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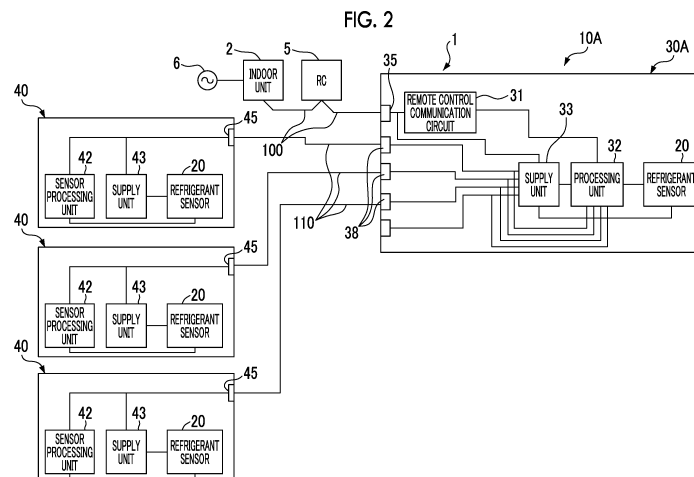
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(54) **REFRIGERANT DETECTION DEVICE AND AIR CONDITIONING SYSTEM**

(57) This refrigerant detection device comprises a signal processing kit that is connected to a remote control communication line to which a direct-current power supply voltage is supplied from an indoor unit. The signal processing kit is provided with a remote control communication circuit that is capable of connection with the remote control communication line, a supply unit that is capable of supplying a sensor drive voltage based on the direct-current power supply voltage to a refrigerant sen-

sor, and a processing unit that is capable of acquiring a refrigerant detection signal detected by the refrigerant sensor. The remote control communication circuit is capable of outputting a superimposed signal in which a pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage, and is capable of bidirectional communication with the indoor unit via the remote control communication line.



Description

Technical Field

[0001] The present disclosure relates to a refrigerant detection device and an air conditioning system.

[0002] This application claims priority to Japanese Patent Application No. 2022-077549, filed in Japan on May 10, 2022, the content of which is incorporated herein by reference.

Background Art

[0003] It is known to provide a refrigerant sensor in order to detect a refrigerant leakage of an air conditioning device. For example, PTL 1 discloses a configuration including a sensor (second sensor unit) capable of detecting a refrigerant and a power supply unit that supplies sensor drive power to the sensor, and detecting the occurrence of a refrigerant leakage based on a detection result of the sensor. In this configuration, the power supply unit is provided in the remote controller disposed below the indoor unit configuring the air conditioning device.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2018-162912

Summary of Invention

Technical Problem

[0005] In a case where the configuration as described in PTL 1 is applied to a commercial air conditioning device installed in a building or the like, the remote controller and the refrigerant sensor are connected to each other by a wired connection, and power supply and a transmission of a signal of the refrigerant sensor are performed through the wired connection. For this reason, in a case where the refrigerant sensor is disposed at a plurality of places in the room where the indoor unit is installed, the communication line may be lengthened depending on the distance between the remote controller and the refrigerant sensor. Then, there is a problem that the signal of the sensor is particularly susceptible to the influence of noise.

[0006] The present disclosure has been made to solve the above problems, and an object thereof is to provide a refrigerant detection device and an air conditioning system capable of suppressing the influence of noise.

Solution to Problem

[0007] In order to solve the above problems, according

to the present disclosure, there is provided a refrigerant detection device including a signal processing kit that is connected to a remote control communication line to which a direct-current power supply voltage is supplied from an indoor unit, in which the signal processing kit includes a remote control communication circuit that is connectable to the remote control communication line, a supply unit that is capable of supplying a sensor drive voltage based on the direct-current power supply voltage to a refrigerant sensor, and a processing unit that is capable of acquiring a refrigerant detection signal detected by the refrigerant sensor, and the remote control communication circuit is capable of outputting a superimposed signal in which a pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage, and performing bidirectional communication with the indoor unit via the remote control communication line.

Advantageous Effects of Invention

[0008] According to the refrigerant detection device and the air conditioning system of the present disclosure, the influence of noise can be suppressed.

Brief Description of Drawings

[0009]

Fig. 1 is a diagram illustrating a schematic configuration of an air conditioning system according to an embodiment of the present disclosure.

Fig. 2 is a diagram illustrating a functional configuration of a refrigerant detection device and an air conditioning system according to the first embodiment of the present disclosure.

Fig. 3 is a diagram illustrating a functional configuration of a refrigerant detection device and an air conditioning system according to a second embodiment of the present disclosure.

Fig. 4 is a diagram illustrating a functional configuration of a refrigerant detection device and an air conditioning system according to a third embodiment of the present disclosure.

Fig. 5 is a diagram illustrating a functional configuration of a refrigerant detection device and an air conditioning system according to a modification example of the third embodiment of the present disclosure.

Description of Embodiments

<First Embodiment>

(Configuration of Air Conditioning System)

[0010] Hereinafter, a refrigerant detection device and an air conditioning system according to an embodiment of the present disclosure will be described with reference

to Figs. 1 and 2.

[0011] As illustrated in Figs. 1 and 2, the air conditioning system 1 includes an indoor unit 2, an outdoor unit (not illustrated), a remote controller 5, and a refrigerant detection device 10A.

[0012] As illustrated in Fig. 1, the indoor unit 2 is provided in a room R provided in various buildings or structures.

[0013] The indoor unit 2 is disposed, for example, on the ceiling Rt of the room R.

[0014] The indoor unit 2 may be disposed on, for example, a wall Rw of the room R.

[0015] The indoor unit 2 and the outdoor unit are connected to each other via a refrigerant circuit (not illustrated).

[0016] A refrigerant circulates through a refrigerant circuit between the indoor unit 2 and the outdoor unit.

[0017] In the present embodiment, for example, a flammable gas is used as the refrigerant.

[0018] The flammable gas as the refrigerant is, for example, a Freon gas such as difluoromethane.

[0019] In the present embodiment, the specific gravity of the flammable gas is higher than that of the air, and the flammable gas sinks downward in the room R.

[0020] As illustrated in Fig. 2, the indoor unit 2 is operated by an alternating-current power supply voltage supplied from the alternating power supply 6.

[0021] The indoor unit 2 includes an AC-DC converter (not illustrated) that converts an alternating-current power supply voltage supplied from the alternating power supply 6 into a direct-current power supply voltage.

[0022] The indoor unit 2 supplies the converted direct-current power supply voltage to the remote controller 5 and the refrigerant detection device 10A via a remote control communication line 100 which will be described later.

[0023] The remote controller 5 is for remotely operating the indoor unit 2.

[0024] The remote controller 5 includes a button, a switch, or the like (not illustrated) for remotely operating the indoor unit 2.

[0025] As illustrated in Fig. 1, the remote controller 5 is disposed on, for example, a wall Rw of the room R.

[0026] The remote controller 5 is disposed below the indoor unit 2.

[0027] The remote controller 5 may have a lamp, a display screen, or the like indicating the operation state of the indoor unit 2.

[0028] The remote controller 5 is connected to the indoor unit 2 via a remote control communication line 100.

[0029] The remote controller 5 is operated by a direct-current power supply voltage supplied via a remote control communication line 100.

[0030] The remote controller 5 remotely operates the operation of the indoor unit 2 via the remote control communication line 100.

[0031] The remote controller 5 transfers a command signal for remotely operating the indoor unit 2 in the room

via the remote control communication line 100.

[0032] The remote control communication line 100 transfers a direct-current power supply voltage and a command signal in a superimposed manner.

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(Configuration of Refrigerant Detection Device)

[0033] As illustrated in Fig. 2, the refrigerant detection device 10A detects a leakage of the refrigerant from a refrigerant circuit (not illustrated).

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[0034] The refrigerant detection device 10A includes at least one or more refrigerant sensors 20 and a signal processing kit 30A.

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[0035] In the present embodiment, the refrigerant detection device 10A includes a plurality of refrigerant sensors 20, a signal processing kit 30A, and a sensor kit 40.

[0036] The refrigerant sensor 20 detects the refrigerant.

[0037] In a case where the refrigerant sensor 20 detects the refrigerant, the refrigerant sensor 20 outputs a refrigerant detection signal indicating that the refrigerant is detected.

[0038] In the present embodiment, the refrigerant sensor 20 is provided in each of the signal processing kit 30A and the sensor kit 40.

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[0039] As illustrated in Fig. 1, the refrigerant sensor 20 is disposed on, for example, a wall Rw of the room R.

[0040] The refrigerant sensor 20 is disposed within a predetermined range of height (for example, 30 cm) from the floor Rf of the room R.

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(Configuration of Signal Processing Kit)

[0041] As illustrated in Fig. 2, the signal processing kit 30A is connected to the remote control communication line 100.

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[0042] The signal processing kit 30A is supplied with a direct-current power supply voltage supplied from the indoor unit 2 via the remote control communication line 100.

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[0043] The signal processing kit 30A includes a remote control communication circuit 31, a processing unit 32, and a supply unit 33.

[0044] In the present embodiment, the signal processing kit 30A further includes a refrigerant sensor 20.

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[0045] The remote control communication circuit 31 can be connected to the remote control communication line 100.

[0046] The remote control communication circuit 31 is connected to the remote control communication line 100 via the input/output interface 35.

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[0047] The remote control communication circuit 31 can output a superimposed signal in which a pulse signal related to the refrigerant detection signal output in a case where the refrigerant is detected by the refrigerant sensor 20 is superimposed on the direct-current power supply voltage supplied from the indoor unit 2 to the remote control communication line 100.

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[0048] The remote control communication circuit 31 superimposes a pulse signal related to the refrigerant detection signal on the direct-current power supply voltage and transfers the pulse signal to the signal processing kit 30A via the remote control communication line 100, thereby performing two-wire communication between the power supply to the signal processing kit 30A and the refrigerant detection signal output from the refrigerant sensor 20 which will be described later.

[0049] The remote control communication circuit 31 can perform bidirectional communication with the indoor unit 2 via the remote control communication line 100.

[0050] The supply unit 33 drives the refrigerant sensor 20 by receiving the direct-current power supply voltage from the indoor unit 2 via the remote control communication line 100.

[0051] The supply unit 33 can supply a sensor drive voltage based on the direct-current power supply voltage to the sensor kit 40 (refrigerant sensor 20).

[0052] The supply unit 33 includes a DC-DC converter or the like (not illustrated) that reduces the direct-current power supply voltage supplied from the indoor unit 2 to a direct-current power supply voltage having a desired voltage, and supplies the direct-current power supply voltage reduced as a sensor drive voltage to the sensor kit 40.

[0053] The processing unit 32 receives the direct-current power supply voltage supplied from the indoor unit 2 via the remote control communication line 100 and the remote control communication circuit 31.

[0054] The processing unit 32 can acquire a refrigerant detection signal that is output in a case where the refrigerant is detected by the refrigerant sensor 20.

[0055] In a case where the processing unit 32 acquires the refrigerant detection signal output from the refrigerant sensor 20, the processing unit 32 outputs the refrigerant detection signal or a signal indicating that the refrigerant detection signal has been acquired, as a pulse signal associated with the refrigerant detection signal.

[0056] The processing unit 32 transfers the pulse signal output in a case where the refrigerant is detected by the refrigerant sensor 20 to the remote controller 5 and the indoor unit 2 via the remote control communication circuit 31 and the remote control communication line 100.

[0057] The processing unit 32 is a processor such as CPU in terms of hardware.

[0058] In a case where the indoor unit 2 receives the pulse signal output from the processing unit 32 in a case where the refrigerant is detected by the refrigerant sensor 20, that is, in a case where the leakage of the refrigerant is detected, for example, the indoor unit 2 stops the operation.

[0059] The remote controller 5 may be configured to output information indicating that a leakage of the refrigerant has occurred to the outside by displaying text information, turning on a lamp, or the like when the pulse signal output in a case where the refrigerant is detected by the refrigerant sensor 20 is received from the processing unit 32.

sing unit 32.

[0060] In addition, in a case where the processing unit 32 acquires the refrigerant detection signal output from the refrigerant sensor 20, the processing unit 32 may output to the outside that the refrigerant leakage has occurred by sounding of a buzzer (not illustrated) or the like.

(Configuration of Sensor Kit)

[0061] The sensor kit 40 is connected to the signal processing kit 30A via a sensor signal line 110.

[0062] In the present embodiment, a plurality of (for example, three) sensor kits 40 are disposed.

[0063] Each of the plurality of sensor kits 40 is provided with address information, and the processing unit 32 of the signal processing kit 30A can identify the plurality of sensor kits 40.

[0064] Each of the sensor kits 40 is connected to the connection interface 38 of the signal processing kit 30A via the sensor signal line 110.

[0065] The sensor signal line 110 is connected to the connection interface 45 of the sensor kit 40.

[0066] The sensor kit 40 is supplied with the direct-current power supply voltage supplied from the indoor unit 2 to the signal processing kit 30A via the sensor signal line 110.

[0067] The sensor kit 40 includes a sensor processing unit 42, a supply unit 43, and the refrigerant sensor 20.

[0068] The supply unit 43 drives the refrigerant sensor 20 by the direct-current power supply voltage received from the supply unit 33 of the signal processing kit 30A via the sensor signal line 110.

[0069] The supply unit 43 can supply a sensor drive voltage based on the direct-current power supply voltage to the refrigerant sensor 20.

[0070] The supply unit 43 supplies the direct-current power supply voltage received from the supply unit 33 of the signal processing kit 30A via the sensor signal line 110 to the refrigerant sensor 20 of the sensor kit 40 as a sensor drive voltage.

[0071] The sensor processing unit 42 receives a direct-current power supply voltage supplied from the supply unit 33 of the signal processing kit 30A via the sensor signal line 110.

[0072] The sensor processing unit 42 can acquire a refrigerant detection signal that is output in a case where the refrigerant is detected by the refrigerant sensor 20 of the sensor kit 40.

[0073] In a case where the sensor processing unit 42 acquires the refrigerant detection signal output from the refrigerant sensor 20, the sensor processing unit 42 outputs the refrigerant detection signal or a signal indicating that the refrigerant detection signal has been acquired, as a pulse signal associated with the refrigerant detection signal.

[0074] The sensor processing unit 42 transmits a pulse signal output in a case where the refrigerant is detected

by the refrigerant sensor 20 to the processing unit 32 of the signal processing kit 30A via the sensor signal line 110.

[0075] The processing unit 32 transfers the pulse signal transmitted via the sensor signal line 110 to the indoor unit 2.

[0076] In the refrigerant detection device 10A, the signal processing kit 30A receives the direct-current power supply voltage supplied from the indoor unit 2 via the remote control communication line 100 and the remote control communication circuit 31. The remote control communication circuit 31 outputs a superimposed signal in which a pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage. The supply unit 33 supplies a sensor drive voltage based on the direct-current power supply voltage received via the remote control communication circuit 31 to the refrigerant sensor 20. Accordingly, it is not necessary to separately provide a configuration for supplying power to the refrigerant sensor 20. When the refrigerant sensor 20 detects the refrigerant, the refrigerant sensor 20 outputs a refrigerant detection signal. When the processing unit 32 acquires the refrigerant detection signal detected by the refrigerant sensor 20, the processing unit 32 outputs the pulse signal related to the refrigerant detection signal to the indoor unit 2 via the remote control communication line 100. In this manner, in a case where the leakage of the refrigerant is detected by the refrigerant sensor 20, a measure such as stopping the indoor unit 2 can be taken.

[0077] According to the above-described configuration, the power supply to the refrigerant sensor 20 and the transmission of the pulse signal related to the refrigerant detection signal in the refrigerant sensor 20 are performed through the remote control communication line 100. Therefore, it is not necessary to newly provide a new signal line in order to supply power to the refrigerant sensor 20 and to transmit the pulse signal related to the refrigerant detection signal in the refrigerant sensor 20. In addition, since the remote control communication circuit 31 is capable of bidirectional communication with the indoor unit 2 via the remote control communication line 100, in a case where a pulse signal related to the refrigerant detection signal is transmitted from the remote control communication circuit 31 to the indoor unit 2, the indoor unit 2 responds to the remote control communication circuit 31 as to whether or not the pulse signal is correctly received on the indoor unit 2. Therefore, even in a case where the remote control communication line 100 is long and noise is likely to be superimposed on the pulse signal, in a case where the noise is superimposed on the pulse signal and the pulse signal is not correctly received on the indoor unit 2 side, the pulse signal with the superimposed noise can be discarded. As a result, it is possible to suppress the influence of noise.

[0078] In addition, the signal processing kit 30A further includes a refrigerant sensor 20 that can detect the refrigerant.

[0079] Accordingly, the refrigerant can be detected by the refrigerant sensor 20 included in the signal processing kit 30A.

[0080] In addition, the signal processing kit 30A further includes a sensor kit 40 that is connected to the signal processing kit 30A via the sensor signal line 110 and includes the refrigerant sensor 20.

[0081] Accordingly, the sensor kit 40 including the refrigerant sensor 20 can be provided at a position different from the signal processing kit 30A. In this case, the signal processing kit 30A and the sensor kit 40 are connected to each other via the sensor signal line 110. The power supply to the refrigerant sensor 20 and the transmission of the refrigerant detection signal of the refrigerant sensor 20 can be performed between the signal processing kit 30A and the refrigerant sensor 20 of the sensor kit 40 via the sensor signal line 110.

[0082] As described above, the sensor kit 40 is connected to the signal processing kit 30A which is connected to the indoor unit 2 via the remote control communication line 100. For this reason, the sensor kit 40 is not directly connected to the indoor unit 2. Therefore, it is not necessary to assign an address for control to the refrigerant sensor 20 of the sensor kit 40. Accordingly, the sensor kit 40 can be disposed by using the remote control communication line 100 without increasing the number of addresses, and the degree of design freedom of the entire refrigerant detection device 10A can be increased.

[0083] In addition, the sensor kit 40 further includes a sensor processing unit 42.

[0084] The sensor processing unit 42 outputs the refrigerant detection signal detected by the refrigerant sensor 20 to the signal processing kit 30A. Therefore, on the signal processing kit 30A side, even in a case where a plurality of the sensor kits 40 are disposed, it is possible to easily determine which refrigerant sensor 20 has detected the refrigerant.

[0085] In addition, the signal processing kit 30A is connected to the remote controller 5 via the remote control communication line 100.

[0086] As described above, the signal processing kit 30A is connected to the remote controller 5 via the remote control communication line 100. In this manner, the length of the remote control communication line 100 connecting the remote controller 5 and the signal processing kit 30A disposed at a lower position than the indoor unit 2 can be reduced compared to a case where the indoor unit 2 and the signal processing kit 30A often disposed at a high position such as the ceiling Rt are directly connected to each other via the remote control communication line 100.

[0087] In addition, by including the plurality of refrigerant sensors 20, the refrigerant detection device 10A which can detect the refrigerant at the plurality of places in the room R can be configured.

<Second Embodiment>

[0088] Next, a second embodiment will be described with reference to Fig. 3. In the second embodiment, the same components as those in the first embodiment will be denoted by the same reference numerals, and detailed description thereof will be omitted.

[0089] The signal processing kit 30B of the first embodiment includes the refrigerant sensor 20 and the sensor kit 40. On the other hand, in the second embodiment, the sensor kit 40 is not provided, and the refrigerant sensor 20 is disposed outside the signal processing kit 30B.

[0090] As illustrated in Fig. 3, the refrigerant detection device 10B of the air conditioning system 1 in the present embodiment includes one or more refrigerant sensors 20 and a signal processing kit 30B.

[0091] In the present embodiment, the refrigerant detection device 10B includes a plurality of refrigerant sensors 20 and a signal processing kit 30B.

(Configuration of Signal Processing Kit)

[0092] As illustrated in Fig. 3, the signal processing kit 30B is connected to the remote control communication line 100.

[0093] The signal processing kit 30B is supplied with a direct-current power supply voltage supplied from the indoor unit 2 via the remote control communication line 100.

[0094] The signal processing kit 30B includes a remote control communication circuit 31, a processing unit 32, and a supply unit 33.

[0095] The refrigerant sensor 20 is disposed outside the signal processing kit 30B.

[0096] The refrigerant sensor 20 is connected to the connection interface 38 of the signal processing kit 30B via the signal line 120.

[0097] In a case where the refrigerant sensor 20 detects the refrigerant, the refrigerant sensor 20 outputs a refrigerant detection signal indicating that the refrigerant is detected.

[0098] The processing unit 32 can acquire a refrigerant detection signal that is output in a case where the refrigerant is detected by the refrigerant sensor 20 disposed outside the signal processing kit 30B.

[0099] In a case where the processing unit 32 acquires the refrigerant detection signal output from the refrigerant sensor 20, the processing unit 32 outputs the refrigerant detection signal or a signal indicating that the refrigerant detection signal has been acquired, as a pulse signal associated with the refrigerant detection signal.

[0100] The processing unit 32 transfers the pulse signal output in a case where the refrigerant is detected by the refrigerant sensor 20 to the remote controller 5 and the indoor unit 2 via the remote control communication circuit 31 and the remote control communication line 100.

[0101] Also in the refrigerant detection device 10B, the remote control communication circuit 31 can perform the

bidirectional communication with the indoor unit 2 via the remote control communication line 100. Therefore, in a case where noise is superimposed on the pulse signal and the pulse signal is not correctly received on the indoor unit 2 side, the pulse signal with the superimposed noise can be discarded. As a result, it is possible to suppress the influence of noise.

<Third Embodiment>

[0102] Next, a third embodiment will be described with reference to Fig. 4. In the third embodiment, the same components as those in the first embodiment and the second embodiment are denoted by the same reference numerals, and a detailed description thereof will be omitted.

[0103] In the third embodiment, the plurality of signal processing kits 30C are provided, which is different from the first and second embodiments.

[0104] As illustrated in Fig. 4, the refrigerant detection device 10C of the air conditioning system 1 in the present embodiment includes one or more refrigerant sensors 20 and a signal processing kit 30C.

[0105] In the present embodiment, the refrigerant detection device 10C includes a plurality of refrigerant sensors 20 and a signal processing kit 30C.

(Configuration of Signal Processing Kit)

[0106] As illustrated in Fig. 4, the plurality of signal processing kits 30C are respectively connected to the remote control communication line 100.

[0107] The plurality of signal processing kits 30C are connected in parallel to the remote controller 5 by the remote control communication line 100.

[0108] A direct-current power supply voltage supplied from the indoor unit 2 is supplied to each of the signal processing kits 30C via the remote control communication line 100.

[0109] Each of the signal processing kits 30C includes a remote control communication circuit 31, a processing unit 32, and a supply unit 33.

[0110] The refrigerant sensor 20 is disposed outside each of the signal processing kits 30C.

[0111] The refrigerant sensor 20 is connected to the connection interface 38 of each signal processing kit 30C via the signal line 120.

[0112] The processing unit 32 can acquire a refrigerant detection signal that is output in a case where the refrigerant is detected by the refrigerant sensor 20 disposed outside the signal processing kit 30C.

[0113] In a case where the processing unit 32 acquires the refrigerant detection signal output from the refrigerant sensor 20, the processing unit 32 outputs the refrigerant detection signal or a signal indicating that the refrigerant detection signal has been acquired, as a pulse signal associated with the refrigerant detection signal.

[0114] The processing unit 32 transfers the pulse sig-

nal output in a case where the refrigerant is detected by the refrigerant sensor 20 to the remote controller 5 and the indoor unit 2 via the remote control communication circuit 31 and the remote control communication line 100.

[0115] Also in the refrigerant detection device 10C, the remote control communication circuit 31 can perform the bidirectional communication with the indoor unit 2 via the remote control communication line 100. Therefore, in a case where noise is superimposed on the pulse signal and the pulse signal is not correctly received on the indoor unit 2 side, the pulse signal with the superimposed noise can be discarded. As a result, it is possible to suppress the influence of noise.

[0116] In the refrigerant detection device 10C, a plurality of the signal processing kits 30C are connected to the remote control communication line 100.

[0117] Accordingly, the plurality of signal processing kits 30C can be disposed via the remote control communication line 100 with the indoor unit 2 as a starting point.

(Modification Example of Third Embodiment)

[0118] As illustrated in Fig. 5, the signal processing kit 30C of the refrigerant detection device 10C illustrated in the third embodiment may further include a temperature sensor 50 capable of detecting the temperature of a space air-conditioned by the indoor unit 2.

[0119] In the refrigerant detection device 10C, the temperature sensor 50 that detects the temperature of the space air-conditioned by the indoor unit 2 is provided. In this manner, the temperature change of the space caused by the leakage of the refrigerant can be detected with a higher sensitivity.

[0120] In addition, the temperature sensor 50 is provided in the signal processing kit 30C disposed at a position lower than the indoor unit 2. In this manner, the temperature in the vicinity of a person in the indoor space can be more accurately detected.

[0121] Although the embodiments of the present disclosure have been described above, the embodiments are presented as examples and are not intended to limit the scope of the disclosure. The embodiments can be implemented in various other embodiments, and various omissions, replacements, and changes can be made without departing from the spirit of the disclosure. These embodiments and modifications thereof are included in the claims and the equivalents thereof as well as in the scope of the disclosure and the spirit thereof.

[0122] For example, in the above embodiment, the remote controller 5 is disposed between the signal processing kits 30A to 30C and the indoor unit 2. However, the present disclosure is not limited to such a configuration. The signal processing kits 30A to 30C may be directly connected to the remote control communication line 100 without the remote controller 5.

<Supplementary Notes>

[0123] The refrigerant detection devices 10A, 10B, and 10C and the air conditioning system 1 described in each embodiment are understood as follows, for example.

[0124]

(1) The refrigerant detection devices 10A, 10B, and 10C according to a first aspect include the signal processing kits 30A, 30B, and 30C connected to the remote control communication line 100 to which the direct-current power supply voltage is supplied from the indoor unit 2, the signal processing kits 30A, 30B, and 30C include the remote control communication circuit 31 that is connectable to the remote control communication line 100, the supply unit 33 that is capable of supplying the sensor drive voltage based on the direct-current power supply voltage to the refrigerant sensor 20, and the processing unit 32 that is capable of acquiring the refrigerant detection signal detected by the refrigerant sensor 20, and the remote control communication circuit 31 is capable of outputting the superimposed signal in which the pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage, and performing bidirectional communication with the indoor unit 2 via the remote control communication line 100.

[0125] In the refrigerant detection devices 10A, 10B, and 10C, the signal processing kits 30A, 30B, and 30C receive the direct-current power supply voltage supplied from the indoor unit 2 via the remote control communication line 100 and the remote control communication circuit 31. The remote control communication circuit 31 outputs a superimposed signal in which a pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage. The supply unit 33 supplies a sensor drive voltage based on the direct-current power supply voltage received via the remote control communication circuit 31 to the refrigerant sensor 20. Accordingly, it is not necessary to separately provide a configuration for supplying power to the refrigerant sensor 20. When the refrigerant sensor 20 detects the refrigerant, the refrigerant sensor 20 outputs a refrigerant detection signal. When the processing unit 32 acquires the refrigerant detection signal detected by the refrigerant sensor 20, the processing unit 32 outputs the pulse signal related to the refrigerant detection signal to the indoor unit 2 via the remote control communication line 100. In this way, the pulse signal related to the refrigerant detection signal is transmitted via the remote control communication line 100. Therefore, it is not necessary to newly provide a signal line for transmitting the pulse signal. In addition, since the remote control communication circuit 31 is capable of bidirectional communication with the indoor unit 2 via the remote control communication line 100, for example, in a case where

a pulse signal related to a refrigerant detection signal is transmitted from the remote control communication circuit 31 to the indoor unit 2, the indoor unit 2 can respond to the remote control communication circuit 31 as to whether or not the pulse signal is correctly received in the indoor unit 2 or the like. Therefore, even in a case where the remote control communication line 100 is long and noise is likely to be superimposed on the pulse signal, in a case where the noise is superimposed on the pulse signal and the pulse signal is not correctly received on the indoor unit 2 side, the pulse signal with the superimposed noise can be discarded. As a result, it is possible to suppress the influence of noise.

[0126] (2) The refrigerant detection device 10A according to a second aspect is the refrigerant detection device 10A according to (1), in which the signal processing kit 30A further includes the refrigerant sensor 20 capable of detecting the refrigerant.

[0127] Accordingly, the refrigerant can be detected by the refrigerant sensor 20 included in the signal processing kit 30A.

[0128] (3) The refrigerant detection device 10A according to a third aspect is the refrigerant detection device 10A according to (1) or (2), further including the sensor kit 40 that is connected to the signal processing kit 30A via the sensor signal line 110 and includes the refrigerant sensor 20 capable of detecting the refrigerant.

[0129] In this manner, in a case where the sensor kit 40 including the refrigerant sensor 20 is provided at a position different from the signal processing kit 30A, the signal processing kit 30A and the sensor kit 40 are connected to each other via the sensor signal line 110. The power supply to the refrigerant sensor 20 and the transmission of the refrigerant detection signal of the refrigerant sensor 20 can be performed between the signal processing kit 30A and the refrigerant sensor 20 of the sensor kit 40 via the sensor signal line 110.

[0130] As described above, the sensor kit 40 is connected to the signal processing kit 30A which is connected to the indoor unit 2 via the remote control communication line 100. For this reason, the sensor kit 40 is not directly connected to the indoor unit 2. Therefore, it is not necessary to assign an address for control to the refrigerant sensor 20 of the sensor kit 40. Accordingly, the sensor kit 40 can be disposed by using the remote control communication line 100 without increasing the number of addresses, and the degree of design freedom of the entire refrigerant detection device 10A can be increased.

[0131] (4) The refrigerant detection device 10A according to a fourth aspect is the refrigerant detection device 10A according to (3), in which the sensor kit 40 further includes the sensor processing unit 42 that is capable of acquiring the refrigerant detection signal detected by the refrigerant sensor 20 and outputting the refrigerant detection signal to the signal processing kit 30A.

[0132] In this manner, the sensor processing unit 42 outputs the refrigerant detection signal detected by the refrigerant sensor 20 to the signal processing kit 30A.

Therefore, on the signal processing kit 30A side, even in a case where a plurality of the sensor kits 40 are disposed, it is possible to easily determine which refrigerant sensor 20 has detected the refrigerant.

[0133] (5) The refrigerant detection device 10C according to a fifth aspect is the refrigerant detection device 10C according to any one of (1) to (4), in which a plurality of the signal processing kits 30C are connected to the remote control communication line 100.

[0134] Accordingly, the plurality of signal processing kits 30C are connected to the remote control communication line 100, so that the plurality of signal processing kits 30C can be disposed via the remote control communication line 100 with the indoor unit 2 as a starting point.

[0135] (6) The refrigerant detection devices 10A, 10B, and 10C according to a sixth aspect are the refrigerant detection devices 10A, 10B, and 10C according to any one of (1) to (5), further including the remote controller 5 that is connected to the remote control communication line 100 and that is capable of performing remote operation of the indoor unit 2, in which the signal processing kits 30A, 30B, and 30C are connected to the remote controller 5 via the remote control communication line 100.

[0136] Accordingly, the signal processing kits 30A, 30B, and 30C are connected to the remote controller 5 via the remote control communication line 100, so that the length of the remote control communication line 100 connecting the remote controller 5 and the signal processing kits 30A, 30B, and 30C disposed at a lower position than the indoor unit 2 can be reduced, compared to a case where the indoor unit 2 and the signal processing kits 30A, 30B, and 30C often disposed at a high position such as the ceiling Rt are connected to each other via the remote control communication line 100.

[0137] (7) The refrigerant detection devices 10A, 10B, and 10C according to a seventh aspect are the refrigerant detection devices 10A, 10B, and 10C according to any one of (1) to (6), including a plurality of the refrigerant sensors 20.

[0138] Accordingly, by including the plurality of refrigerant sensors 20, the refrigerant detection devices 10A, 10B, and 10C that can detect the refrigerant at the plurality of places in the room R can be configured.

[0139] (8) The refrigerant detection devices 10A, 10B, and 10C according to an eighth aspect are the refrigerant detection devices 10A, 10B, and 10C according to any one of (1) to (7), in which the signal processing kits 30A, 30B, and 30C further include the temperature sensor 50 capable of detecting the temperature of the space air-conditioned by the indoor unit 2.

[0140] Accordingly, the signal processing kits 30A, 30B, and 30C include the temperature sensor 50 that detects the temperature of the space air-conditioned by the indoor unit 2 with the temperature sensor 50. In this manner, the signal processing kits 30A, 30B, and 30C can detect the temperature change of the space caused by the leakage of the refrigerant with a higher sensitivity.

[0141] (9) The air conditioning system 1 according to a

ninth aspect includes the refrigerant detection devices 10A, 10B, and 10C according to any one of (1) to (8).

[0142] Accordingly, the air conditioning system 1 including the refrigerant detection devices 10A, 10B, and 10C capable of suppressing the influence of noise can be configured. 5

Industrial Applicability

[0143] According to the refrigerant detection device 10 and the air conditioning system of the present disclosure, the influence of noise can be suppressed.

Reference Signs List

[0144]

1: Air conditioning system
 2: Indoor unit
 5: Remote controller
 6: Alternating power supply
 10A to 10C: Refrigerant detection device
 20: Refrigerant sensor
 30A to 30C: Signal processing kit
 31: Remote control communication circuit
 32: Processing unit
 33: Supply unit
 35: Input/output interface
 38: Connection interface
 40: Sensor kit
 42: Sensor processing unit
 43: Supply unit
 45: Connection interface
 50: Temperature sensor
 100: Remote control communication line
 110: Sensor signal line
 120: Signal line
 R: Room
 Rf: Floor
 Rt: Ceiling
 Rw: Wall

Claims

1. A refrigerant detection device comprising:

a signal processing kit that is connected to a remote control communication line to which a direct-current power supply voltage is supplied from an indoor unit, 50
 wherein the signal processing kit includes

a remote control communication circuit that is connectable to the remote control communication line, 55
 a supply unit that is capable of supplying a sensor drive voltage based on the direct-

current power supply voltage to a refrigerant sensor, and
 a processing unit that is capable of acquiring a refrigerant detection signal detected by the refrigerant sensor, and

the remote control communication circuit is capable of

outputting a superimposed signal in which a pulse signal related to the refrigerant detection signal is superimposed on the direct-current power supply voltage, and performing bidirectional communication with the indoor unit via the remote control communication line.

2. The refrigerant detection device according to claim 1, wherein the signal processing kit further includes the refrigerant sensor that is capable of detecting a refrigerant.

3. The refrigerant detection device according to claim 1 or 2, further comprising: a sensor kit that is connected to the signal processing kit via a sensor signal line and includes the refrigerant sensor capable of detecting a refrigerant.

4. The refrigerant detection device according to claim 3, wherein the sensor kit further includes a sensor processing unit that is capable of acquiring the refrigerant detection signal detected by the refrigerant sensor and outputting the refrigerant detection signal to the signal processing kit.

5. The refrigerant detection device according to claim 1 or 2, wherein a plurality of the signal processing kits are connected to the remote control communication line.

6. The refrigerant detection device according to claim 1 or 2, further comprising:

a remote controller connected to the remote control communication line and capable of performing remote operation of the indoor unit, wherein the signal processing kit is connected to the remote controller via the remote control communication line.

7. The refrigerant detection device according to claim 1 or 2, comprising: a plurality of the refrigerant sensors.

8. The refrigerant detection device according to claim 1 or 2,

wherein the signal processing kit further includes a temperature sensor that is capable of detecting a temperature of a space which is air-conditioned by the indoor unit.

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9. An air conditioning system comprising:
the refrigerant detection device according to claim 1
or 2.

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FIG. 1

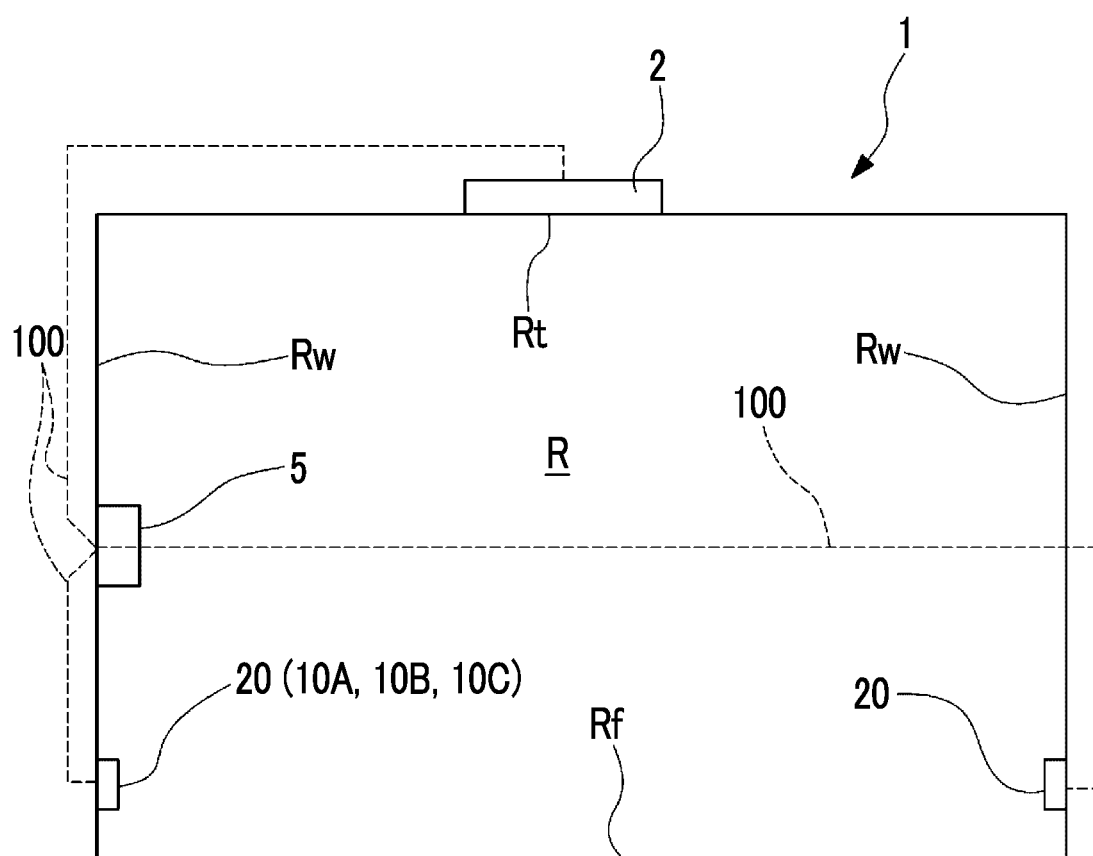


FIG. 2

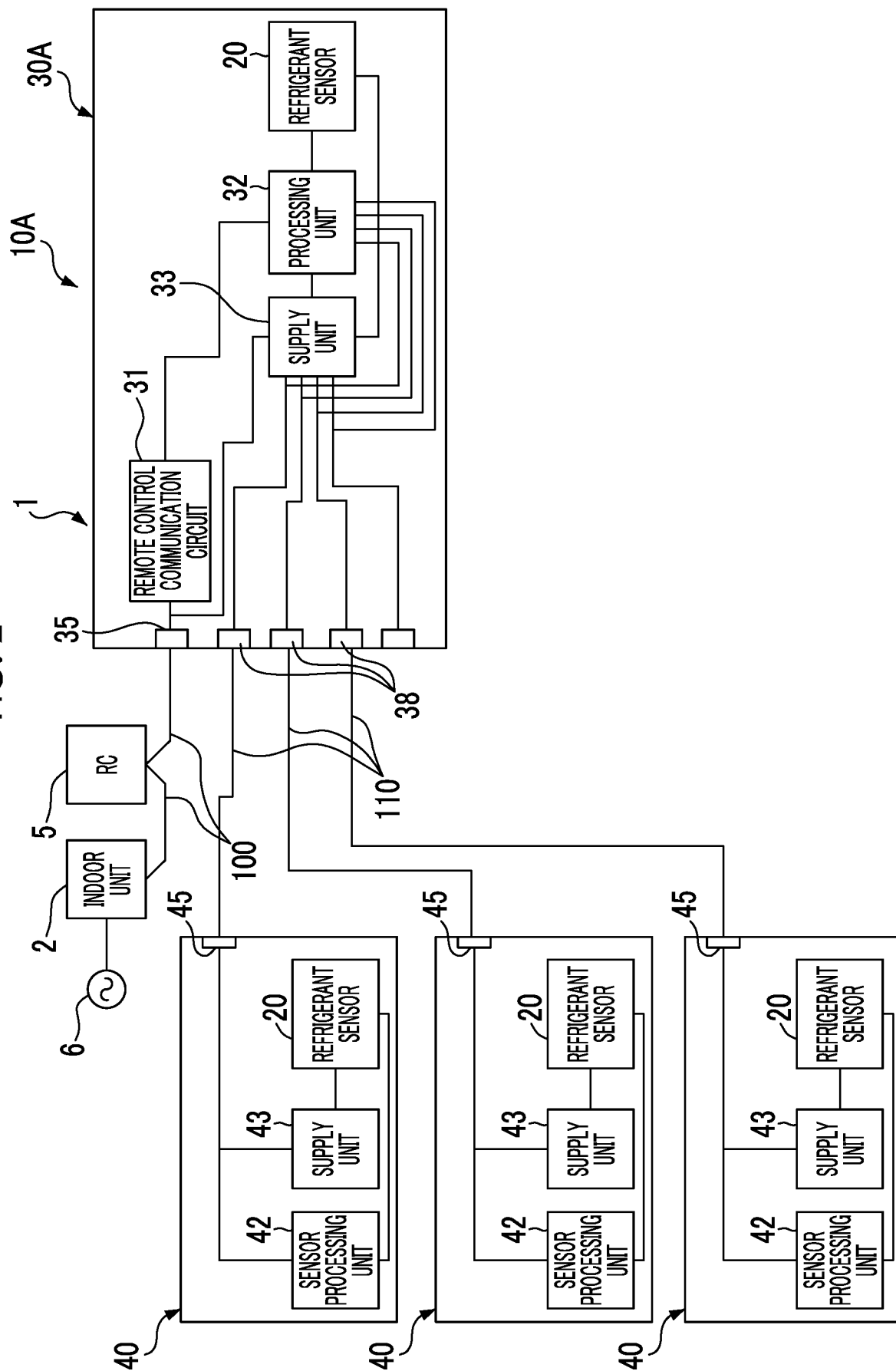


FIG. 3

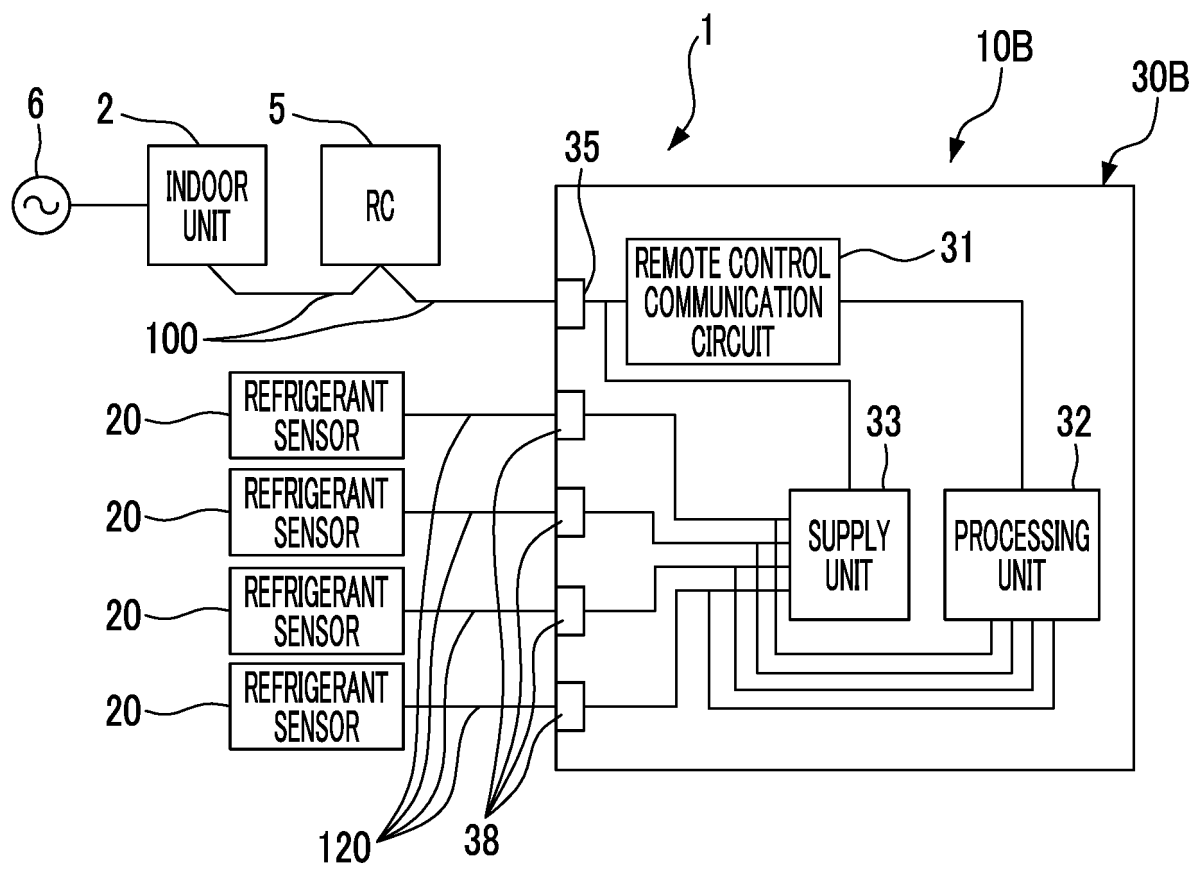


FIG. 4

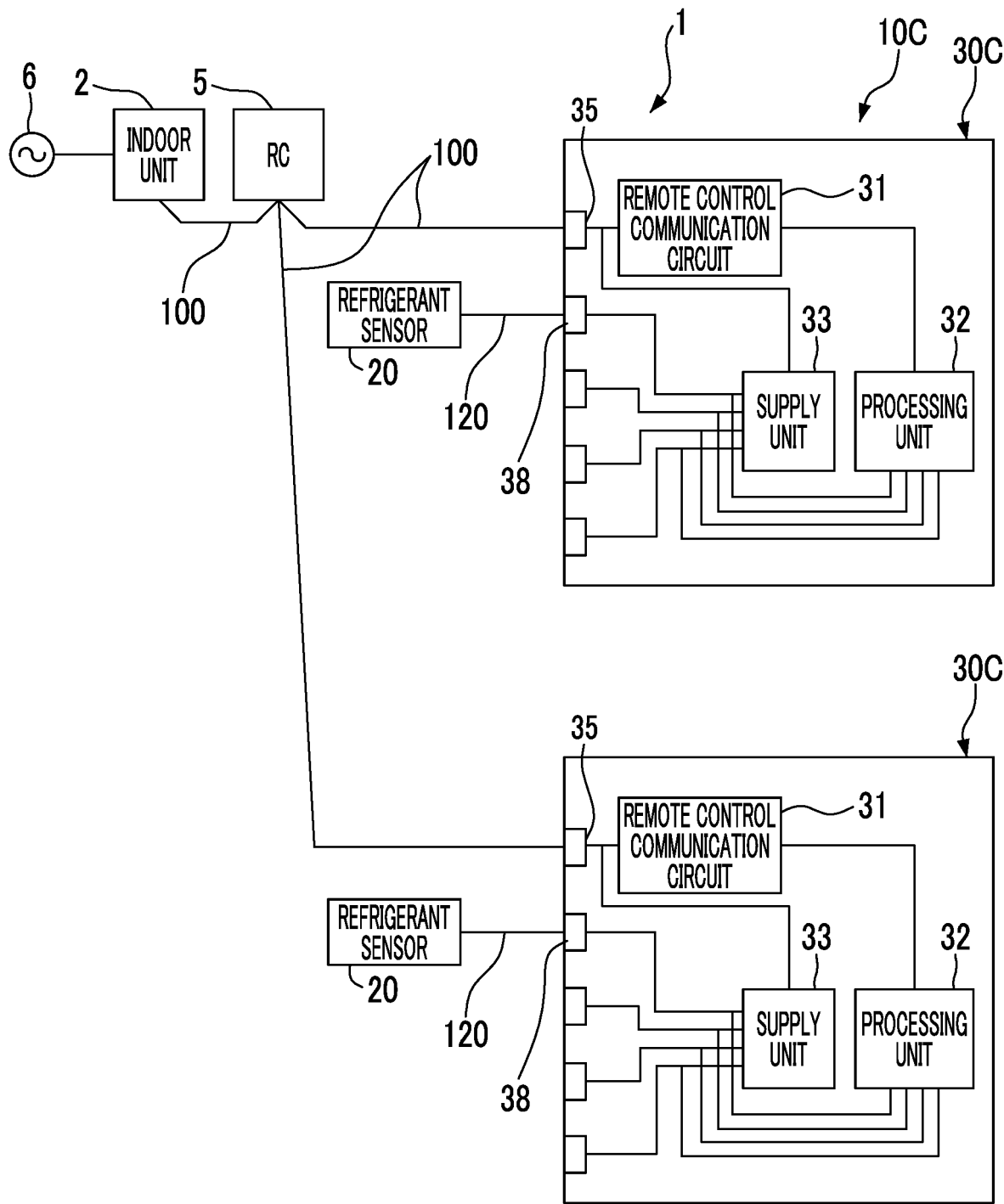
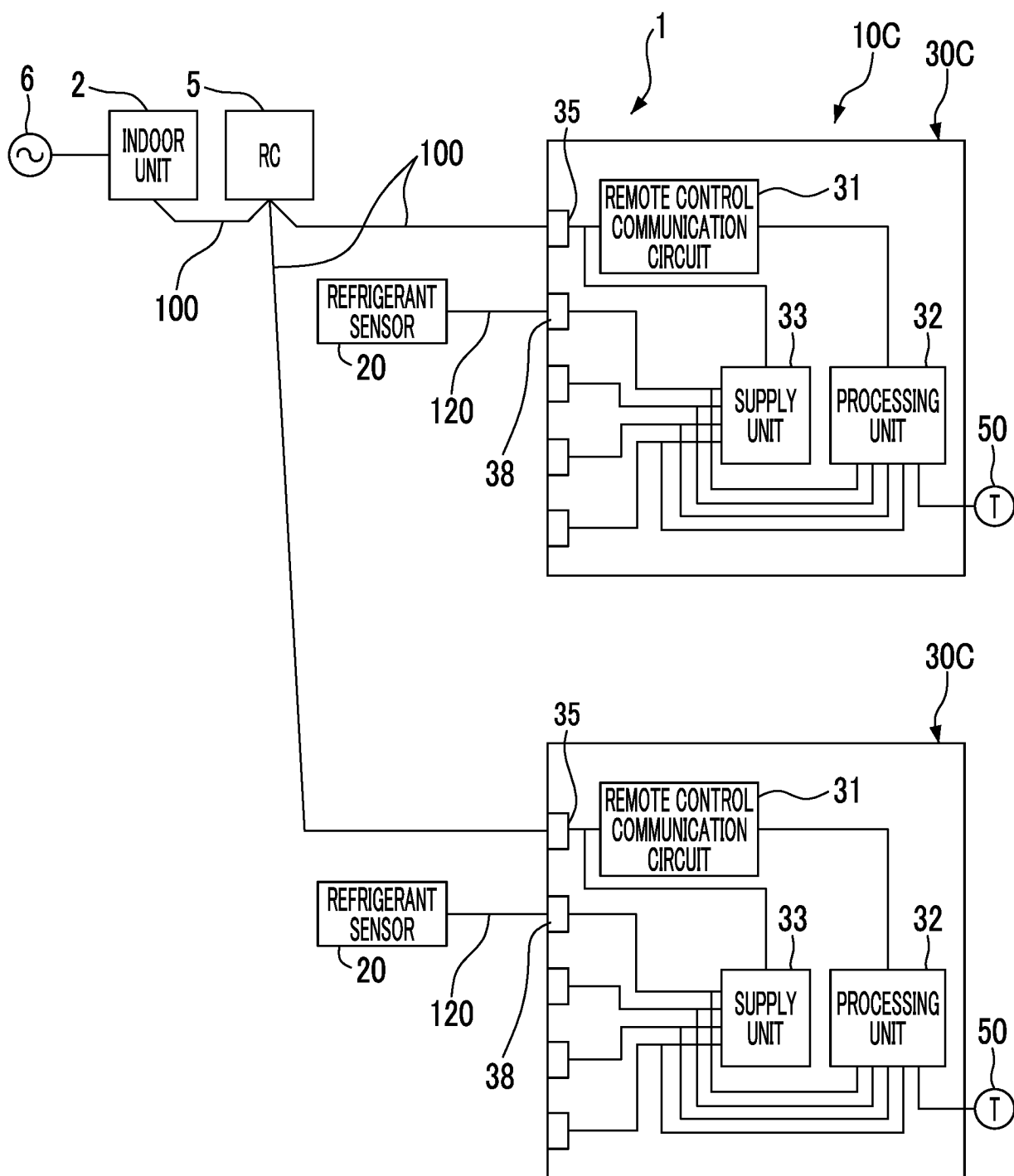


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/017299

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/50(2018.01)i; **F24F 11/36**(2018.01)i; **F24F 11/56**(2018.01)i; **F24F 11/89**(2018.01)i; **F25B 49/02**(2006.01)i
FI: F24F11/50; F24F11/89; F24F11/56; F25B49/02 520M; F24F11/36

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)

F24F11/00-11/89; 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.
A	JP 2013-181700 A (PANASONIC CORP) 12 September 2013 (2013-09-12) paragraphs [0021]-[0050], fig. 1-4	1-9
A	JP 2020-197350 A (HITACHI JOHNSON CONTROLS AIR CONDITIONING INC) 10 December 2020 (2020-12-10) paragraph [0047], fig. 2, 6	1-9
A	JP 2018-162912 A (MITSUBISHI ELECTRIC CORP) 18 October 2018 (2018-10-18) entire text, all drawings	1-9
A	JP 2017-53571 A (JOHNSON CONTROLS HITACHI AIR CONDITIONING TECH (HONGKONG) LTD) 16 March 2017 (2017-03-16) entire text, all drawings	1-9
A	WO 2017/195365 A1 (MITSUBISHI ELECTRIC CORP) 16 November 2017 (2017-11-16) entire text, all drawings	1-9
A	WO 2018/220758 A1 (MITSUBISHI ELECTRIC CORP) 06 December 2018 (2018-12-06) entire text, all drawings	1-9

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Date of the actual completion of the international search

07 July 2023

Date of mailing of the international search report

25 July 2023

Name and mailing address of the ISA/JP

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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/017299

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2013-181700 A	12 September 2013	(Family: none)	
JP 2020-197350 A	10 December 2020	EP 3748244 A2 paragraph [0069], fig. 2, 6 CN 112032824 A	
JP 2018-162912 A	18 October 2018	(Family: none)	
JP 2017-53571 A	16 March 2017	(Family: none)	
WO 2017/195365 A1	16 November 2017	EP 3457043 A1 entire text, all drawings CN 109073263 A	
WO 2018/220758 A1	06 December 2018	GB 2575606 A entire text, all drawings	

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

REFERENCES CITED IN THE DESCRIPTION

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- JP 2018162912 A [0004]