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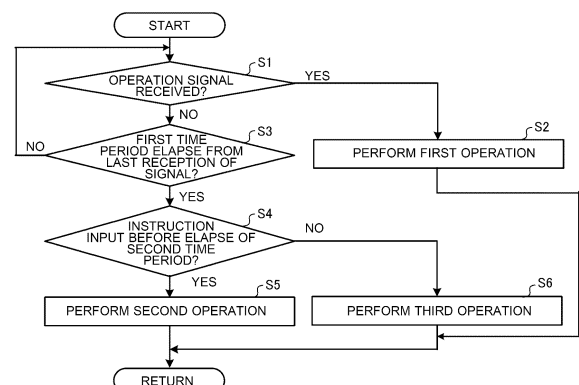
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(54) **HEAT PUMP SYSTEM AND CONTROL SYSTEM**

(57) A heat pump system includes a heat pump apparatus, a communication device, an input device, and a controller. The heat pump apparatus controls the temperature of a substance. The communication device receives from the server, a signal including an operation signal regarding the operation of the heat pump apparatus. The input device is configured for a user to input an instruction for the heat pump apparatus. The controller causes the heat pump apparatus to perform a first operation based on an operation signal while the communication device is receiving a signal. When the communication device does not receive a signal for a predetermined first time period or longer, the controller causes the heat pump apparatus to perform a second operation based on the instruction input to the input device.

FIG. 5



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Description

Solution to Problem

Technical Field

[0001] The present disclosure relates to a heat pump system that operates based on a signal received via a network and a control system including the heat pump system.

Background Art

[0002] In recent years, in the field of heat pumps, a larger number of heat pumps have had the aim of optimizing the operation of a heat pump apparatus. In order to optimize the operation of heat pump apparatus, it is necessary to obtain data indicating at least any of the capability of the heat pump apparatus, the type of the heat pump apparatus, a weather condition at the location where the heat pump apparatus is installed, the operation schedule of the heat pump apparatus, etc. However, the amount of such data can be huge as the amount of data to be processed by a controller, such as a remote control provided at the heat pump apparatus. Therefore, in most cases, a remotely installed server determines an optimal operation of the heat pump apparatus based on the data. The server then transmits information regarding the determined optimal operation to a heat pump system through Internet connection and causes the heat pump apparatus to perform the optimal operation (see, for example, Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: International Publication No. 2020/059473

Summary of Invention

Technical Problem

[0004] In the above system in which the server manages the operation of the heat pump apparatus, it may be set that the user is not allowed to operate the heat pump apparatus, in order to prevent the user from interfering with an operation management by the server. In such a case, for example, if communication is lost due to a disaster such as a typhoon, the heat pump apparatus fails to receive a signal from the server, and as a result, may unable to operate, or perform an undesired operation for the user.

[0005] The present disclosure is applied to solve the above problem, and relates to a heat pump system and a control system that enable a heat pump apparatus to perform a desired operation for the user when communication with a server is lost.

[0006] A heat pump system according to an embodiment of the present disclosure includes: a heat pump apparatus configured to adjust a temperature of a substance; a communication device configured to communicate with a server to receive from the server, a signal including an operation signal regarding an operation of the heat pump apparatus; an input device configured to input an instruction for the heat pump apparatus; and a controller configured to causes the heat pump apparatus to perform a first operation based on the operation signal while the communication device is receiving the signal. The controller is configured to cause, when the communication device does not receive the signal for a predetermined first time period or longer, the heat pump apparatus to perform a second operation based on the instruction input to the input device.

[0007] A control system according to another embodiment of the present disclosure includes: a server; a heat pump apparatus configured to adjust a temperature of a substance; a communication device configured to communicate with the server to receive from the server, a signal including an operation signal regarding an operation of the heat pump apparatus; an input device configured to input an instruction for the heat pump apparatus; and a controller configured to causes as a control, the heat pump apparatus to perform a first operation based on the operation signal while the communication device is receiving the signal. The controller is configured to cause as a control, when the communication device does not receive the signal for predetermined first time period or longer, the heat pump apparatus to perform a second operation based on the instruction input to the input device.

Advantageous Effects of Invention

[0008] In the heat pump system and the control system according to the embodiments of the present disclosure, when the communication device does not receive a signal from the server for the first time period, the controller causes the heat pump apparatus to perform the second operation based on an instruction input to the input device. Thus, the heat pump apparatus can operate even when communication is lost. Furthermore, a user can cause the heat pump apparatus to perform a desired operation by inputting an instruction to the input device.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a block diagram illustrating a configuration example of a control system and a heat pump system according to Embodiment 1.

[Fig. 2] Fig. 2 is a block diagram illustrating a configuration example of the heat pump system according-

ing to Embodiment 1 in the case where the heat pump system includes a remote control.

[Fig. 3] Fig. 3 is a block diagram illustrating a first example of the hardware configuration of the heat pump system according to Embodiment 1.

[Fig. 4] Fig. 4 is a block diagram illustrating a second example of the hardware configuration of the heat pump system according to Embodiment 1.

[Fig. 5] Fig. 5 is a flowchart illustrating a control process for a heat pump apparatus that is executed by a controller of Embodiment 1.

[Fig. 6] Fig. 6 is a block diagram illustrating a configuration example of a heat pump system and a control system according to Embodiment 2.

[Fig. 7] Fig. 7 is a block diagram illustrating a configuration example of the heat pump system according to Embodiment 2 in the case where the heat pump system includes a remote control.

[Fig. 8] Fig. 8 illustrates an example of a notification made by a notification device of Embodiment 2.

[Fig. 9] Fig. 9 is a block diagram illustrating a first example of the hardware configuration of the heat pump system according to Embodiment 2.

[Fig. 10] Fig. 10 is a block diagram illustrating a second example of the hardware configuration of the heat pump system according to Embodiment 2.

[Fig. 11] Fig. 11 is a flowchart illustrating a control process for a heat pump apparatus and the notification device that is executed by a controller of Embodiment 2.

[Fig. 12] Fig. 12 is a flowchart illustrating a control process for a heat pump apparatus and a notification device that is executed by a controller of Embodiment 3.

[Fig. 13] Fig. 13 illustrates a configuration example of a control system according to Embodiment 4.

Description of Embodiments

[0010] Hereinafter, heat pump systems and control systems according to embodiments will be described in detail with reference to the drawings.

Embodiment 1

[0011] Fig. 1 is a block diagram illustrating a configuration example of a control system and a heat pump system according to Embodiment 1. A control system 100 includes a heat pump system 1 and a server 3. The server 3 is, for example, a cloud server, and wirelessly communicates with the heat pump system 1.

[0012] The heat pump system 1 includes a heat pump apparatus 10, a communication device 11, an input device 12, and a controller 13. The communication device 11 and the controller 13 may be provided in a housing that forms an outer portion of the heat pump apparatus 10 or outside the housing. The input device 12 may be provided on a surface of the housing of the heat pump apparatus

10 or may be provided separate from the heat pump apparatus 10.

[0013] The heat pump apparatus 10 is a heat pump-type apparatus that adjusts the temperature of a substance such as water or air. The heat pump apparatus 10 is, for example, a water heater, air-conditioning apparatus, a freezer, or a refrigerator. The communication device 11 wirelessly communicates with the server 3 and receives a signal from the server 3. As the signal, various kinds of signals are present. One of the signals is an operation signal regarding the operation of the heat pump apparatus 10. The communication device 11 periodically receives the operation signal from the server 3.

[0014] The operation signal is a signal that indicates an operation content of the heat pump apparatus 10. The operation content may correspond to an operation schedule. For example, in the case where the heat pump apparatus 10 is a water heater, as the operation content, a target storage amount of hot water and a target temperature are present. The target storage amount of hot water means the target amount of hot water to be stored in a tank of the water heater. The target temperature means the target temperature of hot water stored in the tank.

[0015] The signals that are transmitted from the server 3 to the communication device 11 include a condition request signal in addition to the operation signal. The condition request signal is a signal that requests information indicating the current operating condition of the heat pump apparatus 10. In the case where the heat pump apparatus 10 is a water heater, the information indicating the current operating condition of the heat pump apparatus 10 corresponds to the current amount of hot water stored in the tank and the current temperature of the hot water in the tank.

[0016] The various kinds of signals that are transmitted from the server 3 to the communication device 11 may include a response request signal that requests a response from the heat pump system 1 and that is transmitted as a request from the server 3. The response request signal is intended to confirm whether or not communication of the server 3 with the heat pump system 1 is established.

[0017] The input device 12 corresponds to, for example, buttons or a touch panel that enables a user to input an instruction to the heat pump apparatus 10.

[0018] The controller 13 causes the heat pump apparatus 10 to perform a first operation based on an operation signal that the communication device 11 receives from the server 3. While the communication device 11 is receiving a signal from the server 3, that is, while communication between the communication device 11 and the server 3 is established, the controller 13 causes the heat pump apparatus 10 to perform the first operation, even when the user inputs an instruction to the input device 12.

[0019] It should be noted that in order to optimize the operation of the heat pump apparatus 10, it is necessary

to provide information indicating at least any of a weather condition at the location where the heat pump apparatus 10 is installed, the model of the heat pump apparatus 10, the capability of the heat pump apparatus 10, a desired temperature of the substance for the user, and a desired operation schedule of the heat pump apparatus 10 for the user. In the following, information necessary for optimization of the operation of the heat pump apparatus 10 may be referred to as optimization information. In some cases, the optimization information is a huge amount of data for processing by the heat pump system 1. Therefore, instead of the heat pump system 1, the server 3 produces an operation signal regarding the operation of the heat pump apparatus 10 based on the optimization information. The heat pump apparatus 10 operates in response to the operation signal, whereby the operation of the heat pump apparatus 10 is optimized. By contrast, the instruction input to the input device 12 do not necessarily optimize the operation of the heat pump apparatus 10. In addition, in some cases, the contents of the instruction do not necessarily conform to content indicated by the operation signal. While communication between the communication device 11 and the server 3 is established, even when an instruction is input to the input device 12, the controller 13 causes the heat pump apparatus 10 to perform the first operation based on the operation signal, in order to prevent optimization of the operation of the heat pump apparatus 10 from being hindered by the instruction input by the input device 12.

[0020] Communication between the heat pump system 1 and the server 3 may be lost when a disaster such as a typhoon occurs. If the communication is lost for a long time period, the operation of the heat pump apparatus 10 may be stopped for a long time period or the heat pump apparatus 10 may perform, based on, for example, a default value, an undesired operation for the user, or an operation that does not match an actual condition. The operation that is based on the default value and does not match the actual condition means an operation that can cause shortage of hot water in the case where the heat pump apparatus 10 is a water heater. In order to avoid such a situation, the heat pump system 1 according to Embodiment 1 has the following functions.

[0021] When the communication device 11 does not receive a signal from the server 3 for a predetermined first time period or longer, the controller 13 of Embodiment 1 causes the heat pump apparatus 10 to perform a second operation based on an instruction input to the input device 12. It is therefore possible to reduce the likelihood that when the communication is lost, the operation of the heat pump apparatus 10 will be stopped or the heat pump apparatus 10 will perform an undesired operation. The undesired operation is, for example, an operation that is based on the default value and that is not desired by the user or an operation that does not match the actual condition.

[0022] When no signal is received from the server 3 and no instruction is input to the input device 12 for the

first time period or longer, the controller 13 of Embodiment 1 causes the heat pump apparatus 10 to perform a third operation. The third operation is an operation based on an operation schedule for a specific date, such as the previous day or the same day of the last week. The operation schedule for the specific date is information corresponding to an operation signal that is received by the communication device 11 from the server 3 prior to the specific date. In this case, the controller 13 temporarily stores the information corresponding to the operation signal that is received by the communication device 11 from the server 3. For example, the controller 13 stores information corresponding to an operation signal for a specific period such as a week or a month.

[0023] When the communication device 11 receives a condition request signal from the server 3, the controller 13 causes as a control, the communication device 11 to transmit to the server 3, a condition signal that indicates the operating condition of the heat pump apparatus 10. The information indicated by the condition signal includes information corresponding to a control signal that the controller 13 outputs to the heat pump apparatus 10. In the case where the heat pump apparatus 10 includes various sensors, the controller 13 obtains detection results from the various sensors, and the information indicated by the condition signal includes the detection results from the various sensors. When the communication device 11 receives a response request signal from the server 3, the controller 13 causes as a control, the communication device 11 to transmit a response signal to the server 3.

[0024] The heat pump system 1 according to Embodiment 1 may include a remote control 20 for use in remote control of the heat pump apparatus 10 by the user. Fig. 2 is a block diagram illustrating a configuration example of the heat pump system according to Embodiment 1 in the case where the heat pump system includes a remote control. In the case where the heat pump apparatus 10 or being provided in contact with the housing. The input device 12 may be provided on the surface of the housing that forms the outer portion of the heat pump apparatus 10 or may be provided at the remote control 20. The following description concerning Embodiment 1 is made by referring to by way of example the case where the heat pump apparatus 10 and the remote control 20 include respective communication devices 11, and the remote control 20 also includes the input device 12. Also, in the following description, the communication device 11 provided in the heat pump apparatus 10 may be referred to as a first communication device 11A, and the communication device 11 provided in the remote control 20 may be referred to as a second communication device 11B.

[0025] The first controller 13A and the second controller 13B perform wire communication with each other. It should be noted that the first controller 13A and the second controller 13B may wirelessly communicate with each other through infrared communication. Even when an instruction is input to the input device 12 while com-

munication between the second communication device 11B and the server 3 is established, the second controller 13B does not transmit the instruction to the first controller 13A. The first controller 13A causes the heat pump apparatus 10 to perform the first operation based on an operation signal received by the first communication device 11A. When the second communication device 11B does not receive a signal for the first time period or longer, the second controller 13B transmits to the first controller 13A, the instruction input to the input device 12, and the first controller 13A causes the heat pump apparatus 10 to perform the second operation based on the instruction.

[0026] Even when communication between the second communication device 11B and the server 3 is established, the second controller 13B may transmit the instruction input to the input device 12 to the first controller 13A. In this case, while communication between the first communication device 11A and the server 3 is established, the first controller 13A causes the heat pump apparatus 10 to perform the first operation based on the operation signal received by the first communication device 11A, not the second operation based on the instruction obtained from the second controller 13B. When the first communication device 11A does not receive a signal from the server 3 for the first time period or longer, the first controller 13A causes the heat pump apparatus 10 to perform the second operation based on the instruction input to the input device 12 and obtained from the second controller 13B.

[0027] When both or one of the first communication devices 11A and the second communication device 11B receives a response request signal from the server 3, the first controller 13A causes, as a control, the first communication device 11A to transmit a response signal to the server 3. When the first communication device 11A does not receive a response request signal, but the second communication device 11B receives a response request signal, the first controller 13A obtains the response request signal via the second controller 13B. When both or one of the first communication devices 11A and the second communication device 11B receives a response request signal from the server 3, the second controller 13B may cause, as a control, the second communication device 11B to transmit a response signal to the server 3. In this case, when the second communication device 11B does not receive a response request signal, and the first communication device 11A receives a response request signal, the second controller 13B obtains the response request signal via the first controller 13A.

[0028] When both or one of the first communication devices 11A and the second communication device 11B receives a condition request signal from the server 3, the first controller 13A causes, as a control, the first communication device 11A to transmit a condition signal to the server 3. When the first communication device 11A does not receive a condition request signal, but the second communication device 11B receives a condition request signal, the first controller 13A obtains the condition re-

quest signal via the second controller 13B.

[0029] When both or one of the first communication devices 11A and the second communication device 11B receives an information request signal from the server 3, the second controller 13B may cause, as a control, the second communication device 11B to transmit a condition signal to the server 3. In this case, when the second communication device 11B does not receive a response request signal, but the first communication device 11A receives a response request signal, the second controller 13B obtains the response request signal via the first controller 13A. When the second controller 13B causes, as a control, the second communication device 11B to transmit a condition signal to the server 3, the second controller 13B may obtain, from the first controller 13A, information corresponding to a control signal for controlling the heat pump apparatus 10. Furthermore, the second controller 13B may also obtain detection results from the various sensors provided at the heat pump apparatus 10, through the first controller 13A.

[0030] When neither the first communication device 11A nor the second communication device 11B receives an operation signal, and no instruction is input to the input device 12, the first controller 13A does not receive an operation signal or an instruction from the second controller 13B. Furthermore, the first controller 13A does not obtain an operation signal from the first communication device 11A. In this case, the first controller 13A causes the heat pump apparatus 10 to perform the third operation.

[0031] In the case where the communication device 11 is provided at the remote control 20 only, the first communication device 11A as illustrated in Fig. 2 is not provided. In this case, while communication between the second communication device 11B and the server 3 is established, the second controller 13B transmits to the first controller 13A, an operation signal received by the second communication device 11B. Then, the first controller 13A causes the heat pump apparatus 10 to perform the first operation based on the operation signal obtained from the second controller 13B. While communication between the second communication device 11B and the server 3 is established, the second controller 13B may or may not transmit an instruction input to the input device 12 to the first controller 13A. When the second communication device 11B does not receive a signal from the server 3 for the first time period or longer, the second controller 13B transmits to the first controller 13A, the instruction input to the input device 12. When the first controller 13A does not receive an operation signal from the second controller 13B for the first time period or longer, the first controller 13A causes the heat pump apparatus 10 to perform the second operation based on the instruction obtained from the second controller 13B.

[0032] In the case where the communication device 11 is provided at the remote control 20 only, when the second communication device 11B receives a response

request signal from the server 3, the second controller 13B causes as a control, the second communication device 11B to transmit a response signal to the server 3.

[0033] In the case where the communication device 11 is provided at the remote control 20 only, when the second communication device 11B receives a condition request signal from the server 3, the second controller 13B causes as a control, the second communication device 11B to transmit a condition signal to the server 3. In this case, the second controller 13B may obtain, from the first controller 13A, information corresponding to a control signal for controlling the heat pump apparatus 10. Furthermore, the second controller 13B may obtain detection results from the various sensors provided at the heat pump apparatus 10, via the first controller 13A.

[0034] In the case where the communication device 11 is provided at the remote control 20 only, when the second communication device 11B does not receive an operation signal, and no instruction is input to the input device 12, the first controller 13A does not receive an operation signal or an instruction from the second controller 13B. In this case, the first controller 13A causes the heat pump apparatus 10 to perform the third operation.

[0035] In the case where the communication device 11 is not provided at the remote control 20 but is provided in the heat pump apparatus 10 only, the second communication device 11B as illustrated in Fig. 2 is not provided. In this case, while communication between the first communication device 11A and the server 3 is established, the first controller 13A causes the heat pump apparatus 10 to perform the first operation based on an operation signal received by the first communication device 11A. When the first communication device 11A does not receive a signal from the server 3 for the first time period or longer, the first controller 13A causes the heat pump apparatus 10 to perform the second operation based on an instruction that is input to the input device 12 and obtained from the second controller 13B.

[0036] In the case where the communication device 11 is provided in the heat pump apparatus 10 only, when the first communication device 11A receives a response request signal from the server 3, the first controller 13A causes as a control, the first communication device 11A to transmit a response signal to the server 3. Furthermore, when the first communication device 11A receives a condition request signal from the server 3, the first controller 13A causes as a control, the first communication device 11A to transmit a condition signal to the server 3.

[0037] In the case where the communication device 11 is provided in the heat pump apparatus 10 only, when the first communication device 11A does not receive an operation signal from the server 3, and no instruction is input to the input device 12, the first controller 13A does not obtain an operation signal from the first communication device 11A. Furthermore, the first controller 13A does not receive an instruction from the second controller 13B. In this case, the first controller 13A causes the heat

pump apparatus 10 to perform the third operation.

[0038] A hardware configuration of the heat pump system 1 according to Embodiment 1 will be described. Fig. 3 is a block diagram illustrating a first example of the hardware configuration of the heat pump system according to Embodiment 1. In the hardware configuration of the heat pump system 1 as illustrated in Fig. 3, the heat pump system 1 does not include the remote control 20. The communication device 11 and the controller 13 of the heat pump system 1 include a first processor 41A, a first memory 42A, a first communication interface circuit 43A, an input interface circuit 44, and a first output interface circuit 45A, which are connected by a first bus 40A. The input device 12 corresponds to, for example, buttons or a touch panel, as described above. The input device 12 is connected to the input interface circuit 44 by a first cable 46A. The first cable 46A is, for example, a communication line or a signal line.

[0039] The first processor 41A is, for example, a central processing unit (CPU) or a micro processing unit (MPU). The first memory 42A is, for example, a read only memory (ROM) or a random access memory (RAM). The first communication interface circuit 43A is a wireless communication interface circuit. The function of the communication device 11 is fulfilled by the first communication interface circuit 43A. The function of the controller 13 is fulfilled by reading and execution of various kinds of information stored in the first memory 42A that are performed by the first processor 41A. The function of control of the heat pump apparatus 10 that is performed by the controller 13 can be fulfilled by the first processor 41A, the first memory 42A, and the first output interface circuit 45A. The heat pump apparatus 10 is connected to the first output interface circuit 45A by a second cable 46B. The second cable 46B is, for example, a control line. In the case where various sensors are provided at the heat pump apparatus 10, and the controller 13 obtains detection results from the various sensors, the heat pump system 1 includes an input/output interface circuit instead of the first output interface circuit 45A.

[0040] Next, a hardware configuration of the heat pump system 1 in the case where the heat pump system 1 includes the remote control 20 will be described. Fig. 4 is a block diagram illustrating a second example of the hardware configuration of the heat pump system according to Embodiment 1. In the hardware configuration of the heat pump system 1 as illustrated in Fig. 4, the communication device 11 is provided in the heat pump apparatus 10 and the remote control 20, and the input device 12 is provided at the remote control 20. In Fig. 4, components that are the same as those in Fig. 3 are denoted by the same reference sigs. The heat pump system 1 includes the first processor 41A, the first memory 42A, the first communication interface circuit 43A, the first output interface circuit 45A, and a first wire communication interface circuit 47A, which are connected by a first bus 40A. The heat pump system 1 also includes a second processor 41B, a second memory 42B, a second communication

interface circuit 43B, an input interface circuit 44, and a second wire communication interface circuit 47B, which are connected by a second bus 40B.

[0041] The second processor 41B is, for example, a CPU or an MPU. The second memory 42B is, for example, a ROM or a RAM. The second communication interface circuit 43B is a wireless communication interface circuit. The first wire communication interface circuit 47A and the second wire communication interface circuit 47B are interface circuits for wire communication. The input device 12 is connected to the input interface circuit 44 by a first cable 46A. The heat pump apparatus 10 is connected to the first output interface circuit 45A by a second cable 46B. The first wire communication interface circuit 47A and the second wire communication interface circuit 47B are connected by a third cable 46C. The third cable 46C is, for example, a communication line.

[0042] The function of the first communication device 11A is fulfilled by the first communication interface circuit 43A. The function of the first controller 13A is fulfilled by the first processor 41A, the first memory 42A, the first output interface circuit 45A, and the first wire communication interface circuit 47A. The function of the second communication device 11B is fulfilled by the second communication interface circuit 43B. The function of the second controller 13B is fulfilled by the second processor 41B, the second memory 42B, and the second wire communication interface circuit 47B.

[0043] In the case where various sensors are provided at the heat pump apparatus 10, and the first controller 13A obtains detection results from the various sensors, the heat pump system 1 includes an input/output interface circuit instead of the first output interface circuit 45A.

[0044] In the case where the first controller 13A and the second controller 13B perform infrared communication, not wire communication, the heat pump system 1 includes a first infrared communication interface circuit instead of the first wire communication interface circuit 47A. The heat pump system 1 also includes a second infrared communication interface circuit instead of the second wire communication interface circuit 47B. The heat pump system 1 does not include the third cable 46C. The first infrared communication interface circuit and the second infrared communication interface circuit are interface circuits for infrared communication.

[0045] In the case where the communication device 11 is provided at the remote control 20 only, it is not indispensable that the first communication interface circuit 43A is included in the heat pump system 1. In the case where the communication device 11 is provided in the heat pump apparatus 10 only, it is not indispensable that the second communication interface circuit 43B is included in the heat pump system 1.

[0046] In addition to such a manner as described above, the function of the heat pump system 1 may be fulfilled by dedicated hardware. For example, the function of the controller 13 may be fulfilled by a complex programmable logic device (CPLD) or a field programmable

gate array (FPGA).

[0047] It will be described with reference to Fig. 5 how the heat pump apparatus 10 is controlled by the controller 13 of Embodiment 1. Fig. 5 is a flowchart illustrating a control process on the heat pump apparatus that is executed by the controller of Embodiment 1. In step S1, the controller 13 determines whether or not the communication device 11 receives an operation signal from the server 3. When determining that the communication device 11 receives an operation signal from the server 3 (Yes in step S1), in step S2, the controller 13 causes the heat pump apparatus 10 to perform the first operation based on the operation signal. When determining that the communication device 11 does not receive an operation signal from the server 3 (No in step S1), in step S3, the controller 13 determines whether or not the first time period elapses from the time at which the communication device 11 last receives a signal such as an operation signal from the server 3. When determining that the first time period does not elapse (No in step S3), the controller 13 returns the process to be executed to step S1.

[0048] When determining that the first time period elapses (Yes in step S3), in step S4, the controller 13 determines whether or not an instruction is input to the input device 12 between the time at which the first time period elapses and the time at which a predetermined second time period elapses. When determining that an instruction is input to the input device 12 before the second time period elapses (Yes in step S4), in step S5, the controller 13 causes the heat pump apparatus 10 to perform the second operation based on the instruction. When no instruction is input to the input device 12 before the second time period elapses (No in step S4), in step S6, the controller 13 causes the heat pump apparatus 10 to perform the third operation. After the step S2, the step S5, or the step S6, the controller 13 returns the process to be executed to step S1.

[0049] After step S5, in the case where the controller 13 repeats the processes from the step S1 onward, the controller 13 may skip the process of step S4 and execute the process of step S5. Alternatively, after step S5, the controller 13 may repeat the processes from step S1 to step S6. After step S6, the controller 13 repeats the processes from step S1 to step S6.

[0050] Advantages of the heat pump system 1 according to Embodiment 1 will be described. The heat pump system 1 according to Embodiment 1 includes the heat pump apparatus 10, the communication device 11, the input device 12, and the controller 13. The heat pump apparatus 10 adjust the temperature of a substance such as water or air. The communication device 11 communicates with the server 3 and receives from the server 3, a signal including an operation signal regarding the operation of the heat pump apparatus 10. The input device 12 is configured to input an instruction to be given to the heat pump apparatus 10. The controller 13 causes the heat pump apparatus 10 to perform the first operation based

on an operation signal from the server 3, while the communication device 11 is receiving a signal from the server 3. When the communication device 11 does not receive a signal for the predetermined first time period or longer, the controller 13 causes as a control, the heat pump apparatus 10 to perform the second operation based on an instruction input to the input device 12. Therefore, when the communication is lost, the controller 13 can cause the heat pump apparatus 10 to perform the second operation based on the instruction input to the input device 12. Thus, even when the communication is lost, the heat pump system 1 can reduce the likelihood that the heat pump apparatus 10 will be stopped, and can also cause the heat pump apparatus 10 to perform a desired operation for the user.

[0051] While the communication device 11 is receiving a signal from the server 3, even when an instruction is input to the input device 12, the controller 13 of Embodiment 1 causes as a control, the heat pump apparatus 10 to perform the first operation based on the operation signal from the server 3. Therefore, the heat pump system 1 can optimize the operation of the heat pump apparatus 10 in the cases other than the case where the communication is lost.

[0052] When the communication device 11 does not receive a signal for the first time period or longer, and no instruction is input to the input device 12 for the predetermined second time period or longer after the first time period elapses, the controller 13 of Embodiment 1 performs the following process. The controller 13 causes the heat pump apparatus 10 to perform the third operation based on an operation schedule indicated by an operation signal received from the server 3 on or before the previous day. This can reduce the likelihood that the heat pump apparatus 10 will stop its operation and will also perform its operation based on a default value. The operation of the heat pump apparatus 10 based on the default value may be unsuitable for at least any of the user's usage state of the heat pump apparatus 10, the operating state of the heat pump apparatus 10, the weather condition, etc. The operation schedule for the previous day or the same day of the previous week may be suitable for the user's usage state of the heat pump apparatus 10, the operating state of the heat pump apparatus 10, the weather condition, etc. Therefore, by causing the heat pump apparatus 10 to perform the third operation, it is possible to reduce the likelihood that the user's comfort will be reduced when the communication is lost.

Embodiment 2

[0053] A heat pump system 5 according to Embodiment 2 will be described. Regarding Embodiment 2, components that are the same as those in Embodiment 1 will be denoted by the same reference signs. Regarding Embodiment 2, descriptions concerning configurations and functions that are the same as those in Embodiment

1 will be omitted, unless the circumstances are exceptional.

[0054] Fig. 6 is a block diagram illustrating a configuration example of a heat pump system and a control system according to Embodiment 2. A control system 200 according to Embodiment 2 includes the heat pump system 5 instead of the heat pump system 1. The heat pump system 5 according to Embodiment 2 includes a notification device 14 in addition to the components of the heat pump system 1 according to Embodiment 1.

[0055] The notification device 14 may be a display device including, for example, a liquid crystal display (LCD) or a cathode ray tube (CRT) or an illuminating device including, for example, a light emitting diode (LED).

[0056] When the communication device 11 does not receive a signal from the server 3 for the first time period or longer, the controller 13 causes as a control, the notification device 14 to make a notification that the heat pump apparatus 10 can be controlled using the input device 12. In the case where the notification device 14 is a display device, the controller 13 causes the notification device 14 to display, on a screen thereof, information indicating that the heat pump apparatus 10 can be controlled using the input device 12. When the notification device 14 is an illuminating device, the controller 13 causes the notification device 14 to light or blink.

[0057] In addition to a control of causing the notification device 14 to make a notification that the heat pump apparatus 10 can be controlled using the input device 12, the controller 13 may cause the notification device 14 to make a notification that communication between the communication device 11 and the server 3 is lost. Alternatively, instead of the control of causing the notification device 14 to make a notification that the heat pump apparatus 10 can be controlled using the input device 12, the controller 13 may cause the notification device 14 to make a notification that communication between the communication device 11 and the server 3 is lost.

[0058] Fig. 7 is a block diagram illustrating a configuration example of the heat pump system according to Embodiment 2 in the case where the heat pump system includes a remote control. In the example as illustrated in Fig. 7, a remote control 21 and the heat pump apparatus 10 includes respective communication devices 11, and the input device 12 is provided at the remote control 21. Furthermore, in the example of Fig. 7, the notification device 14 is also provided at the remote control 21. The heat pump apparatus 10 may include the notification device 14 instead of the remote control 21 or the heat pump apparatus 10 and the remote control 21 may include respective notification devices 14. In the case where the remote control 21 and the heat pump apparatus 10 include respective notification devices 14, the kind of the notification device 14 of the remote control 21 may be the same as or different from that of the notification device 14 of the heat pump apparatus 10. For example, the notification device 14 provided at the remote

control 21 may be a display device, and the notification device 14 provided at the heat pump apparatus 10 may be an illuminating device. Alternatively, both the notification device 14 of the remote control 21 and the notification device 14 of the heat pump apparatus 10 may be illuminating devices.

[0059] It will be described by way of example with reference to Fig. 8 how the notification device 14 makes a notification in the case where the heat pump system 5 includes the remote control 21, and the notification device 14 is a display device provided at the remote control 21. Fig. 8 illustrates an example of a notification made by the notification device of Embodiment 2. In the example illustrated in Fig. 8, the heat pump apparatus 10 is an air-conditioning apparatus. In the example illustrated in Fig. 8, the notification device 14 and the input device 12 are formed integral with each other.

[0060] The "Meeting Room 1A" indicated in Fig. 8 is information indicating the location where the air-conditioning apparatus is installed; the "2:30 PM Friday" is information indicating the current date and time; the "Cooling" is information indicating the current operating mode of the heat pump apparatus 10 and also indicating that the heat pump apparatus 10 is in cooling operation. The "Indoor 28.5 degrees C" indicates that the temperature in meeting room 1A that is an air-conditioning target space is 28.5 degrees C. The "Set temperature 27.5 degrees C" indicates that the set temperature of the air-conditioning apparatus is 27.5 degrees C. The "Auto" indicates that an air-sending volume is automatically set.

[0061] An area enclosed by a circle and including the characters "On" and "Off" corresponds to an operation start/stop button. The user can start the heat pump apparatus 10 by pressing the operation start/stop button when the heat pump apparatus 10 is in its stopped state. The user can stop the heat pump apparatus 10 by pressing the operation start/stop button when the heat pump apparatus 10 is in operation. Similarly, areas enclosed by respective circles and including the characters "Menu," "Back," and "Confirm" correspond to buttons for user operations. When the communication device 11 does not receive a signal from the server 3 for the first time period or longer, the user can cause the heat pump apparatus 10 to perform a desired operation by pressing buttons.

[0062] The information "Remote Control Enabled" in Fig. 8 is displayed when the communication device 11 does not receive a signal from the server 3 for the first time period or longer, and is not displayed while communication between communication device 11 and the server 3 is established. In such a manner, since the information "Remote Control Enabled" is displayed on the screen while the communication is lost, the user can know that the heat pump apparatus becomes able to be operated using the remote control 21.

[0063] Fig. 9 is a block diagram illustrating a first example of a hardware configuration of the heat pump system according to Embodiment 2. The hardware con-

figuration of the heat pump system 5 as illustrated in Fig. 9 is a hardware configuration in which the heat pump system 5 does not include the remote control 21. The heat pump system 5 according to Embodiment 2 includes a second output interface circuit 45B connected to a first bus 40A, in addition to the components as illustrated in Fig. 3. The notification device 14 is connected to the second output interface circuit 45B by a fourth cable 46D. The fourth cable 46D is, for example, a control line.

[0064] Fig. 10 is a block diagram illustrating a second example of the hardware configuration of the heat pump system according to Embodiment 2. The hardware configuration of the heat pump system 5 as illustrated in Fig. 10 is a hardware configuration in which the heat pump system 5 includes the remote control 21. Fig. 10 illustrates the hardware configuration of the heat pump system 5 in the case where the notification device 14 is provided at the remote control 21. The heat pump system 5 according to Embodiment 2 includes a third output interface circuit 45C connected to a second bus 40B, in addition to the components as illustrated in Fig. 4. The notification device 14 is connected to the third output interface circuit 45C by a fifth cable 46E. The fifth cable 46E is, for example, a control line. In the case where the notification device 14 is provided at the heat pump apparatus 10, the heat pump system 5 includes the second output interface circuit 45B as illustrated in Fig. 9 in addition to the components as illustrated in Fig. 10. The second output interface circuit 45B is connected to the first bus 40A. The notification device 14 is connected to the second output interface circuit 45B by the fourth cable 46D. In the case where the notification device 14 is not provided at the remote control 21, the third output interface circuit 45C, the fifth cable 46E, and the notification device 14, which can be connected to the third output interface circuit 45C by the fifth cable 46E, are not provided.

[0065] A method of controlling the heat pump apparatus 10 and the notification device 14 using the controller 13 of Embodiment 2 will be described with reference to Fig. 11. Fig. 11 is a flowchart illustrating a control process for the heat pump apparatus and the notification device that is executed by the controller of Embodiment 2. The process of step S11 is the same as step S1. In step S11, when the communication device 11 receives an operation signal (Yes in step S11), in step S12, the controller 13 determines whether or not the notification device 14 is in a notification state. It should be noted that the notification state means a state in which the notification device 14 makes a notification that the heat pump apparatus 10 can be controlled using the input device 12 or a notification that the communication between the communication device 11 and the server 3 is lost. When the notification device 14 is not in the notification state (No in step S12), the controller 13 causes the process to be executed to proceed to step S14.

[0066] When the notification device 14 is in the notification state (Yes in step S12), in step S13, the controller

13 causes as a control, the notification device 14 to be in a non-notification state. The non-notification state means a state in which the notification device 14 does not make a notification that the heat pump apparatus 10 can be controlled using the input device 12 or a notification that the communication between the communication device 11 and the server 3 is lost. It should be noted that the non-notification state may be a state in which the notification device 14 makes a notification that the heat pump apparatus 10 cannot be controlled using the input device 12. After step S13, the controller 13 causes the process to be executed to proceed to step S14. The process of step S14 is the same as the process of step S2.

[0067] The controller 13 may execute the process of step S12 or the processes of steps S12 to S13, in parallel with the process of step S14. In this case, in step S12, when the notification device 14 is in the non-notification state, the controller 13 returns the process to step S11 after step S14. By contrast, in step S12, when the notification device 14 is in the notification state, the controller 13 returns the process to step S11 after steps S13 and S14.

[0068] The controller 13 may execute the process of step S12 or the processes of steps S12 and S13 after step S14. In this case, in step S12, when the notification device 14 is in the non-notification state, the controller 13 returns the process to step S11. By contrast, in step S12, when the notification device 14 is in the notification state, the controller 13 returns the process to step S11 after step S13.

[0069] In step S11, when the communication device 11 does not receive an operation signal (No in step S11), the controller 13 causes the process to proceed to step S15. The process of step S15 is the same as the process of step S3. In step S15, when not determining that the first time period elapses (No in step S15), the controller 13 returns the process to step S11. In step S15, when determining that the first time period elapses (Yes in step S15), in step S16, the controller 13 determines whether the notification device 14 is in the notification state or not. When determining that the notification device 14 is in the notification state (Yes in step S16), the controller 13 causes the process to proceed to step S18. When determining that the notification device 14 is not in the notification state, that is, the notification device 14 is in the non-notification state (No in step S16), in step S17, the controller 13 causes as a control, the notification device 14 to be in the notification state. After step S17, the controller 13 causes the process to proceed to step S18. The processes of steps S18 to S20 are the same as the processes of steps S4 to S6. After step S14, S19, or S20, the controller 13 returns the process to step S11.

[0070] After step S19, in the case of repeating the processes from the process of step S11 onward, the controller 13 may skip the process of step S18 and execute the process of step S19. Alternatively, after step S19, the controller 13 may repeat the processes from step S11 to step S20. After step S20, the controller 13

repeats the operations from step S11 to step S20.

[0071] The advantages of the heat pump system 5 according to Embodiment 2 will be described. In addition to the components included in the heat pump system 1 according to Embodiment 1, the heat pump system 5 according to Embodiment 2 further includes the notification device 14. When the communication device 11 does not receive a signal for the first time period or longer, the notification device 14 makes a notification that the heat pump apparatus 10 can be controlled using the input device 12. It should be noted that in some cases, the user does not notice that the communication between the communication device 11 and the server 3 is lost. As a result, the heat pump apparatus 10 may perform an undesired operation for the user or an operation that does not match the actual condition such as the operating state or the weather condition. When the communication with the server 3 is lost, in the heat pump system 5 according to Embodiment 2, the notification device 14 makes a notification that the heat pump apparatus 10 can be controlled using the input device 12, thereby prompting the user to input an instruction to the input device 12. Thus, the user can promptly notice the necessity of inputting an instruction to the input device 12. When the user promptly inputs an instruction to the input device 12, it is possible to reduce the likelihood that the heat pump apparatus 10 will operate in a manner that does not match the actual condition, and is therefore possible to ensure the comfort for the user.

[0072] The heat pump system 5 according to Embodiment 2 includes the notification device 14 in addition to the components included in the heat pump system 1 according to Embodiment 1. When the communication device 11 does not receive a signals for the first time period or longer, the notification device 14 makes a notification that communication between the communication device 11 and the server 3 is not established. As a result, the user can recognize that the operation of the heat pump apparatus 10 is not optimized. In addition, the user can recognize that the heat pump apparatus 10 may perform an operation that does not match the actual condition such as the operating condition or the weather condition. Thus, the user can promptly recognize the necessity of inputting an instruction to the input device 12. When the user promptly input an instruction to the input device 12, it is possible to reduce the likelihood that the heat pump apparatus 10 will operate in a manner that does not match the actual condition, and is therefore possible to ensure the comfort for the user.

[0073] In addition to the components included in the heat pump system 1 according to Embodiment 1, the heat pump system 5 according to Embodiment 2 further includes the notification device 14. While the communication device 11 is receiving a signal from the server 3, the notification device 14 makes a notification that the heat pump apparatus 10 cannot be controlled using the input device 12. As a result, while the communication between the server 3 and the communication device 11 is estab-

lished, the user can recognize that the heat pump apparatus 10 performs an optimized first operation. Therefore, the heat pump system 5 can reduce the likelihood that the user will input an unnecessary instruction to the input device 12. It is therefore possible to reduce the processing of the controller 13 that would be executed if the instruction is input to the input device 12.

Embodiment 3

[0074] In a heat pump system 5 according to Embodiment 3, the notification device 14 provides information regarding inputting of an instruction to the input device 12 when the communication device 11 does not receive a signal from the server 3 for the first time period or longer. The heat pump system 5 according to Embodiment 3 will be described in detail. It should be noted that regarding Embodiment 3, components that are the same as those in Embodiments 1 and 2 will be denoted by the same reference signs. In addition, regarding Embodiment 3, descriptions concerning configurations and functions that are same as those in Embodiments 1 and 2 will be omitted, unless the circumstances are exceptional.

[0075] A configuration example of a control system 200 according to Embodiment 3 is illustrated in Fig. 6 as in Embodiment 2. The heat pump system 5 according to Embodiment 3 may include the remote control 21 as in Embodiment 2, and in this case, a configuration example of the heat pump system 5 is illustrated in Fig. 7. A hardware configuration of the heat pump system 5 according to Embodiment 3 is illustrated in Figs. 9 and 10 as in Embodiment 2.

[0076] In the environment that the heat pump apparatus 10 operates based on an operation signal from the server 3 for optimization of the operation of the heat pump apparatus 10, when the user tries to control the heat pump apparatus 10 using the input device 12 while the communication is lost, the user may not know what instruction should be input to the input device 12. The following description concerning the above problem is made with respect to the case where the heat pump apparatus 10 is a water heater. In the water heater, in some cases, the amount of supplied hot water is less than the amount of consumed hot water per unit time. For this reason, the water heater may be provided with a tank for storage of hot water, and store hot water in the tank before consumption of hot water. Furthermore, the water heater also performs an operation to heat hot water in the tank or an operation to maintain the temperature of hot water in the tank.

[0077] While communication between the server 3 and the communication device 11 in the water heater is established, the server 3 transmits an operation signal indicating a target storage amount of hot water and a target temperature to the water heater. The water heater adjusts the storage amount of hot water in the tank and the temperature of the hot water in the tank based on an operation signal. However, when the communication is

lost, the heat pump system 5 cannot obtain from the server 3, an operation signal indicating the target storage amount of the hot water and the target temperature. Furthermore, when inputting an instruction to the water heater, in many cases, the user does not know that the target storage amount of the hot water and the target temperature are necessary. Also, in many cases, the user does not know those values of the target storage amount of the hot water and the target temperature that are necessary for the comfort for the user.

[0078] The notification device 14 in Embodiment 3 is the above display device. When the communication between the communication device 11 and the server 3 is lost, the notification device 14 is caused by the control by the controller 13 to display on the screen, guidance information regarding inputting of an instruction to the input device 12, such as the above target storage amount of hot water and the target temperature. The guidance information may include, for example, content that prompts the user to input the target storage amount of hot water and the target temperature. The guidance information may include specific values of the target storage amount of hot water and the target temperature.

[0079] A process of controlling the heat pump apparatus 10 and the notification device 14 using the controller 13 of Embodiment 3 will be described with reference to Fig. 12. Fig. 12 is a flowchart illustrating a control process of the heat pump apparatus and the notification device that is executed by the controller of Embodiment 3. The process of step S31 is the same as step S1. In step S31, when the communication device 11 receives an operation signal (Yes in step S31), in step S32, the controller 13 determines whether the notification device 14 is in a guidance state or not. The guidance state is a state in which the notification device 14 displays guidance information on the screen. When the notification device 14 is not in the guidance state (No in step S32), the controller 13 causes the process to proceed to step S34.

[0080] When determining that the notification device 14 is in the guidance state (Yes in step S32), in step S33, the controller 13 causes as a control, the notification device 14 to be in a non-guidance state. The non-guidance state is a state in which the notification device 14 does not display guidance information on the screen. After step S33, the controller 13 causes the process to proceed to step S34. The process of step S34 is the same as the process of step S2.

[0081] The controller 13 may execute the process of step S32 or the processes of steps S32 to S33, in parallel with the process of step S34. In this case, in step S32, when the notification device 14 is in the guidance state, the controller 13 returns the process to step S31, after step S34. In step S32, when the notification device 14 is in the guidance state, the controller 13 returns the process to step S31 after steps S33 and S34.

[0082] The controller 13 may execute the process of step S32 or the processes of steps S32 and S33, after step S34. In this case, in step S32, when the notification

device 14 is not in the guidance state, the controller 13 returns the process to step S31. In step 32, when the notification device 14 is in the guidance state, the controller 13 returns the process to step S31, after step S33.

[0083] In step S31, when the communication device 11 does not receive an operation signal (No in step S31), the controller 13 causes the process to proceed to step S35. The process of step S35 is the same as the process of step S3. In step S35, when determining that the first time period does not elapse (No in step S35), the controller 13 returns the process to step S31. In step S35, when determining that the first time period elapses (Yes in step S35), in step S36, the controller 13 determines whether the notification device 14 is in the guidance state or not. When the notification device 14 is in the guidance state (Yes in step S36), the controller 13 causes the process to proceed to step S38. When determining that the notification device 14 is not in the guidance state (No in step S36), in step S37, the controller 13 causes as a control, the notification device 14 to be in the guidance state. After step S37, the controller 13 causes the process to proceed to step S38. The processes of steps S38 to S40 are the same as the processes of steps S4 to S6. After step S34, S39, or S40, the controller 13 returns the process to step S31.

[0084] After step S39, in the case of repeating the processes from step S31 onward, the controller 13 may skip the process of step S38 and execute the process of step S39. Alternatively, after step S39, the controller 13 may repeat the processes of step S31 to step S40. After step S40, the controller 13 repeats the processes of step S31 to step S40.

[0085] Advantages of the heat pump system 5 according to Embodiment 3 will be described. In addition to the components included in the heat pump system 1 according to Embodiment 1, the heat pump system 5 according to Embodiment 3 further includes the notification device 14. When the communication device 11 does not receive a signal for the first time period or longer, the notification device 14 provides as a notification, guidance information regarding inputting of an instruction to the input device 12. As a result, the user can input to the input device 12, information that needs to be input to the input device 12 for the operation of the heat pump apparatus 10. Therefore, when the communication is lost, the heat pump system 5 can reduce the likelihood that the heat pump apparatus 10 will stop its operation. The heat pump system 5 can also assist the user such that the heat pump apparatus 10 can perform a desired operation for the user. Even when the communication is lost, the user can input an instruction to the input device 12 based on the guidance information, thereby causing the heat pump apparatus 10 to maintain the comfort for the user.

[0086] The heat pump apparatus 10 is a heat pump water heater, and the above substance is hot water. The water heater includes a tank for storing hot water. The guidance information includes information regarding both or one of the target amount of hot water to be stored

in the tank and the target temperature of hot water in the tank. Thus, in the case where the heat pump apparatus 10 is a water heater, the heat pump system 5 can assist the user in inputting an instruction to the input device 12. Therefore, when the user inputs an instruction to the input device 12 based on the guidance information, the heat pump apparatus 10 can maintain the comfort for the user without stopping its operation.

[0087] In addition, the controller 13 of Embodiment 3 may cause as a control, the notification device 14 to display condition information indicating the operating state of the heat pump apparatus 10, and the notification device 14 may display the condition information. The condition information corresponds to the above condition signal. In the case where the heat pump system 5 includes the remote control 21, and the notification device 14 is provided at the remote control 21, the second controller 13B may obtain from the first controller 13A, a control signal that the first controller 13A outputs to the heat pump apparatus 10. The notification device 14 displays the operating condition of the heat pump apparatus 10 that is an operation condition indicated by the control signal. In the case where the heat pump apparatus 10 includes various sensors, the second controller 13B may also obtain detection results from the various sensors through the first controller 13A. Also, in the case where the heat pump apparatus 10 includes various sensors, the notification device 14 displays that operating condition of the heat pump apparatus 10 that is an operating condition based on detection results from the various sensors. Thus, the user can recognize the operating condition of the heat pump apparatus 10 through the notification device 14.

Embodiment 4

[0088] A control system 300 according to Embodiment 4 enables the user to easily recognize the operating condition of the heat pump apparatus 10. The control system 300 according to Embodiment 4 will be described in detail. It should be noted that regarding Embodiment 4, components that are the same as those in any of Embodiments 1 to 3 will be denoted by the same reference signs. Regarding Embodiment 4, descriptions concerning configurations and functions that are the same as those in any of Embodiments 1 to 3 will be omitted, unless the circumstances are exceptional.

[0089] Fig. 13 illustrates a configuration example of the control system according to Embodiment 4. The control system 300 according to Embodiment 4 includes a server 6 instead of the server 3 in the control system 100 of Embodiment 1 or the control system 200 of Embodiments 2 and 3.

[0090] The server 6 wirelessly communicates with a terminal device 7 of the user. The server 6 may also perform wire communication with the terminal device 7. The terminal device 7 is, for example, a communication terminal device, such as a smartphone, a personal com-

puter (PC), or a tablet terminal. The server 6 transmits to the terminal device 7, a condition signal received from the communication device 11. The user can recognize the operating condition of the heat pump apparatus 10 by checking condition information displayed on a screen of the terminal device 7.

[0091] In the case where the control system 300 does not include the notification device 14 that is a display device, the user can know the operating condition of the heat pump apparatus 10, through the terminal device 7. In the case where the control system 300 includes the notification device 14 that is a display device, the user can easily know the operating condition of the heat pump apparatus 10 without moving to a location where the heat pump apparatus 10 or the remote control 21 provided with the notification device 14 is installed.

[0092] The above descriptions are made with respect to the embodiments, but are not limiting. They encompass all conceivable equivalents.

Reference Signs List

[0093] 1, 5: heat pump system, 3, 6: server, 7: terminal device, 10: heat pump apparatus, 11: communication device, 11A: first communication device, 11B: second communication device, 12: input device, 13: controller, 13A: first controller, 13B: second controller, 14: notification device, 20, 21: remote control, 40A: first bus, 40B: second bus, 41A: first processor, 41B: second processor, 42A: first memory, 42B: second memory, 43A: first communication interface circuit, 43B: second communication interface circuit, 44: input interface circuit, 45A: first output interface circuit, 45B: second output interface circuit, 45C: third output interface circuit, 46A: first cable, 46B: second cable, 46C: third cable, 46D: fourth cable, 46E: fifth cable, 47A: first wire communication interface circuit, 47B: second wire communication interface circuit, 100, 200, 300: control system

Claims

1. A heat pump system comprising:

a heat pump apparatus configured to adjust a temperature of a substance;
a communication device configured to communicate with a server to receive from the server, a signal including an operation signal regarding an operation of the heat pump apparatus;
an input device configured to input an instruction for the heat pump apparatus; and

a controller configured to causes, the heat pump apparatus to perform a first operation based on the operation signal while the communication device is receiving the signal,

wherein the controller is configured to cause, when the communication device does not receive the signal for a predetermined first time period or longer, the heat pump apparatus to perform a second operation based on the instruction input to the input device.

2. The heat pump system of claim 1, wherein the controller is configured to cause, while the communication device is receiving the signal, the heat pump apparatus to perform the first operation, even when the instruction is input to the input device.

3. The heat pump system of claim 1 or 2, wherein the controller is configured to cause the heat pump apparatus to perform a third operation based on an operation schedule indicated by the operating signal received from the server on or before a previous day, when the communication device does not receive the signal for the first time period or longer and the instruction is not input to the input device for a predetermined second time period or longer after the first time period elapses.

4. The heat pump system of claim 3, wherein the operation schedule indicated by the operation signal received on or before the previous day is an operation schedule for the previous day or an operation schedule for the same day of a previous week.

5. The heat pump system of any one of claims 1 to 4, further comprising a notification device configured to make, when the communication device does not receive the signal for the first time period or longer, a notification that the heat pump apparatus is operable using the input device.

6. The heat pump system of any one of claims 1 to 5, further comprising a notification device configured to make, when the communication device does not receive the signal for the first time period or longer, a notification that communication between the communication device and the server is not established.

7. The heat pump system of any one of claims 1 to 6, further comprising a notification device configured to make, while the communication device is receiving the signal, a notification that the heat pump apparatus is not operable using the input device.

8. The heat pump system of any one of claims 1 to 7, further comprising a notification device configured to display, on a screen, condition information including information corresponding to a control signal that the controller outputs to the heat pump apparatus to control the heat pump apparatus, the condition information indicating an operating condition of the

heat pump apparatus.

9. The heat pump system of any one of claims 1 to 8, further comprising a notification device configured to provide as a notification, when the communication device does not receive the signal for the first time period or longer, guidance information regarding inputting of the instruction to the input device. 5

10. The heat pump system of claim 9, wherein 10

the heat pump apparatus is a heat pump water heater, the substance is hot water, and the water heater includes a tank configured to store the hot water, and 15
the information regarding inputting of the instruction includes information regarding both or one of a target amount of the hot water to be stored in the tank and a target temperature of the hot water in the tank. 20

11. A control system comprising:

a server;
a heat pump apparatus configured to adjust a temperature of a substance; 25
a communication device configured to communicate with the server to receive from the server, a signal including an operation signal regarding an operation of the heat pump apparatus; 30
an input device configured to input an instruction for the heat pump apparatus; and
a controller configured to causes the heat pump apparatus to perform a first operation based on the operation signal while the communication device is receiving the signal, 35
wherein the controller is configured to cause, when the communication device does not receive the signal for a predetermined first time period or longer, the heat pump apparatus to perform a second operation based on the instruction input to the input device. 40

12. The control system of claim 11, wherein 45

the communication device is configured to transmit, to the server, condition information including information corresponding to a control signal that the controller outputs to the heat pump apparatus to control the heat pump apparatus, 50
the condition information indicating an operating condition of the heat pump apparatus, and
the server is configured to communicate with the terminal device to transmit the condition information to the terminal device. 55

FIG. 1

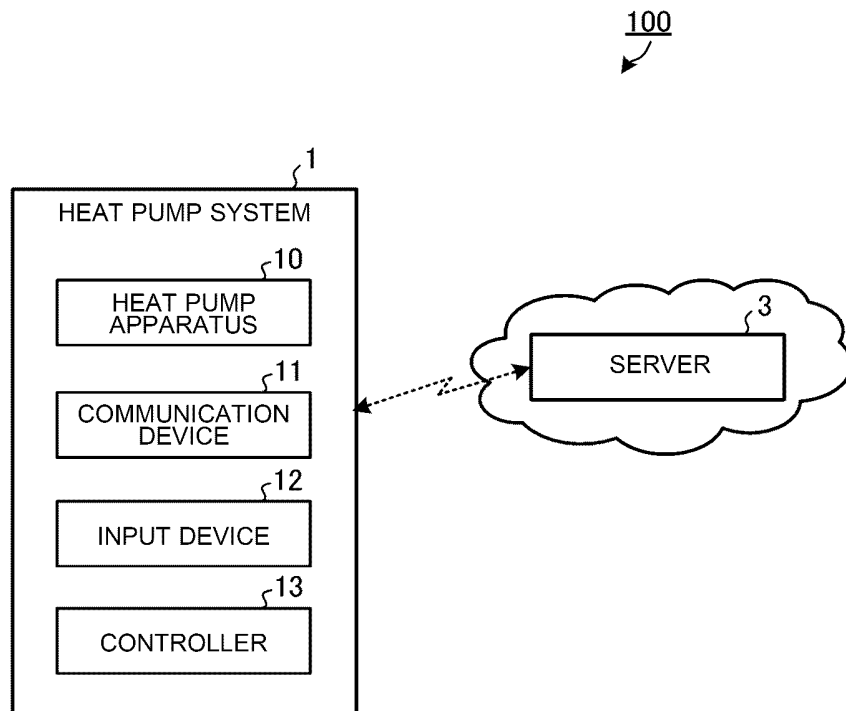


FIG. 2

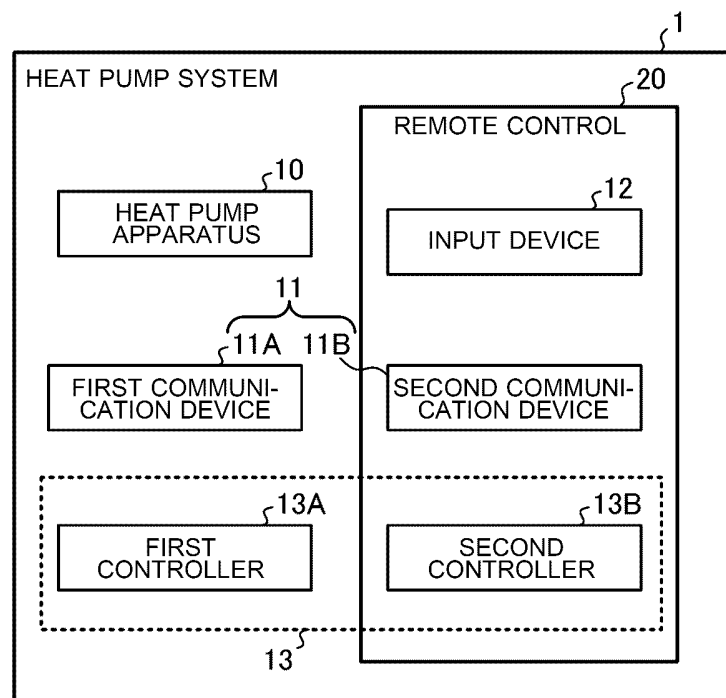


FIG. 3

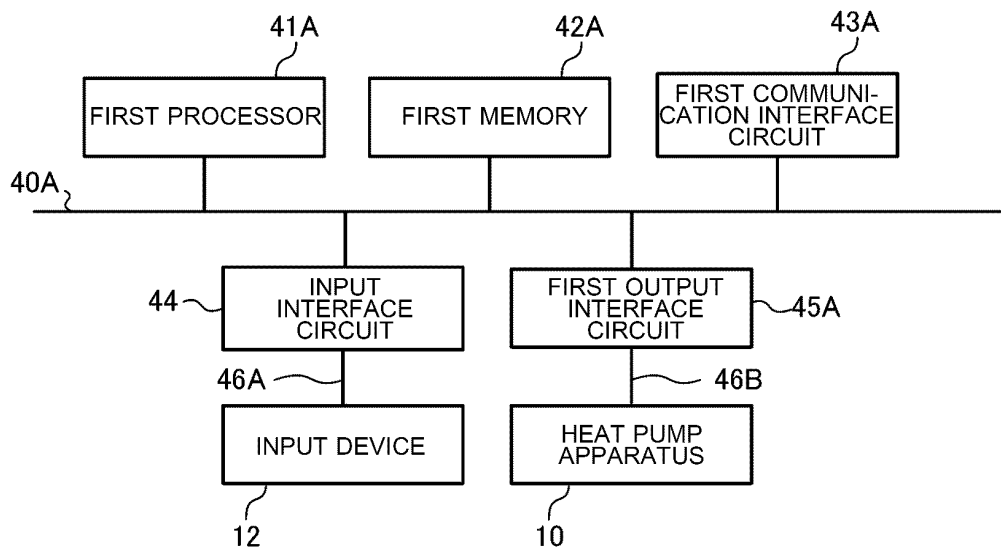


FIG. 4

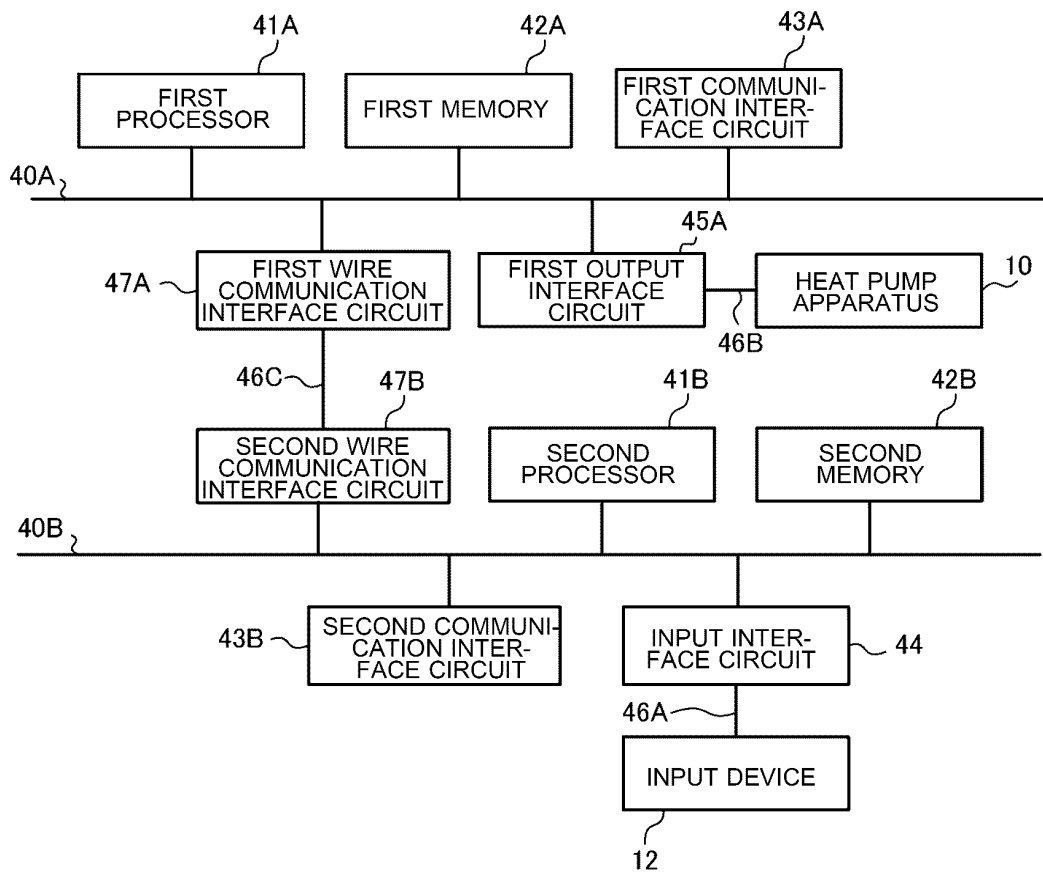


FIG. 5

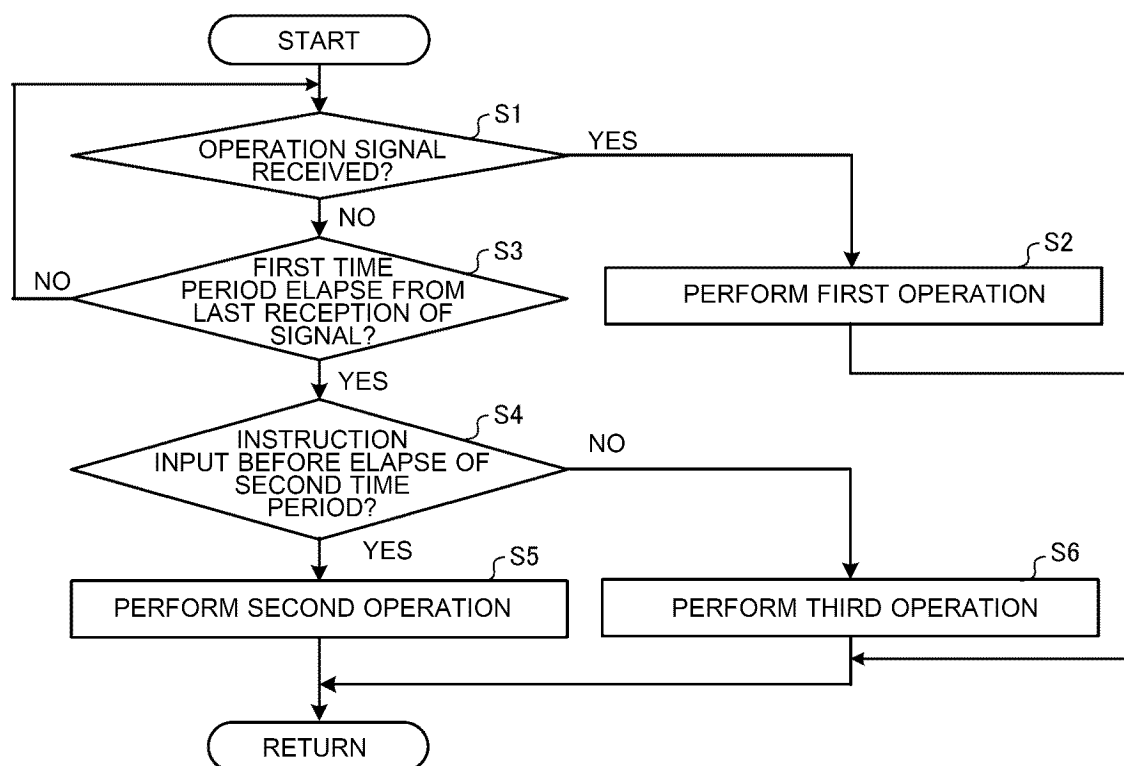


FIG. 6

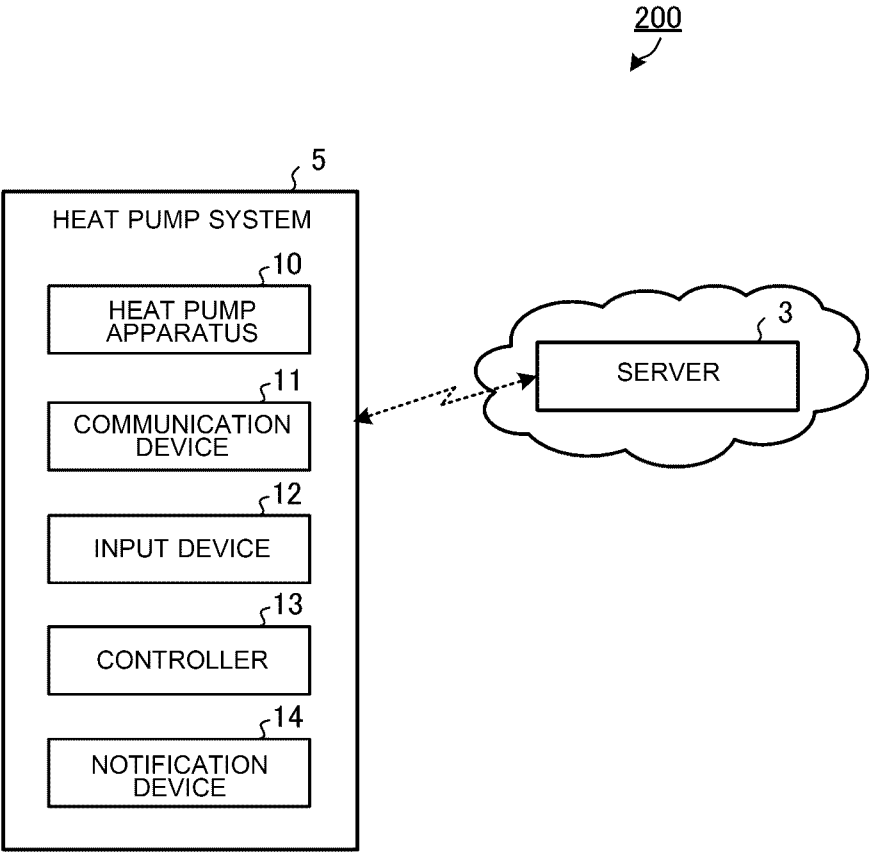


FIG. 7

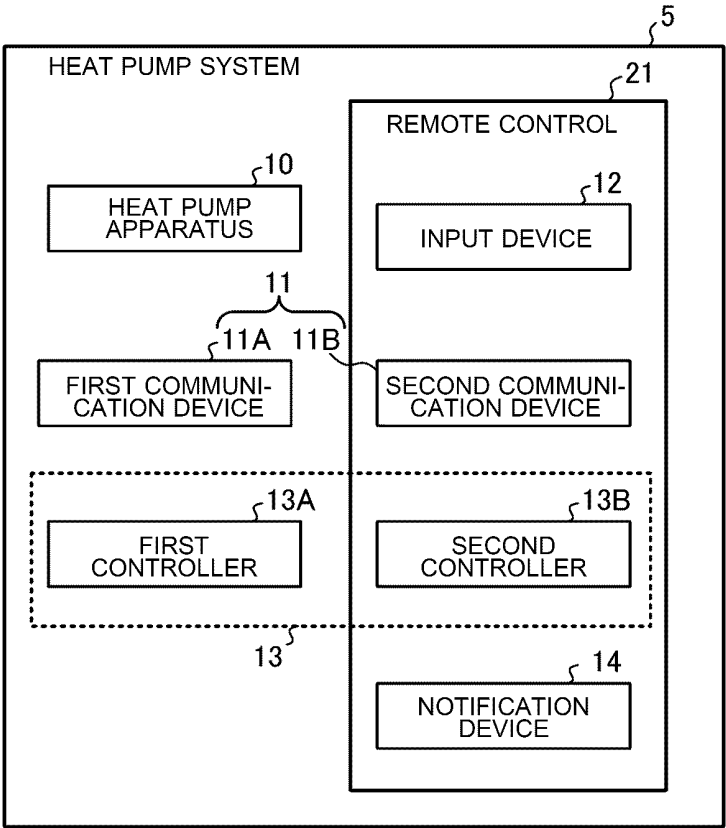


FIG. 8

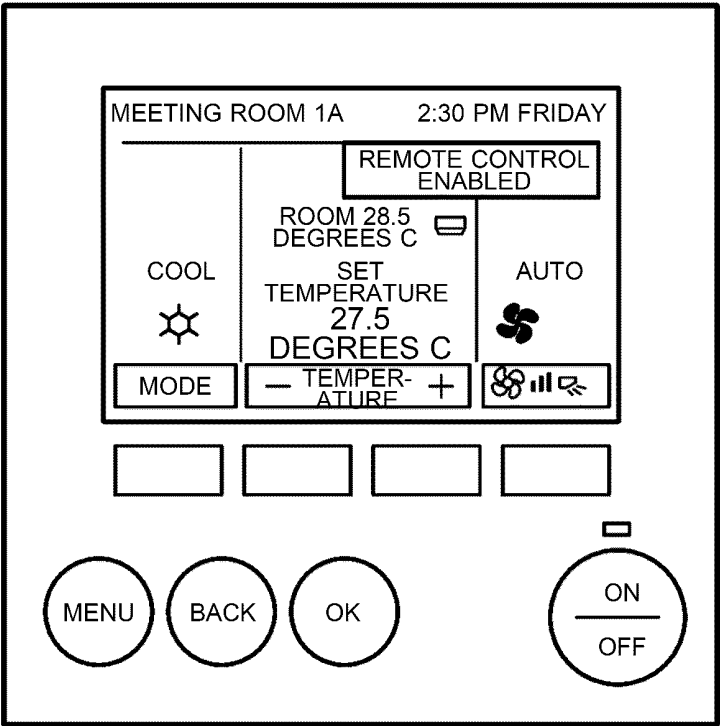


FIG. 9

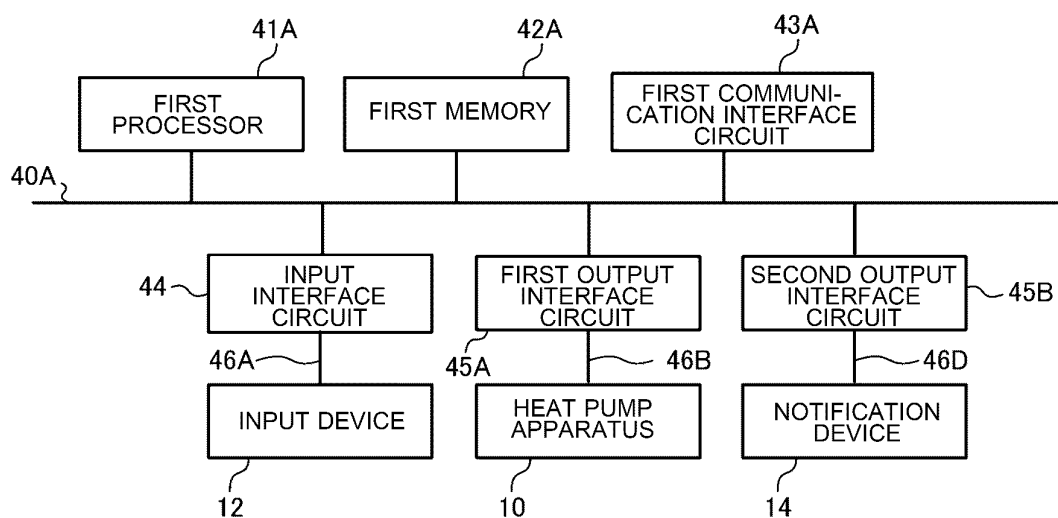


FIG. 10

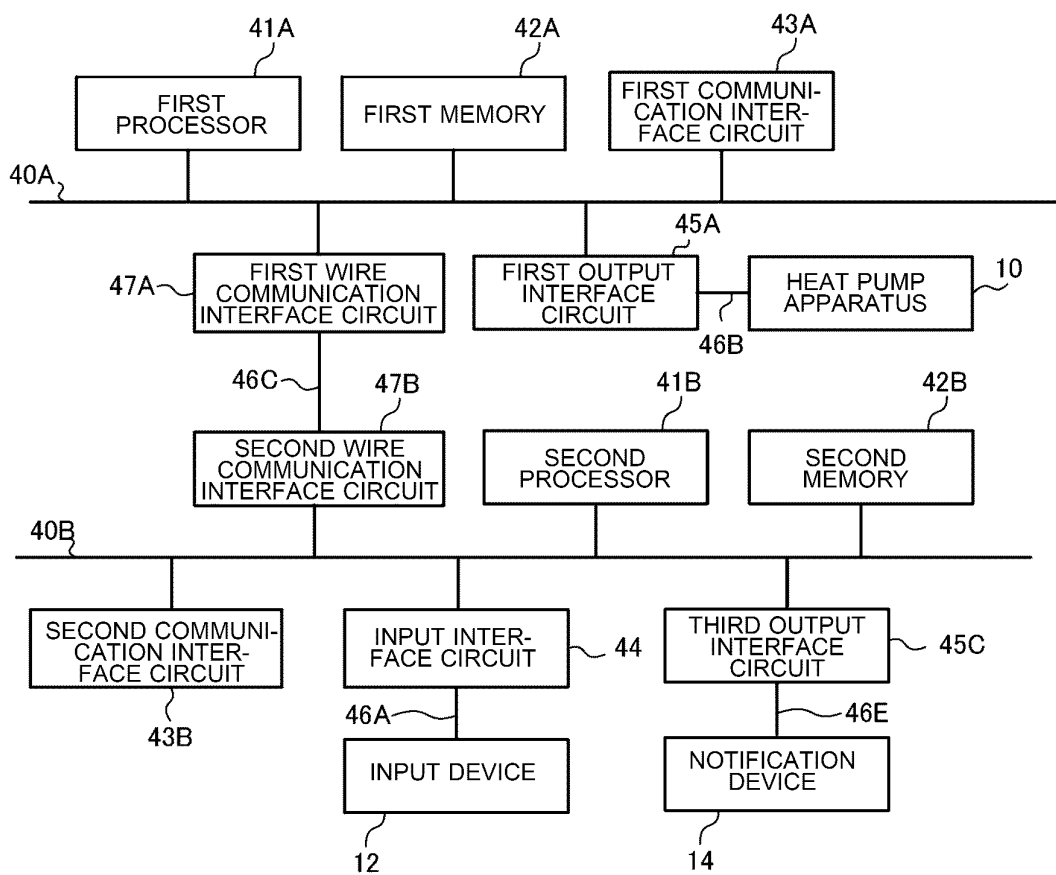


FIG. 11

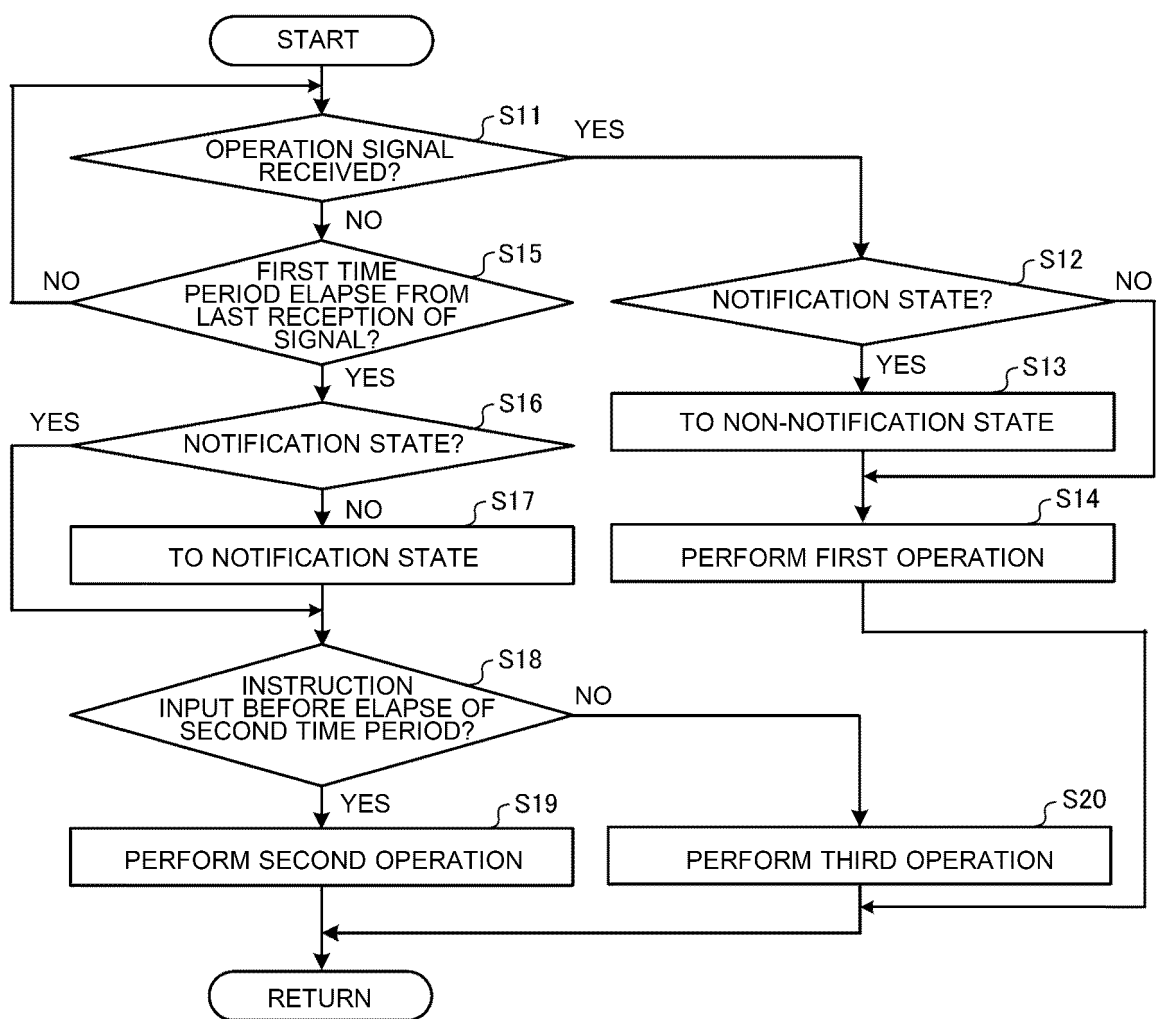


FIG. 12

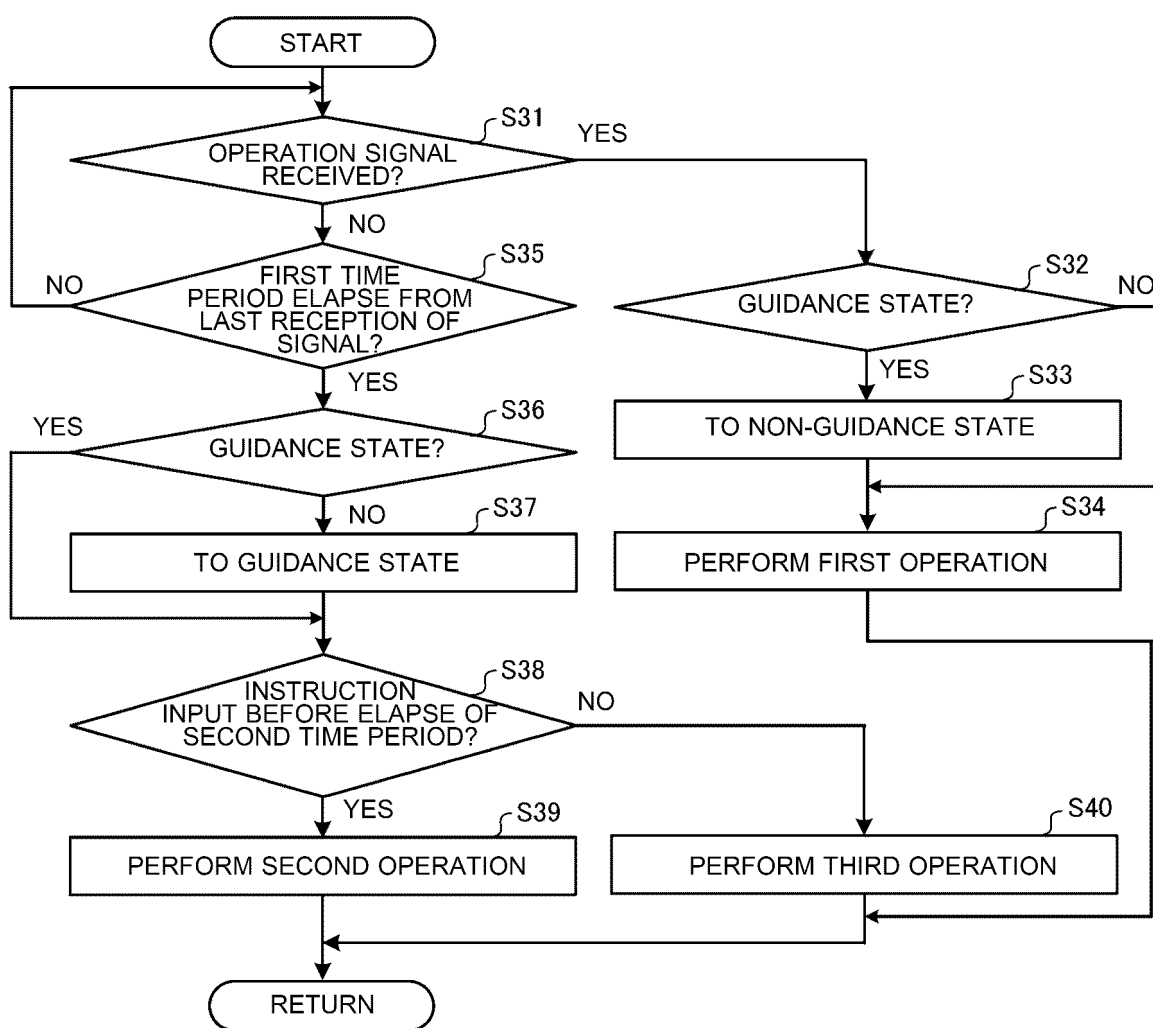
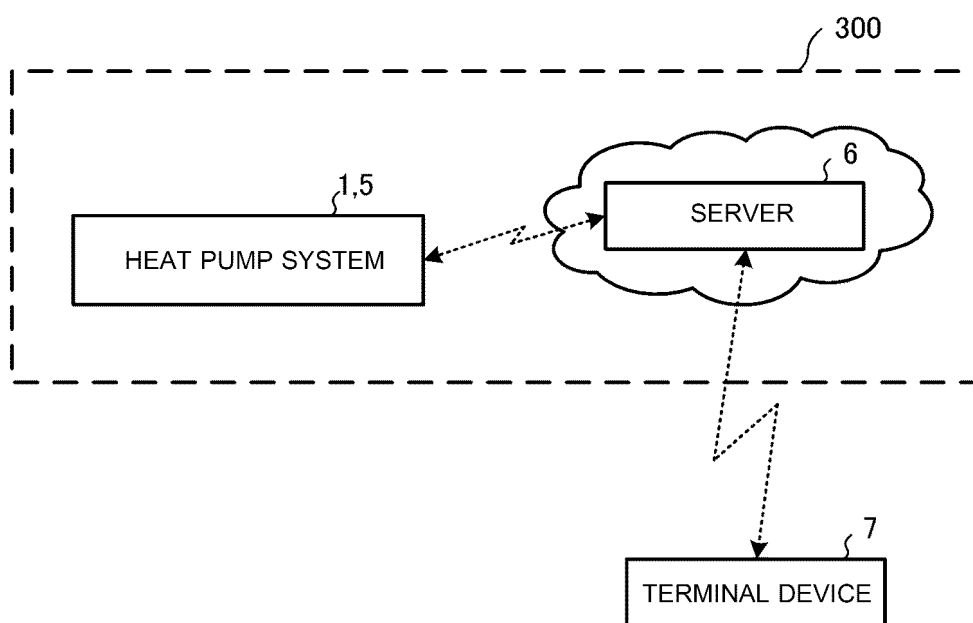


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/004171

A. CLASSIFICATION OF SUBJECT MATTER

F24H 15/375(2022.01)i; *F25B 49/02*(2006.01)i

FI: F25B49/02 570Z; F24H4/02 H

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; F24H4/00-4/06; F25B1/00; F25B49/00-49/04; H04Q9/00-9/16

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 1971-2022
 Registered utility model specifications of Japan 1996-2022
 Published registered utility model applications of Japan 1994-2022

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.
X	JP 2007-46842 A (TOSHIBA KYARIA KK) 22 February 2007 (2007-02-22) paragraphs [0002]-[0022]	1-2, 5-9, 11
Y		2-4, 6, 9-10, 12
X	JP 2015-35647 A (MITSUBISHI ELECTRIC CORP.) 19 February 2015 (2015-02-19) paragraphs [0002]-[0031], fig. 1	1, 5-12
Y		2-4, 6, 9-10, 12
Y	WO 2020/202295 A1 (MITSUBISHI ELECTRIC CORP.) 08 October 2020 (2020-10-08) paragraphs [0001]-[0006], [0055], [0056]	3-4
A	JP 2014-212496 A (HITACHI APPLIANCES INC.) 13 November 2014 (2014-11-13) entire text, all drawings	1-12
A	JP 2021-107745 A (DAIKIN IND., LTD.) 29 July 2021 (2021-07-29) entire text, all drawings	1-12

☐ Further documents are listed in the continuation of Box C.
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Date of the actual completion of the international search

01 March 2022

Date of mailing of the international search report

15 March 2022

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.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/004171

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2007-46842 A	22 February 2007	(Family: none)	
JP 2015-35647 A	19 February 2015	US 2016/0171878 A1 paragraphs [0002]-[0044], fig. 1	
		WO 2015/020022 A1	
		EP 3032841 A1	
		CN 105474659 A	
		KR 10-2016-0033742 A	
WO 2020/202295 A1	08 October 2020	(Family: none)	
JP 2014-212496 A	13 November 2014	(Family: none)	
JP 2021-107745 A	29 July 2021	(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

- WO 2020059473 A [0003]