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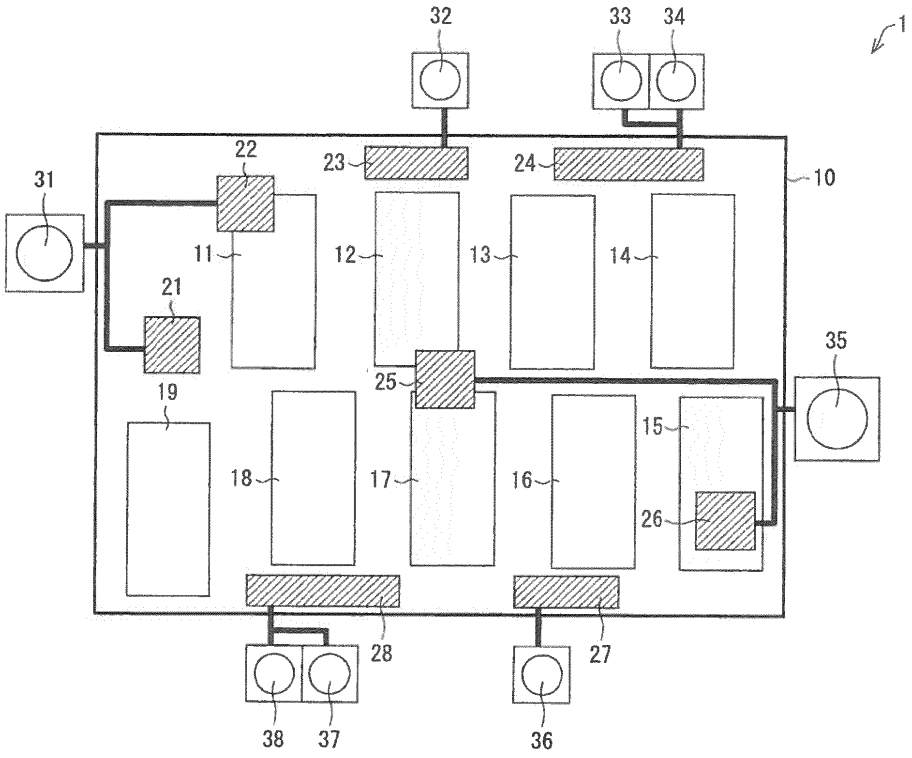
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(54) CONTROL DEVICE, CONTROL METHOD, PROGRAM AND RECORDING MEDIUM

(57) A control device (50) is provided with a control unit (53) that divides a plurality of air conditioners (21 to 28) into a first group and second group, operates the air conditioners belonging to the first group regardless of the operational state of production lines (11 to 19), and controls the operation of the air conditioners belonging to the second group according to the operational state of the production lines (11 to 19).

Fig. 1



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Fig. 3

First group	Air conditioner 21 Air conditioner 25
Second group	Air conditioner 22 Air conditioner 23 Air conditioner 24 Air conditioner 26 Air conditioner 27 Air conditioner 28

Description

TECHNICAL FIELD

[0001] The present invention relates to a control device that controls air conditioning in an air conditioning target area such as a production factory where a facility generating heat during operation is installed.

BACKGROUND ART

[0002] In a production line that processes or assembles a product, heating devices constituting the production line, or a motor, a controller, and a transformer of a production device generate heat to radiate a large amount of heat into air.

[0003] On the other hand, in a clean room necessary for production of a semiconductor device and the like, a print line, and a precision processing line, air conditioning is performed for maintaining the temperature substantially constant in a production factory in order to stabilize processing accuracy of the product. An air conditioner having a high cooling capability is used to suppress a temperature raise caused by the heat radiated from the facility.

[0004] For this reason, in the case that the production line stops not to radiate the heat, the production factory is cooled to below a preset temperature (overshoot) by the high-capability air conditioner operation, and unfortunately wasted power consumption is generated.

[0005] In order to solve the problem, for example, Patent Document 1 proposes a method for measuring environmental data (air temperature, CO_2 concentration, and power consumption) in the air conditioning target area, and changing the preset temperature of the air conditioner to an optimum value from an increase or decrease in the environmental data which changes depending on an operational state of the device in the target area or presence of persons. According to the method of Patent Document 1, because the operational capability of the air conditioner can be set by previously predicting the temperature change in the air conditioning target area, the wasted power consumption caused by extremely cooling the air conditioning target area can be suppressed.

[0006] Patent Document 2 also proposes a method for calculating a time necessary to reach the preset temperature from the power consumption of the facility in the air conditioning target area and the present temperature, and selecting an optimum air conditioning control pattern from the calculation result to reduce the power consumption.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0007]

Patent Document 1: Japanese Unexamined Patent Publication No. 2011-64416
Patent Document 2: Japanese Unexamined Patent Publication No. 2011-38705

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0008] However, the method of Patent Document 1 is not suitable to the use in the production factory in which the temperature needs to be controlled so as to be kept constant because the operation capability of the air conditioner is set by changing the preset temperature. Additionally, it is necessary to previously derive a relationship between the environmental data and the preset temperature. The relationship depends on a combination of various pieces of data such as the extent of the target area, an outdoor air temperature, the device, the person, and an arrangement of the air conditioner. Therefore, it is difficult to previously understand the correct relationship in the production factory.

[0009] Although the method of Patent Document 2 can be applied to the production factory because of the control performed in the constant temperature setting, it is necessary to previously derive a relationship between the environmental data and a control pattern. Therefore, in the case that the method of Patent Document 2 is applied to the production factory, there is still the problem that the correct relationship cannot previously be set in the combination of various pieces of data on the extent of the target area, the outdoor air temperature, the device, the person, and the arrangement of the air conditioner.

[0010] The present invention has been devised to solve the above problems, and an object thereof is to provide a control device that can easily perform the proper air conditioning according to the situation of the heat radiated from the facility, a control method, a program, and a recording medium.

MEANS FOR SOLVING THE PROBLEM

[0011] To solve the above problems, a control device of the present invention is a control device configured to control a plurality of air conditioners, the control device includes a control unit configured to divide the plurality of air conditioners into a first group and a second group, operate an air conditioner belonging to the first group regardless of an operational state of a facility, and control an operation of an air conditioner belonging to the second group according to the operational state of the facility.

[0012] A control method of the present invention is a method for controlling a plurality of air conditioners, the control method includes the step of dividing the plurality of air conditioners into a first group and a second group, operating an air conditioner belonging to the first group regardless of an operational state of a facility, and controlling an operation of an air conditioner belonging to the

second group according to the operational state of the facility.

EFFECT OF THE INVENTION

[0013] As described above, according to the present invention, advantageously the proper air conditioning can easily be performed according to the situation of the heat radiated from the facility.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic diagram illustrating a production factory to which a control system according to one embodiment of the present invention is applied.
Fig. 2 is a block diagram illustrating a schematic configuration of a control system of a first embodiment.
Fig. 3 is a diagram illustrating an example of group information stored in a group information storage unit.
Fig. 4 is a diagram illustrating an example of an air conditioner-line correspondence table stored in an air conditioner-line correspondence table storage unit of the first embodiment.
Fig. 5 is a flowchart illustrating a flow of air conditioner control processing (cooling operation) in the first embodiment.
Fig. 6 is a flowchart illustrating a flow of air conditioner control processing (heating operation) in the first embodiment.
Fig. 7 is a block diagram illustrating a schematic configuration of a control system according to a second embodiment.
Fig. 8 is a diagram illustrating an example of peripheral device information stored in a peripheral device information storage unit.
Fig. 9 is a flowchart illustrating a flow of air conditioner control processing (cooling operation) in the second embodiment.
Fig. 10 is a flowchart illustrating a flow of air conditioner control processing (heating operation) in the second embodiment.
Fig. 11 is a block diagram illustrating a schematic configuration of a control system according to a third embodiment.
Fig. 12 is a diagram illustrating an example of the air conditioner-line correspondence table stored in an air conditioner-line correspondence table storage unit of the third embodiment.
Fig. 13 is a flowchart illustrating a flow of air conditioner control processing (cooling operation) in the third embodiment.
Fig. 14 is a flowchart illustrating a flow of air conditioner control processing (heating operation) in the third embodiment.

MODE FOR CARRYING OUT THE INVENTION

<First Embodiment>

(Entire configuration of control system)

[0015] Hereinafter, one embodiment of the present invention will be described in detail with reference to the drawings. Fig. 1 is a schematic diagram illustrating a production factory to which a control system of the one embodiment is applied. Fig. 2 is a block diagram illustrating a schematic configuration of the control system.

[0016] A control system 1 of the first embodiment includes a plurality of production lines (facilities) 11 to 19, a plurality of air conditioners 21 to 28, and a control device 50. The production lines 11 to 19, the air conditioners 21 to 28, and the control device 50 are installed in one production factory (air conditioning target area) 10.

[0017] Each of the production lines 11 to 19 is a facility including various production apparatuses that process or assemble a product, and the facility generates heat during operation. The production lines 11 to 19 are connected to wattmeters 41 to 49 that measure electric energy consumed in the production lines, respectively.

[0018] The air conditioners 21, 22, 25, and 26 are hanging type air conditioners, and the air conditioners 23, 24, 27, and 28 are floor type air conditioners. Each of the air conditioners 21 to 28 is connected to one of corresponding accessory outdoor machines 31 to 38. There is no particular limitation to the number of outdoor machines connected to the air conditioners. For example, the air conditioner 24 is connected to two outdoor machines 33 and 34, the air conditioner 28 is connected to two outdoor machines 37 and 38, and each of the remaining air conditioners is connected to one of the outdoor machines. An air conditioning capability of the air conditioner can be enhanced by increasing the number of connected outdoor machines. One outdoor machine may be shared by a plurality of air conditioners. For example, the outdoor machine 31 is shared by the air conditioners 21 and 22, and the outdoor machine 35 is shared by the air conditioners 25 and 26.

[0019] The air conditioners 21 to 28 measure surrounding temperatures during operation. The air conditioners 21 to 28 are controlled such that the measured temperatures are equal to preset temperatures. For example, during cooling operation, the air conditioners 21 to 28 perform an operation to lower an indoor temperature (temperature turning-down operation) in the case that the measured temperature is higher than the preset temperature, and temporarily stop in the case that the measured temperature is lower than the preset temperature. During heating operation, the air conditioners 21 to 28 temporarily stop in the case that the measured temperature is higher than the preset temperature, and perform an operation to raise the indoor temperature (temperature turning-up operation) in the case that the measured temperature is lower than the preset temperature.

[0020] The control device 50 controls the operations of the air conditioners 21 to 28. The control device 50 divides the air conditioners 21 to 28 into a first group and a second group, and performs the control according to each group. In the first group, the air conditioners are operated regardless of the operations of the production lines 11 to 19. In the second group, the air conditioners are operated according to the operations of the production lines 11 to 19.

(Configuration of control device)

[0021] An internal configuration of the control device 50 will be described below. As illustrated in Fig. 2, the control device 50 includes a group information storage unit 51, an air conditioner-line correspondence table storage unit (facility identification information storage unit) 52, a control unit 53, and an input unit 54.

[0022] The group information storage unit 51 stores group information therein. The group information indicates the air conditioner belonging to the first group in which the air conditioners are operated regardless of the operations of the production lines 11 to 19 and the second group in which the air conditioners are operated according to the operations of the production lines 11 to 19. Fig. 3 is a diagram illustrating an example of the group information stored in the group information storage unit 51. As illustrated in Fig. 3, the air conditioners 21 and 25 belong to the first group, and the air conditioners 22 to 24 and 26 to 28 belong to the second group.

[0023] In response to input to the input unit 54 by a user, the group information storage unit 51 stores the group information therein. Therefore, in the case that the group to which a certain air conditioner belongs is changed, the user inputs the change of the group to the input unit 54, and the group information storage unit 51 updates the group information in response to the input of the change of the group.

[0024] The air conditioner-line correspondence table storage unit 52 stores an air conditioner-line correspondence table therein. In the air conditioner-line correspondence table, air conditioner identification information indicating the air conditioner concerned, first line identification information (first facility identification information) identifying the production line installed closest to the air conditioner concerned, and a first threshold used to determine stopping of the production line concerned are correlated with one another with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. Fig. 4 is a diagram illustrating an example of the air conditioner-line correspondence table stored in the air conditioner-line correspondence table storage unit 52.

[0025] The first threshold is set to a value which is smaller than the power consumption during a predetermined period (for example, 10 minutes) when the corresponding production line is operated and is slightly larger than the power consumption during the predetermined period when the production line stops.

[0026] In response to the input to the input unit 54 by the user, the air conditioner-line correspondence table storage unit 52 stores the air conditioner-line correspondence table therein. Therefore, in the case that a layout is changed in the production factory 10, the user inputs an instruction to change the first line identification information corresponding to the new layout to the input unit 54, and the air conditioner-line correspondence table storage unit 52 updates the air conditioner-line correspondence table in response to the input.

[0027] The control unit 53 controls the air conditioners 21 to 28 according to the group. The control unit 53 performs the control such that each of the air conditioners 21 and 25 belonging to the first group performs the operation according to the existing preset temperature. That is, the air conditioners 21 and 25 belonging to the first group are operated such that the measured temperature is equal to the preset temperature.

[0028] The control unit 53 reads the first line identification information and first threshold which correspond to the air conditioner identification information indicating the air conditioner concerned, from the air conditioner-line correspondence table with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. Based on measured data of the wattmeter connected to the production line indicated by the read first line identification information, the control unit 53 calculates power consumption (hereinafter, referred to as first power consumption) of a predetermined period (for example, past 10 minutes from a present clock time), and compares the first power consumption to the first threshold.

[0029] As described above, the first threshold is set to a value which is smaller than the power consumption during the predetermined period (for example, 10 minutes) when the production line is operated, and is slightly larger than the power consumption during the predetermined period when the production line concerned stops. Therefore, in the case that the calculated first power consumption is lower than the first threshold, the control unit 53 can determine that the production line indicated by the first line identification information stops. In the case that the calculated first power consumption is greater than or equal to the first threshold, the control unit 53 can determine that the production line indicated by the first line identification information operates.

[0030] When determining that the production line stops, the control unit 53 stops the operation of the air conditioner during the cooling operation, and operates the air conditioner during the heating operation. On the other hand, when determining that the production line operates, the control unit 53 operates the air conditioner during the cooling operation, and stops the operation of the air conditioner during the heating operation. The operation of the air conditioner is controlled by the control unit 53 such that the measured temperature is equal to the preset temperature.

[0031] The control unit 53 divides the air conditioners 21 to 28 into the first group and the second group, operates the air conditioners 21 and 25 belonging to the first group regardless of operational states of the production lines 11 to 19, and controls the air conditioners 22 to 24 and 26 to 28 belonging to the second group according to the operational states of the production lines 11 to 19. Therefore, the air conditioners 22 to 24 and 26 to 28 of the second group can be operated according to heat radiation amounts of the production lines 11 to 19. As a result, for the air conditioners 22 to 24 and 26 to 28 of the second group, the wasted operation can be avoided in consideration of the heat radiated from the production lines 11 to 19 to achieve energy saving. For example, when the production lines 11 to 19 stop not to radiate the heat, the wasted operation can be avoided by stopping the cooling operations of the air conditioners 22 to 24 and 26 to 28 of the second group. The air conditioners 21 and 25 belonging to the first group are operated regardless of the operational states of the production lines 11 to 19. Therefore, for example, even if the facility is not operated, the temperature in the production factory is maintained at the preset temperature with the air conditioner belonging to the first group during the cooling operation.

[0032] By the simple setting in which the air conditioners 21 to 28 are divided into the first group and the second group, the temperature in the production factory can be kept constant without consuming the wasted power. That is, unlike Patent Documents 1 and 2, it is not necessary to acquire the detailed environmental data that changes depending on the conditions of the production factory. Even if the layout of the facility or air conditioner in the air conditioning target area is changed, it is not necessary to acquire again the environmental data required in Patent Documents 1 and 2.

(Flow (during cooling operation) of air conditioner control processing)

[0033] An example of processing of controlling the air conditioners 21 to 28 in the first embodiment will be described below with reference to Fig. 5. Fig. 5 is a flowchart illustrating a flow of the processing of controlling the air conditioners 21 to 28 in the first embodiment. Fig. 5 illustrates an example of the case that the air conditioners 21 to 28 perform the cooling operation in summer.

[0034] The control unit 53 selects a control target from the air conditioners 21 to 28. The control unit 53 determines whether the air conditioner of the control target belongs to the second group (S1). The control unit 53 makes the determination in S1 by referring to the group information stored in the group information storage unit 51.

[0035] When the air conditioner of the control target does not belong to the second group (NO in S1), namely, when the air conditioner of the control target belongs to the first group, the control unit 53 compares the measured temperature of the air conditioner of the control target to the preset temperature (S2). When the measured temperature is higher than the preset temperature (YES in S2), the control unit 53 causes the air conditioner of the control target to perform the temperature turning-down operation (S3). On the other hand, when the measured temperature is less than or equal to the preset temperature (NO in S2), the control unit 53 temporarily stops the air conditioner of the control target (S4).

[0036] When the air conditioner of the control target belongs to the second group (YES in S1), the control unit 53 reads the first line identification information and first threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target, from the air conditioner-line correspondence table (S5). Therefore, the control unit 53 can specify the production line closest to the air conditioner of the control target.

[0037] Then the control unit 53 calculates the first power consumption of the predetermined period (for example, past 10 minutes from the present clock time) from the measured data of the wattmeter connected to the production line indicated by the read first line identification information read in S5. The control unit 53 accumulates the pieces of past measured data of the wattmeters 41 to 49 corresponding to the production lines 11 to 19 respectively, which allows the first power consumption to be calculated. The control unit 53 determines whether the calculated first power consumption is greater than or equal to the first threshold read in S5 (S6).

[0038] When the first power consumption is greater than or equal to the first threshold (YES in S6), the control unit 53 determines that the production line operates, and the flow goes to the processing in S2 performed to the air conditioner of the control target. That is, the control unit 53 causes the air conditioner of the control target to perform the normal operation according to the preset temperature without degrading the air conditioning capability.

[0039] On the other hand, when the first power consumption is less than the first threshold (NO in S6), the control unit 53 determines that the production line stops, and stops the operation of the air conditioner of the control target (S7). For example, the operation of the air conditioner 23 that is of the control target installed on the floor close to the production line 12 is stopped in the case that the first power consumption of the production line 12 indicated by the first line identification information is lower than the first threshold (0.5 kW, see Fig. 4). The operation of the air conditioner 26 that is of the control target installed immediately above the production line 15 is stopped in the case that the first power consumption of the production line 15 indicated by the first line identification information is lower than the first threshold (0.3 kW, see Fig. 4). Then, the flow returns to S1, and the pieces of processing in S1 to S7 are repeated.

[0040] The control unit 53 performs the pieces of processing in S1 to S7 to all the air conditioners 21 to 28.

[0041] Thus, for the air conditioners belonging to the second group, (1) the control unit 53 stops each of the air conditioners in the case that the first power consumption of the production line (facility) indicated by the first line identification information corresponding to the air conditioner concerned is less than the predetermined first threshold, and (2) the control unit 53 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is greater than or equal to the first threshold.

[0042] Therefore, each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group performs the cooling operation such that the measured temperature is equal to the preset temperature, only when the production line installed closest to the air conditioner operates. Each of the air conditioners 22 to 24 and 26 to 28 stops when the production line installed closest to the air conditioner stops. As a result, in the case that the production line does not radiate the heat while the production line concerned stops, the wasted operation of the close air conditioner can be eliminated to prevent undercooling. The close air conditioner can be operated during the operation of the production line, and the temperature raise caused by the heat radiated from the production line can effectively be prevented.

(Flow (during heating operation) of air conditioner control processing)

[0043] Another example of the processing of controlling the air conditioners 21 to 28 in the second embodiment will be described with reference to Fig. 6. Fig. 6 illustrates an example of the case that the air conditioners 21 to 28 perform the heating operation in winter.

[0044] Similarly to the processing in Fig. 5, the control unit 53 performs the processing in S1. When the air conditioner of the control target does not belong to the second group (NO in S1), namely, when the air conditioner of the control target belongs to the first group, the control unit 53 compares the measured temperature of the air conditioner of the control target to the preset temperature (S8). When the measured temperature is less than the preset temperature (YES in S8), the control unit 53 causes the air conditioner of the control target to perform the temperature turning-up operation (S9). On the other hand, when the measured temperature is greater than or equal to the preset temperature (NO in S8), the control unit 53 temporarily stops the air conditioner of the control target (S4).

[0045] When the air conditioner of the control target belongs to the second group (YES in S1), the control unit 53 performs the pieces of processing in S5 and S6 similarly to the first embodiment. That is, the control unit 53 calculates the first power consumption of the predetermined period in the production line closest to the air conditioner of the control target, and compares the first power consumption to the first threshold.

[0046] When the first power consumption is less than the first threshold (NO in S6), the control unit 53 determines that the production line stops, and transfers to the processing in S8 performed to the air conditioner of the control target. That is, the air conditioner of the control target is allowed to operate normally according to the preset temperature without degrading the air conditioning capability.

[0047] On the other hand, when the first power consumption is greater than or equal to the first threshold (YES in S6), the control unit 53 determines that the production line operates, and stops the operation of the air conditioner of the control target (S7). Then, the flow returns to S1 and the pieces of processing in S1 to S9 (excluding S2 and S3) are repeated.

[0048] The control unit 53 performs the pieces of processing in S1 to S9 (excluding S2 and S3) in Fig. 6 to all the air conditioners.

[0049] Thus, for the air conditioners belonging to the second group, (1) the control unit 53 stops each of the air conditioners in the case that the first power consumption of the production line (facility) indicated by the first line identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined first threshold, and (2) the control unit 53 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is less than the first threshold.

[0050] Therefore, each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group performs the heating operation such that the measured temperature is equal to the preset temperature, only when the production line installed closest to the air conditioner stops. Each of the air conditioners 22 to 24 and 26 to 28 stops when the production line installed closest to the air conditioner operates. As a result, in the case that the production line radiates the heat while the production line concerned operates, the wasted heating operation of the close air conditioner is eliminated. The close air conditioner can perform the heating operation when the production line stops, and the temperature lowering caused by the absence of the heat radiated from the production line can effectively be prevented.

[0051] In the above description, the information indicating the production line closest to the air conditioner is stored as the first line identification information in the air conditioner-line correspondence table storage unit 52. Alternatively, the information indicating the production line close to the air conditioner may be stored as the first line identification information in the air conditioner-line correspondence table storage unit 52. For example, in the case that the heat radiation amount of the operating second-closest production line is much larger than the heat radiation amount of the operating closest production line, the information indicating the second closest production line may be set to the first line identification information. Therefore, the operation of the air conditioner can be controlled according to the operation of the production line that is installed close to the air conditioner

and has the large heat radiation amount.

<Second Embodiment>

[0052] A second embodiment of the present invention will be described below. For the sake of convenience, the component having the same function as the first embodiment is designated by the same numeral as the first embodiment, and the description is neglected.

[0053] In the first embodiment, when the air conditioner adjacent to a certain air conditioner that is stopped due to a breakdown is stopped through the processing in S7, there is a possibility that the air conditioning capability is extremely degraded. When adjacent production lines are simultaneously stopped, adjacent air conditioners are simultaneously stopped. Therefore, depending on the layout of the production factory, there is a possibility that the air conditioning capability is extremely degraded. In the second embodiment, such problems can also be solved.

[0054] Fig. 7 is a block diagram illustrating a control system 101 of the second embodiment. As illustrated in Fig. 7, the control system 101 differs from the control system 1 of the first embodiment in that the air conditioners 21 to 28 are connected to wattmeters 61 to 68 that measure electric energy consumed by the air conditioners. A control device 150 of the second embodiment differs from the control device 50 of the first embodiment in that the control device 150 includes a control unit 153 instead of the control unit 53, and that the control device 150 further includes a peripheral device information storage unit 155.

[0055] The peripheral device information storage unit 155 stores peripheral device information therein with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. The air conditioner identification information identifying the air conditioner, peripheral device identification information (device identification information) identifying the air conditioner (peripheral air conditioner) installed around the air conditioner concerned, and a second threshold used to determine the stopping of the peripheral air conditioner are correlated with one another in the peripheral device information. Fig. 8 is a diagram illustrating an example of the peripheral device information.

[0056] The second threshold is set to a value which is smaller than the power consumption during a predetermined period (for example, 10 minutes) when the corresponding air conditioner is operated and is slightly larger than the power consumption during the predetermined period when the air conditioner stops.

[0057] In response to the input to the input unit 54 by the user, the peripheral device information storage unit 155 stores the peripheral device information therein. Therefore, in the case that the layout is changed in the production factory, the user inputs the instruction to change the peripheral device information corresponding to the new layout to the input unit 54, and the peripheral device information storage unit 155 updates the peripheral device information in response to the input.

[0058] Similarly to the control unit 53 of the first embodiment, the control unit 153 controls the air conditioners 21 to 28 according to the group. However, the second embodiment differs from the first embodiment in the control processing performed to the air conditioners 22 to 24 and 26 to 28 belonging to the second group.

[0059] The control unit 153 reads the first line identification information and first threshold which correspond to the air conditioner identification information indicating the air conditioner concerned, from the air conditioner-line correspondence table with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. Based on the measured data of the wattmeter connected to the production line indicated by the read first line identification information, the control unit 153 calculates the first power consumption of the predetermined period (for example, past 10 minutes from the present clock time), and compares the first power consumption to the first threshold. Similarly to the first embodiment, the control unit 153 determines that the production line stops in the case that the calculated first power consumption is less than the first threshold, and the control unit 153 determines that the production line operates in the case that the calculated first power consumption is greater than or equal to the first threshold. The control unit 153 operates the air conditioner when determining that the production line stops during the heating operation, and the control unit 153 operates the air conditioner when determining that the production line operates during the cooling operation.

[0060] On the other hand, the control unit 153 performs the following processing when determining that the production line stops during the cooling operation, or when determining that the production line operates during the heating operation. That is, the control unit 153 reads the peripheral device identification information and second threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target, from the peripheral device information. Based on the measured data of the wattmeter of the air conditioner indicated by the read peripheral device identification information, the control unit 153 calculates power consumption (hereinafter, referred to as second power consumption) of the predetermined period (for example, past 10 minutes from the present clock time), and compares the second power consumption to the second threshold.

[0061] As described above, the second threshold is set to a value which is smaller than the power consumption during the predetermined period when the air conditioner is operated and is slightly larger than the power consumption during the predetermined period when the air conditioner stops. Therefore, in the case that the second power consumption is less than the second threshold, the control unit 153 can determine that the air conditioner stops.

[0062] In the case that the second power consumption is less than or equal to the second threshold, the control unit 153 determines that the peripheral air conditioner is operated, and stops the air conditioner of the control target. On the other hand, in the case that the second power consumption is less than the second threshold, the control unit 153 determines that the peripheral air conditioner stops, and does not stop the air conditioner of the control target but operates the air conditioner of the control target. The operation of the air conditioner controlled to operate by the control unit 153 is controlled such that the measured temperature is equal to the preset temperature.

(Flow (during cooling operation) of air conditioner control processing)

[0063] An example of the air conditioner control processing of the second embodiment will be described with reference to Fig. 9. Fig. 9 is a flowchart illustrating a flow of the air conditioner control processing (cooling operation) in the second embodiment. Fig. 9 illustrates an example of the case that the air conditioners perform the cooling operation in summer. Because the pieces of processing in S1 to S6 are similar to those of the first embodiment (see Fig. 5), the description is neglected.

[0064] When the first power consumption is less than the first threshold (NO in S6), the control unit 153 reads the peripheral device identification information and second threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target from the peripheral device information, and specifies the air conditioner located around the air conditioner of the control target (S11).

[0065] Then the control unit 153 calculates the second power consumption of the predetermined period (for example, past 10 minutes from the present clock time) based on the measured data of the wattmeter of the air conditioner indicated by the peripheral device identification information. The control unit 153 can calculate the second power consumption by storing the pieces of measured data of the wattmeters 61 to 68 corresponding to the air conditioners 21 to 28. The control unit 153 compares the calculated second power consumption to the second threshold read in S11 (S12).

[0066] When the second power consumption is greater than or equal to the second threshold (YES in S12), the control unit 153 determines that the peripheral air conditioner is operated, and stops the air conditioner of the control target (S7). On the other hand, when the second power consumption is less than the second threshold (NO in S12), the control unit 153 determines that the peripheral air conditioner stops, and transfers to the processing in S2. That is, the air conditioner of the control target is allowed to operate normally according to the preset temperature without degrading the air conditioning capability.

[0067] For example, even if the production line 15 closest to the air conditioner 26 of the control target stops, the air conditioner 26 is operated in the case that the air conditioner 27 (see Fig. 8) around the air conditioner 26 stops. On the other hand, the air conditioner 26 is stopped in the case that the air conditioner 27 (see Fig. 8) around the air conditioner 26 is operated. Therefore, the extreme degradation of the air conditioning capability in the production factory due to the stopping of both the air conditioner 26 and air conditioner 27 adjacent to each other can be prevented. The air conditioner 26 is stopped in the case that the peripheral air conditioner 27 is operated, which allows the wasted power consumption to be prevented.

[0068] The control unit 153 performs the pieces of processing in S1 to S12 of Fig. 9 to all the air conditioners 21 to 28.

[0069] Thus, for the air conditioners belonging to the second group, (1) the control unit 153 stops each of the air conditioners in the case that the first power consumption of the production line indicated by the first line identification information corresponding to the air conditioner concerned is less than the first threshold, and that the second power consumption of the air conditioner indicated by the peripheral device identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined second threshold, and (2) the control unit 153 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is greater than or equal to the first threshold, or that the second power consumption is less than the second threshold.

[0070] Therefore, in the air conditioners 22 to 24 and 26 to 28 belonging to the second group, the cooling operation is stopped only when the production line installed closest to the air conditioner stops while the peripheral air conditioner is operated. As a result, the extreme degradation of the air conditioning capability can be prevented in the production factory.

(Flow (during heating operation) of air conditioner control processing)

[0071] An example of the air conditioner control processing of the second embodiment will be described with reference to Fig. 10. Fig. 10 illustrates an example of the case that the air conditioners 21 to 28 perform the heating operation in winter.

[0072] Because the pieces of processing in S1, S4 to S6, S8, and S9 are similar to those of the first embodiment in Fig. 6, the description is neglected.

[0073] When the first power consumption is greater than or equal to the first threshold (YES in S6), the control unit 153 reads the peripheral device identification information and second threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target from the peripheral device information, and specifies the air conditioner located around the air conditioner of the control target (S11).

[0074] Then the control unit 153 calculates the second power consumption of the predetermined period (for example, past 10 minutes from the present clock time) based on the measured data of the wattmeter of the air conditioner indicated by the peripheral device identification information. The control unit 153 can calculate the second power consumption by storing the pieces of measured data of the wattmeters 61 to 68 corresponding to the air conditioners 21 to 28. The control unit 153 compares the calculated second power consumption to the second threshold read in S11 (S12).

[0075] When the second power consumption is greater than or equal to the second threshold (YES in S12), the control unit 153 determines that the peripheral air conditioner is operated, and stops the air conditioner of the control target (S7). On the other hand, when the second power consumption is less than the second threshold (NO in S12), the control unit 153 determines that the peripheral air conditioner stops, and transfers to the processing in S2. That is, the air conditioner of the control target is allowed to operate normally according to the preset temperature without degrading the air conditioning capability.

[0076] The control unit 153 performs the pieces of processing in S1 to S12 of Fig. 10 to all the air conditioners 21 to 28.

[0077] Thus, the air conditioners belonging to the second group, (1) the control unit 153 stops each of the air conditioners in the case that the first power consumption of the production line indicated by the first line identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined first threshold, and that the second power consumption of the air conditioner indicated by the peripheral device identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined second threshold, and (2) the control unit 153 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is less than the first threshold, or that the second power consumption is less than the second threshold.

[0078] Therefore, in the air conditioners 22 to 24 and 26 to 28 belonging to the second group, the heating operation is stopped only when the production line installed closest to the air conditioner operates while the peripheral air conditioner is operated. As a result, the extreme degradation of the air conditioning capability can be prevented in the production factory.

<Third Embodiment>

[0079] A third embodiment of the present invention will be described below. For the sake of convenience, the component having the same function as the first embodiment is designated by the same numeral as the first embodiment, and the description is neglected.

[0080] Sometimes, depending on the production factory, the plurality of production lines may differ from each other in the heat radiation amount during the operation. For example, sometimes a certain production line includes a heating device while a peripheral production line does not include the heating device. The air conditioner installed close to the production line that does not include the heating device has a function of preventing the temperature raise caused by the heat radiated from the peripheral production line including the heating device of the production line. For this reason, when the air conditioner close to the production line that does not include the heating device is stopped in synchronization with the stopping of the production line like in the first embodiment, there is the possibility that the air conditioning capability is extremely degraded in the production factory. In the third embodiment, such problems can also be solved.

[0081] Fig. 11 illustrates a control system 201 of the third embodiment. As illustrated in Fig. 11, a control device 250 of the third embodiment differs from the control device 50 of the first embodiment in that the control device 250 includes a control unit 253 instead of the control unit 53, and that the control device 250 includes an air conditioner-line correspondence table storage unit 252 instead of the air conditioner-line correspondence table storage unit 52.

[0082] The air conditioner-line correspondence table storage unit 252 stores an air conditioner-line correspondence table therein with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. The air conditioner identification information identifying the air conditioner, the first line identification information identifying the production line installed closest to the air conditioner, the first threshold used to determine the stopping of the production line, second line identification information identifying the peripheral production line which is installed around the production line and selected as a line to be monitored, and a third threshold used to determine the stopping of the peripheral production line are correlated with one another in the air conditioner-line correspondence table. Fig. 12 is a diagram illustrating an example of the air conditioner-line correspondence table stored in the air conditioner-line correspondence table storage unit 252.

[0083] The third threshold is set to a value which is smaller than the power consumption during the predetermined period (for example, 10 minutes) when the corresponding peripheral production line is operated and is slightly larger than the power consumption during the predetermined period when the peripheral production line stops.

[0084] For example, the large-heat-radiation-amount production line including the heating device is properly selected as the peripheral production line. It is not necessary to set the peripheral production line to all the air conditioners, but the production line of the monitoring target may be set to some air conditioners according to the layout in the production factory. For example, as illustrated in Fig. 12, the second line identification infor-

mation is not set to the air conditioner 27. It is because the production lines 15 and 17 around the production line 16 closest to the air conditioner 27 include no heating device and have the small heat radiation amount, and it is not necessary to monitor the production lines 15 and 17. The plurality of pieces of second line identification information and the plurality of third thresholds may be set to one air conditioner like in the air conditioner 23.

[0085] In response to the input to the input unit 54 by the user, the air conditioner-line correspondence table storage unit 252 stores the air conditioner-line correspondence table therein. Therefore, in the case that the layout is changed in the production factory 10, the user inputs the instruction to change the first line identification information and second line identification information corresponding to the new layout to the input unit 54, and the air conditioner-line correspondence table storage unit 252 updates the air conditioner-line correspondence table in response to the input.

[0086] Similarly to the control unit 53 of the first embodiment, the control unit 253 controls the air conditioners 21 to 28 according to the group. However, the third embodiment differs from the first embodiment in the control processing performed to the air conditioners 22 to 24 and 26 to 28 belonging to the second group.

[0087] The control unit 253 reads the first line identification information and first threshold which correspond to the air conditioner identification information indicating the air conditioner concerned, from the air conditioner-line correspondence table with respect to each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group. Based on the measured data of the wattmeter connected to the production line indicated by the read first line identification information, the control unit 253 calculates the first power consumption of the predetermined period (for example, past 10 minutes from the present clock time), and compares the first power consumption to the first threshold. Similarly to the first embodiment, the control unit 253 determines that the production line stops in the case that the calculated first power consumption is less than the first threshold, and the control unit 253 determines that the production line operates in the case that the calculated first power consumption is greater than or equal to the first threshold. The control unit 253 operates the air conditioner when determining that the production line stops during the heating operation, and the control unit 253 operates the air conditioner when determining that the production line operates during the cooling operation.

[0088] On the other hand, the control unit 253 performs the following processing when determining that the production line stops during the cooling operation, or when determining that the production line operates during the heating operation. That is, the control unit 253 reads the second line identification information and third threshold which correspond to the air conditioner of the control target, from the air conditioner-line correspondence table. Based on the measured data of the wattmeter of the production line indicated by the read second line identification information, the control unit 253 calculates power consumption (hereinafter, referred to as third power consumption) of the predetermined period (for example, past 10 minutes from the present clock time), and compares the third power consumption to the third threshold.

[0089] As described above, the third threshold is set to a value which is smaller than the power consumption during the predetermined period when the corresponding peripheral production line is operated and is slightly larger than the power consumption during the predetermined period when the peripheral production line stops. Therefore, in the case that the third power consumption is less than the third threshold, the control unit 253 can determine that the peripheral production line stops. In the case that the third power consumption is less than or equal to the third threshold, the control unit 253 determines that the peripheral production line is operated, and does not stop the air conditioner of the control target but operates the air conditioner of the control target. On the other hand, in the case that the third power consumption is less than the third threshold, the control unit 253 determines that the peripheral production line stops, and stops the air conditioner of the control target. The operation of the air conditioner controlled to operate by the control unit 253 is controlled such that the measured temperature is equal to the preset temperature.

(Flow (during cooling operation) of air conditioner control processing)

[0090] An example of the air conditioner control processing of the third embodiment will be described with reference to Fig. 13. Fig. 13 is a flowchart illustrating a flow of the air the conditioner control processing in the third embodiment. Fig. 13 illustrates an example of the case that the air conditioners perform the cooling operation in summer. Because the pieces of processing in S1 to S6 are similar to those of the first embodiment (see Fig. 5), the description is neglected.

[0091] When the first power consumption is less than the first threshold (NO in S6), the control unit 253 determines whether the second line identification information and third threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target are set based on the air conditioner-line correspondence table (S13).

[0092] When the second line identification information and third threshold which correspond to the air conditioner identification information are not set (NO in S13), the control unit 253 determines that the peripheral production line to be monitored does not exist, and stops the air conditioner of the control target (S7).

[0093] When the second line identification information and third threshold which correspond to the air conditioner identification information are set (YES in S13), the control unit 253 reads the second line identification information and the third threshold. The read second line iden-

tification information indicates the peripheral production line to be monitored. Based on the measured data of the wattmeter of the production line indicated by the second line identification information, the control unit 253 calculates the third power consumption of the predetermined period (for example, past 10 minutes from the present clock time). The control unit 253 compares the third power consumption to the third threshold (S14).

[0094] When the third power consumption is less than the third threshold (YES in S14), the control unit 253 determines that the peripheral production line to be monitored stops, and stops the air conditioner of the control target (S7). On the other hand, when the third power consumption is greater than or equal to the third threshold (NO in S14), the control unit 253 determines that the peripheral production line to be monitored operates, and transfers to the processing in S2. That is, the air conditioner of the control target is allowed to operate normally according to the preset temperature without degrading the air conditioning capability.

[0095] For example, even if the production line 15 closest to the air conditioner 26 of the control target stops, the air conditioner 26 is operated in the case that the production line 16 (see Figs. 1 and 12) around the production line 15 operates. On the other hand, the air conditioner 26 is stopped in the case that the peripheral production line 16 also stops. Therefore, the extreme degradation of the air conditioning capability in the production factory can be prevented due to the operation of the air conditioner 26 while the production line 16 is operated to radiate the heat. The air conditioner 26 is stopped in the case that the production line 16 stops, which allows the wasted power consumption to be prevented.

[0096] As illustrated in Fig. 12, the following processing in S14 may be performed to the air conditioner 23 to which the plurality of peripheral production lines are set. The control unit 253 reads a combination of the second line identification information and the third threshold in each peripheral production line. The control unit 253 compares the third power consumption obtained from the measured data of the wattmeter of the production line indicated by the second line identification Information to the third threshold in each combination. The affirmative determination is made in S14 when the third power consumption is less than the third threshold in all the combinations, and the negative determination is made in S14 in other cases. Alternatively, the affirmative determination may be made in S14 when the third power consumption is less than the third threshold in at least one of the combinations, and the negative determination may be made in S14 in other cases. For example, for the air conditioner 23 of the control target, when the third power consumption of the production line 11 is less than the third threshold (1 kW) while the third power consumption of the production line 13 is less than the third threshold (1 kW), the flow transfers to the processing in S7. Alternatively, when the third power consumption of at least one of the production line 11 and the production line 12 is less than the third threshold, the flow may transfer to the processing in S7.

[0097] The control unit 253 performs the pieces of processing in S1 to S14 of Fig. 13 to all the air conditioners 21 to 28.

[0098] Thus, for the air conditioners belonging to the second group, (1) the control unit 253 stops each of the air conditioners in the case that the first power consumption of the production line indicated by the first line identification information corresponding to the air conditioner concerned is less than the predetermined first threshold, and that the third power consumption of the peripheral production line indicated by the second line identification information corresponding to the air conditioner concerned is less than the predetermined third threshold, and (2) the control unit 253 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is greater than or equal to the first threshold, or that the third power consumption is greater than or equal to the third threshold.

[0099] Therefore, each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group is stopped only when the production line installed closest to the air conditioner concerned stops while the peripheral production line to be monitored also stops. As a result, the extreme degradation of the air conditioning capability can be prevented in the production factory.

(Flow (during heating operation) of air conditioner control processing)

[0100] An example of the air conditioner control processing of the third embodiment will be described with reference to Fig. 14. Fig. 14 illustrates an example of the case that the air conditioners 21 to 28 perform the heating operation in winter.

[0101] Because the pieces of processing in S1, S4 to S6, S8, and S9 are similar to those of the first embodiment in Fig. 6, the description is neglected.

[0102] When the first power consumption is greater than or equal to the first threshold (YES in S6), the control unit 253 determines whether the second line identification information and third threshold which correspond to the air conditioner identification information indicating the air conditioner of the control target are set based on the air conditioner-line correspondence table (S13).

[0103] When the second line identification information and third threshold which correspond to the air conditioner identification information are not set (NO in S13), the control unit 253 determines that the peripheral production line to be monitored does not exist, and stops the air conditioner of the control target (S7).

[0104] When the second line identification information and third threshold which correspond to the air conditioner identification information are set (YES in S13), the control unit 253 reads the second line identification information and the third threshold. The read second line identification information indicates the peripheral production

line to be monitored. Based on the measured data of the wattmeter of the production line indicated by the second line identification information, the control unit 253 calculates the third power consumption of the predetermined period (for example, past 10 minutes from the present clock time). The control unit 253 compares the calculated third power consumption to the third threshold (S14).

[0105] When the third power consumption is less than the third threshold (YES in S14), the control unit 253 determines that the peripheral production line to be monitored stops, and transfers to the processing in S8. That is, the air conditioner of the control target is allowed to operate normally according to the preset temperature without degrading the air conditioning capability. On the other hand, when the third power consumption is greater than or equal to the third threshold (NO in S14), the control unit 253 determines that the peripheral production line to be monitored operates, and stops the air conditioner of the control target (S7).

[0106] The control unit 253 performs the pieces of processing in S1 to S14 of Fig. 14 to all the air conditioners 21 to 28.

[0107] Thus, for the air conditioners belonging to the second group, (1) the control unit 253 stops each of the air conditioners in the case that the first power consumption of the production line indicated by the first line identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined first threshold, and that the third power consumption of the peripheral production line indicated by the second line identification information corresponding to the air conditioner concerned is greater than or equal to the predetermined third threshold, and (2) the control unit 253 operates the air conditioner without degrading the air conditioning capability in the case that the first power consumption is less than the first threshold, or that the third power consumption is less than the third threshold.

[0108] Therefore, each of the air conditioners 22 to 24 and 26 to 28 belonging to the second group is stopped only when the production line installed closest to the air conditioner concerned operates while the peripheral production line to be monitored also operates. As a result, the extreme degradation of the air conditioning capability can be prevented in the production factory.

<Modifications>

[0109] In the above description, the control units 53, 153, and 253 stop the air conditioner of the control target in Step S7. However, in Step S7, the control units 53, 153, and 253 may perform the control so as to degrade the air conditioning capability of the air conditioner of the control target. For example, in the case that the air conditioner is connected to two outdoor machines as in the manner of the air conditioners 24 and 28, only one of the outdoor machines may be stopped, whereby the air conditioners 24 and 28 may be operated with the air conditioning capability degraded.

[0110] In the case that the air conditioner is connected to two outdoor machines as in the manner of the air conditioners 24 and 28 and the air conditioning capability is degraded by stopping one of the outdoor machines in S7, the following processing may be performed. Whether one of the two outdoor machines is already stopped is determined in S7. When one of the two outdoor machines is already stopped, the other outdoor machine is maintained as it is because the air conditioning capability is already degraded. On the other hand, when both the two outdoor machines operate, one of the outdoor machines is stopped to degrade the air conditioning capability.

[0111] The present invention is not limited to the above embodiments, but various changes can be made without departing from the scope of the present invention. An embodiment obtained by properly combining technical units disclosed in the different embodiments is also included in the technical scope of the present invention.

[0112] Each unit of the control devices 50, 150, and 250 of the embodiments can be constructed in a manner such that a computing unit such as a CPU (Central Processing Unit) controls an input unit such as a keyboard, an output unit such as a display, and a communication unit such as an interface circuit by executing a program stored in a storage unit such as a ROM (Read Only Memory) and a RAM (Random Access Memory). Accordingly, only the computer including these units reads a recording medium in which the program is recorded and executes the program, which allows various functions and pieces of processing of the control devices 50, 150, and 250 of the embodiments to be implemented and performed. The functions and pieces of processing can be implemented and performed on any computer by recording the program in a removable recording medium.

[0113] The recording medium may be a memory (not illustrated), such as the ROM, which is used as a program medium in the processing performed by a microcomputer. The recording medium may also be a program medium that can be read by inserting the recording medium in a program reading device (not illustrated) that is of an external storage device.

[0114] In each case, preferably the microprocessor accesses and executes the stored program. More preferably the microprocessor reads the program, downloads the program in a program storage area of a microcomputer, and executes the program. It is assumed that the program to be downloaded is previously stored in a main body device.

[0115] The program medium is the recording medium configured to be able to separate from the main body device and to fixedly carry the program. Examples of the recording medium include tape systems such as a magnetic tape and a cassette tape, disk systems including a magnetic disk such as a flexible disk and a hard disk and a disk such as a CD, an MO, an MD, and a DVD, card systems such as an IC card (including a memory card), and semiconductor memories such as a mask ROM, an EPROM (Erasable Programmable Read Only Memory),

an EEPROM (Electrically Erasable Programmable Read Only Memory), and a flash ROM.

[0116] In a system configuration to which a communication network including the Internet can be connected, preferably the recording medium carries the program in a fluid manner such that the program is downloaded through the communication network.

[0117] In the case that the program is downloaded through the communication network, preferably the program to be downloaded is previously stored in the main body device, or installed from another recording medium.

[0118] As described above, a control device of the present invention is configured to control the plurality of air conditioners, and the control device includes the control unit configured to divide the plurality of air conditioners into the first group and the second group, operate the air conditioner belonging to the first group regardless of the operational state of the facility, and control the operation of the air conditioner belonging to the second group according to the operational state of the facility.

[0119] According to the configuration, the operation of the air conditioner belonging to the second group is controlled according to the operational state of the facility. The heat radiation amount from the facility depends on the operational state of the facility. Therefore, the air conditioner of the second group is operated according to the operational state of the facility, which allows the air conditioner of the second group to be operated according to the heat radiation amount from the facility. As a result, for the air conditioner belonging to the second group, the wasted operation can be avoided according to the heat radiation amount from the facility to achieve energy saving. For example, when the facility stops not to radiate the heat, the wasted operation can be avoided by stopping the cooling operations of the air conditioner of the second group. The air conditioner belonging to the first group is operated irrespective of the operational state of the facility. Therefore, for example, during the cooling operation, even if the facility is not operated, the temperature in the production factory is maintained at the preset temperature by the air conditioner belonging to the first group.

[0120] Thus, the temperature in the production factory can be kept constant without consuming the wasted power by the simple setting, in which the plurality of air conditioners are divided into the first group in which the air conditioner is operated regardless of the operational state of the facility and the second group in which the operation of the air conditioner is controlled according to the operational state of the facility. Unlike Patent Documents 1 and 2, it is not necessary to acquire the detailed environmental data that changes depending on the condition of the production factory. Additionally, even if the layout of the facility or the air conditioner is changed in the air conditioning target area, it is not necessary to acquire again the environmental data required in Patent Documents 1 and 2.

[0121] Therefore, the control device that can easily perform the proper air conditioning control according to the situation of the heat radiated from the facility can be constructed.

[0122] In the control device, the control unit may determine the operational state of the facility based on the power consumption of the facility, and control the operation of the air conditioner belonging to the second group according to the determination result thereof.

[0123] According to the configuration, the operational state of the facility can easily be understood only by measuring the power consumption of the facility.

[0124] For example, the air conditioner performs the cooling operation, (1) the control unit stops the air conditioner belonging to the second group, or operates the air conditioner belonging to the second group with an air conditioning capability degraded when power consumption of the facility is less than the predetermined first threshold, and (2) the control unit operates the air conditioner belonging to the second group without degrading the air conditioning capability when the power consumption of the facility is greater than or equal to the first threshold. When power consumption of the facility is less than the predetermined first threshold, the heat radiation amount from the facility decreases relatively. Therefore, the air conditioner belonging to the second group is stopped, or the air conditioner belonging to the second group is operated with the air conditioning capability degraded, which allows the extreme cooling in the air conditioning target area to be prevented to achieve the energy saving of the air conditioner belonging to the second group.

[0125] The air conditioner performs a heating operation, (1) the control unit stops the air conditioner belonging to the second group, or operates the air conditioner belonging to the second group with the air conditioning capability degraded when the power consumption of the facility is greater than or equal to the first threshold, and (2) the control unit operates the air conditioner belonging to the second group without degrading the air conditioning capability when the power consumption of the facility is less than the first threshold. When the power consumption of the facility is greater than or equal to the first threshold, the heat radiation amount from the facility increases relatively. Therefore, the air conditioner belonging to the second group is stopped, or the air conditioner belonging to the second group is operated with the air conditioning capability degraded, which allows the extreme heating in the air conditioning target area to be prevented to achieve the energy saving of the air conditioner belonging to the second group.

[0126] In the control device, the facility may be provided in plural. The control device may further include a facility identification information storage unit configured to store first facility identification information, the first facility identification information being used to identify the facility installed close to the air conditioner belonging to the second group. In the control device, the control unit may control the operation of the air conditioner belonging

to the second group according to the operational state of the facility indicated by the first facility identification information.

[0127] According to the configuration, the operation of the air conditioner belonging to the second group is controlled according to the operational state of the facility installed close to the air conditioner. Therefore, the air conditioning can properly be performed according to the heat radiation from the close facility.

[0128] In the control device, the facility may be provided in plural. The control device may further include: a facility identification information storage unit configured to store first facility identification information, the first facility identification information being used to identify the facility installed close to the air conditioner belonging to the second group; and a peripheral device information storage unit configured to store device identification information, the device identification information being used to identify another air conditioner installed close to the air conditioner belonging to the second group. In the control device, the control unit may control the operation of the air conditioner belonging to the second group according to the operational state of the facility indicated by the first facility identification information and the operational state of the air conditioner indicated by the device identification information.

[0129] According to the configuration, the operation of the air conditioner can be controlled according to not only the operational state of the facility installed close to the air conditioner but also the operational state of the peripheral air conditioner.

[0130] In the control device, the facility may be provided in plural. The control device may further include a facility identification information storage unit configured to store first facility identification information and second facility identification information while correlated with each other, the first facility identification information being used to identify a first facility installed close to the air conditioner belonging to the second group, the second facility identification information being used to identify a second facility installed close to the first facility. In the control device, the control unit may control the operation of the air conditioner belonging to the second group according to the operational state of the facility indicated by the first facility identification information and the operational state of the facility indicated by the second facility identification information.

[0131] According to the configuration, the operation of the air conditioner is controlled according to not only the operational state of the facility installed close to the air conditioner but also the operational state of the peripheral facility. Therefore, the operation of the air conditioner can be controlled in consideration of the heat radiation amounts of the plurality of facilities.

[0132] The air conditioner may be connected to a plurality of outdoor machines, and the control unit may operate the air conditioner with the air conditioning capability degraded by stopping some of the plurality of outdoor machines.

[0133] The control device may be constructed with a computer. In this case, the present invention also includes a program that causes the computer to act as each unit of the control device and a computer-readable recording medium in which the program is recorded.

INDUSTRIAL APPLICABILITY

[0134] The present invention can be applied to a system that performs air conditioning of a production factory, in which a production line is installed, using a plurality of air conditioners.

DESCRIPTION OF SYMBOLS

[0135]

1, 101, 201	control system
10	production factory (air conditioning target area)
11 to 19	production line (facility)
21 to 28	air conditioner
31 to 38	outdoor machine
41 to 49	wattmeter
50, 150, 250	control device
51	group information storage unit
52, 152	air conditioner-line correspondence table storage unit (facility identification information storage unit)
53, 153, 253	control unit
61 to 68	wattmeter
155	peripheral device information storage unit

Claims

1. A control device configured to control a plurality of air conditioners, the control device comprising:

a control unit configured to divide the plurality of air conditioners into a first group and a second group, operate an air conditioner belonging to the first group regardless of an operational state of a facility, and control an operation of an air conditioner belonging to the second group according to the operational state of the facility.

2. The control device according to claim 1, wherein the facility is provided in plural,
the control device further comprising:

a facility identification information storage unit configured to store first facility identification information, the first facility identification information being used to identify a facility installed close to the air conditioner belonging to the sec-

ond group, wherein
the control unit is configured to control the operation of the air conditioner belonging to the second group according to an operational state of the facility indicated by the first facility identification information.

3. The control device according to claim 1, wherein
the facility is provided in plural,
the control device further comprising:

a facility identification information storage unit configured to store first facility identification information, the first facility identification information being used to identify a facility installed close to the air conditioner belonging to the second group; and
a peripheral device information storage unit configured to store device identification information, the device identification information being used to identify another air conditioner installed close to the air conditioner belonging to the second group, wherein
the control unit is configured to control the operation of the air conditioner belonging to the second group according to an operational state of the facility indicated by the first facility identification information and an operational state of an air conditioner indicated by the device identification information.

4. The control device according to claim 1, wherein
the facility is provided in plural,
the control device further comprising:

a facility identification information storage unit configured to store first facility identification information and second facility identification information while correlated with each other, the first facility identification information being used to identify a first facility installed close to the air conditioner belonging to the second group, the second facility identification information being used to identify a second facility installed close to the first facility, wherein
the control unit is configured to control the operation of the air conditioner belonging to the second group according to an operational state of the facility indicated by the first facility identification information and an operational state of the facility indicated by the second facility identification information.

5. The control device according to any one of claims 1 to 4, wherein
the control unit is configured to determine the operational state of the facility based on power consumption of the facility, and control the operation of the air conditioner belonging to the second group according to a determination result thereof.

6. The control device according to claim 1, wherein
the air conditioner is configured to perform a cooling operation,

(1) the control unit is configured to stop the air conditioner belonging to the second group, or operate the air conditioner belonging to the second group with an air conditioning capability degraded when power consumption of the facility is less than a predetermined first threshold, and
(2) the control unit is configured to operate the air conditioner belonging to the second group without degrading the air conditioning capability when the power consumption of the facility is greater than or equal to the first threshold.

7. The control device according to claim 1 or 6, wherein
the air conditioner is configured to perform a heating operation,

(1) the control unit is configured to stop the air conditioner belonging to the second group, or operate the air conditioner belonging to the second group with the air conditioning capability degraded when the power consumption of the facility is greater than or equal to the first threshold, and
(2) the control unit is configured to operate the air conditioner belonging to the second group without degrading the air conditioning capability when the power consumption of the facility is less than the first threshold.

8. The control device according to claim 6 or 7, wherein
the air conditioner is connected to a plurality of outdoor machines, and
the control unit is configured to operate the air conditioner with the air conditioning capability degraded by stopping some of the plurality of outdoor machines.

9. A method for controlling a plurality of air conditioners, the method comprising the step of:

dividing the plurality of air conditioners into a first group and a second group, operating an air conditioner belonging to the first group regardless of an operational state of a facility, and controlling an operation of an air conditioner belonging to the second group according to the operational state of the facility.

10. A program that is executed by a computer configured to control a plurality of air conditioners, the program causing the computer to execute the step of:

dividing the plurality of air conditioners into a first group and a second group, operating an air conditioner belonging to the first group regardless of an operational state of a facility, and controlling an operation of an air conditioner belonging to the second group according to the operational state of the facility.

11. A computer-readable recording medium in which the program according to claim 10 is recorded.

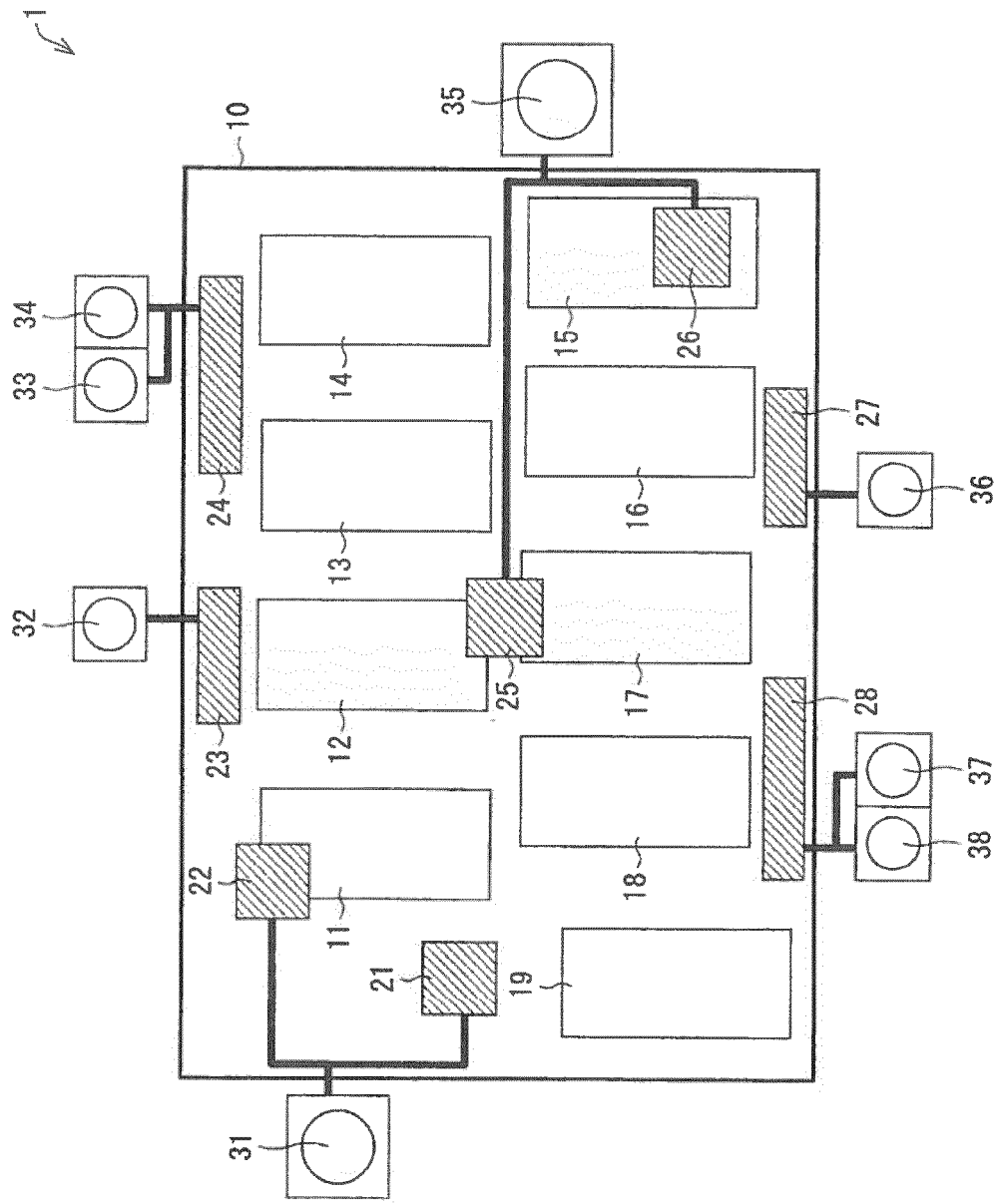

1
10
35
34
33
32
31
36
37
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14
15
26
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12
22
18
11
21
19

Fig. 1

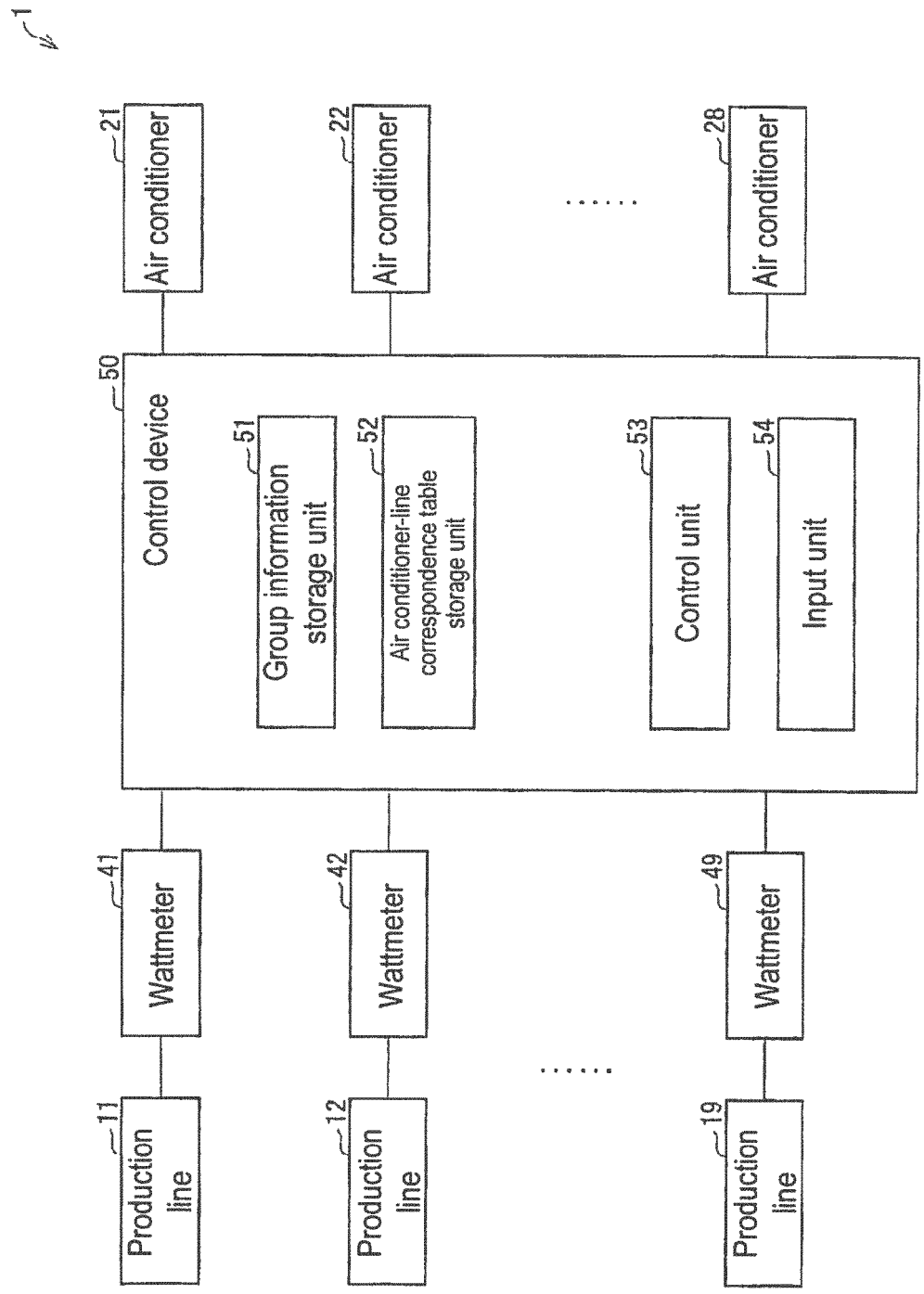

1
21
Air conditioner
22
Air conditioner
28
Air conditioner
50
Control device
51
Group information storage unit
52
Air conditioner-line correspondence table storage unit
53
Control unit
54
Input unit
41
Wattmeter
42
Wattmeter
49
Wattmeter
11
Production line
12
Production line
19
Production line

Fig. 2

Fig. 3

First group	Air conditioner 21 Air conditioner 25
Second group	Air conditioner 22 Air conditioner 23 Air conditioner 24 Air conditioner 26 Air conditioner 27 Air conditioner 28

Fig. 4

Air conditioner identification information	First line identification information (closest production line)	First threshold
Air conditioner 22	Production line 11	1kW
Air conditioner 23	Production line 12	0.5kW
Air conditioner 24	Production line 14	1kW
Air conditioner 26	Production line 15	0.3kW
Air conditioner 27	Production line 16	0.2kW
Air conditioner 28	Production line 18	0.2kW

Fig. 5

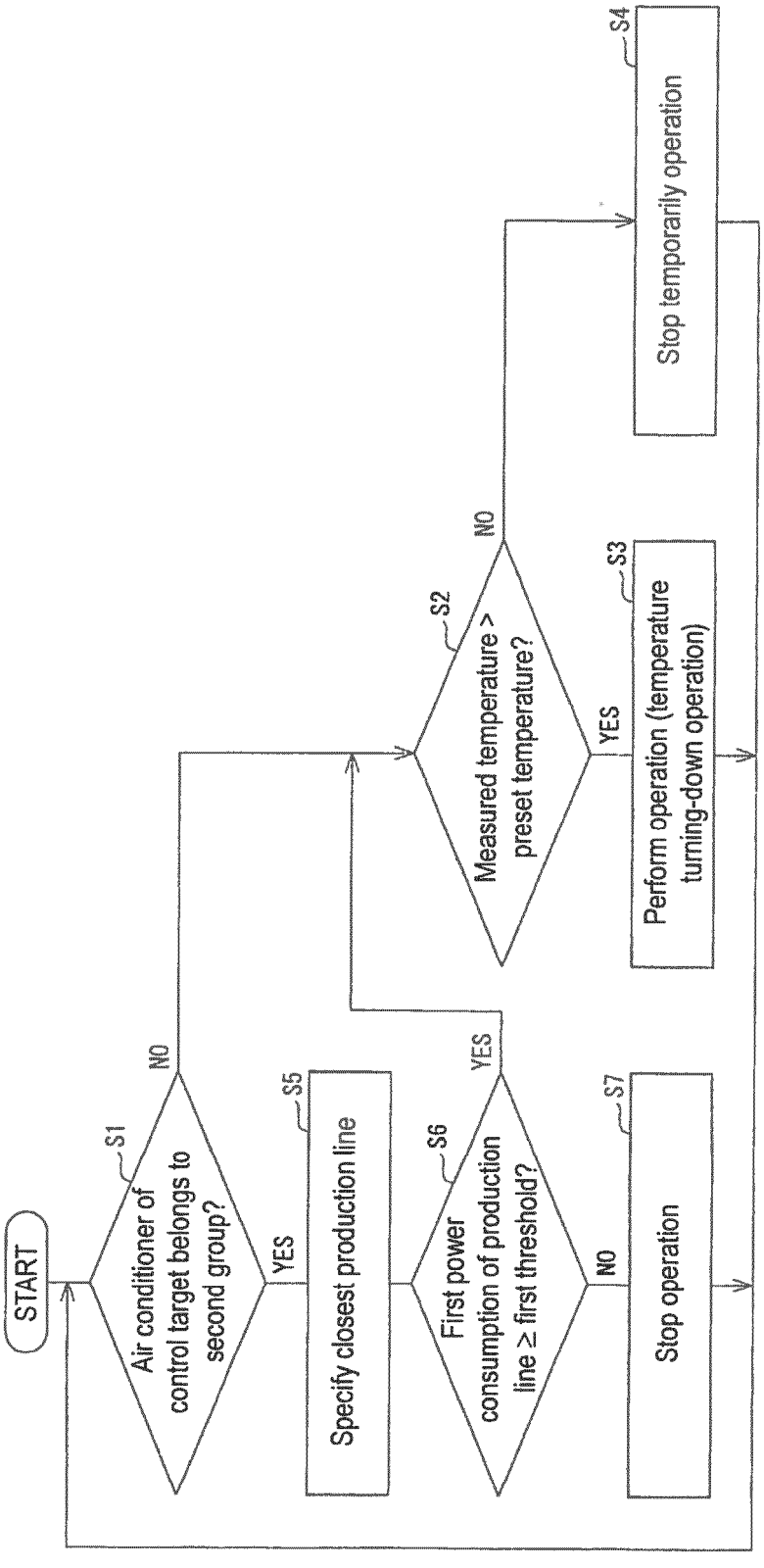
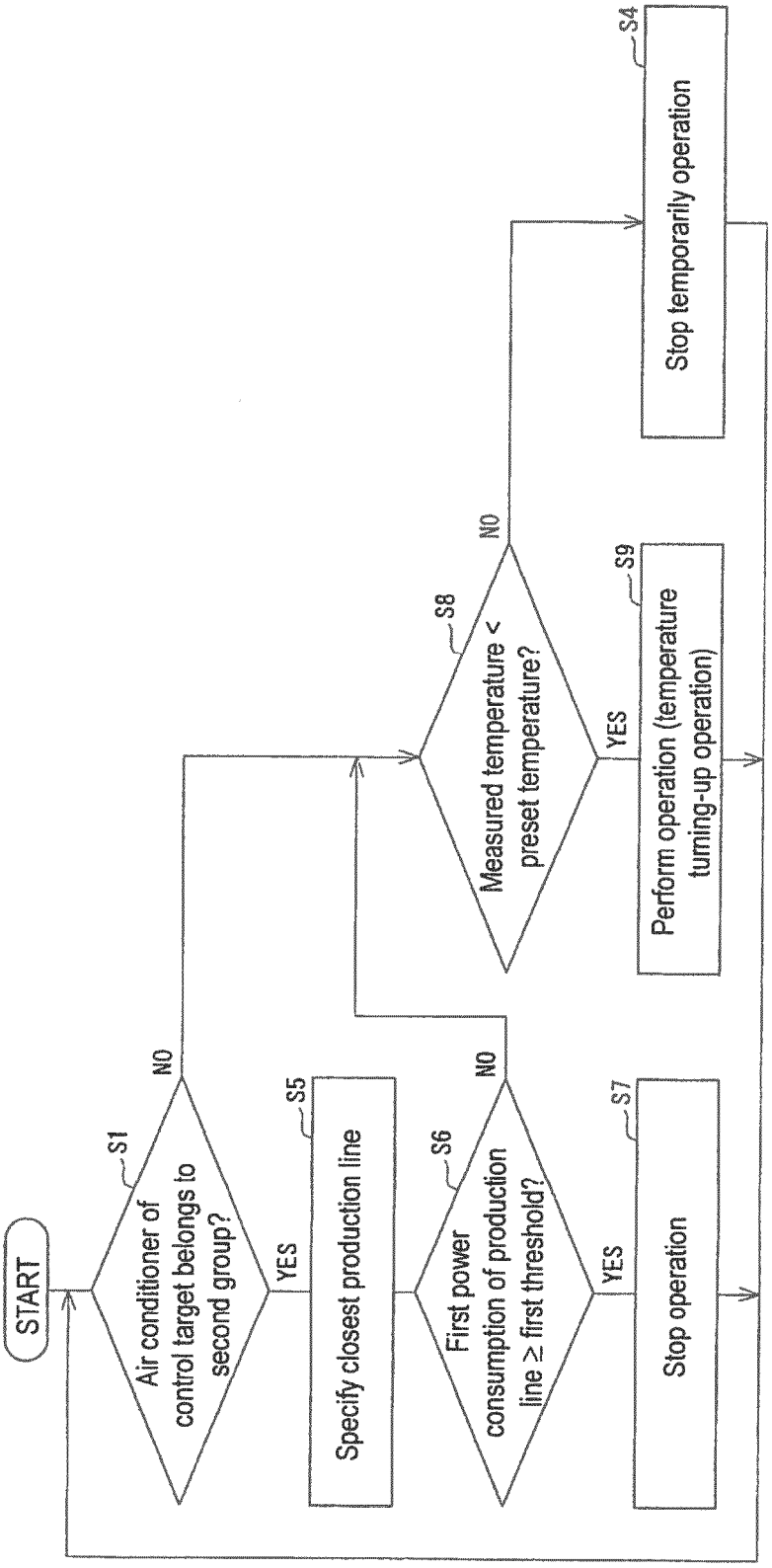

START
S1
Air conditioner of control target belongs to second group?
NO
YES
S2
Measured temperature > preset temperature?
NO
YES
S3
Perform operation (temperature turning-down operation)
S4
Stop temporarily operation
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
YES
NO
S7
Stop operation

Fig. 6


START
S1
Air conditioner of control target belongs to second group?
NO
YES
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
NO
YES
S7
Stop operation
S8
Measured temperature < preset temperature?
NO
YES
S9
Perform operation (temperature turning-up operation)
S4
Stop temporarily operation

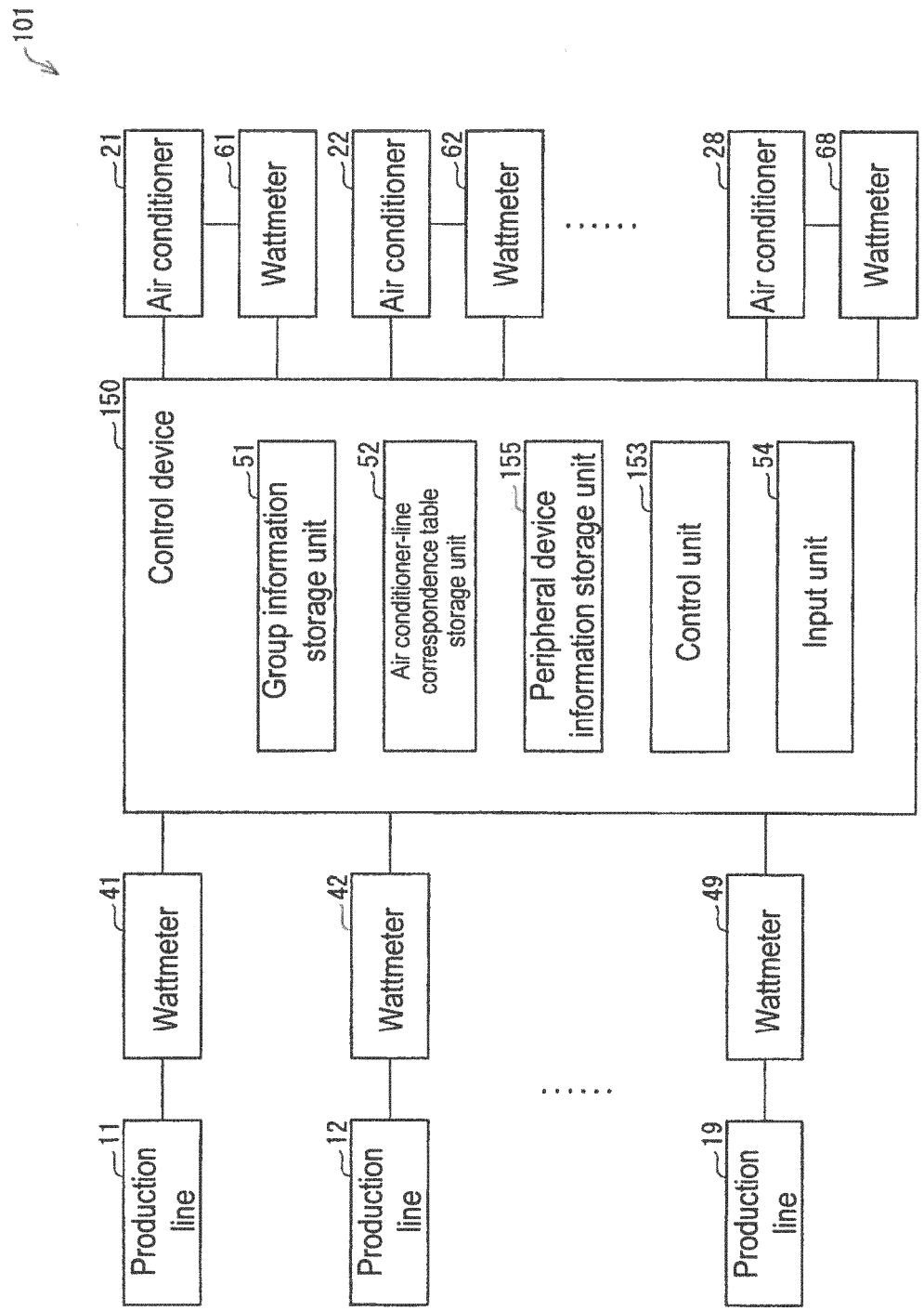

101
21
Air conditioner
61
Wattmeter
22
Air conditioner
62
Wattmeter
28
Air conditioner
68
Wattmeter
150
Control device
51
Group information storage unit
52
Air conditioner-line correspondence table storage unit
155
Peripheral device information storage unit
153
Control unit
54
Input unit
41
Wattmeter
42
Wattmeter
49
Wattmeter
11
Production line
12
Production line
19
Production line

Fig. 7

Fig. 8

Air conditioner identification information	Peripheral device identification information	Second threshold
Air conditioner 22	Air conditioner 23	0. 2kW
Air conditioner 23	Air conditioner 22	0. 3kW
Air conditioner 24	Air conditioner 23	0. 2kW
Air conditioner 26	Air conditioner 27	0. 2kW
Air conditioner 27	Air conditioner 26	0. 3kW
Air conditioner 28	Air conditioner 27	0. 2kW

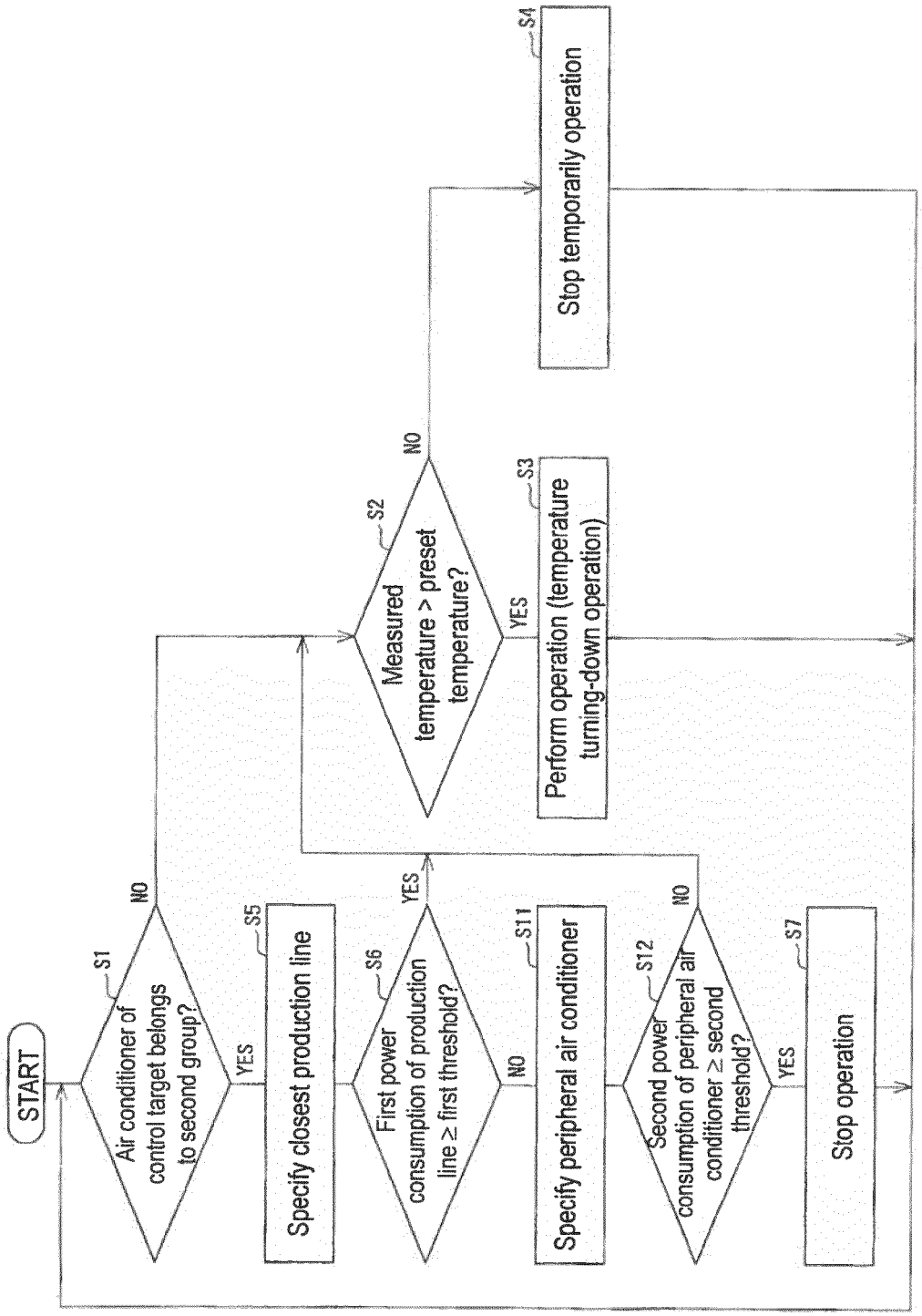

START
S1
Air conditioner of control target belongs to second group?
NO
YES
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
YES
NO
S11
Specify peripheral air conditioner
S12
Second power consumption of peripheral air conditioner ≥ second threshold?
NO
YES
S7
Stop operation
S2
Measured temperature > preset temperature?
NO
YES
S3
Perform operation (temperature turning-down operation)
S4
Stop temporarily operation

Fig. 9

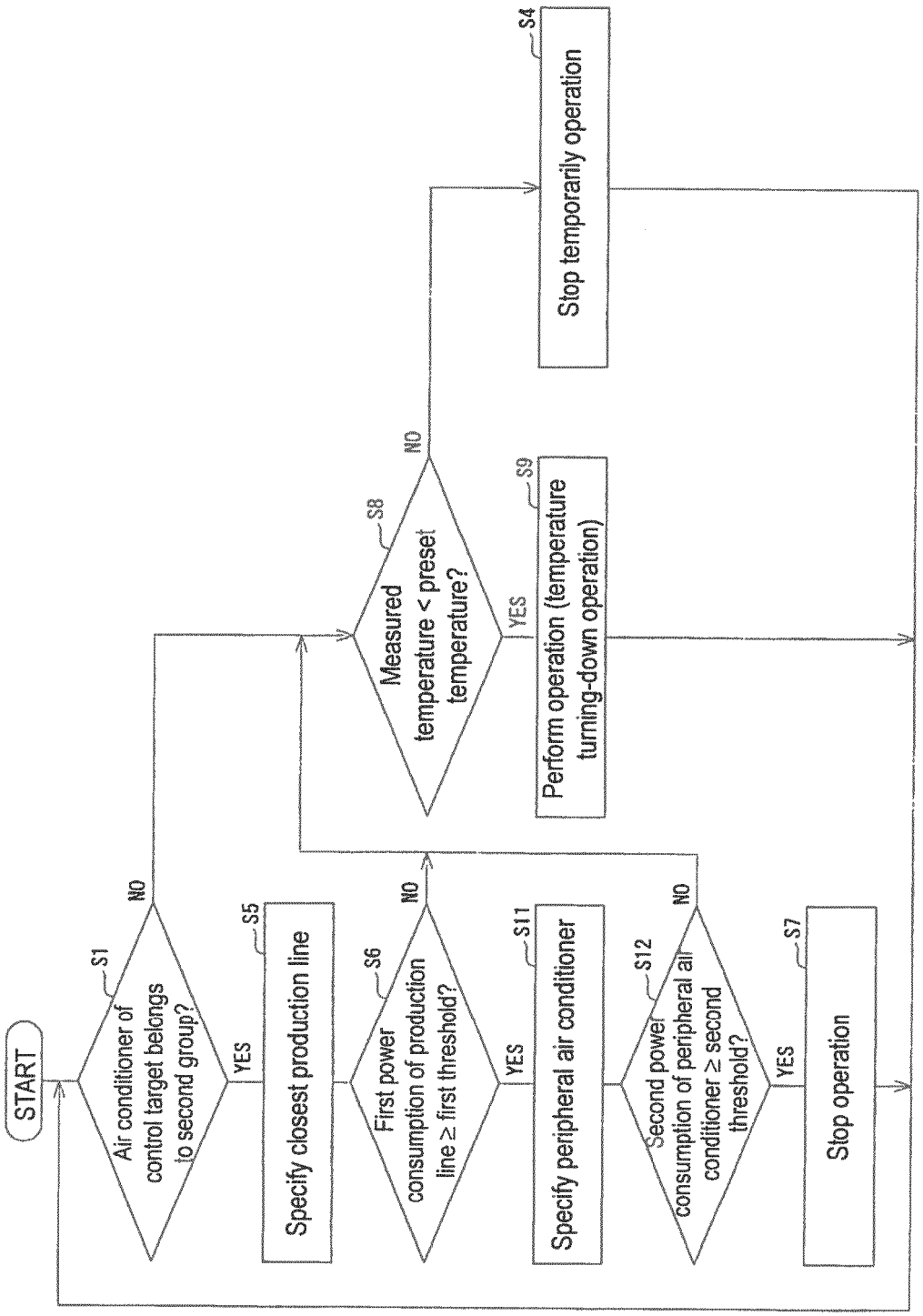

START
S1
Air conditioner of control target belongs to second group?
NO
YES
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
NO
YES
S11
Specify peripheral air conditioner
S12
Second power consumption of peripheral air conditioner ≥ second threshold?
NO
YES
S7
Stop operation
S8
Measured temperature < preset temperature?
NO
YES
S9
Perform operation (temperature turning-down operation)
S4
Stop temporarily operation

Fig. 10

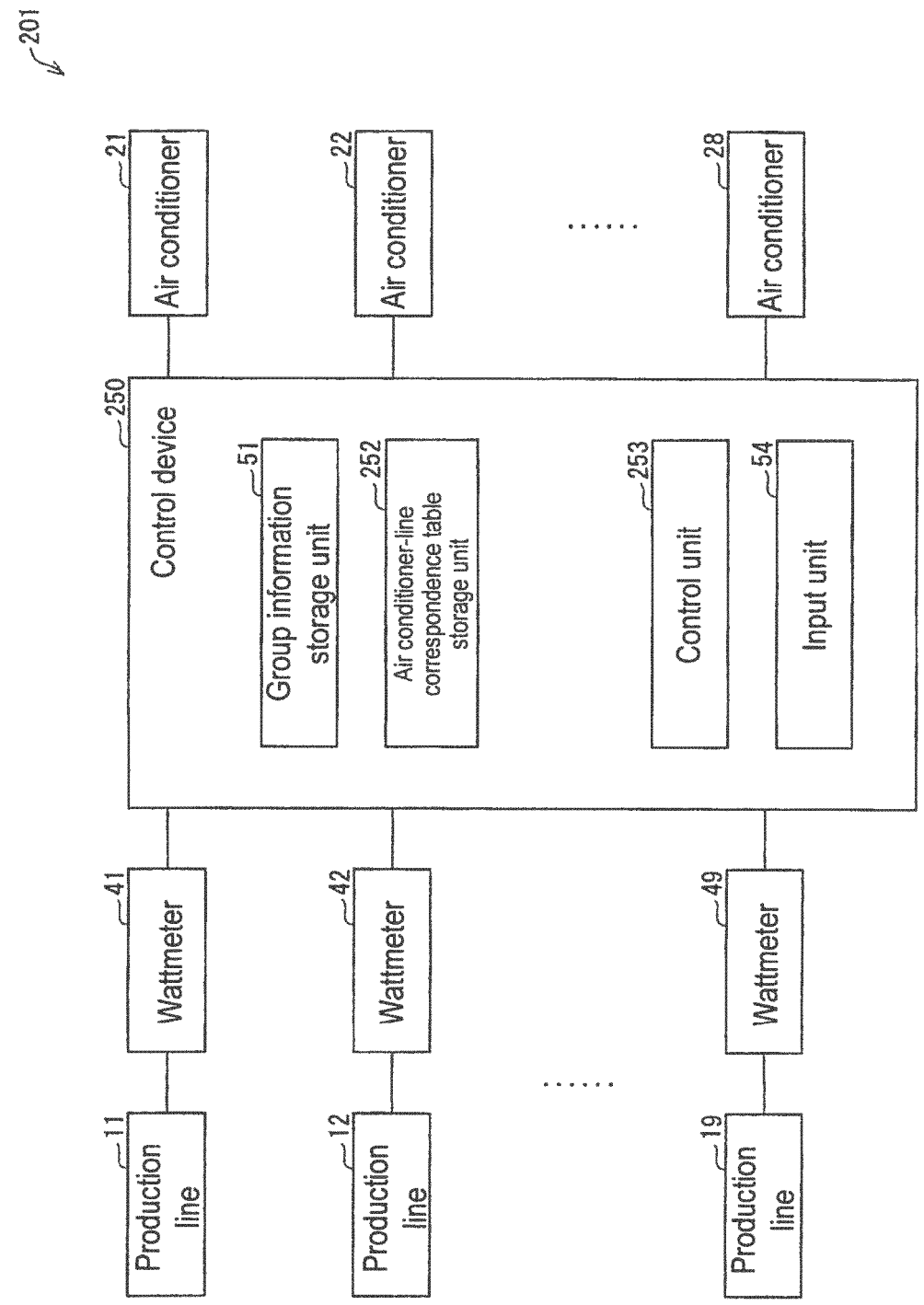

201
21
Air conditioner
22
Air conditioner
28
Air conditioner
250
Control device
51
Group information storage unit
252
Air conditioner-line correspondence table storage unit
253
Control unit
54
Input unit
41
Wattmeter
42
Wattmeter
49
Wattmeter
11
Production line
12
Production line
19
Production line

Fig. 11

Fig. 12

Air conditioner identification information	First line identification information (closest production line)	First threshold	Second line identification information (peripheral production line)	Third threshold
Air conditioner 22	Production line 11	1kW	Production line 12	0.5kW
Air conditioner 23	Production line 12	0.5kW	Production line 11 Production line 13	1kW 1kW
Air conditioner 24	Production line 14	1kW	Production line 13	1kW
Air conditioner 26	Production line 15	0.3kW	Production line 16	0.2kW
Air conditioner 27	Production line 16	0.2kW	—	—
Air conditioner 28	Production line 18	0.2kW	Production line 19	1kW

Fig. 13

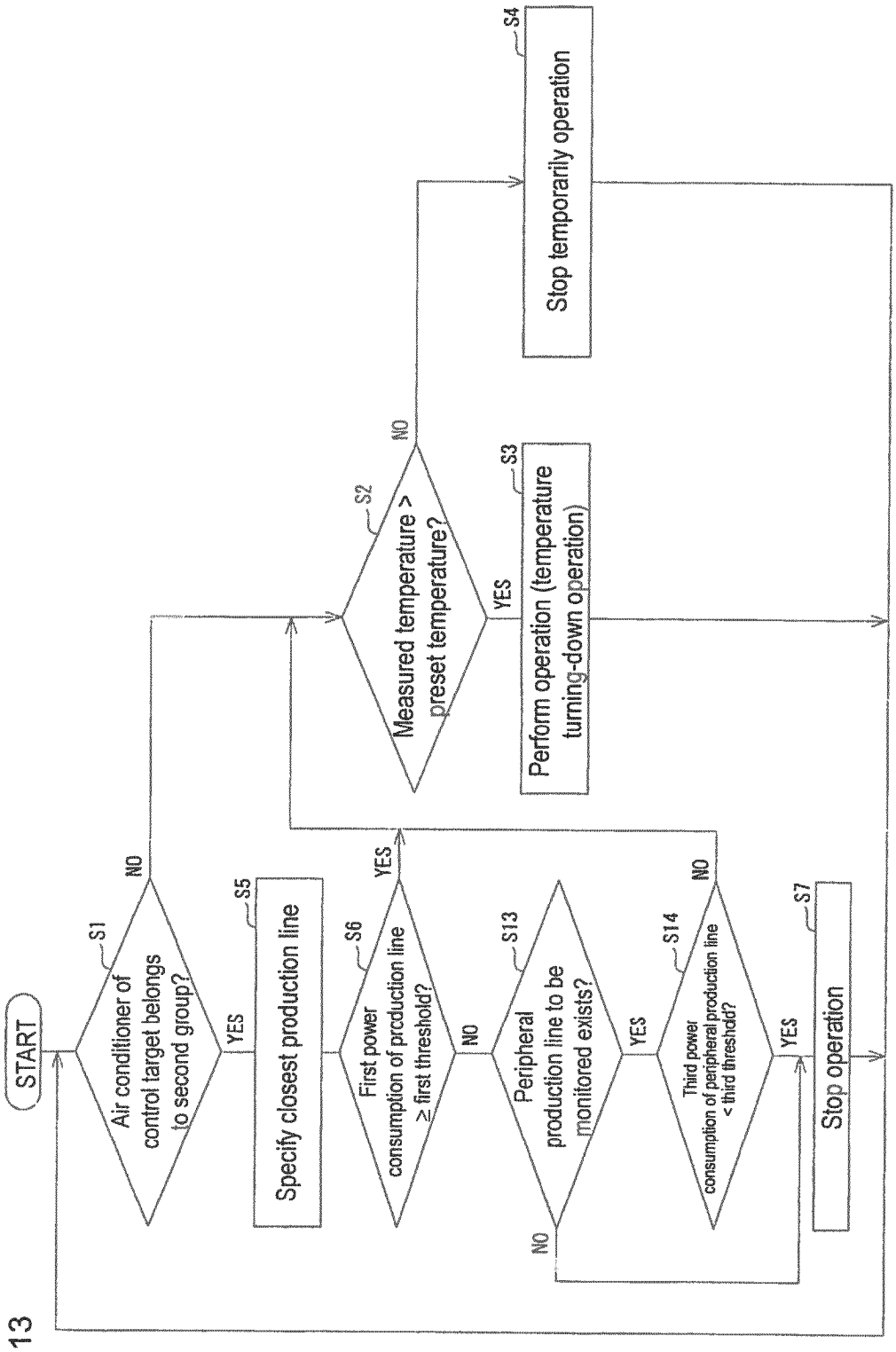
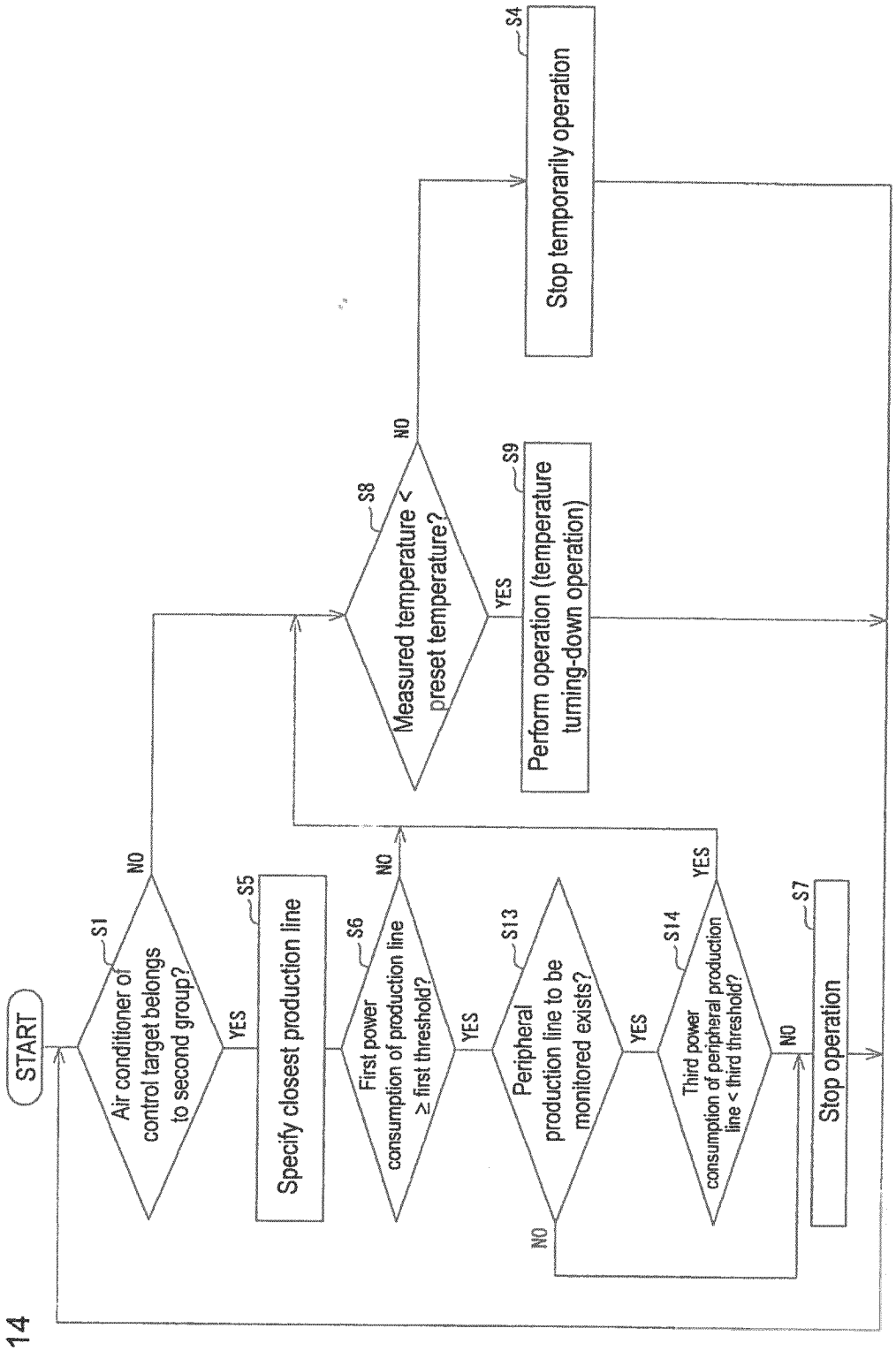

START
S1
Air conditioner of control target belongs to second group?
NO
YES
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
YES
NO
S13
Peripheral production line to be monitored exists?
YES
NO
S14
Third power consumption of peripheral production line < third threshold?
NO
YES
S7
Stop operation
S2
Measured temperature > preset temperature?
NO
YES
S3
Perform operation (temperature turning-down operation)
S4
Stop temporarily operation

Fig. 14


START
S1
Air conditioner of control target belongs to second group?
NO
YES
S5
Specify closest production line
S6
First power consumption of production line ≥ first threshold?
NO
YES
S13
Peripheral production line to be monitored exists?
NO
YES
S14
Third power consumption of peripheral production line < third threshold?
YES
NO
S7
Stop operation
S8
Measured temperature < preset temperature?
NO
YES
S9
Perform operation (temperature turning-down operation)
S4
Stop temporarily operation

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/080367

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i

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)
F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-156494 A (Daikin Industries, Ltd.), 15 July 2010 (15.07.2010), paragraphs [0018] to [0023]; fig. 1 & WO 2010/073579 A1	1-11
Y	JP 2009-293851 A (NTT Facilities, Inc.), 17 December 2009 (17.12.2009), claim 1; paragraphs [0009] to [0017]; fig. 1 to 3 (Family: none)	1-11
Y	JP 2008-304104 A (The Chugoku Electric Power Co., Inc.), 18 December 2008 (18.12.2008), claim 5; paragraphs [0042] to [0044] (Family: none)	1-11

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

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Date of the actual completion of the international search	Date of mailing of the international search report
14 March, 2012 (14.03.12)	27 March, 2012 (27.03.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/080367

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-275458 A (Mitsubishi Electric Corp.), 12 October 2006 (12.10.2006), claim 5; paragraphs [0031], [0032] (Family: none)	3
Y	JP 2006-64283 A (NTT Facilities, Inc.), 09 March 2006 (09.03.2006), paragraphs [0061] to [0065]; fig. 8, 9 (Family: none)	4
Y	JP 6-129689 A (Matsushita Electric Industrial Co., Ltd.), 13 May 1994 (13.05.1994), paragraph [0009]; fig. 2 (Family: none)	6-8
A	JP 6-185783 A (Hitachi, Ltd.), 08 July 1994 (08.07.1994), paragraph [0017]; fig. 2 (Family: none)	1-11

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- JP 2011064416 A **[0007]**
- JP 2011038705 A **[0007]**