

DESCRIPTION

TITLE: CONTROL SYSTEM

FIELD

[0001]

The present disclosure relates to a control system.

BACKGROUND

[0002]

PTL 1 discloses a system for air conditioning. The system disclosed in PTL 1 includes a device for obtaining the number of persons on each floor. Outdoor air is taken in according to the number of persons obtained by the device.

Citation List

Patent Literature

[0003]

[PTL 1] JP H9-269262 A

SUMMARY

Technical Problem

[0004]

The system disclosed in PTL 1 can control ventilation according to the number of persons. In such a system, appropriately controlling air conditioning according to the state of an object region is further desired.

[0005]

The present disclosure is made to solve the above-mentioned problem. An object of the present disclosure is to provide a control system capable of realizing appropriate air conditioning control according to a state of an object region.

Solution to Problem

[0006]

A control system of the present disclosure comprises an air conditioning device for delivering conditioned air to a specific region, and a controller that controls the air conditioning device. The controller includes a time determination unit configured to determine, on the basis of present weather, a time lag from activation of the air conditioning device until stabilization in temperature of the region at a target temperature, a number-of-persons estimation unit configured to estimate the number of persons in the region at a time when the time lag determined by the time determination unit has elapsed, a determination unit configured to determine whether to activate the air conditioning device on the basis of the number of persons estimated by the number-of-persons estimation unit, and an operation control unit configured to activate the air conditioning device according to a determination result obtained by the determination unit.

[0007]

A control system of the present disclosure comprises an air conditioning device for delivering conditioned air to a specific region, and a controller that controls the air conditioning device. The controller includes a time determination unit configured to determine, on the basis of present weather, a time lag from change of parameter setting content for controlling the air conditioning device until stabilization in temperature of the region at a target temperature, a number-of-persons estimation unit configured to estimate

the number of persons in the region at a time when the time lag determined by the time determination unit has elapsed, a determination unit configured to determine whether to change the setting content on the basis of the number of persons estimated by the number-of-persons estimation unit, and an operation control unit configured to change the setting content according to a determination result obtained by the determination unit.

[0008]

A control system of the present disclosure comprises an air conditioning device for delivering conditioned air to a specific region, a ventilation device for supplying outdoor air to the region and discharging air in the region to the outside, and a controller that controls the air conditioning device. The controller includes a first load determination unit configured to determine a first load based on an amount of solar radiation to the region and a difference in temperature between an inside and an outside of the region, a second load determination unit configured to determine a second load based on a difference in enthalpy between the inside and the outside of the region and an air volume of the ventilation device, a third load determination unit configured to determine a third load based on a quantity of heat generated by persons in the region and a quantity of heat generated by equipment in the region, a determination unit configured to determine parameter setting content for controlling the air conditioning device, on the basis of the first load determined by the first load determination unit, the second load determined by the second load determination unit, and the third load determined by the third load determination unit, and an operation control unit configured to change the setting content according to a determination result obtained by the determination unit.

[0009]

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A control system of the present disclosure comprises an air conditioning device for delivering conditioned air to a specific region, and a controller that controls the air conditioning device. The air conditioning device includes a ventilation device for taking outdoor air into the region, a primary air conditioner for treating the outdoor air taken in by the ventilation device, and a secondary air conditioner for treating the outdoor air treated by the primary air conditioner and air in the region. The controller includes a mode determination unit configured to determine an operation mode of the primary air conditioner and an operation mode of the secondary air conditioner on the basis of a first ability required for the primary air conditioner and a second ability required for the secondary air conditioner, a humidification/dehumidification determination unit configured to determine a humidification amount or a dehumidification amount required for the region on the basis of the first ability and the second ability, an allocation determination unit configured to determine a portion to be allocated to the primary air conditioner and a portion to be allocated to the secondary air conditioner, of a sum of the first ability and the second ability, on the basis of a determination result obtained by the mode determination unit, a determination result obtained by the humidification/dehumidification determination unit, a first COP characteristic curve of the primary air conditioner, and a second COP characteristic curve of the secondary air conditioner, and an operation control unit configured to control the air conditioning device according to a determination result obtained by the allocation determination unit.

Advantageous Effect of Invention

[0010]

The control system according to the present disclosure can realize appropriate air conditioning control according to a state of an object region.

BRIEF DESCRIPTION of DRAWINGS

[0011]

Figure 1 is a drawing illustrating an example of a control system according to a first embodiment.

Figure 2 is a drawing illustrating a function of the control system required to perform a first control.

Figure 3 is a flowchart illustrating an exemplary operation of the control system.

Figure 4 is a drawing illustrating a function of the control system required to create a time lag database.

Figure 5 is a flowchart illustrating an exemplary operation of the control system.

Figure 6 is a flowchart illustrating an exemplary operation of the control system.

Figure 7 is a drawing illustrating a function of the control system required to perform a third control.

Figure 8 is a flowchart illustrating an exemplary operation of the control system.

Figure 9 is a flowchart illustrating an example of determination of a first load.

Figure 10 is a flowchart illustrating an example of determination of a second load.

Figure 11 is a flowchart illustrating an example of determination of a third load.

Figure 12 is a drawing illustrating a function of the control system required to create a database of an amount of solar radiation.

Figure 13 is a drawing illustrating an example of a load determination unit.

Figure 14 is a flowchart illustrating an exemplary operation of an estimation unit.

Figure 15 is a drawing illustrating an example of a load determination unit.

Figure 16 is a drawing illustrating an example of a load determination unit.

Figure 17 is a drawing illustrating a function of the control system required to perform a fourth control.

Figure 18 is a drawing illustrating a ventilation control function according to the number of persons D after elapse of X minutes.

Figure 19 is a drawing illustrating a function of the control system required to perform a fifth control.

Figure 20 is a flowchart illustrating an exemplary operation of the control system.

Figure 21 is a drawing illustrating an example of a first COP characteristic curve and a second COP characteristic curve extracted by an allocation determination unit.

Figure 22 is a drawing illustrating exemplary hardware resources of a controller.

Figure 23 is a drawing illustrating another exemplary hardware resources of the controller.

DESCRIPTION of EMBODIMENTS

[0012]

Hereinafter, a detailed description will be given with reference to attached drawings. Redundant descriptions will be simplified or omitted appropriately. In each drawing, the same reference numerals indicate the same part or the corresponding part.

[0013]

First Embodiment

Fig. 1 is a drawing illustrating an example of a control system according to a first embodiment. The control system illustrated in Fig. 1 includes a management operation

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facility 1, an air conditioning facility 2, an elevator facility 3, an environment measurement facility 4, and an electric power measurement facility 5. The control system may further include another facility such as a lighting facility.

[0014]

The management operation facility 1 manages facilities included in the system in an integrated manner. The management operation facility 1 includes a display device 11 and a controller 12. In examples illustrated in the present embodiment, an object to be controlled by the controller 12 is the air conditioning facility 2. The elevator facility 3, the environment measurement facility 4, and the electric power measurement facility 5 function as sensors that provide information to the controller 12. The controller 12 may further include a function of displaying necessary information on the display device 11.

[0015]

The air conditioning facility 2 includes an air conditioning device 21 and a ventilation device 22. The air conditioning device 21 and the ventilation device 22 are controlled by the controller 12.

[0016]

The air conditioning device 21 is a device for delivering conditioned air to a specific region. The conditioned air is air that is adjusted at least in temperature or humidity. The region is present on a specific floor in a building. In the following description, the region is denoted as a region A. The floor where the region A is located is denoted as a floor B. The building including the region A is denoted as a building C. The number of persons in the region A is denoted as the number of persons D. The region A may be a part or the whole of the floor B. In the following description, it is assumed that the whole of the floor B is the region A.

[0017]

The ventilation device 22 is a device for supplying air outside the building C to the region A and discharging air in the region A to the outside of the region A, preferably to the outside of the building C. The ventilation device 22 takes in air from the outside of the building C, that is, outdoor air. As an example, the outdoor air taken in by the ventilation device 22 is directly supplied to the region A. The ventilation device 22 may be one of functions of the air conditioning device 21. In such a case, the outdoor air taken in by the ventilation device 22 may be supplied to the region A after temperature or humidity is adjusted by the air conditioning device 21. The outdoor air taken in by the ventilation device 22 may be directly supplied to the region A.

[0018]

The elevator facility 3 is a facility for carrying passengers to each floor in the building C. Therefore, the elevator facility 3 can also carry passengers to the floor B. Fig. 1 illustrates an example of the elevator facility 3 that includes a plurality of elevator devices. In such a case, the elevator facility 3 includes, in addition to the plurality of elevator devices, a communication device 31 and a group control panel 32.

[0019]

The communication device 31 is a device for enabling the elevator facility 3 to communicate with other facilities including the management operation facility 1. The group control panel 32 controls the plurality of elevator devices. Each elevator device includes a control panel 33, a traction machine 34, and a car 35. The car 35 moves up and down in a shaft. The traction machine 34 drives the car 35. The control panel 33 controls the traction machine 34.

[0020]

The environment measurement facility 4 includes an input/output device 41 and various measuring devices. The input/output device 41 performs processing for inputting and outputting information. Fig. 1 illustrates an example in which the environment measurement facility 4 includes a pyranometer 42, an outdoor thermo-hygrometer 43, an indoor thermo-hygrometer 44, and a CO₂ densitometer 45, as measuring devices that measure environmental information. The environment measurement facility 4 may include other measuring devices.

[0021]

The pyranometer 42 measures an amount of solar radiation to the region A. The "amount of solar radiation to the region A" also includes an amount of solar radiation that does not actually reach the region A. For example, the pyranometer 42 is installed on a roof floor of the building C. The pyranometer 42 may be installed in the site of the building C. The thermo-hygrometer 43 measures temperature and humidity outside the building C. The thermo-hygrometer 43 may include a thermometer and a hygrometer that are separate measuring devices. The thermo-hygrometer 44 measures temperature and humidity in the region A. The thermo-hygrometer 44 may include a thermometer and a hygrometer that are separate measuring devices. The CO₂ densitometer 45 measures concentration of carbon dioxide in the region A.

[0022]

In the present embodiment, "outdoor" also means "outside of the building C". "Indoor" also means "inside of the region A" in comparison with the "outdoor". The air from the outside of the building C is also denoted as "outdoor air". Further, the inside of the building C (the region A) and the outside of the building C are also denoted as "inside and outside".

[0023]

The electric power measurement facility 5 includes a measuring device 51, a lighting board 52, a power board 53, and a solar power generator 54. The measuring device 51 measures power consumption of equipment provided in the region A on the basis of information from the lighting board 52, the power board 53, and the solar power generator 54.

[0024]

Next, characteristic controls that can be performed by the present control system will be described. The present control system performs first to fifth controls described below.

First control: Air conditioning activation control according to the number of persons D

Second control: Air conditioning change control according to the number of persons D

Third control: Air conditioning change control according to load

Fourth control: Ventilation control according to the number of persons D

Fifth control: Efficiency optimization control

[0025]

[First Control]

Fig. 2 is a drawing illustrating a function of the control system required to perform the first control. The controller 12 includes a storage unit 120, a weather estimation unit 121, a time determination unit 122, a number-of-persons estimation unit 123, a determination unit 124, and an operation control unit 125.

[0026]

Fig. 3 is a flowchart illustrating an exemplary operation of the control system.

Fig. 3 illustrates an example in which the control system performs the first control. As

an example, the first control is started in the morning when the air conditioning device 21 is stopped. That is, when the first control is started, conditioned air is not supplied from the air conditioning device 21 to the region A.

[0027]

The weather estimation unit 121 estimates weather. First, the weather estimation unit 121 obtains an actual measurement value of a present amount of solar radiation measured by the pyranometer 42 (S101). The weather estimation unit 121 obtains an actual measurement value of present temperature and an actual measurement value of present humidity measured by the thermo-hygrometer 43 (S102). The weather estimation unit 121 obtains information about a current time from a clock 150 included in the controller 12 (S103). The weather estimation unit 121 may obtain information about the current time from another facility.

[0028]

The weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation measured by the pyranometer 42, the present temperature and humidity measured by the thermo-hygrometer 43, and the current time (S104). For example, a table T1 for estimating the weather is stored in the storage unit 120. Table 1 is an example of the table T1.

[0029]

[Table 1]

Weather	Sunny			Cloudy			Rainy		
Time	6:00-6:59	7:00-7:59	8:00-8:59	6:00-6:59	7:00-7:59	8:00-8:59	6:00-6:59	7:00-7:59	8:00-8:59
Amount of solar radiation (MJ/m ²)	≥0.10	≥0.50	≥0.80	-	-	-	≤0.05	≤0.20	≤0.30
Temperature	≥27°C	≥28°C	≥29°C	-	-	-	≤25°C	≤26°C	≤27°C
Humidity	≤85%	≤80%	≤75%	-	-	-	≥90%	≥90%	≥90%

[0030]

Table 1 illustrates an example in which the weather can be determined according to the time, the amount of solar radiation, the outdoor temperature, and the outdoor humidity. A case where the weather estimation unit 121 estimates the weather with reference to the table T1 is considered. In such a case, if the amount of solar radiation at 7:30 is 0.55 [MJ/m²], the temperature is 29°C, and the humidity is 75%, the weather estimation unit 121 determines that it is sunny at present. If respective measurement values of amount of solar radiation, temperature, and humidity do not apply to both sunny and rainy conditions, the weather estimation unit 121 determines that it is cloudy at present.

[0031]

The method by which the weather estimation unit 121 estimates the weather is not limited to the above-described example. For example, the weather estimation unit 121 may estimate the present weather on the basis of only the present amount of solar radiation. The weather estimation unit 121 may estimate the present weather on the basis of only the present amount of solar radiation and the present outdoor temperature. The weather estimation unit 121 may estimate the present weather on the basis of the present amount of solar radiation and other environmental information.

[0032]

The time determination unit 122 determines a time lag at the present time (S105).

The time lag in the first control indicates a time interval from activation of the air conditioning device 21 until stabilization in temperature of the region A at a target temperature.

[0033]

The time determination unit 122 first obtains information about the weather estimated by the weather estimation unit 121. Further, the time determination unit 122 obtains information about the current time from the clock 150. The weather estimation unit 121 may obtain the information about the current time from another facility.

[0034]

In S105, the time determination unit 122 determines the time lag on the basis of the present weather estimated by the weather estimation unit 121 and the current time. For example, a table T2 for determining the time lag is stored in the storage unit 120. Table 2 is an example of the table T2.

[0035]

[Table 2]

Weather	Sunny			Cloudy			Rainy		
Time	7:00-7:29	7:30-7:59	8:00-8:29	7:00-7:29	7:30-7:59	8:00-8:29	7:00-7:29	7:30-7:59	8:00-8:29
Time lag (min)	30	45	60	25	40	50	20	30	40

[0036]

Table 2 illustrates an example in which the time lag can be determined according to the weather and time. A case where the time determination unit 122 determines the time lag on the basis of the table T2 is considered. In this case, when the current time is 7:15 and if the weather is sunny, the time determination unit 122 determines that the time lag at the present time is 30 minutes. When the current time is 8:10 and if the weather is

rainy, the time determination unit 122 determines that the time lag at the present time is 40 minutes.

[0037]

The method by which the time determination unit 122 determines the time lag is not limited to the above-described example. For example, the time determination unit 122 may determine the time lag on the basis of only the present weather. The time determination unit 122 may determine the time lag on the basis of the present weather, the current time, and present season.

[0038]

The number-of-persons estimation unit 123 estimates the number of persons D at a time when the time lag determined by the time determination unit 122 has elapsed. That is, if the time lag is determined as 30 minutes in S105, the number-of-persons estimation unit 123 estimates the number of persons D at the time when the duration of 30 minutes has elapsed from the current time. In the following description, an example in which the number-of-persons estimation unit 123 obtains information necessary for estimating the number of persons D from the elevator facility 3 will be described.

[0039]

In the example illustrated in Fig. 2, the elevator facility 3 further includes a number-of-persons management device 36. The number-of-persons management device 36 includes a storage unit 360, a detection unit 361, a calculation unit 362, and a learning unit 363. Further, the car 35 includes a weighing device 37. The weighing device 37 measures a mounted load of the car 35.

[0040]

The detection unit 361 detects an amount of change in the load measured by the weighing device 37. The calculation unit 362 calculates the number of persons who got on the car 35 and the number of persons who got off the car 35, for each floor, on the basis of the load change amount detected by the detection unit 361. Further, the calculation unit 362 calculates the number of persons on each floor. The calculation unit 362 calculates an actual measurement value of the number of persons on the floor B at the present time, that is, the actual measurement value of the number of persons D at the present time.

[0041]

As described above, the calculation unit 362 calculates the number of persons on each floor in real time. The learning unit 363 classifies the number of persons on each floor under arbitrary conditions on the basis of a calculation result obtained by the calculation unit 362, and creates a database. The learning method by the learning unit 363 may be any method. The database created by the learning unit 363 is stored in the storage unit 360. The created database is updated periodically. Therefore, even if there are restrictions on going to work due to an epidemic, for example, the effects of the restrictions will be reflected in the database after a certain period of time.

[0042]

As an example, the database is constructed so that, by designating a certain time, an estimation value of the number of persons D at the said time can be determined. As another example, the database is constructed so that, by designating a certain day of a certain week and a certain time, an estimation value of the number of persons D at the day of the week and the time can be determined.

[0043]

First, the number-of-persons estimation unit 123 obtains an actual measurement value N1 of the number of persons D at the current time from the calculation unit 362 (S106). The number-of-persons estimation unit 123 obtains an estimation value N2 of the number of persons D at the current time from the storage unit 360 (S107). The number-of-persons estimation unit 123 obtains, from the storage unit 360, an estimation value N3 of the number of persons D at the time when the time lag determined by the time determination unit 122 has elapsed from the current time (S108).

[0044]

The number-of-persons estimation unit 123 estimates the number of persons D at the time when the time lag determined by the time determination unit 122 has elapsed from the current time on the basis of the actual measurement value N1, the estimation value N2, and the estimation value N3 (S109). As an example, the number-of-persons estimation unit 123 calculates a correction coefficient using the actual measurement value N1 and the estimation value N2. The correction coefficient may be calculated on the basis of a difference between the actual measurement value N1 and the estimation value N2. In S109, the number-of-persons estimation unit 123 estimates the number of persons D by correcting the estimation value N3 using the calculated correction coefficient.

[0045]

The method by which the number-of-persons estimation unit 123 estimates the number of persons D is not limited to the above-described example. For example, the number-of-persons estimation unit 123 may estimate the number of persons D on the basis of only the estimation value N3.

[0046]

The number-of-persons estimation unit 123 may obtain information necessary for estimating the number of persons D from a facility other than the elevator facility 3. For example, if a passage management facility is included in the building C, the number-of-persons estimation unit 123 may obtain the necessary information from the passage management facility. The passage management facility includes a card reader or any other authentication device. As another example, if multiple cameras are provided in the building C, the number-of-persons estimation unit 123 may obtain the necessary information from images captured by these cameras.

[0047]

The determination unit 124 determines whether to activate the air conditioning device 21 on the basis of the number of persons D estimated by the number-of-persons estimation unit 123. For example, the determination unit 124 determines whether the number of persons D estimated by the number-of-persons estimation unit 123 is greater than a reference value Dth1 (S110). The reference value Dth1 is set in advance. It is desirable that the reference value Dth1 is set according to the environment of the building C or the like. As an example, the number of persons corresponding to 50% of the number of persons with their own seats in the region A is set as the reference value Dth1.

[0048]

The operation control unit 125 activates the air conditioning device 21 according to a determination result obtained by the determination unit 124. For example, if the number of persons D estimated by the number-of-persons estimation unit 123 is larger than the reference value Dth1, the determination unit 124 determines Yes in S110. When the determination result in S110 is Yes, the operation control unit 125 activates the air conditioning device 21 (S111). In S111, the operation control unit 125 may activate

both the air conditioning device 21 and the ventilation device 22. Upon activating the air conditioning device 21 in S111, the operation control unit 125 starts control for bringing the temperature of the region A closer to the target temperature and then stabilizing the temperature of the region A at the target temperature.

[0049]

On the other hand, if the number of persons D estimated by the number-of-persons estimation unit 123 is not greater than the reference value Dth1, the determination unit 124 determines No in S110. When the determination result in S110 is No, the operation control unit 125 does not activate the air conditioning device 21. The operation control unit 125 holds the air conditioning device 21 stopped. When the determination result in S110 is No, the processing returns to S101. The sequential processing from S101 to S110 is performed repeatedly until the determination result in S110 turns to Yes.

[0050]

In the first control, if the number of persons D estimated by the number-of-persons estimation unit 123 is greater than the reference value Dth1, the determination unit 124 determines to activate the air conditioning device 21. The number of persons D estimated by the number-of-persons estimation unit 123 is the number of persons at the time when the time lag determined by the time determination unit 122 has elapsed. Therefore, the present control system can activate the air conditioning device 21 in advance according to the time lag before many people gather in the region A. That is, the present control system can realize appropriate air conditioning control according to the state of the region A.

[0051]

Next, an example of preprocessing for creating a time lag database will be described with reference to Figs. 4 and 5.

[0052]

Fig. 4 is a drawing illustrating a function of the control system required to create the time lag database. In the example illustrated in Fig. 4, the controller 12 includes the storage unit 120, the weather estimation unit 121, a determination unit 126, a detection unit 127, and a creation unit 128. Fig. 5 is a flowchart illustrating an exemplary operation of the control system.

[0053]

The controller 12 determines whether the air conditioning device 21 has been activated (S201). When the air conditioning device 21 is activated, an activation signal is transmitted from the air conditioning device 21 to the controller 12. When the controller 12 receives the activation signal from the air conditioning device 21, it is determined as Yes in S201.

[0054]

The detection unit 127 detects a time interval after activation of the air conditioning device 21 until stabilization in temperature of the region A at the target temperature, that is, the time lag in the first control. When the determination result in S201 is Yes, the detection unit 127 starts counting of time (S202).

[0055]

When the counting is started in S202, the determination unit 126 obtains information about the target temperature from the air conditioning device 21 (S203). For example, the target temperature is set by a user. Further, the determination unit 126 obtains an actual measurement value of the present temperature measured by the thermo-

hygrometer 44 (S204). In the case where the air conditioning device 21 has a function of detecting intake temperature, the determination unit 126 may obtain the actual measurement value of the indoor temperature from the air conditioning device 21. Similarly, in other controls, the controller 12 may obtain the actual measurement value of the indoor temperature (the temperature of the region A) from the air conditioning device 21.

[0056]

The determination unit 126 determines whether the temperature of the region A is stabilized at the target temperature on the basis of the target temperature set in the air conditioning device 21 and the indoor temperature measured by the thermo-hygrometer 44 (S205). As an example, when a difference between the target temperature and the indoor temperature is within 0.2°C and the state continues for 10 minutes, the determination unit 126 determines Yes in S205. As another example, the determination in S205 may be performed by further using a target humidity set in the air conditioning device 21 and an indoor humidity measured by the thermo-hygrometer 44.

[0057]

The determination unit 126 performs the processing of S204 and S205 repeatedly until the determination result in S205 turns to Yes.

[0058]

When the determination result in S205 is Yes, the detection unit 127 terminates the counting of time (S206). The detection unit 127 detects, as the time lag, the time interval after starting the counting in S202 until terminating the counting in S206.

[0059]

The weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation (S207). For example, similar to the example illustrated in Figs. 2 and 3, the weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation measured by the pyranometer 42, the present temperature and humidity measured by the thermo-hygrometer 43, and the current time. In such a case, the weather estimation unit 121 performs processing similar to the processing from S101 to S104 in Fig. 3.

[0060]

The creation unit 128 creates the time lag database (S208). For example, the creation unit 128 obtains, from the detection unit 127, information about the time lag and information about activation time of the air conditioning device 21. The creation unit 128 obtains information about the present weather from the weather estimation unit 121. The creation unit 128 obtains the correlation between the time lag, the activation time, and the weather, and constructs a database as illustrated by the table T2. The database created by the creation unit 128 is stored in the storage unit 120. The creation unit 128 may create a mathematical formula having a similar function, instead of the database.

[0061]

[Second Control]

Next, the second control will be described with reference to Figs. 2 and 6. Fig. 6 is a flowchart illustrating an exemplary operation of the control system. Fig. 6 illustrates an example in which the control system performs the second control. As an example, the second control starts before a lunch break during which the number of persons D changes significantly. When the second control is started, the air conditioning device 21 is already in operation.

[0062]

Processing from S301 to S309 in Fig. 6 is similar to the processing from S101 to S109 in Fig. 3. For example, in S304, the weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation measured by the pyranometer 42, the present temperature and humidity measured by the thermo-hygrometer 43, and the current time. The weather estimation unit 121 may estimate the weather with reference to the table T1.

[0063]

In S305, the time determination unit 122 determines a time lag at the present time on the basis of the present weather estimated by the weather estimation unit 121 and the current time. The time lag used in the second control is different from the time lag used in the first control. The time lag in the second control indicates a time interval from change in parameter setting contents for controlling the air conditioning device 21 until stabilization in temperature of the region A at the target temperature.

[0064]

Table 3 illustrates examples of the parameter setting contents and the time lag.

[0065]

[Table 3]

	At start			At termination		
Weather	Sunny	Cloudy	Rainy	Sunny	Cloudy	Rainy
Time lag (min)	20	15	10	10	15	20
Target temperature	24°C	25°C	26°C	22°C	23°C	24°C
Air volume	Weak	Weak	Weak	Strong	Strong	Strong
Wind direction	Down	Down	Down	Up	Up	Up

[0066]

In S309, the number-of-persons estimation unit 123 estimates the number of persons D at a time when the time lag determined by the time determination unit 122 has elapsed, from the current time. As an example, the number of persons D is estimated on the basis of the actual measurement value N1, the estimation value N2, and the estimation value N3.

[0067]

Next, the determination unit 124 determines whether to change the parameter setting contents for controlling the air conditioning device 21 on the basis of the number of persons D estimated by the number-of-persons estimation unit 123 (S310). The condition for changing the parameter (control parameter) setting content is set in advance. In the following description, this condition may be referred to as a change condition. That is, in S310, the determination unit 124 determines whether the change condition is met.

[0068]

As an example, in S310, the determination unit 124 determines whether the number of persons D estimated by the number-of-persons estimation unit 123 is less than a reference value Dth2. The reference value Dth2 is set in advance. It is desirable that the reference value Dth2 is set according to the environment of the building C or the like.

As an example, the number of persons corresponding to 10% of the number of persons with their own seats in the region A is set as the reference value Dth2.

[0069]

The operation control unit 125 changes the control parameter setting contents of the air conditioning device 21 according to a determination result obtained by the determination unit 124. For example, if the number of persons D estimated by the number-of-persons estimation unit 123 is less than the reference value Dth2, the change condition is met. Accordingly, it is determined as Yes in S310. When the determination result in S310 is Yes, the operation control unit 125 changes the control parameter setting contents of the air conditioning device 21 (S311). Accordingly, the control on the premise that the number of persons in the region A decreases from now is started.

[0070]

Table 4 illustrates an example of the control parameter setting contents when it is determined as Yes in S310 because the number of persons D is less than the reference value Dth2. In S311, the control parameter setting contents are changed from the specific first contents to second contents of Table 4.

[0071]

[Table 4]

Weather	Sunny	Cloudy	Rainy
Target temperature	+2°C	+3°C	+4°C
Air volume	Weak	Weak	Weak
Wind direction	Down	Down	Down
Dehumidification	-	-	-

[0072]

If the number of persons D estimated by the number-of-persons estimation unit 123 is not smaller than the reference value Dth2, the change condition is not met. Accordingly, it is determined as No in S310. When the determination result in S310 is No, the operation control unit 125 does not change the control parameter setting contents of the air conditioning device 21. When the determination result in S310 is No, the processing returns to S301. The sequential processing from S301 to S310 is performed repeatedly until the determination result in S310 turns to Yes.

[0073]

As another example, after the control parameter setting contents are changed from the first contents to the second contents, the processing of Fig. 6 may be performed again by changing the change condition. In such a case, from S301 to S309, processing similar to the processing from S101 to S109 in Fig. 3 is performed.

[0074]

For example, in S310, the determination unit 124 determines whether the number of persons D estimated by the number-of-persons estimation unit 123 is greater than a reference value Dth3. The reference value Dth3 is set in advance. It is desirable that the reference value Dth3 is greater than the reference value Dth2. The reference value Dth3 may be the same as the reference value Dth1. It is desirable that the reference value Dth3 is set according to the environment of the building C or the like. As an example, the number of persons corresponding to 50% of the number of persons with their own seats in the region A is set as the reference value Dth3.

[0075]

If the number of persons D estimated by the number-of-persons estimation unit 123 is greater than the reference value Dth3, the change condition is met. Accordingly,

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it is determined as Yes in S310. When the determination result in S310 is Yes after the control parameter setting contents are changed to the second contents, the operation control unit 125 changes the control parameter setting contents of the air conditioning device 21 (S311). Accordingly, the control on the premise that the number of persons in the region A increases from now is started.

[0076]

Table 5 is an example of the control parameter setting contents when it is determined as Yes in S310 because the number of persons D is greater than the reference value Dth3. In S311, the control parameter setting contents are changed from the second contents illustrated in Table 4 to the first contents illustrated in Table 5.

[0077]

[Table 5]

Weather	Sunny	Cloudy	Rainy
Target temperature	Undo (± 0)		
Air volume	Automatic	Automatic	Automatic
Wind direction	Up	Up	Up
Dehumidification	-	-	-

[0078]

If the number of persons D estimated by the number-of-persons estimation unit 123 is not greater than the reference value Dth3, the change condition is not met. Accordingly, it is determined as No in S310. When the determination result in S310 is No, the operation control unit 125 does not change the control parameter setting contents of the air conditioning device 21. The operation control unit 125 controls the air conditioning device 21 while holding the control parameter setting contents at the second contents.

[0079]

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In the second control, if the number of persons D estimated by the number-of-persons estimation unit 123 is less than the reference value Dth2, the control on the premise that the number of persons in the region A decreases from now is started. Subsequently, when the number of persons D estimated by the number-of-persons estimation unit 123 becomes greater than the reference value Dth3, the control on the premise that the number of persons in the region A increases from now is started. Therefore, the present control system can change the control content of the air conditioning device 21 in advance before many people leave the region A and before many people gather in the region A. That is, the present control system can realize appropriate air conditioning control according to the state of the region A.

[0080]

[Third Control]

Fig. 7 is a drawing illustrating a function of the control system required to perform the third control. In the example illustrated in Fig. 7, the controller 12 includes the storage unit 120, a load determination unit 129, a load determination unit 130, a load determination unit 131, the determination unit 124, and the operation control unit 125.

[0081]

The load determination unit 129 determines a first load. The first load is an indoor intrusion load based on an amount of solar radiation to the region A and a difference in temperature between the inside and outside of the region A. The load determination unit 129 includes the weather estimation unit 121, a solar radiation estimation unit 132, a load calculation unit 133, a load calculation unit 134, and a load calculation unit 135.

[0082]

The load determination unit 130 determines a second load. The second load is an outdoor air load based on a difference in enthalpy between the inside and outside of the region A and an air volume of the ventilation device 22. The load determination unit 130 includes an estimation unit 136 and a load calculation unit 137.

[0083]

The load determination unit 131 determines a third load. The third load is an internal heat generation load based on a quantity of heat generated by persons in the region A and a quantity of heat generated by equipment in the region A. The load determination unit 131 includes a heat quantity estimation unit 138, a heat quantity estimation unit 139, and a load calculation unit 140.

[0084]

Fig. 8 is a flowchart illustrating an exemplary operation of the control system. Fig. 8 illustrates an example in which the control system performs the third control. As an example, the third control is started when a specific start condition is met. The start condition is set in advance. The start condition will be described below.

[0085]

First, the load determination unit 129 determines the first load (S401). Fig. 9 is a flowchart illustrating an example of determination of the first load. Fig. 9 illustrates an exemplary operation that the load determination unit 129 performs in S401.

[0086]

The weather estimation unit 121 estimates the present weather. Processing from S501 to S504 in Fig. 9 is similar to the processing from S101 to S104 in Fig. 3. For example, in S504, the weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation measured by the pyranometer 42, the

present temperature and humidity measured by the thermo-hygrometer 43, and the current time. The weather estimation unit 121 may estimate the weather with reference to the table T1.

[0087]

The solar radiation estimation unit 132 estimates an amount of solar radiation in each direction (S505). The solar radiation estimation unit 132 estimates the amount of solar radiation in each direction on the basis of the present weather estimated by the weather estimation unit 121 and the current time. For example, a table T3 for estimating the amount of solar radiation in each direction is stored in the storage unit 120. Table 6 illustrates a part of the table T3. Table 6 is a table for estimating the amount of solar radiation to a wall facing east.

[0088]

[Table 6]

Wall orientation: East										
Weather	Sunny									
Time	6:00-6:59	7:00-7:59	8:00-8:59	9:00-9:59	10:00-10:59	11:00-11:59	12:00-12:59	13:00-13:59	14:00-14:59	
Amount of solar radiation (MJ/m ²)	2.00	1.80	1.50	1.2	0.9	0.6	0.3	0.3	0.3	
Weather	Cloudy									Rainy
Time	6:00-6:59	7:00-7:59	8:00-8:59	9:00-9:59	10:00-10:59	11:00-11:59	12:00-12:59	13:00-13:59	14:00-14:59	
Amount of solar radiation (MJ/m ²)	1.00	0.90	0.75	0.6	0.45	0.3	0.15	0.15	0.15	0.1

[0089]

Table 7 illustrates a part of the table T3. Table 7 is a table for estimating the amount of solar radiation to a wall facing west. The table T3 includes a table for a wall facing north and a table for a wall facing south.

[0090]

[Table 7]

Wall orientation: West										
Weather	Sunny									
Time	11:00-11:59	12:00-12:59	13:00-13:59	14:00-14:59	15:00-15:59	16:00-16:59	17:00-17:59	18:00-18:59	19:00-19:59	
Amount of solar radiation (MJ/m ²)	0.3	0.3	0.6	0.9	1.2	1.5	1.8	1.0	0	
Weather	Cloudy									Rainy
Time	11:00-11:59	12:00-12:59	13:00-13:59	14:00-14:59	15:00-15:59	16:00-16:59	17:00-17:59	18:00-18:59	19:00-19:59	
Amount of solar radiation (MJ/m ²)	0.15	0.15	0.3	0.45	0.6	0.75	0.9	0.5	0	0.1

[0091]

Table 6 illustrates an example in which the amount of solar radiation to the wall facing east can be identified according to the weather and time. A case where the solar radiation estimation unit 132 estimates the amount of solar radiation in each direction on the basis of the table T3 is considered. In such a case, the amount of solar radiation in the direction "east" is estimated as 0.3 [MJ/m²] at 12:30 on a sunny day. The method by which the solar radiation estimation unit 132 estimates the amount of solar radiation in each direction is not limited to the above-described example. For example, when estimating the amount of solar radiation in each direction, a correction coefficient according to the season may be used.

[0092]

The load calculation unit 133 calculates an indoor intrusion load due to solar radiation (S506). For example, the load calculation unit 133 calculates the indoor intrusion load due to solar radiation in each direction on the basis of the amount of solar radiation in each direction estimated by the solar radiation estimation unit 132, a solar

radiation acquisition rate for the wall, and a solar radiation acquisition rate for the window. The load calculation unit 133 sums up the calculated loads of respective directions to calculate the entire load of the region A in S506.

[0093]

The load calculation unit 134 calculates an indoor intrusion load due to the difference in temperature between the inside and outside (S507). For example, the load calculation unit 134 calculates the difference in temperature between the inside and outside on the basis of the present temperature measured by the thermo-hygrometer 43 and the present temperature measured by the thermo-hygrometer 44. The load calculation unit 134 calculates the indoor intrusion load due to the temperature difference on the basis of the calculated temperature difference, a coefficient of heat transmission for the wall, and a coefficient of heat transmission for the window.

[0094]

The load calculation unit 135 calculates the first load (S508). The load calculation unit 135 calculates the first load on the basis of the load calculated by the load calculation unit 133 and the load calculated by the load calculation unit 134. For example, the first load is the sum of the indoor intrusion load due to solar radiation and the indoor intrusion load due to the difference in temperature between the inside and outside.

[0095]

The load determination unit 130 determines the second load (S402). Fig. 10 is a flowchart illustrating an example of determination of the second load. Fig. 10 illustrates an exemplary operation that the load determination unit 130 performs in S402.

[0096]

The estimation unit 136 estimates the difference in enthalpy between the inside and outside. First, the estimation unit 136 obtains the actual measurement value of the present temperature and the actual measurement value of the humidity measured by the thermo-hygrometer 43 (S601). The estimation unit 136 obtains the actual measurement value of the present temperature and the actual measurement value of the humidity measured by the thermo-hygrometer 44 (S602). The estimation unit 136 estimates the difference in enthalpy between the inside and outside on the basis of the present temperature and humidity measured by the thermo-hygrometer 43 and the present temperature and humidity measured by the thermo-hygrometer 44 (S603).

[0097]

The load calculation unit 137 calculates the second load. The load calculation unit 137 obtains information about a present air volume from the ventilation device 22 (S604). The load calculation unit 137 calculates the second load on the basis of the enthalpy difference estimated by the estimation unit 136 and the air volume of the ventilation device 22 (S605).

[0098]

The load determination unit 131 determines the third load (S403). Fig. 11 is a flowchart illustrating an example of determination of the third load. Fig. 11 illustrates an exemplary operation that the load determination unit 131 performs in S403.

[0099]

The heat quantity estimation unit 138 estimates a heat quantity Q_1 generated by the persons in the region A. First, the heat quantity estimation unit 138 obtains information about the number of persons in the region A, that is, the number of persons D (S701). For example, the heat quantity estimation unit 138 obtains this information

from the elevator facility 3. In S701, the heat quantity estimation unit 138 may obtain the actual measurement value N1 of the number of persons D at the current time, from the calculation unit 362. In S701, the heat quantity estimation unit 138 may obtain the estimation value N2 of the number of persons D at the current time, from the storage unit 360.

[0100]

Next, the heat quantity estimation unit 138 estimates the heat quantity Q1 by multiplying a heat generation amount per person with the number of persons D (S702). The heat generation amount per person is set in advance.

[0101]

The heat quantity estimation unit 139 estimates a heat quantity Q2 generated by the equipment in the region A. For example, the heat quantity estimation unit 139 obtains information about power consumption in the region A, from the measuring device 51 (S703). The heat quantity estimation unit 139 estimates the heat quantity Q2 on the basis of the power consumption measured by the measuring device 51 (S704).

[0102]

The load calculation unit 140 calculates the third load (S705). The load calculation unit 140 calculates the third load on the basis of the heat quantity Q1 estimated by the heat quantity estimation unit 138 and the heat quantity Q2 estimated by the heat quantity estimation unit 139.

[0103]

Next, the determination unit 124 performs processing for determining the control parameter setting contents of the air conditioning device 21 (S404). In the following description, this processing performed by the determination unit 124 may be referred to

as determination processing. This determination processing is performed on the basis of the first load determined by the load determination unit 129, the second load determined by the load determination unit 130, and the third load determined by the load determination unit 131. The operation control unit 125 changes the control parameter setting contents of the air conditioning device 21 according to a determination result obtained by the determination unit 124 (S405).

[0104]

As described above, the third control illustrated in Fig. 8 is started when the start condition is met. That is, when the start condition is met, the determination processing is performed by the determination unit 124. For example, the determination unit 124 calculates a change amount $\Delta H1$ in indoor enthalpy within a specific first time. The determination unit 124 determines whether the calculated change amount $\Delta H1$ is equal to or greater than a reference value $\Delta Hth1$. The reference value $\Delta Hth1$ is set in advance. It is desirable that the reference value $\Delta Hth1$ is set according to the environment of the building C or the like. As an example, the reference value $\Delta Hth1$ is 1.5%.

[0105]

Further, the determination unit 124 calculates a change amount $\Delta H2$ in outdoor enthalpy within the first time. The determination unit 124 determines whether the calculated change amount $\Delta H2$ is equal to or greater than a reference value $\Delta Hth2$. The reference value $\Delta Hth2$ is set in advance. It is desirable that the reference value $\Delta Hth2$ is set according to the environment of the building C or the like. As an example, the reference value $\Delta Hth2$ is 5%.

[0106]

For example, if the calculated change amount $\Delta H1$ is equal to or greater than the reference value ΔH_{th1} , the determination unit 124 determines that the start condition is met. If the calculated change amount $\Delta H2$ is equal to or greater than the reference value ΔH_{th2} , the determination unit 124 determines that the start condition is met. That is, if the change amount $\Delta H1$ is equal to or greater than the reference value ΔH_{th1} , even if the change amount $\Delta H2$ is less than the reference value ΔH_{th2} , the determination unit 124 starts the determination processing. If the change amount $\Delta H2$ is equal to or greater than the reference value ΔH_{th2} , even if the change amount $\Delta H1$ is less than the reference value ΔH_{th1} , the determination unit 124 starts the determination processing.

[0107]

In this determination processing, the determination unit 124 calculates a required quantity of cold energy from a difference between the presently supplying quantity of cold energy and the first load, the second load, and the third load. The determination unit 124 sets the target temperature, the air volume, and the wind direction of the air conditioning device 21 on the basis of the calculated quantity of cold energy. The operation control unit 125 changes the control parameter setting contents from the first contents indicated in Table 5 to the second contents indicated in Table 4 according to the determination result obtained by the determination unit 124, for example.

[0108]

After the start condition is met, the determination unit 124 determines whether a specific termination condition is met (S406). The termination condition is a condition for terminating the determination processing by the determination unit 124. The termination processing is set in advance. If the termination condition is not met, processing from S401 to S405 is performed repeatedly.

[0109]

For example, if the change amount $\Delta H1$ is less than the reference value ΔH_{th1} and the change amount $\Delta H2$ is less than the reference value ΔH_{th2} , the determination unit 124 determines that the termination condition is met. Accordingly, it is determined as Yes in S406. If the change amount $\Delta H2$ is equal to or greater than the reference value ΔH_{th2} even when the change amount $\Delta H1$ is less than the reference value ΔH_{th1} , the termination condition is not met. If the change amount $\Delta H1$ is equal to or greater than the reference value ΔH_{th1} even when the change amount $\Delta H2$ is less than the reference value ΔH_{th2} , the termination condition is not met.

[0110]

When the determination result in S406 is Yes, the determination processing by the determination unit 124 terminates. Further, when the determination result in S406 is Yes, the operation control unit 125 undoes the control parameter setting contents (S407). Accordingly, the setting contents are changed from the second contents indicated in Table 4 to the first contents indicated in Table 5.

[0111]

In the third control, the determination processing by the determination unit 124 is started when the start condition is met. The determination processing is performed on the basis of the first load, the second load, and the third load. Therefore, the present control system can appropriately determine the control parameter setting contents according to the first load, the second load, and the third load. That is, the present control system can realize appropriate air conditioning control according to the state of the region A.

[0112]

Next, exemplary preprocessing for creating a database of the amount of solar radiation in each direction will be described with reference to Fig. 12.

[0113]

Fig. 12 is a drawing illustrating a function of the control system required to create the database of the amount of solar radiation. In the example illustrated in Fig. 12, the controller 12 includes the storage unit 120, the weather estimation unit 121, and the creation unit 128.

[0114]

The weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation. For example, similar to the example illustrated in Figs. 2 and 3, the weather estimation unit 121 estimates the present weather on the basis of the present amount of solar radiation measured by the pyranometer 42, the present temperature and humidity measured by the thermo-hygrometer 43, and the current time. In such a case, the weather estimation unit 121 performs processing similar to the processing from S101 to S104 in Fig. 3.

[0115]

The creation unit 128 creates a database of the amount of solar radiation in each direction. For example, the creation unit 128 obtains information about the present weather and information about the current time from the weather estimation unit 121. The creation unit 128 obtains the actual measurement value of the present amount of solar radiation measured by the pyranometer 42. The amount of solar radiation measured by the pyranometer 42 is the actual measurement value on a horizontal plane. The creation unit 128 decomposes the amount of solar radiation measured by the pyranometer 42 for each direction, and obtains the amount of solar radiation in each

direction. The creation unit 128 obtains the correlation between the time, the weather, and the amount of solar radiation to construct a database as illustrated by the table T3. The database created by the creation unit 128 is stored in the storage unit 120. The creation unit 128 may create a mathematical formula having a similar function, instead of the database.

[0116]

Fig. 7 illustrates the function for performing air conditioning change control according to the present load. Hereinafter, an exemplary air conditioning change control according to load after elapse of a constant time from the current time will be described. In the following description, an example in which the constant time is X minutes will be described. The value of X can be set arbitrarily. The time lag in the second control may be adopted as the value of X.

[0117]

Even in this example, similar to the example illustrated in Fig. 7, the controller 12 includes the storage unit 120, the load determination unit 129, the load determination unit 130, the load determination unit 131, the determination unit 124, and the operation control unit 125. However, in this example, the load determination units 129 to 131 have functions different from the above-described functions.

[0118]

Fig. 13 is a drawing illustrating an example of the load determination unit 129. The load determination unit 129 determines the first load at a time when the duration of X minutes from the current time has elapsed. In the example illustrated in Fig. 13, the load determination unit 129 further includes an estimation unit 141, in addition to the

weather estimation unit 121, the solar radiation estimation unit 132, the load calculation unit 133, the load calculation unit 134, and the load calculation unit 135.

[0119]

In order to enable the load determination unit 129 to determine the first load after elapse of X minutes, it is necessary to input the amount of solar radiation after elapse of X minutes, the outdoor temperature after elapse of X minutes, and the outdoor humidity after elapse of X minutes to the weather estimation unit 121. It is necessary to input the outdoor temperature after elapse of X minutes and the indoor temperature after elapse of X minutes to the load calculation unit 134. The weather estimation unit 121 and the solar radiation estimation unit 132 can specify a time after elapse of X minutes on the basis of the current time from the clock 150.

[0120]

Fig. 14 is a flowchart illustrating an exemplary operation of the estimation unit 141. The estimation unit 141 estimates the amount of solar radiation after elapse of X minutes, the outdoor temperature after elapse of X minutes, and the outdoor humidity after elapse of X minutes. For example, the estimation unit 141 obtains the actual measurement value of the present amount of solar radiation measured by the pyranometer 42. The estimation unit 141 obtains the actual measurement value of the present outdoor temperature and the actual measurement value of the outdoor humidity measured by the thermo-hygrometer 43 (S801).

[0121]

Next, the estimation unit 141 obtains the estimation value of the present amount of solar radiation from a weather forecast device 6. Similarly, the estimation unit 141 obtains, from the weather forecast device 6, the estimation value of the present outdoor

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temperature and the estimation value of the outdoor humidity (S802). Further, the estimation unit 141 obtains, from the weather forecast device 6, the estimation value of the amount of solar radiation after elapse of X minutes. Similarly, the estimation unit 141 obtains, from the weather forecast device 6, the estimation value of the outdoor temperature and the estimation value of the outdoor humidity after elapse of X minutes (S803).

[0122]

Based on the information obtained from S801 to S803, the estimation unit 141 estimates the amount of solar radiation after elapse of X minutes, the outdoor temperature after elapse of X minutes, and the outdoor humidity after elapse of X minutes (S804). For example, the estimation unit 141 calculates a correction coefficient on the basis of both the actual measurement value and the estimation value, with respect to the present amount of solar radiation. The estimation unit 141 estimates the amount of solar radiation after elapse of X minutes in S804 by correcting the estimation value of the amount of solar radiation after elapse of X minutes using the calculated correction coefficient.

[0123]

Similarly, the estimation unit 141 calculates a correction coefficient on the basis of the actual measurement value and the estimation value, with respect to the present outdoor temperature. The estimation unit 141 estimates the outdoor temperature after elapse of X minutes in S804 by correcting the estimation value of the outdoor temperature after elapse of X minutes using the calculated correction coefficient. The estimation unit 141 calculates a correction coefficient on the basis of the actual measurement value and the estimation value, with respect to the present outdoor humidity.

The estimation unit 141 estimates the outdoor humidity after elapse of X minutes in S804 by correcting the estimation value of the outdoor humidity after elapse of X minutes using the calculated correction coefficient.

[0124]

In the example illustrated in Fig. 13, the weather estimation unit 121 estimates the weather after elapse of X minutes on the basis of the amount of solar radiation after elapse of X minutes, the outdoor temperature after elapse of X minutes, and the outdoor humidity after elapse of X minutes, which have been estimated by the estimation unit 141 in S804.

[0125]

The load calculation unit 134 calculates the indoor intrusion load due to the difference in temperature between the inside and outside on the basis of the outdoor temperature after elapse of X minutes estimated by the estimation unit 141 in S804. The estimation unit 141 may estimate the indoor temperature after elapse of X minutes by a method similar to the method for estimating the outdoor temperature after elapse of X minutes. In the case where the control for holding the temperature of the region A at a constant value is performed, the actual measurement value of the present indoor temperature may be used as the indoor temperature after elapse of X minutes.

[0126]

Fig. 15 is a drawing illustrating an example of the load determination unit 130. The load determination unit 130 determines the second load at the time when the duration of X minutes from the current time has elapsed. In the example illustrated in Fig. 15, the load determination unit 130 further includes the number-of-persons estimation unit

123, and an air volume estimation unit 142 in addition to the estimation unit 136, and the load calculation unit 137.

[0127]

In order to enable the load determination unit 130 to determine the second load after elapse of X minutes, it is necessary to input the outdoor temperature after elapse of X minutes, the outdoor humidity after elapse of X minutes, the indoor temperature after elapse of X minutes, and the indoor humidity after elapse of X minutes into the estimation unit 136. It is necessary to input the air volume after elapse of X minutes into the load calculation unit 137.

[0128]

As described above, the outdoor temperature after elapse of X minutes and the outdoor humidity after elapse of X minutes are estimated by the estimation unit 141. The estimation unit 141 may estimate the indoor temperature after elapse of X minutes by a method similar to the method for estimating the outdoor temperature after elapse of X minutes. The estimation unit 141 may estimate the indoor humidity after elapse of X minutes by a method similar to the method for estimating the outdoor humidity after elapse of X minutes. In the case where the control for holding the temperature of the region A at a constant value is performed, the actual measurement value of the present indoor temperature may be used as the indoor temperature after elapse of X minutes. In the case where the control for holding the humidity of the region A at a constant value is performed, the actual measurement value of the present indoor humidity may be used as the indoor humidity after elapse of X minutes. The estimation unit 136 estimates the difference in enthalpy between the inside and outside after elapse of X minutes on the

basis of the outdoor temperature and humidity after elapse of X minutes and the indoor temperature and humidity after elapse of X minutes.

[0129]

The air volume estimation unit 142 estimates the air volume after elapse of X minutes for the ventilation device 22. In the case where the air volume of the ventilation device 22 is controlled according to the number of persons D, the air volume estimation unit 142 estimates the air volume of the ventilation device 22 on the basis of the number of persons D after elapse of X minutes.

[0130]

For example, the number-of-persons estimation unit 123 performs processing similar to the processing from S106 to S109 to estimate the number of persons D after elapse of X minutes. That is, the number-of-persons estimation unit 123 obtains the actual measurement value N1 of the number of persons D at the current time from the calculation unit 362. The number-of-persons estimation unit 123 obtains the estimation value N2 of the number of persons D at the current time from the storage unit 360. The number-of-persons estimation unit 123 obtains, from the storage unit 360, the estimation value N3 of the number of persons D at the time when the duration of X minutes has elapsed from the current time.

[0131]

The number-of-persons estimation unit 123 estimates the number of persons D at the time when the duration of X minutes from the current time has elapsed on the basis of the actual measurement value N1, the estimation value N2, and the estimation value N3. As an example, the number-of-persons estimation unit 123 calculates a correction coefficient using the actual measurement value N1 and the estimation value N2. The

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number-of-persons estimation unit 123 estimates the number of persons D after elapse of X minutes by correcting the estimation value N3 using the calculated correction coefficient. The air volume estimation unit 142 estimates the air volume of the ventilation device 22 after elapse of X minutes on the basis of the number of persons D after elapse of X minutes estimated by the number-of-persons estimation unit 123.

[0132]

The load calculation unit 137 calculates the second load on the basis of the difference in enthalpy between the inside and outside after elapse of X minutes estimated by the estimation unit 136 and the air volume of the ventilation device 22 after elapse of X minutes estimated by the air volume estimation unit 142.

[0133]

Fig. 16 is a drawing illustrating an example of the load determination unit 131. The load determination unit 131 determines the third load at the time when the duration of X minutes from the current time has elapsed. In the example illustrated in Fig. 16, the load determination unit 131 further includes the number-of-persons estimation unit 123 and an electric power estimation unit 143, in addition to the heat quantity estimation unit 138, the heat quantity estimation unit 139, and the load calculation unit 140.

[0134]

In order to enable the load determination unit 131 to determine the third load after elapse of X minutes, it is necessary to input the number of persons D after elapse of X minutes to the heat quantity estimation unit 138. It is necessary to input the power consumption after elapse of X minutes to the heat quantity estimation unit 139.

[0135]

The number-of-persons estimation unit 123 performs processing similar to the processing from S106 to S109 to estimate the number of persons D after elapse of X minutes. For example, similar to the above-described example, the number-of-persons estimation unit 123 estimates the number of persons D at the time when the duration of X minutes from the current time has elapsed on the basis of the actual measurement value N1, the estimation value N2, and the estimation value N3. The estimation value N3 is an estimation value of the number of persons D at the time when the duration of X minutes from the current time has elapsed. The heat quantity estimation unit 138 estimates the heat quantity Q1 on the basis of the number of persons D after elapse of X minutes, estimated by the number-of-persons estimation unit 123.

[0136]

The electric power estimation unit 143 estimates the power consumption at the time when the duration of X minutes from the current time has elapsed. For example, the electric power estimation unit 143 obtains information about the present power consumption in the region A from the measuring device 51. Further, the electric power estimation unit 143 obtains, from the calculation unit 362, the actual measurement value N1 of the number of persons D at the current time. The electric power estimation unit 143 obtains, from the number-of-persons estimation unit 123, an estimation value N4 of the number of persons D at the time when the duration of X minutes from the current time has elapsed.

[0137]

The electric power estimation unit 143 estimates the power consumption after elapse of X minutes on the basis of the present power consumption, the actual measurement value N1, and the estimation value N4. As an example, the electric power

estimation unit 143 calculates a correction coefficient using the actual measurement value N1 and the estimation value N4. The electric power estimation unit 143 estimates the power consumption after elapse of X minutes by correcting the present power consumption using the calculated correction coefficient. The heat quantity estimation unit 139 estimates the heat quantity Q2 on the basis of the power consumption after elapse of X minutes, estimated by the electric power estimation unit 143.

[0138]

[Fourth Control]

Fig. 17 is a drawing illustrating a function of the control system required to perform the fourth control. The controller 12 includes a ventilation amount determination unit 144 and the operation control unit 125.

[0139]

The ventilation amount determination unit 144 determines a ventilation amount required for the region A. First, the ventilation amount determination unit 144 obtains information about the number of persons who are present in the region A, that is, the present number of persons D. For example, the ventilation amount determination unit 144 obtains the information about the number of persons D from the elevator facility 3. The ventilation amount determination unit 144 may obtain the actual measurement value N1 of the number of persons D at the current time from the calculation unit 362. The ventilation amount determination unit 144 may obtain the estimation value N2 of the number of persons D at the current time from the storage unit 360.

[0140]

Next, the ventilation amount determination unit 144 calculates the ventilation amount required for the region A on the basis of the present number of persons D. For

example, the ventilation amount determination unit 144 performs this calculation by multiplying a required ventilation amount per person with the number of persons D. The required ventilation amount per person is set in advance.

[0141]

The operation control unit 125 controls the ventilation device 22. The control of the ventilation device 22 is performed according to the ventilation amount determined by the ventilation amount determination unit 144.

[0142]

Fig. 17 illustrates the function for performing the ventilation control according to the present number of persons D. Fig. 18 is a drawing illustrating a ventilation control function according to the number of persons D after elapse of X minutes. In the example illustrated in Fig. 18, the controller 12 further includes the number-of-persons estimation unit 123, in addition to the ventilation amount determination unit 144 and the operation control unit 125.

[0143]

Similar to the above-described example, the number-of-persons estimation unit 123 performs processing similar to the processing from S106 to S109 to estimate the number of persons D at the time of elapse of X minutes from the current time. The ventilation amount determination unit 144 determines the ventilation amount required for the region A on the basis of the number of persons D after elapse of X minutes, estimated by the number-of-persons estimation unit 123.

[0144]

[Fifth Control]

Fig. 19 is a drawing illustrating a function of the control system required to perform the fifth control. In the example illustrated in Fig. 19, the air conditioning device 21 includes the ventilation device 22, a primary air conditioner 211, and a secondary air conditioner 212. The controller 12 includes the storage unit 120, the load determination units 129 to 131, the ventilation amount determination unit 144, an ability determination unit 145, an ability determination unit 146, a mode determination unit 147, a humidification/dehumidification determination unit 148, an allocation determination unit 149, and the operation control unit 125.

[0145]

As described above, the ventilation device 22 is a device for taking outdoor air into the region A. The primary air conditioner 211 treats the outdoor air taken in by the ventilation device 22. The primary air conditioner 211 may include the ventilation device 22, as one of the functions of the primary air conditioner 211. The primary air conditioner 211 may directly treat the outdoor air taken in by the ventilation device 22. The outdoor air from the ventilation device 22 may be taken into a space other than the region A, and then the air in this space may be treated by the primary air conditioner 211. The primary air conditioner 211 may treat only a part of the outdoor air taken in by the ventilation device 22. In the primary air conditioner 211, water may be used as a heat carrying medium, or a refrigerant such as a substitute for CFCs may be used.

[0146]

The secondary air conditioner 212 treats the outdoor air treated by the primary air conditioner 211. Further, the secondary air conditioner 212 treats the air in the region A. The secondary air conditioner 212 delivers the conditioned air to the region A. In the

secondary air conditioner 212, water may be used as a heat carrying medium, or a refrigerant such as a substitute for CFCs may be used.

[0147]

In general, a characteristic curve of the coefficient of performance (COP) of an air conditioning device depends on various factors. The factors include manufacturer, model of the device, type of heat carrying medium, and flow rate of the medium. Further, in the case of using water as the heat carrying medium, temperature difference between cold water or hot water and temperature difference at the outlet are included in the factors.

[0148]

The characteristic curve of the coefficient of performance for the primary air conditioner 211 is stored in the storage unit 120 of the controller 12. In the following description, this characteristic curve is also referred to as a first COP characteristic curve. The first COP characteristic curve is variable depending on the control parameter setting contents of the primary air conditioner 211. Therefore, it is desirable that numerous first COP characteristic curves corresponding to various setting contents are stored in the storage unit 120.

[0149]

The characteristic curve of the coefficient of performance for the secondary air conditioner 212 is stored in the storage unit 120. In the following description, this characteristic curve is also referred to as a second COP characteristic curve. The second COP characteristic curve is variable depending on the control parameter setting contents of the secondary air conditioner 212. Therefore, it is desirable that numerous second

COP characteristic curves corresponding to various setting contents are stored in the storage unit 120.

[0150]

Fig. 20 is a flowchart illustrating an exemplary operation of the control system.

Fig. 20 illustrates an example in which the control system performs the fifth control.

[0151]

Each of the load determination units 129 to 131 has the functions described in the third control. That is, the load determination unit 129 determines the first load based on the amount of solar radiation to the region A and the difference in temperature between the inside and outside of the region A (S901). The load determination unit 130 determines the second load based on the difference in enthalpy between the inside and outside of the region A and the air volume of the ventilation device 22 (S902). The load determination unit 131 determines the third load based on the quantity of heat generated by the persons in the region A and the quantity of heat generated by the equipment in the region A (S903).

[0152]

The ventilation amount determination unit 144 has the function described in the fourth control. That is, the ventilation amount determination unit 144 determines the ventilation amount required for the region A, that is, the ventilation amount according to the number of persons in the region A (S904).

[0153]

The ability determination unit 145 determines an ability required for the primary air conditioner 211 (S905). The ability determination unit 145 performs the ability determination in S905 on the basis of the first load determined by the load determination

unit 129, the second load determined by the load determination unit 130, and the ventilation amount determined by the ventilation amount determination unit 144.

[0154]

The ability determination unit 146 determines an ability required for the secondary air conditioner 212 (S906). The ability determination unit 146 performs the ability determination in S906 on the basis of the third load determined by the load determination unit 131.

[0155]

The mode determination unit 147 determines an operation mode (S907). For example, the mode determination unit 147 determines a cooling mode or a heating mode as the operation mode. The mode determination unit 147 determines the operation mode of the primary air conditioner 211 on the basis of the ability determined by the ability determination unit 145 and the ability determined by the ability determination unit 146. The mode determination unit 147 determines the operation mode of the secondary air conditioner 212 on the basis of the ability determined by the ability determination unit 145 and the ability determined by the ability determination unit 146.

[0156]

The humidification/dehumidification determination unit 148 determines a humidification amount or a dehumidification amount required for the region A (S908). For example, if humidification by the air conditioning device 21 is required, the humidification/dehumidification determination unit 148 determines the humidification amount required. If dehumidification by the air conditioning device 21 is required, the humidification/dehumidification determination unit 148 determines the dehumidification

amount required. The determination in S908 is performed on the basis of the ability determined by the ability determination unit 145 and the ability determined by the ability determination unit 146.

[0157]

The allocation determination unit 149 determines a ratio between the ability to be allocated to the primary air conditioner 211 and the ability to be allocated to the secondary air conditioner 212 (S909). The determination in S909 is performed on the basis of a determination result obtained by the mode determination unit 147, a determination result obtained by the humidification/dehumidification determination unit 148, the first COP characteristic curve, and the second COP characteristic curve.

[0158]

In S909, the allocation determination unit 149 first sums up the ability determined by the ability determination unit 145 and the ability determined by the ability determination unit 146. Further, the allocation determination unit 149 determines whether the humidification amount or dehumidification amount determined by the humidification/dehumidification determination unit 148 can be realized only by the performance of the secondary air conditioner 212 on the basis of the outdoor environmental condition measured by the thermo-hygrometer 43 or the like.

[0159]

For example, a case where the secondary air conditioner 212 has a lower humidification performance is considered. In such a case, if the humidification amount determined by the humidification/dehumidification determination unit 148 cannot be realized only by the secondary air conditioner 212, the allocation determination unit 149 determines to use both the primary air conditioner 211 and the secondary air conditioner

212 for humidification. Further, in dehumidification, it is necessary to treat the latent heat of the entire ability (sensible heat and latent heat). Therefore, in the case of performing dehumidification, it is necessary for the allocation determination unit 149 to consider the latent heat treatment ability of the primary air conditioner 211 and the latent heat treatment ability of the secondary air conditioner 212. If the sensible heat factor (SHF) varies, the COP characteristic curve varies. Therefore, it is desirable that the storage unit 120 stores a plurality of first COP characteristic curves different in sensible heat factor value. It is desirable that the storage unit 120 stores a plurality of second COP characteristic curves different in sensible heat factor value.

[0160]

Next, the allocation determination unit 149 extracts, from the storage unit 120, a first COP characteristic curve corresponding to various conditions for the primary air conditioner 211. Similarly, the allocation determination unit 149 extracts, from the storage unit 120, a second COP characteristic curve corresponding to various conditions for the secondary air conditioner 212. Then, based on the extracted first COP characteristic curve and the extracted second COP characteristic curve, the allocation determination unit 149 determines a portion to be allocated to the primary air conditioner 211 and a portion to be allocated to the secondary air conditioner 212, of the above-described summed-up ability, so that the entire COP of the air conditioning device 21 is maximized or maximized as much as possible.

[0161]

Fig. 21 is a drawing illustrating an example of the first COP characteristic curve and the second COP characteristic curve extracted by the allocation determination unit 149. In the example illustrated in Fig. 21, the entire COP of the air conditioning device

21 becomes maximum at P1. The allocation determination unit 149 determines a ratio of the ability to be allocated to the primary air conditioner 211 to the ability to be allocated to the secondary air conditioner 212, so that the primary air conditioner 211 and the secondary air conditioner 212 can operate with the ability as close to P1 as possible.

[0162]

As mentioned above, the COP characteristic curves depend on various factors. For example, a case where the secondary air conditioner 212 includes a refrigerant is considered. In such a case, the second COP characteristic curve varies as the refrigerant temperature varies. The change in refrigerant temperature has a great influence on the change in the second COP characteristic curve. Therefore, it is desirable that the storage unit 120 stores the plurality of second COP characteristic curves different in refrigerant temperature value. For example, in an air conditioner, the condensation performance can be improved by lowering the refrigerant temperature. Even when the refrigerant temperature is lowered for enabling the secondary air conditioner 212 to perform dehumidification, the allocation determination unit 149 can extract an optimum second COP characteristic curve.

[0163]

Similarly, when the primary air conditioner 211 includes a refrigerant serving as a heat carrying medium, it is desirable that the storage unit 120 stores the plurality of first COP characteristic curves different in refrigerant temperature value. When each of the primary air conditioner 211 and the secondary air conditioner 212 includes a refrigerant serving as a heat carrying medium, it is desirable that the storage unit 120 stores the plurality of first COP characteristic curves and the plurality of second COP characteristic curves, which are different in refrigerant temperature value.

[0164]

The operation control unit 125 controls the air conditioning device 21 according to a determination result obtained by the allocation determination unit 149 (S910). For example, the operation control unit 125 outputs target values of temperature, humidity, and air volume for each of the primary air conditioner 211 and the secondary air conditioner 212. If the primary air conditioner 211 includes a refrigerant, the operation control unit 125 outputs a target refrigerant temperature value for the primary air conditioner 211. If the secondary air conditioner 212 includes a refrigerant, the operation control unit 125 outputs a target refrigerant temperature value for the secondary air conditioner 212.

[0165]

Regarding the target temperature and humidity values for the secondary air conditioner 212, it is desirable to use the values determined by a user or the third control. The target temperature and humidity values for the primary air conditioner 211 can be changed arbitrarily. Regarding the target air volume value for the ventilation device 22, it is desirable to use the value corresponding to the number of persons D estimated by the first control or the value determined by the fourth control. The target refrigerant temperature value is mainly determined according to the above-mentioned latent heat treatment ability.

[0166]

When the indoor humidity is higher than the target value, dehumidification may be prioritized in the control. In such a case, for example, an instruction is output to lower the target temperature for the one having a higher COP, which is the primary air conditioner 211 or the secondary air conditioner 212. An instruction may be output so

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as to lower the refrigerant temperature for the above-mentioned one. As another example, in the case of prioritizing dehumidification by the primary air conditioner 211, and when a sufficient amount of dehumidification cannot be obtained by the primary air conditioner 211, an instruction for lowering the refrigerant temperature of the secondary air conditioner 212 may be output.

[0167]

In the fifth control, the allocation determination unit 149 determines the ratio between the ability to be allocated to the primary air conditioner 211 and the ability to be allocated to the secondary air conditioner 212. This determination is performed in consideration of the entire COP of the air conditioning device 21, based on the determination result obtained by the mode determination unit 147, the determination result obtained by the humidification/dehumidification determination unit 148, the first COP characteristic curve, and the second COP characteristic curve. Therefore, the present control system can realize appropriate air conditioning control according to the state of the region A, while taking the entire COP of the air conditioning device 21 into consideration.

[0168]

Fig. 22 is a drawing illustrating exemplary hardware resources of the controller 12. The controller 12 includes processing circuitry 60 that includes a processor 61 and a memory 62 as hardware resources. The processing circuitry 60 may include a plurality of processors 61. The processing circuitry 60 may include a plurality of memories 62.

[0169]

In the present embodiment, each unit denoted by reference numerals 120 to 149 indicates a function of the controller 12. The functions of the storage unit 120 can be

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realized by the memory 62. The functions of respective units denoted by the reference numerals 121 to 149 can be realized by software, firmware, or a combination of the software and the firmware, which is described as a program. This program is stored in the memory 62. The controller 12 causes the processor 61 (computer) to execute the program stored in the memory 62 so that the functions of respective units denoted by the reference numerals 121 to 149 can be realized.

[0170]

The processor 61 is also referred to as a central processing unit (CPU), a central processing device, a processing device, an arithmetic device, a microprocessor, a microcomputer, or a DSP. A semiconductor memory, a magnetic disk, a flexible disk, an optical disk, a compact disk, a mini disk, or a DVD can be adopted as the memory 62. The semiconductor memories adoptable include RAM, ROM, flash memory, EPROM, EEPROM and the like.

[0171]

Fig. 23 is a drawing illustrating another exemplary hardware resources of the controller 12. In the example illustrated in Fig. 23, the controller 12 includes the processing circuitry 60 that includes dedicated hardware 63 in addition to the processor 61 and the memory 62. Fig. 23 illustrates an example in which a part of the functions of the controller 12 is realized by the dedicated hardware 63. The whole of the functions of the controller 12 may be realized by the dedicated hardware 63. A single circuit, a composite circuit, a programmed processor, a parallel programmed processor, an ASIC, an FPGA, or a combination thereof can be adopted as the dedicated hardware 63.

[0172]

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The hardware resources of the number-of-persons management device 36 are similar to the example illustrated in Fig. 22 or Fig. 23. The number-of-persons management device 36 has processing circuitry including a processor and a memory that serve as hardware resources. The number-of-persons management device 36 causes the processor to execute a program stored in the memory so as to realize the functions of respective units denoted by the reference numerals 361 to 363. The number-of-persons management device 36 may have processing circuitry including a processor, a memory, and dedicated hardware that serve as hardware resources. A part of the whole of the functions of the number-of-persons management device 36 may be realized by the dedicated hardware.

Industrial Applicability

[0173]

The control system according to the present disclosure is applicable to a system including an air conditioning device.

Reference Signs List

[0174]

1 management operation facility, 2 air conditioning facility, 3 elevator facility, 4 environment measurement facility, 5 electric power measurement facility, 6 weather forecast device, 11 display device, 12 controller, 21 air conditioning device, 211 primary air conditioner, 212 secondary air conditioner, 22 ventilation device, 31 communication device, 32 group control panel, 33 control panel, 34 traction machine, 35 car, 36 number-of-persons management device, 37

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weighing device, 41 input/output device, 42 pyranometer 43-44
thermo-hygrometer 45 CO₂ densitometer, 51 measuring device, 52
lighting board, 53 power board, 54 solar power generator, 60
processing circuitry, 61 processor, 62 memory, 63 dedicated
hardware, 120 storage unit, 121 weather estimation unit, 122 time
determination unit, 123 number-of-persons estimation unit, 124
determination unit, 125 operation control unit, 126 determination unit,
127 detection unit, 128 creation unit, 129-131 load determination unit,
132 solar radiation estimation unit, 133-135 load calculation unit, 136
estimation unit, 137 load calculation unit, 138-139 heat quantity
estimation unit, 140 load calculation unit, 141 estimation unit, 142
air volume estimation unit, 143 electric power estimation unit, 144
ventilation amount determination unit, 145-146 ability determination unit,
147 mode determination unit, 148 humidification/dehumidification
determination unit 149 allocation determination unit, 150 clock, 360
storage unit, 361 detection unit, 362 calculation unit, 363 learning
unit

CLAIMS**[Claim 1]**

A control system comprising:

an air conditioning device for delivering conditioned air to a specific region; and

a controller that controls the air conditioning device,

the controller including:

a time determination unit configured to determine, on the basis of present weather, a time lag from activation of the air conditioning device until stabilization in temperature of the region at a target temperature;

a number-of-persons estimation unit configured to estimate the number of persons in the region at a time when the time lag determined by the time determination unit has elapsed;

a determination unit configured to determine whether to activate the air conditioning device on the basis of the number of persons estimated by the number-of-persons estimation unit; and

an operation control unit configured to activate the air conditioning device according to a determination result obtained by the determination unit.

[Claim 2]

The control system according to claim 1, wherein

the determination unit determines whether the number of persons estimated by the number-of-persons estimation unit is greater than a first reference value, and

the operation control unit activates the air conditioning device when the determination unit determines that the number of persons estimated by the number-of-persons estimation unit is greater than the first reference value.

[Claim 3]

A control system comprising:

an air conditioning device for delivering conditioned air to a specific region; and

a controller that controls the air conditioning device,

the controller including:

a time determination unit configured to determine, on the basis of present weather, a time lag from change of parameter setting content for controlling the air conditioning device until stabilization in temperature of the region at a target temperature;

a number-of-persons estimation unit configured to estimate the number of persons in the region at a time when the time lag determined by the time determination unit has elapsed;

a determination unit configured to determine whether to change the setting content on the basis of the number of persons estimated by the number-of-persons estimation unit; and

an operation control unit configured to change the setting content according to a determination result obtained by the determination unit.

[Claim 4]

The control system according to claim 3, wherein

the determination unit determines whether the number of persons estimated by the number-of-persons estimation unit is less than a second reference value, and

the operation control unit changes the setting content from a first content to a second content, when the determination unit determines that the number of persons estimated by the number-of-persons estimation unit is less than the second reference value.

[Claim 5]

The control system according to claim 4, wherein

the determination unit determines whether the number of persons estimated by the number-of-persons estimation unit is greater than a third reference value,

the third reference value is greater than the second reference value, and

the operation control unit changes the setting content to the first content when the determination unit determines that the number of persons estimated by the number-of-persons estimation unit is greater than the third reference value, after changing the setting content to the second content.

[Claim 6]

The control system according to any one of claims 1 to 5, wherein

the number-of-persons estimation unit estimates the number of persons in the region on the basis of an actual measurement value at a current time, a first estimation value at the current time, and a second estimation value at the time when the time lag determined by the time determination unit has elapsed, and

the number-of-persons estimation unit obtains the first estimation value and the second estimation value from an elevator facility that can carry passengers to a floor where the region is located.

[Claim 7]

The control system according to claim 6, wherein the number-of-persons estimation unit calculates a correction coefficient using the actual measurement value and the first estimation value, and estimates the number of persons in the region by correcting the second estimation value using the correction coefficient.

[Claim 8]

The control system according to any one of claims 1 to 7, wherein
the controller further includes a weather estimation unit configured to estimate the
present weather on the basis of a present amount of solar radiation, and
the time determination unit determines the time lag on the basis of the weather
estimated by the weather estimation unit.

[Claim 9]

A control system comprising:
an air conditioning device for delivering conditioned air to a specific region;
a ventilation device for supplying outdoor air to the region and discharging air in
the region to the outside; and
a controller that controls the air conditioning device,
the controller including:
a first load determination unit configured to determine a first load based on an
amount of solar radiation to the region and a difference in temperature between an inside
and an outside of the region;
a second load determination unit configured to determine a second load based on a
difference in enthalpy between the inside and the outside of the region and an air volume
of the ventilation device;
a third load determination unit configured to determine a third load based on a
quantity of heat generated by persons in the region and a quantity of heat generated by
equipment in the region;
a determination unit configured to determine parameter setting content for
controlling the air conditioning device, on the basis of the first load determined by the
first load determination unit, the second load determined by the second load

determination unit, and the third load determined by the third load determination unit;
and

an operation control unit configured to change the setting content according to a determination result obtained by the determination unit.

[Claim 10]

The control system according to claim 9, wherein
the determination unit
calculates a first change amount in indoor enthalpy and a second change amount in outdoor enthalpy, within a specific first time,
determines whether the first change amount is equal to or greater than a fourth reference value,
determines whether the second change amount is equal to or greater than a fifth reference value, and
starts processing for determining the setting content when the first change amount is equal to or greater than the fourth reference value, or when the second change amount is equal to or greater than the fifth reference value.

[Claim 11]

The control system according to claim 10, wherein when the first change amount becomes smaller than the fourth reference value and the second change amount becomes smaller than the fifth reference value, after starting the processing for determining the setting content, the determination unit terminates the processing.

[Claim 12]

The control system according to any one of claims 9 to 11, wherein

the first load determination unit determines the first load at a time when a specific second time has elapsed,

the second load determination unit determines the second load at the time when the second time has elapsed, and

the third load determination unit determines the third load at the time when the second time has elapsed.

[Claim 13]

The control system according to claim 12, wherein

the third load determination unit includes a number-of-persons estimation unit configured to estimate the number of persons in the region at the time when the second time has elapsed,

the number-of-persons estimation unit estimates the number of persons in the region on the basis of an actual measurement value at a current time, a first estimation value at the current time, and a second estimation value at the time when the second time has elapsed, and

the number-of-persons estimation unit obtains the first estimation value and the second estimation value from an elevator facility that can carry passengers to a floor where the region is located.

[Claim 14]

The control system according to claim 13, wherein the number-of-persons estimation unit calculates a correction coefficient using the actual measurement value and the first estimation value, and estimates the number of persons in the region by correcting the second estimation value using the correction coefficient.

[Claim 15]

A control system comprising:

an air conditioning device for delivering conditioned air to a specific region; and

a controller that controls the air conditioning device,

the air conditioning device including:

a ventilation device for taking outdoor air into the region;

a primary air conditioner for treating the outdoor air taken in by the ventilation device; and

a secondary air conditioner for treating the outdoor air treated by the primary air conditioner and air in the region,

the controller including:

a mode determination unit configured to determine an operation mode of the primary air conditioner and an operation mode of the secondary air conditioner on the basis of a first ability required for the primary air conditioner and a second ability required for the secondary air conditioner;

a humidification/dehumidification determination unit configured to determine a humidification amount or a dehumidification amount required for the region on the basis of the first ability and the second ability;

an allocation determination unit configured to determine a portion to be allocated to the primary air conditioner and a portion to be allocated to the secondary air conditioner, of a sum of the first ability and the second ability, on the basis of a determination result obtained by the mode determination unit, a determination result obtained by the humidification/dehumidification determination unit, a first COP characteristic curve of the primary air conditioner, and a second COP characteristic curve of the secondary air conditioner; and

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an operation control unit configured to control the air conditioning device according to a determination result obtained by the allocation determination unit.

[Claim 16]

The control system according to claim 15, wherein

the controller further includes:

a first load determination unit configured to determine a first load based on an amount of solar radiation to the region and a difference in temperature between an inside and an outside of the region,

a second load determination unit configured to determine a second load based on a difference in enthalpy between the inside and the outside of the region and an air volume of the ventilation device,

a third load determination unit configured to determine a third load based on a quantity of heat generated by persons in the region and a quantity of heat generated by equipment in the region,

a ventilation amount determination unit configured to determine a ventilation amount according to the number of persons in the region,

a first ability determination unit configured to determine the first ability on the basis of the first load determined by the first load determination unit, the second load determined by the second load determination unit, and the ventilation amount determined by the ventilation amount determination unit, and

a second ability determination unit configured to determine the second ability on the basis of the third load determined by the third load determination unit.

[Claim 17]

The control system according to claim 15 or 16, wherein the controller further includes a storage unit configured to store a plurality of first COP characteristic curves different in sensible heat factor value and a plurality of second COP characteristic curves different in sensible heat factor value.

[Claim 18]

The control system according to claim 15 or 16, wherein
the primary air conditioner includes a refrigerant serving as a heat carrying medium, and
the controller further includes a storage unit configured to store a plurality of first COP characteristic curves different in temperature value of the refrigerant.

[Claim 19]

The control system according to claim 15 or 16, wherein
the secondary air conditioner includes a refrigerant serving as a heat carrying medium, and
the controller further includes a storage unit configured to store a plurality of second COP characteristic curves different in temperature value of the refrigerant.