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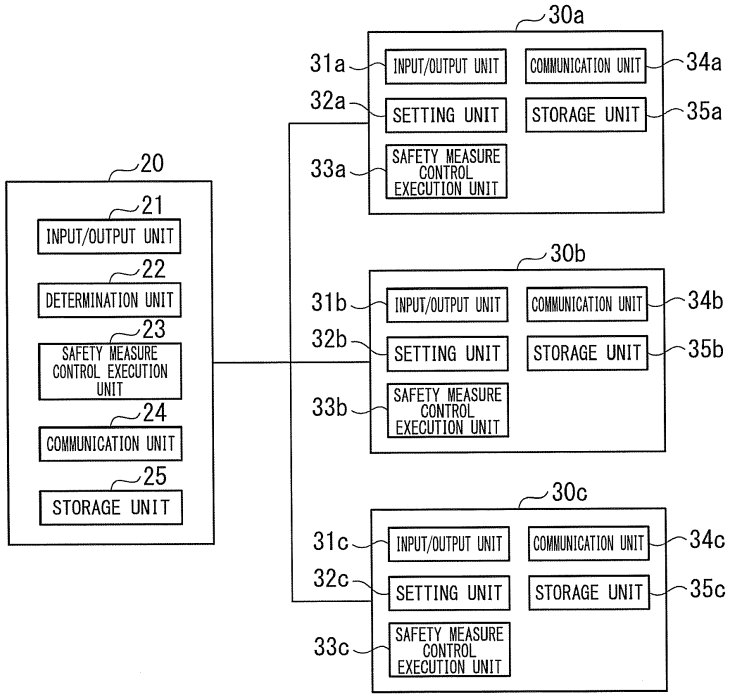
(54) CONTROL SYSTEM, AIR CONDITIONER, AND SETTING METHOD

(57) Provided is a control system configured to reduce effort to manually disable a safety function when the safety function of an air conditioner (1) is not necessary, to determine whether the safety function is necessary, and to automatically switch between enabling and disabling of the safety function according to the determination. A control system of an air conditioner, which includes a setting unit (32) configured to switch between enabling and disabling of a safety function of the air conditioner (1) on the basis of a total amount of refrigerant of the air conditioner, is provided. The control system enables the safety function when the total amount of refrigerant of the air conditioner is large and disables the safety function when the total amount of refrigerant of the air conditioner is small.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a control system of an air conditioner, an air conditioner, and a setting method.

[0002] Priority is claimed on Japanese Patent Application No. 2017-146805, filed July 28, 2017, the content of which is incorporated herein by reference.

Description of Related Art

[0003] In a multiple air-conditioning system having a large total amount of refrigerant, when a refrigerant leaks from an indoor unit and stays in the indoor space, there is a likelihood of suffocation, fire and the like occurring. To prepare for such situations, provision of safety functions in air-conditioning systems is required in some cases. As one such safety function, there is an interlock function of connecting a safety device to an indoor unit and stopping the operation of the indoor unit or the entire air-conditioning system when the safety device does not function, and the like.

[0004] Patent Document 1 discloses control of suppressing a flammable refrigerant leak into the indoor space by absorbing a refrigerant at the side of an indoor unit into an outdoor unit and then stopping the operation of an air conditioner when the flammable refrigerant leak is detected while the air conditioner is being driven.

[Patent Documents]

[0005] [Patent Document 1] Japanese Unexamined Patent Application, First Publication No. H11-325672

SUMMARY OF THE INVENTION

[0006] Although necessity of a safety function is determined according to whether a total amount of refrigerant is large or small, indoor units are common irrespective of refrigerant amounts, and thus it is necessary to provide the safety function even in an indoor unit used in an air-conditioning system having a small amount of refrigerant and there is a problem that an operation of disabling the safety function should be performed if a total amount of refrigerant is small when an air conditioner is installed.

[0007] Accordingly, an object of the present invention is to provide a control system of an air conditioner, an air conditioner, and a setting method which are capable of solving the aforementioned problems.

[0008] A first aspect of the present invention is a control system of an air conditioner, which includes a setting unit configured to switch between enabling and disabling of a safety function of the air conditioner on the basis of a total amount of refrigerant of the air conditioner.

[0009] The setting unit in a second aspect of the present invention enables the safety function when the total amount of refrigerant is equal to or greater than a predetermined threshold value.

[0010] The setting unit in a third aspect of the present invention prohibits disabling of the safety function when the total amount of refrigerant is equal to or greater than the predetermined threshold value.

[0011] The setting unit in a fourth aspect of the present invention sets the safety function to be disabled when the total amount of refrigerant is less than the predetermined threshold value.

[0012] The control system in a fifth aspect of the present invention further includes a determination unit configured to determine whether to enable or disable the safety function on the basis of the total amount of refrigerant calculated on the basis of the sum of capacities of one or more outdoor units included in the air conditioner and the sum of capacities of one or more indoor units included in the air conditioner.

[0013] The determination unit in a sixth aspect of the present invention determines whether to enable or disable the safety function on the basis of the total amount of refrigerant calculated on the basis of the lengths of one or more pipes between the one or more outdoor units and the one or more indoor units connected to the respective outdoor units in addition to the sum of the capacities of the outdoor units and the sum of the capacities of the indoor units.

[0014] The setting unit in a seventh aspect of the present invention performs switching of the safety function based on the total amount of refrigerant only when a refrigerant used in the air conditioner is a predetermined refrigerant.

[0015] The setting unit in an eighth aspect of the present invention performs switching of the safety function based on the total amount of refrigerant only when a country or a region which is a destination of shipment of the air conditioner is a predetermined country or region.

[0016] The setting unit in a ninth aspect of the present invention switches enabling and disabling of the safety function on the basis of the capacity of an outdoor unit included in the air conditioner instead of the total amount of refrigerant.

[0017] A tenth aspect of the present invention is an air conditioner including the control system according to any one of the aforementioned aspects.

[0018] A eleventh aspect of the present invention is a setting method by which a control system of an air conditioner switches between enabling and disabling of a safety function of the air conditioner on the basis of a total amount of refrigerant of the air conditioner.

[0019] In the setting method in a twelfth aspect of the present invention, setting of enabling the safety function is performed as initial setting of the air conditioner, disabling of the safety function is prohibited when the total amount of refrigerant is equal to or greater than a predetermined threshold value, and another predetermined

function instead of the safety function is set when the total amount of refrigerant is less than the predetermined threshold value at the time of introduction of the air conditioner.

[0020] According to the present invention, necessity of safety measures of an air conditioner can be automatically determined and enabling or disabling of a safety function can be set on the basis of the determination, and thus effort to set the safety function can be reduced. In addition, when the safety function is essential, control for prohibiting disabling of the safety function is performed in addition to enabling of the safety functions, and thus safety can be secured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a block diagram showing an example of an air conditioner according to an embodiment of the present invention.

FIG. 2 is a diagram showing an example of an external input port of an indoor unit according to an embodiment of the present invention.

FIG. 3 is a functional block diagram showing an example of a control system according to an embodiment of the present invention.

FIG. 4 is a diagram showing examples of setting used for a process of allocating a function to an external input port according to an embodiment of the present invention.

FIG. 5 is a first flowchart illustrating an example of a process of allocating a function to an external input port according to an embodiment of the present invention.

FIG. 6 is a second flowchart illustrating an example of a process of allocating a function to an external input port according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

<Embodiment>

[0022] Hereinafter, an air conditioner according to an embodiment of the present invention will be described with reference to FIG. 1 to FIG. 6.

[0023] FIG. 1 is a block diagram showing an example of an air conditioner according to an embodiment of the present invention.

[0024] The air conditioner 1 is a multiple type air-conditioning system including a single outdoor unit 12, a plurality of indoor units 11a, 11b and 11c, and remote controllers (remote controllers 13a, 13b and 13c) which input instruction information to the respective indoor units 11a, 11b and 11c. The outdoor unit 12 and each of the indoor units 11a to 11c are connected to each other through a pipe through which a refrigerant passes. Pipes which connect the outdoor unit 12 and the indoor units 11a to 11c may have different lengths depending on installation positions of the outdoor unit 12 and the indoor units 11a to 11c. In addition, the plurality of indoor units 11a may have different capacities. The outdoor unit 12 includes an outdoor control device 20 and the indoor units 11a, 11b and 11c respectively include indoor control devices 30a, 30b and 30c. The outdoor control device 20 and the indoor control devices 30a, 30b and 30c constitute a control system of the air conditioner 1. In addition, the indoor units 11a, 11b and 11c may be collectively described as an indoor unit 11, the remote controllers 13a, 13b and 13c may be collectively described as a remote controller 13, and the indoor control devices 30a, 30b and 30c may be collectively described as an indoor control device 30 hereinafter. The same applies to functions and components included in the indoor control devices 30a to 30c. For example, external input ports 111a to 111c which will be described later may be described as an external input port 111.

[0025] Further, the number of indoor units 11 and the number of outdoor units 12 are not limited to one in FIG. 1. The number of indoor units 11 may be one or two, or four or more. In addition, the number of outdoor units 12 may be two or more.

[0026] With recent rises in concern for safety, a safety function is required to be provided in an air conditioner in order to prevent accidents of suffocation, fire and the like due to a refrigerant leak. Particularly, a multiple type air conditioner having a large total amount of refrigerant often becomes an object which is required to have the safety function. On the other hand, the safety function is not necessarily required when the total amount of refrigerant is small. In the air conditioner 1 of the present embodiment, the outdoor control device 20 in cooperation with the indoor control devices 30a, 30b and 30c controls enabling and disabling of the safety function of the air conditioner 1 and secures safety of the air conditioner 1 while reducing a burden of a setting operation when the air conditioner 1 is installed.

[0027] Next, a safety function of the present embodiment will be described with reference to FIG. 2.

[0028] FIG. 2 is a diagram showing an example of an external input port of an indoor unit according to an embodiment of the present invention. FIG. 2 shows the indoor unit 11a, an internal substrate 110a included in the indoor unit 11a, and external input ports 111a and 112a. As shown, the internal substrate 110a is provided in the indoor unit 11a and the two external input ports 111a and 112a are provided on the internal substrate 110a. A control circuit composed of electronic parts is mounted on the internal substrate 110a and this control circuit operates to realize the function of the indoor control device 30a. An external device 14 is connected to the external input port 111a. For example, the external device 14 is a safety device including a sensor and the like for detecting a refrigerant leak. The external device 14 monitors an indoor state and outputs a signal representing the

monitoring result. The signal output from the external device 14 is input to the indoor unit 11a via the external input port 111a and thus the indoor control device 30a acquires the signal. The indoor control device 30a performs operation control of the indoor unit 11a on the basis of the acquired signal. For example, the external device 14 detects a refrigerant leak and outputs a signal for requesting emergency stop. When the emergency stop signal is received through the external input port 111a, the indoor control device 30a performs control for stopping the operation of the indoor unit 11a. Otherwise, the indoor control device 30a cooperates with the outdoor control device 20 and the indoor control devices 30b and 30c to perform control for stopping the operation of the entire air conditioner 1. The function of urgently stopping the operation of the indoor unit 11 or the entire air conditioner 1 for which the emergency stop signal has been received in this manner is called an interlock function. The interlock function is a safety function of the air conditioner 1 of the present invention.

[0029] Incidentally, in order for the indoor control device 30a to recognize the signal output from the external device 14 as the emergency stop signal, the safety device needs to be connected to the external input port 111a and types of signals output from the safety device need to be set in advance such that the indoor control device 30a is configured to be able to appropriately process various signals. With respect to the external device 14 connected to each of the external input port 111a and the external input port 112a, configuring functions such that an appropriate function corresponding to a signal output from the external device 14 is executed is referred to as allocation of functions. For example, the interlock function is allocated to the external input port 111a in the above-described example. In the indoor unit 11a and the like of the present embodiment, a predetermined function may be allocated to the external input ports 111a and 112a. For example, an ON/OFF control function may be allocated to the external input ports 111a and 112a as an example other than the interlock function. When the ON/OFF control function is allocated, the indoor control device 30a turns on (starts) or turns off (stops) the indoor unit 11a on the basis of a signal output from the external device 14. Alternatively, a cooling/heating switching function may be allocated to the external input ports 111a and 112a. When the cooling/heating switching function is allocated, the indoor control device 30a switches the operation of the indoor unit 11a to cooling or heating on the basis of a signal output from the external device 14. In addition, a function allocated to the external input ports 111a and 112a may be changed to other functions, for example, according to a function allocation operation of a user using the remote controller 13a.

[0030] In the air conditioner 1 of the present embodiment, the interlock function has been allocated to the external input port 111a through initial setting at the time of shipping. Since the safety function is required when a total amount of refrigerant is equal to or greater than a predetermined threshold value, it is determined whether the total amount of refrigerant is equal to or greater than the threshold value and, when the total amount of refrigerant is equal to or greater than the threshold value, it is desirable that the interlock function allocated through initial setting not be changed to other functions for safety. In addition, if the appropriate external device 14 corresponding to the function allocated to each of the external input ports 111a and 112a is not connected to the external input ports 111a and 112a, the indoor control device 30a cannot appropriately process a signal output from the external device 14, and this may lead to an unexpected operation, failure and the like. Accordingly, it is desirable that connection of the appropriate external device 14 (safety device) to the external input port 111a to which the interlock function has been allocated be securable.

[0031] On the other hand, when the total amount of refrigerant of the air conditioner 1 is less than the threshold value, the air conditioner cannot operate unless the safety device is connected, even if the safety device is not necessary in a state in which the interlock function has been allocated, and thus a user must change the interlock function to other functions, which is troublesome. Accordingly, in the present embodiment, it is determined whether the interlock function is essential on the basis of the total amount of refrigerant of the air conditioner 1 and the like, the interlock function allocated to the external input port 111a is controlled such that it cannot be changed to other functions if the interlock function is essential, and the function allocated to the external input port 111a is controlled to be automatically changed to another predetermined function if the interlock function is not essential on the basis of the determination result.

[0032] Next, functions of the outdoor control device 20 and the indoor control device 30 will be described using FIG. 3.

[0033] FIG. 3 is a functional block diagram showing an example of a control system according to an embodiment of the present invention.

[0034] The control system includes the outdoor control device 20 and the indoor control devices 30a, 30b and 30c. As shown in FIG. 3, the outdoor control device 20 includes an input/output unit 21, a determination unit 22, a safety measure control execution unit 23, a communication unit 24, and a storage unit 25.

[0035] The input/output unit 21 is an interface through which various control signals are input and output and setting information and the like are input by a user.

[0036] The determination unit 22 determines whether the air conditioner 1 has the interlock function as an essential function. The determination unit 22 sends the determination result to the indoor units 11a to 11c through the communication unit 24.

[0037] The safety measure control execution unit 23 performs emergency stop of the outdoor unit 12 when a signal for requesting execution of the interlock function (e.g., a signal representing detection of any danger such as a refrigerant leak, an emergency stop signal, or the

like) from the external device 14 is input to any of the indoor units 11a to 11c.

[0038] The communication unit 24 performs communication with the indoor control device 30a of the indoor unit 11a, the indoor control device 30b of the indoor unit 11b and the indoor control device 30c of the indoor unit 11c.

[0039] The storage unit 25 stores various types of information. For example, the storage unit 25 stores information necessary to determine whether the interlock function is required for the air conditioner 1 (determines whether the total amount of refrigerant of the air conditioner 1 is equal to or greater than a predetermined threshold value).

[0040] The indoor control device 30a included in the indoor unit 11 includes an input/output unit 31a, a setting unit 32a, a safety measure control execution unit 33a, a communication unit 34a, and a storage unit 35a.

[0041] The input/output unit 31a is an interface through which various control signals are input and output, setting information is input by the user through the remote controller 13a, signals from the external input port 111a and the external input port 112a are input, and the like.

[0042] The setting unit 32a sets a function allocated to the external input port 111a and the external input port 112a. For example, the setting unit 32a allocates a function to each port on the basis of information for instructing allocation of a function to the external input port 111a and the like from the user. In addition, the setting unit 32a allocates the interlock function (which has already been allocated as initial setting) to the external input port 111a or the external input port 112a if the interlock function is essential, for example, on the basis of the determination result of the determination unit 22 and allocates a predetermined function (e.g., the ON/OFF function and the like) if the interlock function is not essential.

[0043] The safety measure control execution unit 33a stops the indoor unit 11a when the interlock function has been allocated to the external input port 111a and the like and the emergency stop signal has been input from the external device 14. In addition, the safety measure control execution unit 33a sends a signal for requesting execution of the interlock function to other indoor units 11b and 11c and the outdoor unit 12 through the communication unit 34a.

[0044] The communication unit 34a performs communication with the outdoor control device 20 of the outdoor unit 12.

[0045] The storage unit 35a stores various types of information. For example, the storage unit 35a stores setting information such as a function allocated to the external input port 111a when the interlock function is not essential

[0046] Although the function of the indoor control device 30a has been described above, the same applies to the indoor control devices 30b and 30c.

[0047] In addition, although the outdoor control device 20 and the indoor control device 30 have functions of performing various controls (cooling operation, heating operation, defrosting operation and the like) of the air conditioner 1 in addition to the interlock related function, description of functions related to other controls is omitted in the present description.

[0048] Furthermore, although the outdoor control device 20 includes the function of the determination unit 22 in the configuration illustrated in FIG. 3, the indoor control device 30 may have the function of the determination unit 22. Further, the control system of the air conditioner 1 may include a centralized control device configured as a microcomputer and the like which is provided as separate bodies from the indoor unit 11 and the outdoor unit 12. The centralized control device is provided such that the centralized control device can communicate with the outdoor control device 20 and the indoor control device 30. For example, the centralized control device may be configured to include the function of the determination unit 22, to determine whether the interlock function is necessary and to send the determination result to the indoor control devices 30a to 30c.

[0049] Hereinafter, a process of enabling and disabling the interlock function in the control system will be described using FIGS. 4 to 6.

[0050] FIG. 4 is a diagram illustrating examples of setting used for a process of allocating a function to an external input port according to an embodiment of the present invention.

(Determination method)

[0051] FIG. 4(a) is a table showing criteria for determining whether the interlock function is essential. For example, the determination unit 22 determines that the interlock function is essential if the capacity of the outdoor unit 12 is greater than a predetermined threshold value (e.g., 20 horsepower, cooling capacity of about 56 kW) on the basis of the capacity of the outdoor unit 12. In this case, the setting unit 32 allocates the interlock function to any one of the external input ports 111 and 112.

[0052] In addition, the determination unit 22 determines that the interlock function is not essential if the capacity of the outdoor unit 12 is less than the predetermined threshold value. In this case, the setting unit 32 disables the interlock function allocated to any one of the external input ports 111 and 112.

[0053] Here, in the case of an outdoor unit 12 having low performance with a capacity less than a predetermined threshold value, the total amount of refrigerant is small and thus a safety measure is not necessary. On the other hand, in the case of an outdoor unit having a high performance with a capacity equal to or greater than the predetermined threshold value, a safety measure is necessary because of a large total amount of refrigerant. The determination unit 22 reads information on the capacity of the outdoor unit 12 stored in the storage unit 25, and determines whether a safety function (interlock function) is necessary, for example.

[0054] In addition, the determination unit 22 may determine whether the interlock function is necessary on the basis of the total amount of refrigerant injected into the air conditioner 1. That is, the determination unit 22 determines that the interlock function is essential if the value of the total amount of refrigerant is greater than a predetermined threshold value and determines that the interlock function is not essential if the value of the total amount of refrigerant is less than the predetermined threshold value.

[0055] Here, the value of the total amount of refrigerant of the air conditioner 1 may be input by an operator to the outdoor control device 20 when the installation work of the air conditioner 1 is performed. Alternatively, an approximate value of the total amount of refrigerant input to the air conditioner 1 may be calculated from the capacity of the outdoor unit 12 and the sum of the capacities of the indoor units 11a to 11c. Accordingly, the determination unit 22 may acquire information on the capacity of the outdoor unit 12 stored in the storage unit 25 of the outdoor unit 12, and information on the capacities of the indoor units 11a to 11c stored in the storage unit 35 of the indoor unit 11, and sum up the capacities to calculate the total amount of refrigerant (an approximate value). In addition, when a plurality of outdoor units 12 are present, the capacities of the plurality of outdoor units 12 are summed. Further, in order to calculate a more accurate value of the total amount of refrigerant, the operator may input information on the length of the pipe which connects the outdoor unit 12 to each of the indoor units 11a to 11c to the outdoor control device 20 when the installation work of the air conditioner 1 is performed, and the determination unit 22 may calculate the total amount of refrigerant (the amount of refrigerant to be injected) in further consideration of the input information on the pipe length in addition to the sum of the capacity of the outdoor unit 12 and the capacities of the indoor units 11a to 11c. In addition, when a plurality of outdoor units 12 are present, the operator inputs the lengths of the pipes between each outdoor unit 12 and one or more indoor units 11 connected to each outdoor unit 12 and the determination unit 22 calculates the total amount of refrigerant using the sum of the lengths of all of the pipes.

[0056] Further, a refrigerant type (flammable, harmful or the like) may be added to conditions of determination of whether the interlock function is necessary in addition to the total amount of refrigerant and the like. Moreover, threshold values used to determine the total amount of refrigerant and the capacity of the outdoor unit 12 may be set to different values for refrigerant types.

(Example of allocation of function)

[0057] FIG. 4(b) is a table illustrating an example of a method of allocating a function to the external input port 111. In this example, the interlock function is initially set to the external input port 111 at the time of shipping. In addition, when the determination unit 22 determines that the capacity of the outdoor unit 12 or the total amount of refrigerant is small, the setting unit 32 automatically changes the interlock function allocated to the external input port 111 to another function "function 1" (e.g., ON/OFF function). To change the function allocated to the external input port 111, for example, the setting unit 32 switches the connection destination of the external input port 111 from a circuit for the interlock function mounted on the internal substrate 110 to a circuit for "function 1." Alternatively, when allocation to an external port is realized by software, allocation is performed by switching a program which processes signals input and output through the external input port 111 from a program for the interlock function to a program for "function 1." In addition, such determination and change of allocated functions are performed when the air conditioner 1 is installed.

[0058] When the air conditioner 1 is introduced with a relatively small-scale configuration (values of the total amount of refrigerant and the capacity of the outdoor unit 12 are small), a user can use "function 1" from initiation of the operation according to the aforementioned automatic allocation function. In addition, when the interlock function needs to be enabled according to a user's demand, for example, "function 1" allocated to the external input port 111 may be changed to the interlock function or the interlock function may be allocated to the external input port 112 according to a setting operation through the remote controller 13. Further, "function 1" allocated to the external input port 111 may be changed to "function 2."

[0059] On the other hand, when the determination unit 22 determines that the capacity of the outdoor unit 12 or the total amount of refrigerant is large, the setting unit 32 controls the interlock function to be essential (to be forcibly enabled). Since the interlock function has already been allocated to the external input port 111 in the case of this example, the setting unit 32 performs control such that the interlock function allocated to the external input port 111 cannot be changed to other functions. This control is performed, for example, by disabling all function allocation instruction signals for the external input port 111, and the like. Unlike the case in which the total amount of refrigerant is small, change to other functions ("function 1" or "function 2") cannot be performed. Accordingly, it is possible to start operation in a state in which the safety function definitely works.

(Automatic setting process)

[0060] Next, a flow of a process of setting enabling or disabling of the interlock function of the present invention will be described. First, a setting process when the air conditioner 1 is started will be described using FIG. 5.

[0061] FIG. 5 is a first flowchart illustrating an example of a process of allocating a function to an external input port according to an embodiment of the present invention.

[0062] A case in which a process of allocating a function to the external input port 111a according to details illustrated in FIG. 4(b) is performed will be described as an example.

[0063] First, the operator inputs an operation for instructing execution of an automatic setting process for enabling or disabling the interlock function to the outdoor control device 20, for example, when the air conditioner 1 is installed. In addition, the operator inputs, to the outdoor control device 20, information on each of the length of the pipe between the outdoor unit 12 and the indoor unit 11a, the length of the pipe between the outdoor unit 12 and the indoor unit 11b and the length of the pipe between the outdoor unit 12 and the indoor unit 11c. Then, the input/output unit 21 receives this instruction information and the determination unit 22 calculates a total amount of refrigerant (step S11). For example, the determination unit 22 reads the capacity of the outdoor unit 12 from the storage unit 25. In addition, the determination unit 22 acquires information on the capacity of the indoor unit 11a, the capacity of the indoor unit 11b and the capacity of the indoor unit 11c respectively from the indoor control devices 30a, 30b and 30c through the communication unit 24. Further, the determination unit 22 acquires information on the pipe lengths input by the operator. For example, a formula and the like for calculating the total amount of refrigerant of the air conditioner 1 from such information are stored in advance in the storage unit 25, and the determination unit 22 calculates the total amount of refrigerant (the amount of refrigerant to be injected) on the basis of the sum of the capacities of the indoor unit 11a and the like, the capacity of the outdoor unit 12, the length of the pipe between each indoor unit 11 and the outdoor unit 12, and the formula. Alternatively, the determination unit 22 calculates the total amount of refrigerant (or a value thereof) using the sum of the capacities of the indoor unit 11a and the like, the capacity of the outdoor unit 12, a formula for calculating a total amount of refrigerant from the sum of the capacities of the indoor units 11 and the capacity of the outdoor unit 12, and the like.

[0064] Subsequently, the determination unit 22 determines whether the calculated total amount of refrigerant (the amount of refrigerant to be injected into the air conditioner 1 or an approximate amount of refrigerant) is equal or greater than a predetermined threshold value (step S12). The determination unit 22 sends the determination result to the indoor control devices 30a to 30c through the communication unit 24. In the indoor control device 30, the setting unit 32 acquires the determination result through the communication unit 34. The setting unit 32 records the acquired determination result in the storage unit 35. When the total amount of refrigerant is equal to or greater than the predetermined threshold value (Yes in step S12), the setting unit 32 performs control for prohibiting change of the interlock function (step S13). Additionally, the indoor control device 30 has a function of checking, for example whether the appropriate external device 14 (safety device) is connected to the external input port 111a, or whether a predetermined safety device is attached to the indoor unit 11 as well as the external input port 111a and the like, and when the safety device is not connected, controlling the air conditioner 1 such that it cannot operate, and may execute this function when it is determined that the interlock function is essential.

[0065] When the total amount of refrigerant is less than the predetermined threshold value (No in step S12), the setting unit 32 performs a process of changing the interlock function allocated to the external input port 111a to another predetermined function "function 1" (step S14).

[0066] Further, when it is determined that the interlock function is essential, the safety measure control execution unit 33a stops the operation of the indoor unit 11a or performs other necessary safety measure control operations when a signal for requesting emergency stop is input from the external input port 111a. In addition, the safety measure control execution unit 33a notifies the indoor units 11a and 11b and the outdoor unit 12 of input of the signal for requesting emergency stop through the communication unit 34a. In the indoor units 11a and 11b and the outdoor unit 12, the safety measure control execution units 33a, 33b and 23 perform control such as shutdown.

[0067] On the other hand, when the interlock function has been changed to "function 1," the safety measure control execution unit 33a does not operate even if a signal is input from the external input port 111a.

[0068] According to the present embodiment, it is possible to automatically enable the interlock function as necessary, and thus safety of the air conditioner 1 can be secured and effort for setting at the time of installation can be reduced to improve working efficiency. Furthermore, since change to other functions is prohibited when the interlock function has been enabled, security of the air conditioner 1 can be ensured. In addition, when the interlock function is not essential, the interlock function is automatically changed to another predetermined function (e.g., a function that the user can conveniently use) and thus user convenience can be improved.

[0069] When the refrigerant type is necessary to determine whether the interlock function is necessary, the operator inputs information indicating the refrigerant type along with information on the pipe length, for example, and the determination unit 22 may perform the determination of step S12 only when the input refrigerant is a predetermined refrigerant (a flammable refrigerant, a harmful refrigerant or the like).

[0070] In addition, there are countries (e.g., Japan) or regions which require that the interlock function be essential depending on the magnitude of a total amount of refrigerant, whereas there are countries or regions in which there is no such requirement. Accordingly, information on a country or a region which is a destination of shipment of the air conditioner 1 may be input along with the information on the pipe length when the interlock func-

tion is automatically set, and the determination of step S12 may be performed only when the input country or region corresponds to a country or a region which requires the interlock function.

[0071] Furthermore, the interlock function may be required to be essential at the request of a user, for example, even in countries or regions which do not require the interlock function. To cope with such requirement, the outdoor control device 20 may have a function of forcibly enabling the interlock function (e.g., a function of allocating the interlock function to the external input port 111a and controlling change of the interlock function to be prohibited).

[0072] Moreover, although the outdoor control device 20 notifies the indoor control device 30 of the determination result in the above description, the indoor control device 30a and the like may request that the outdoor control device 20 check whether the interlock function is essential and set a function to be allocated to the external input port 111a on the basis of a response to the request. Alternatively, the indoor control device 30a and the like may be provided with the function of the determination unit 22, respectively request the capacity of the outdoor unit 12 or information on the total amount of refrigerant for the outdoor control device 20 and determine whether the interlock function is essential on the basis of information provided in response by the outdoor control device 20.

(Setting after introduction)

[0073] Next, a setting process after introduction of the air conditioner 1 will be described.

[0074] FIG. 6 is a second flowchart illustrating an example of a process of allocating a function to an external input port according to an embodiment of the present invention.

[0075] It is assumed that function allocation is performed according to the details illustrated in FIG. 4(b) in the air conditioner 1. First, it is assumed that the user has performed an operation of changing the function allocated to the external input port 111a using the remote controller 13. In the indoor unit 11, the input/output unit 31 acquires function change instruction information (step S21).

[0076] Then, the setting unit 32 determines whether the interlock function is essential (step S22). For example, the setting unit 32 performs this determination with reference to the determination result of the determination unit 22 recorded in the storage unit 35. When the interlock function is essential (Yes in step S22), the setting unit 32 disables instruction for change of the function allocated to the external input port 111a (step S23). When the interlock function is not essential (No in step S22), the setting unit 32 changes the function allocated to the external input port 111a to a function indicated by the change instruction information (step S24).

[0077] According to the present embodiment, it is possible to prohibit disabling of the interlock function when the interlock function is essential, and thus safety of the air conditioner 1 can be secured. In addition, when the interlock function is not essential, the user can freely allocate a function to the external input port 111a. Furthermore, it is possible to enable the interlock function as necessary even when the interlock function is not essential, and thus a degree of freedom of functions allocated to an external port is not deteriorated.

[0078] All or some functions of the outdoor control device 20 and the indoor control device 30 may be realized by, for example, hardware composed of a large scale integration (LSI), an application specific integrated circuit (ASIC), a programmable logic device (PLD), a field-programmable gate array (FPGA), an integrated circuit or the like. In addition, all or some functions of the outdoor control device 20 and the indoor control device 30 may be configured by a computer such as a microcomputer unit (MCU). In such a case, each process in the outdoor control device 20 and the indoor control device 30 may be realized by executing a program by a CPU included in the indoor control device 30, for example. A program executed by the outdoor control device 20 and the indoor control device 30 may be recorded in a computer readable recording medium, and each process may be realized by reading a program recorded in the recording medium and executing the program. In addition, the outdoor control device 20 and the indoor control device 30 are assumed to include an OS and hardware such as peripheral apparatuses. In addition, the computer readable recording medium is a portable medium such as a flexible disk, a magneto-optical disc, a ROM or a CD-ROM, or a storage device such as a hard disk embedded in a computer system. Furthermore, the computer readable recording medium may also include a medium for dynamically saving a program for a short time, such as a communication link when a program is transmitted through a network such as the Internet or a communication line such as a telephone line, and a medium for saving a program for a certain time, such as a volatile memory in a computer system which is a server or a client in such a case. Moreover, the aforementioned program may be a program for realizing some of the above-described functions or may be a program which can realize the above-described functions in combination with programs which have been recorded in a computer system.

[0079] Additionally, the components in the above-described embodiment may be substituted with known components without departing from the subject matter of the present invention. Further, the technical scope of the present invention is not limited to the above-described embodiment and may be modified in various manners without departing from the subject matter of the present invention.

[0080] For example, although the interlock function is emergency stop of the operation of the air conditioner 1 in the above-described example, it is not limited thereto and may be a function of limiting the operation of the air

conditioner 1, such as limiting the number of revolutions of a compressor within a predetermined range, limiting a continuous operating time of the air conditioner 1 within a predetermined time, and the like.

[0081] Furthermore, although the interlock function is allocated through initial setting at the time of shipment in the above-describe example, setting for forcibly putting the interlock function be in an enabled state may be performed on the basis of the total amount of refrigerant when the air conditioner 1 is installed even when there is no initial setting or other functions have been allocated.

EXPLANATION OF REFERENCES

[0082]

1 Air conditioner
11, 11a, 11b, 11c Indoor unit
12 Outdoor unit
13, 13a, 13b, 13c Remote controller
20 Outdoor control device
21 Input/output unit
22 Determination unit
23 Safety measure control execution unit
24 Communication unit
25 Storage unit
30, 30a, 30b, 30c Indoor control device
31 Input/output unit
32 Setting unit
33 Safety measure control execution unit
34 Communication unit
35 Storage unit
110a Internal substrate
111a, 112a External input port

Claims

1. A control system of an air conditioner (1), comprising: a setting unit (32) configured to switch between enabling and disabling of a safety function of the air conditioner (1) on the basis of a total amount of refrigerant of the air conditioner (1).

2. The control system according to claim 1, wherein the setting unit (32) enables the safety function when the total amount of refrigerant is equal to or greater than a predetermined threshold value.

3. The control system according to claim 2, wherein the setting unit (32) prohibits disabling of the safety function when the total amount of refrigerant is equal to or greater than the predetermined threshold value.

4. The control system according to any one of claims 1 to 3, wherein the setting unit (32) sets the safety function to be disabled when the total amount of refrigerant is less than the predetermined threshold value.

5. The control system according to any one of claims 1 to 4, further comprising a determination unit (22) configured to determine whether to enable or disable the safety function on the basis of the total amount of refrigerant calculated on the basis of the sum of capacities of one or more outdoor units (12) included in the air conditioner (1) and the sum of capacities of one or more indoor units (11a, 11b, 11c) included in the air conditioner (1).

6. The control system according to claim 5, wherein the determination unit (22) is configured to determine whether to enable or disable the safety function on the basis of the total amount of refrigerant calculated on the basis of the lengths of one or more pipes between the one or more outdoor units (12) and the one or more indoor units (11a, 11b, 11c) connected to the respective outdoor units (12) in addition to the sum of the capacities of the outdoor units (12) and the sum of the capacities of the indoor units (11a, 11b, 11c).

7. The control system according to any one of claims 1 to 6, wherein the setting unit (32) performs switching of the safety function based on the total amount of refrigerant only when a refrigerant used in the air conditioner (1) is a predetermined refrigerant.

8. The control system according to any one of claims 1 to 7, wherein the setting unit (32) performs switching of the safety function based on the total amount of refrigerant only when a country or a region which is a destination of shipment of the air conditioner (1) is a predetermined country or region.

9. The control system according to any one of claims 1 to 8, wherein the setting unit (32) is configured to switch enabling and disabling of the safety function on the basis of the capacity of an outdoor unit (12) included in the air conditioner (1) instead of the total amount of refrigerant.

10. An air conditioner comprising the control system according to any one of claims 1 to 9.

11. A setting method by which a control system of an air conditioner (1) switches between enabling and disabling of a safety function of the air conditioner (1) on the basis of a total amount of refrigerant of the air conditioner (1).

12. The setting method according to claim 11, wherein setting of enabling the safety function is performed as initial setting of the air conditioner (1), disabling of the safety function is prohibited when the total amount of refrigerant is equal to or greater than a

predetermined threshold value, and another predetermined function instead of the safety function is set when the total amount of refrigerant is less than the predetermined threshold value at the time of introduction of the air conditioner (1).

FIG. 1

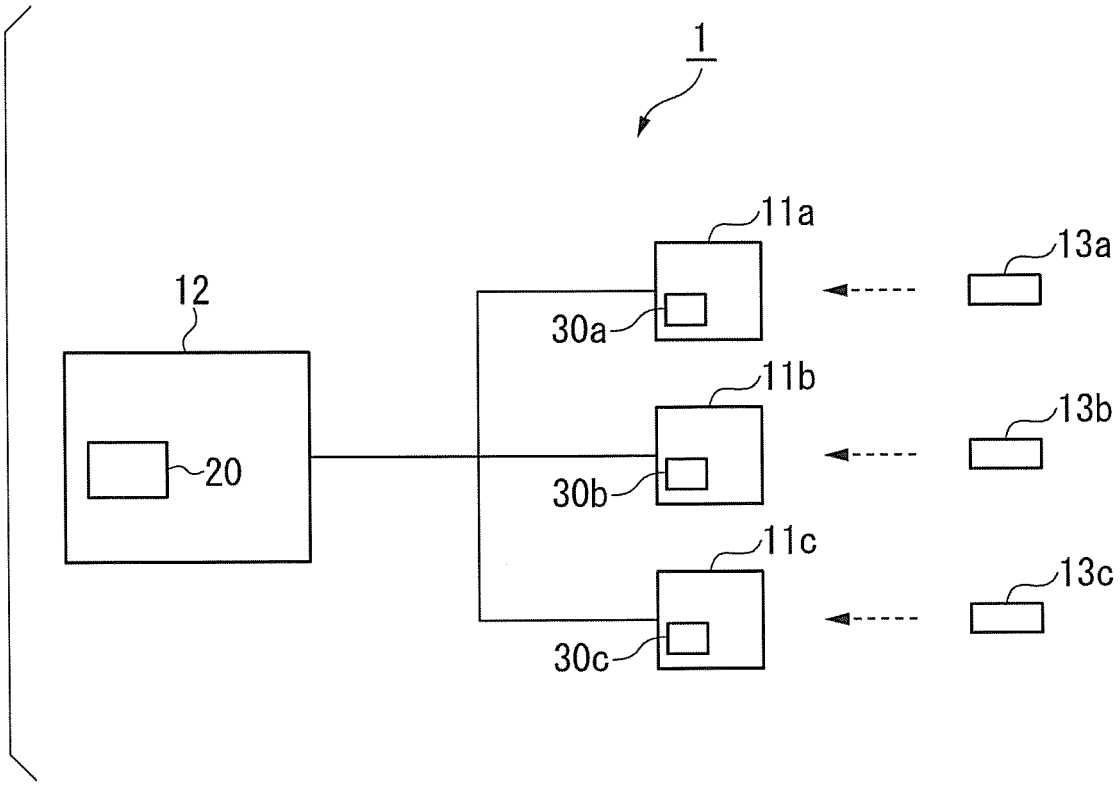

1
11a
13a
12
30a
11b
13b
20
30b
11c
13c
30c

FIG. 2

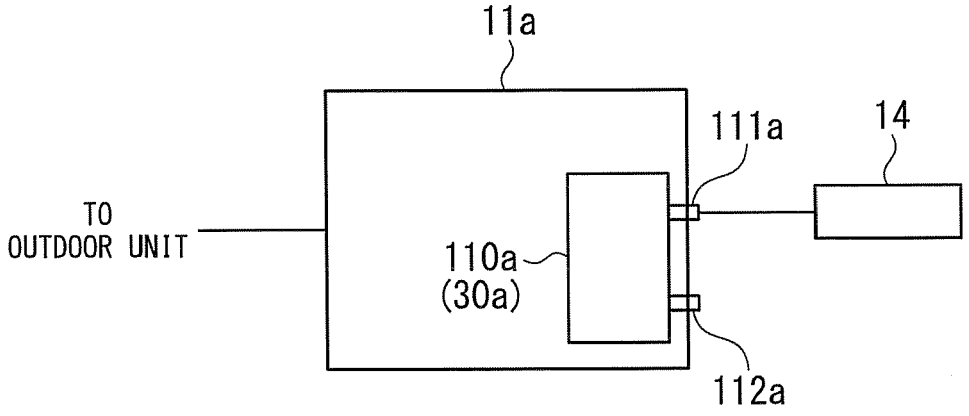

11a
111a
14
TO
OUTDOOR UNIT
110a
(30a)
112a

FIG. 3

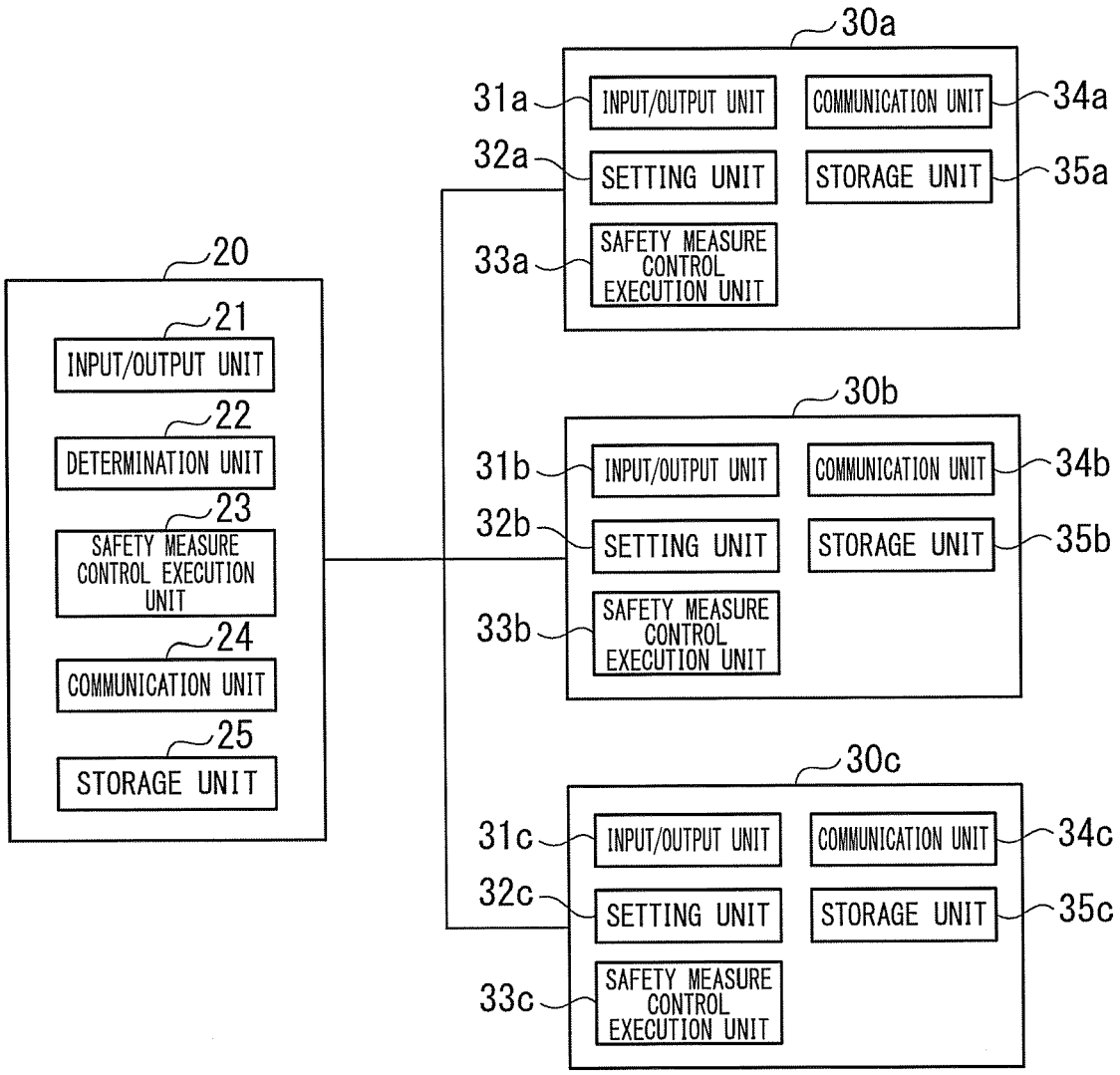

20
21
INPUT/OUTPUT UNIT
22
DETERMINATION UNIT
23
SAFETY MEASURE CONTROL EXECUTION UNIT
24
COMMUNICATION UNIT
25
STORAGE UNIT
30a
31a
INPUT/OUTPUT UNIT
COMMUNICATION UNIT
34a
32a
SETTING UNIT
STORAGE UNIT
35a
33a
SAFETY MEASURE CONTROL EXECUTION UNIT
30b
31b
INPUT/OUTPUT UNIT
COMMUNICATION UNIT
34b
32b
SETTING UNIT
STORAGE UNIT
35b
33b
SAFETY MEASURE CONTROL EXECUTION UNIT
30c
31c
INPUT/OUTPUT UNIT
COMMUNICATION UNIT
34c
32c
SETTING UNIT
STORAGE UNIT
35c
33c
SAFETY MEASURE CONTROL EXECUTION UNIT

FIG. 4

(a)

ITEM	DETAILS OF CONTROL	
CAPACITY OF OUTDOOR UNIT TOTAL AMOUNT OF REFRIGERANT	GREATER THAN THRESHOLD VALUE ↓ SET INTERLOCK FUNCTION TO ESSENTIAL	EQUAL TO OR LESS THAN THRESHOLD VALUE ↓ DISABLE INTERLOCK FUNCTION

(b)

SETTING	AT TIME OF SHIPPING	TOTAL AMOUNT OF REFRIGERANT OR OUTDOOR UNIT CAPACITY IS SMALL	TOTAL AMOUNT OF REFRIGERANT OR OUTDOOR UNIT CAPACITY IS LARGE
INTERLOCK FUNCTION	○		○
FUNCTION 1		○	×
FUNCTION 2			×
...	...	...	...

FIG. 5

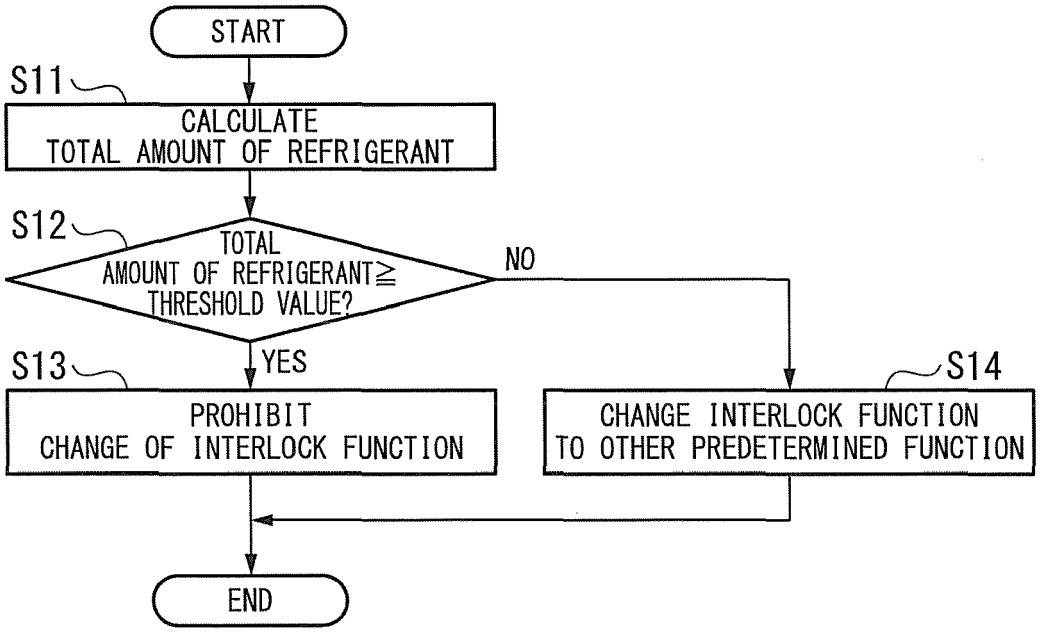
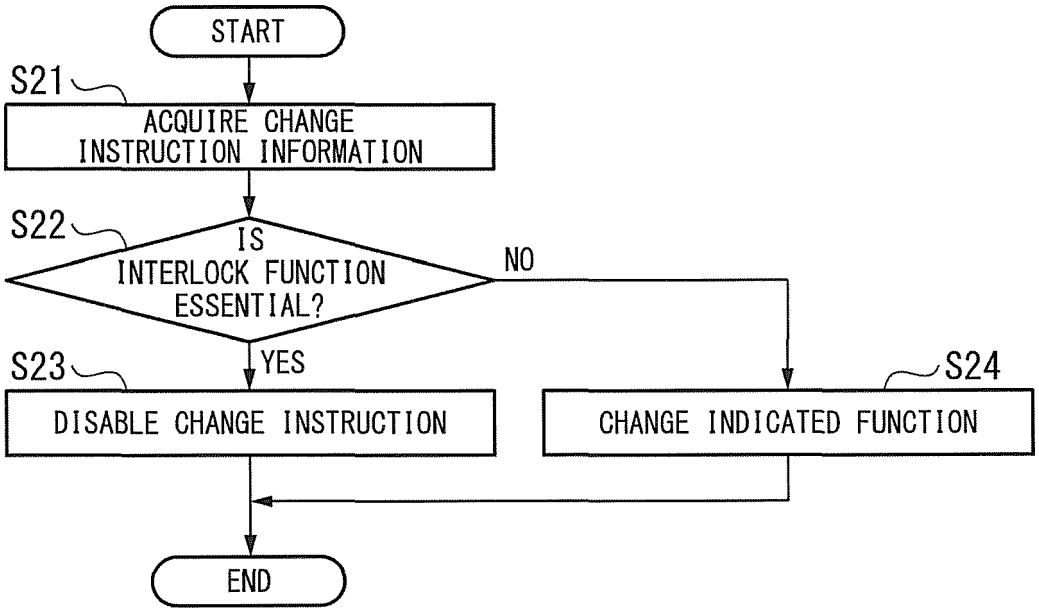


FIG. 6


START
S21
ACQUIRE CHANGE INSTRUCTION INFORMATION
S22
IS INTERLOCK FUNCTION ESSENTIAL?
NO
YES
S23
DISABLE CHANGE INSTRUCTION
S24
CHANGE INDICATED FUNCTION
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2017146805 A **[0002]**
- JP H11325672 B **[0005]**