprising:

a power storage unit that is charged by an external power supply; and
a control unit that controls power supplied from the external power supply or the power storage unit,
wherein, when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, the control unit drives a load connected to an outside using the power charged in the power storage unit.

2. The control device according to Claim 1, wherein the power storage unit is a supercapacitor.

3. The control device according to Claim 1,

wherein the load is a shut-off valve that is disposed in an inter-unit pipe connecting a refrigerant circuit of an indoor unit and an outdoor unit, and that shuts off a flow of a refrigerant between the refrigerant circuit and the outdoor unit, and when the amount of charge in the power storage unit is equal to or greater than the predetermined amount in a state in which the power is being supplied from the external power supply, the control unit controls an open/closed state of the shut-off valve using the power charged in the power storage unit.

4. The control device according to Claim 3, further comprising:

a refrigerant detection unit that detects a refrigerant leak,
wherein, when the refrigerant detection unit detects a refrigerant leak, the control unit controls the shut-off valve to a closed state using the power charged in the power storage unit.

5. A shut-off valve circuit comprising:
the control device according to Claim 1.

6. An air-conditioning device comprising:
the control device according to Claim 1.

7. A control method comprising:

a step of charging a power storage unit that is charged by an external power supply; and
a control step of controlling power supplied from the external power supply or the power storage unit,
wherein in the control step, when power is being supplied from the external power supply and an amount of charge in the power storage unit is equal to or greater than a predetermined amount, control is performed such that a load connected to an outside is driven using the power charged in the power storage unit.

FIG. 1

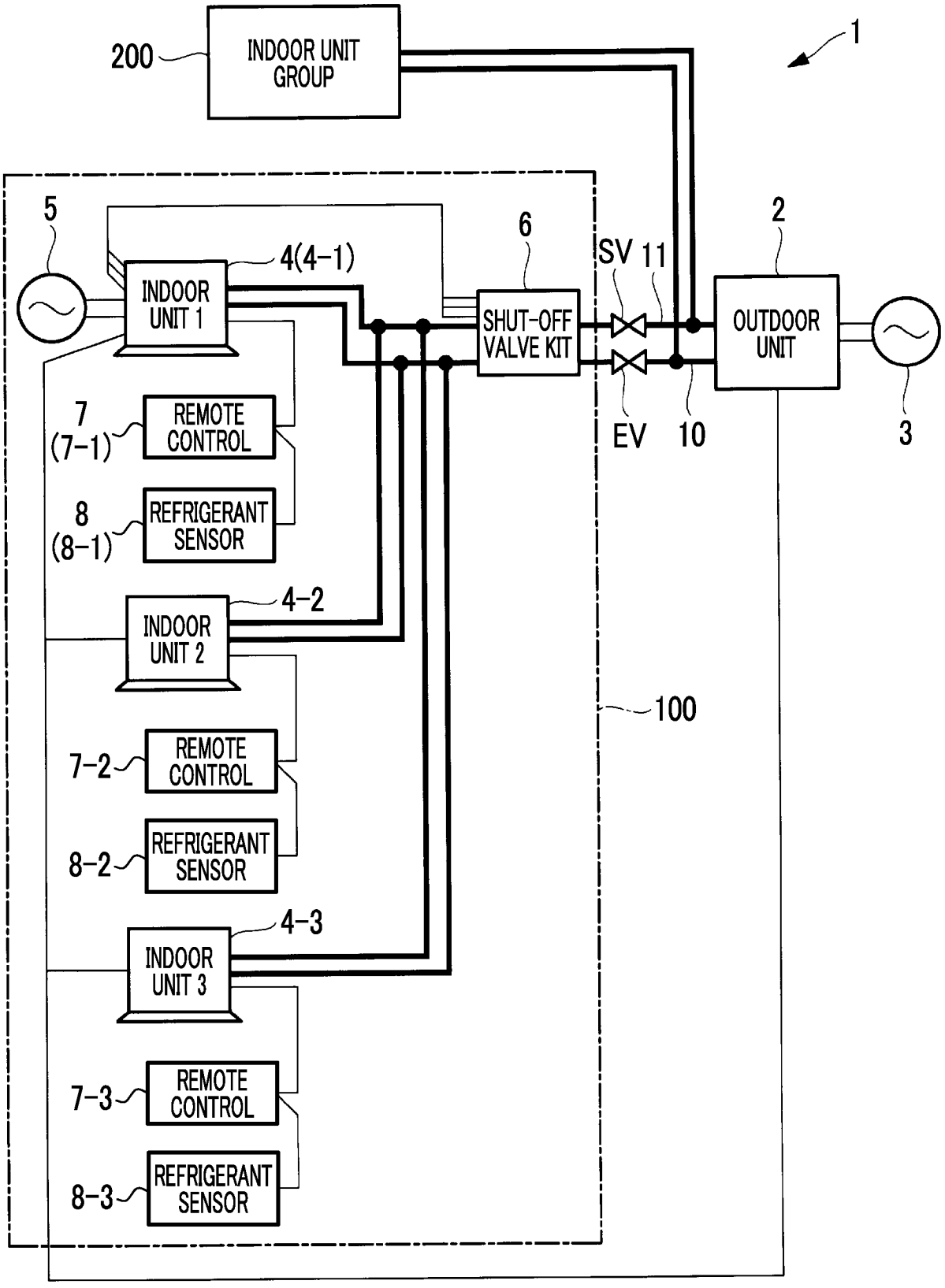
200
INDOOR UNIT GROUP
1
5
4(4-1)
INDOOR UNIT 1
6
SHUT-OFF VALVE KIT
SV
11
2
OUTDOOR UNIT
7
(7-1)
REMOTE CONTROL
8
(8-1)
REFRIGERANT SENSOR
EV
10
3
4-2
INDOOR UNIT 2
100
7-2
REMOTE CONTROL
8-2
REFRIGERANT SENSOR
4-3
INDOOR UNIT 3
7-3
REMOTE CONTROL
8-3
REFRIGERANT SENSOR

FIG. 2

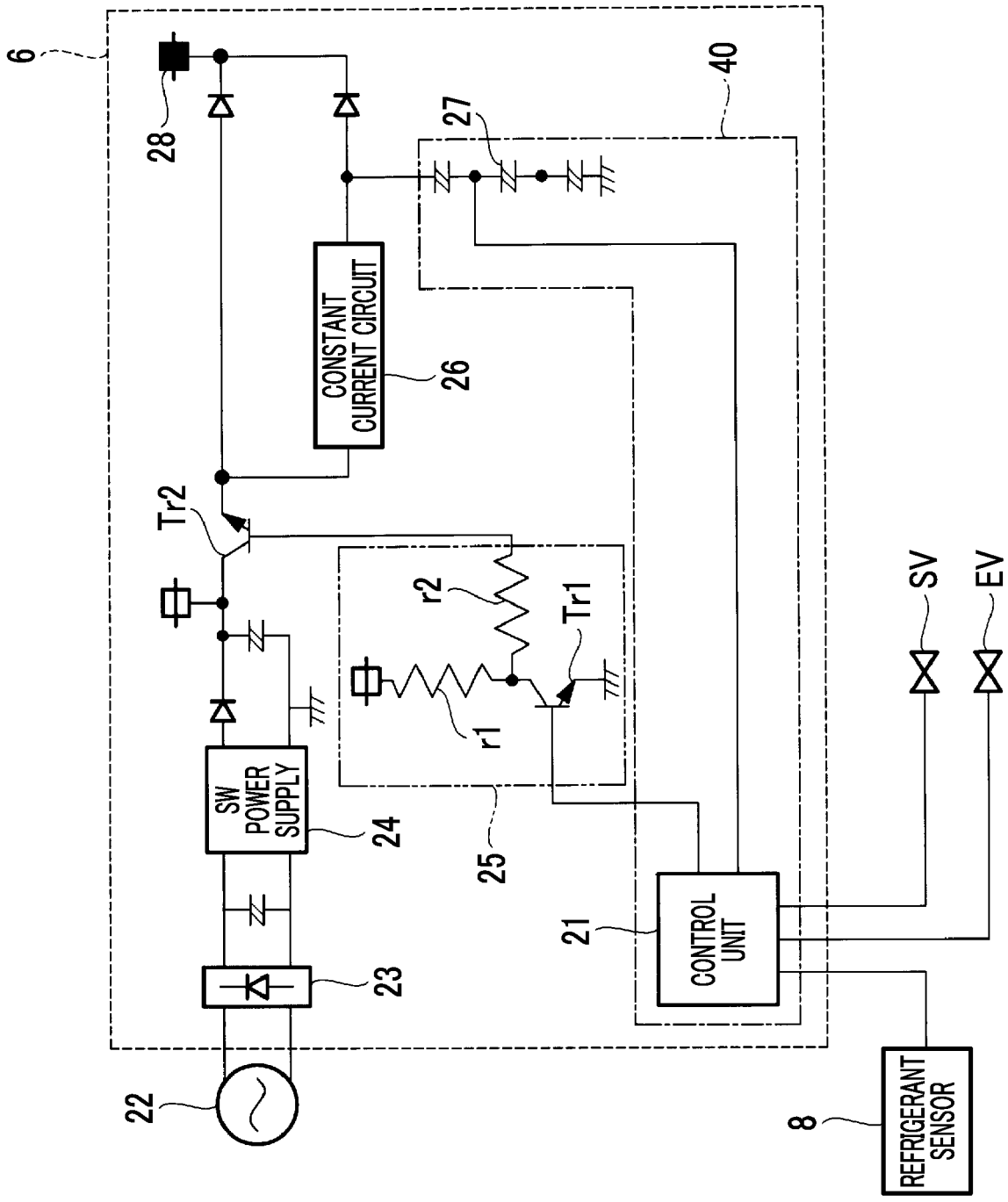
6
28
40
27
CONSTANT CURRENT CIRCUIT
26
Tr2
r2
Tr1
r1
SW POWER SUPPLY
24
25
21
CONTROL UNIT
SV
EV
23
22
8
REFRIGERANT SENSOR

FIG. 3

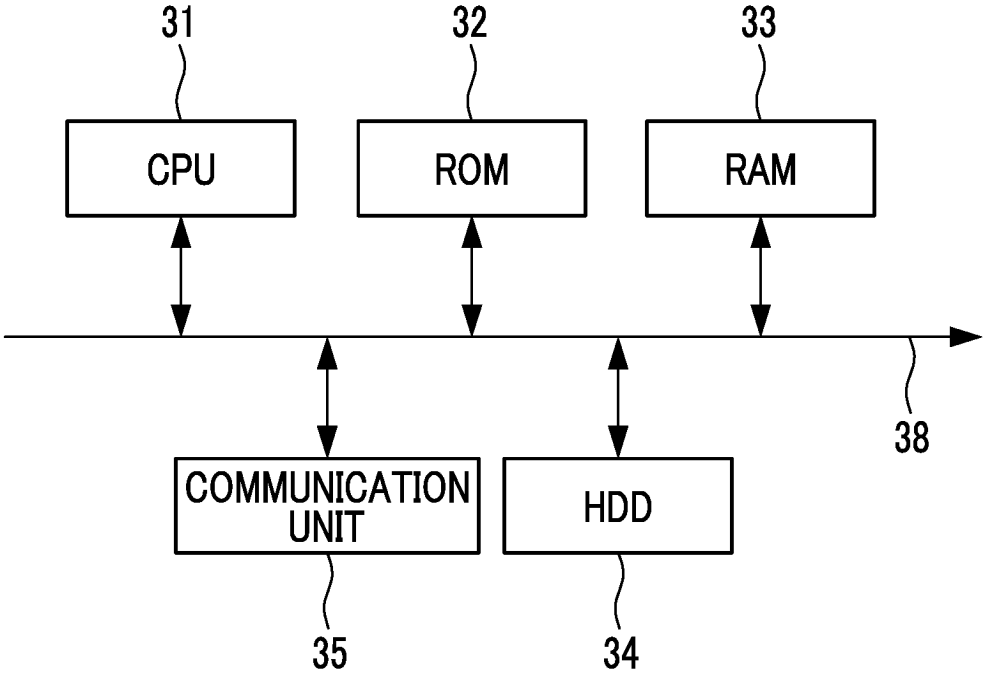

FIG. 4

DURING NORMAL OPERATION

INPUT				OUTPUT	
POWER SUPPLY	REFRIGERANT SENSOR 8	OPERATION PERFORMANCE AFTER POWER ON	CHARGING VOLTAGE OF POWER STORAGE UNIT 27	SOLENOID VALVE SV	ELECTRIC VALVE EV
ON	REFRIGERANT NOT DETECTED	／	6 V OR GREATER	OPEN	OPEN
		／	LESS THAN 6 V	CLOSE	CLOSE
	DETECTED	／	／	CLOSE	CLOSE

DURING COOLING OPERATION OF INDOOR UNIT GROUP 200

INPUT				OUTPUT	
POWER SUPPLY	REFRIGERANT SENSOR 8	OPERATION PERFORMANCE AFTER POWER ON	CHARGING VOLTAGE OF POWER STORAGE UNIT 27	SOLENOID VALVE SV	ELECTRIC VALVE EV
ON	REFRIGERANT NOT DETECTED	／	6 V OR GREATER	CLOSE	CLOSE
		／	LESS THAN 6 V	CLOSE	CLOSE
	DETECTED	／	／	CLOSE	CLOSE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/019336

A. CLASSIFICATION OF SUBJECT MATTER

H02J 9/06(2006.01)i; ***F24F 11/36***(2018.01)i; ***F24F 11/46***(2018.01)i; ***F24F 11/88***(2018.01)i; ***F25B 41/24***(2021.01)i; ***F25B 49/02***(2006.01)i
FI: H02J9/06 110; F24F11/36; F24F11/88; F25B49/02 520M; F25B41/24; F24F11/46

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H02J9/06; F24F11/36; F24F11/46; F24F11/88; F25B41/24; F25B49/02

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2020-134005 A (PANASONIC IP MANAGEMENT CO., LTD.) 31 August 2020 (2020-08-31) paragraphs [0013]-[0055]	1-7
Y	JP 2009-159730 A (PANASONIC ELECTRIC WORKS CO., LTD.) 16 July 2009 (2009-07-16) paragraph [0024]	1-7

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 June 2023	**04 July 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/019336

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2020-134005 A	31 August 2020	(Family: none)	
JP 2009-159730 A	16 July 2009	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2020134005 A **[0004]**