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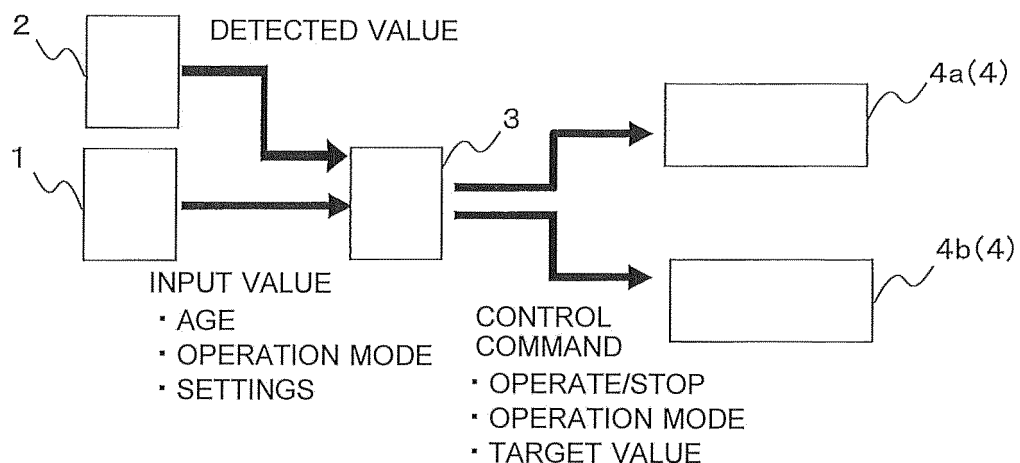
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(54) **AIR CONDITIONING SYSTEM**

(57) An air-conditioning system includes an input unit that receives at least information on a human body factor, which is an element for identifying a person, and an operation mode, a plurality of variable devices that changes at least one environmental factor, which is an element

for identifying an environment, and a control unit that controls the plurality of variable devices based on the information received from the input unit and that causes a plurality of the environmental factors to be within a comfort range.

**FIG. 1**



## Description

## Summary of Invention

## Technical Field

## Technical Problem

**[0001]** The present invention relates to an air-conditioning system that controls an environmental factor variable device to perform air-conditioning.

## Background Art

**[0002]** There have been conventional air-conditioning systems that include an input unit capable of receiving at least one of information on a human body factor (age, body height, body weight, sex, past medical history, amount of clothing, amount of work, tiredness, etc.) determining the comfort of a user, information on the user's life pattern and time, and information on the building (cooling and heating loads, ventilation frequency, geometric factors, location conditions, etc.), an environmental factor detection unit that detects at least one of environmental factors (temperature, humidity, radiation temperature, air velocity, amount of light, sound volume, amount of airborne dust, and concentration of a specific gas) determining the comfort of the user, an integrated circuit (IC) card that calculates and stores a target value from a signal from the input unit and a signal from the environmental factor detection unit, an environmental factor variable device that has at least one of, for example, a heating element, a heat absorber, a fan, a dehumidifier or a humidifier, a light source, a sound source, a dust remover, and an absorber or generator of a particular gas, a control unit that controls the environmental factor variable device by the difference between the detection signal from the environmental factor detection unit and the target value stored in the IC card, and a mediation unit that enables attachment and removal of the IC card and mediates communication between the input unit, the environmental factor detection unit, the control unit and the IC card (see, for example, Patent Literature 1).

**[0003]** Patent Literature 1 described that the target value is calculated with the IC card based on the signal from the input unit and the signal from the environmental factor detection unit, the value is stored in the IC card, and the control unit controls the environmental factor variable device according to the difference between the signal from the environmental factor detection unit and the target value stored in the IC card, thereby controlling the environment to be comfortable.

## Citation List

## Patent Literature

**[0004]** Patent Literature 1: Japanese Patent Publication No. H08-16538

**[0005]** To achieve comfort of an environment, a need may arise, for example, for a plurality of environmental factors such as an air temperature and a radiation temperature to be controlled within a comfort range. Unfortunately, Patent Literature 1 describes that only one environmental factor variable device is controlled, so that the plurality of environmental factors cannot be controlled within the comfort range, resulting in comfort being impaired.

**[0006]** The present invention has been made to solve the above problem and it is an object of the present invention to provide an air-conditioning system that is capable of improving comfort without impairing the same.

## Solution to Problem

**[0007]** An air-conditioning system according to the present invention includes an input unit that receives at least information on a human body factor, which is an element for identifying a person, and an operation mode, a plurality of variable devices each of which changes an environmental factor, which is an element for identifying an environment, and a control unit that controls the plurality of variable devices based on the information received at the input unit and causes a plurality of the environmental factors to be within a comfort range.

## Advantageous Effects of Invention

**[0008]** The air-conditioning system according to the present invention is capable of controlling a plurality of environmental factors within a comfort range by controlling a plurality of variable devices, and can thus improve comfort without impairing the same. Brief Description of Drawings

**[0009]**

[Fig. 1] Fig. 1 is a block diagram of an air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a diagram showing an initial registration screen displayed on a display unit of a console display terminal of the air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a diagram showing an operation mode selection screen displayed on the display unit of the console display terminal of the air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a diagram showing a heating mode screen displayed on the display unit of the console display terminal of the air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 is a diagram showing the relationship

between floor temperature, air temperature, and comfort ranges depending on age of the air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 6] Fig. 6 is a diagram illustrating a method of determining target values for the air temperature and the floor temperature of the air-conditioning system according to Embodiment 1 of the present invention.

[Fig. 7] Fig. 7 is a block diagram of the air-conditioning system according to Embodiment 2 of the present invention.

[Fig. 8] Fig. 8 is a diagram showing the relationship between wall temperature, air temperature, and comfort ranges depending on age of the air-conditioning system according to Embodiment 2 of the present invention.

[Fig. 9] Fig. 9 is a block diagram of the air-conditioning system according to Embodiment 3 of the present invention.

[Fig. 10] Fig. 10 is a diagram showing the relationship between air temperature, absolute humidity, and comfort ranges depending on sex of the air-conditioning system according to Embodiment 3 of the present invention.

[Fig. 11] Fig. 11 is a block diagram of the air-conditioning system according to Embodiment 4 of the present invention.

[Fig. 12] Fig. 12 is a diagram showing the relationship between air temperature, absolute humidity, and comfort ranges depending on sex of the air-conditioning system according to Embodiment 4 of the present invention.

[Fig. 13] Fig. 13 is a block diagram of the air-conditioning system according to Embodiment 5 of the present invention.

[Fig. 14] Fig. 14 is a diagram showing the relationship between wind velocity, dust concentration, and comfort ranges depending on physical constitution of the air-conditioning system according to Embodiment 5 of the present invention. Description of Embodiments

**[0010]** The embodiments of the present invention will now be described with reference to the drawings. It should be noted that the present invention is not limited to the embodiments described below. In the drawings below, the dimensional relationships between each of the components may vary from actual relationships. The following "user(s)" are those who use the air-conditioning system. The following "current user(s)" are people who are about to use or are using the air-conditioning system among the users.

Embodiment 1.

**[0011]** Fig. 1 is a block diagram of an air-conditioning system according to Embodiment 1 of the present invention. The air-conditioning system according to Embodi-

ment 1 is for air-conditioning a space to be air-conditioned and includes a console display terminal 1, an environmental factor detection unit 2, an information collection unit 3, and a plurality of environmental factor variable devices 4. Air-conditioning herein includes, for example, heating, cooling, dehumidification, humidification, and air purification.

**[0012]** The console display terminal 1 is a communication device having a display unit and an input unit and into which are entered information on a human body factor that determines the comfort of a user and is an element identifying a person, that is, for example, age, body height, body weight, sex, past medical history, amount of clothing, amount of work, and tiredness, information on the user's life pattern and time, and information on the building such as cooling and heating loads, ventilation frequency, geometric factors, and location conditions. The console display terminal 1 is, for example, a tablet, a remote control, a mobile phone, a smartphone, a personal computer, a television, or a car navigation system.

**[0013]** The console display terminal 1 corresponds to an "input unit" and a "display unit" of the present invention.

**[0014]** The environmental factor detection unit 2, singularly or in plurality, detects one or more environmental factors that determine the comfort of the user and are elements identifying an environment, that is, for example, temperature, humidity, radiation temperature, air velocity, amount of light, sound volume, amount of airborne dust, and concentration of a specific gas. The environmental factor detection unit 2 may be a built-in sensor in the environmental factor variable devices 4.

**[0015]** The environmental factor detection unit 2 corresponds to a "detection unit" of one embodiment of the present invention.

**[0016]** The information collection unit 3 has a storage unit and a control unit, and the storage unit stores information on a comfort range corresponding to an environmental factor for each human body factor. Comfort range herein is the range of an environmental factor predetermined as being capable of maintaining a comfortable environment for the user. In Embodiment 1, the storage unit stores at least the information on the comfort range corresponding to an air temperature and a floor temperature for each age (age group).

**[0017]** An optimum comfort range is selected based on the information from the console display terminal 1, and a value within that comfort range is determined as a target value. Each environmental factor variable device 4 is controlled according to the difference between this target value and a value detected by the environmental factor detection unit 2 so that the value detected by the environmental factor detection unit 2 reaches the target value.

**[0018]** The information collection unit 3 corresponds to a "control unit" and a "storage unit" of one embodiment of the present invention.

**[0019]** The environmental factor variable devices 4 are

devices for changing the environmental factors, such as a room air conditioner, a floor heating, a radiant cooling panel, a dehumidifier, a humidifier, or an air purifier. In Embodiment 1, the plurality of environmental factor variable devices 4 includes at least a room air conditioner 4a that mainly changes the air temperature and a floor heating 4b that mainly changes the floor temperature.

[0020] The environmental factor variable devices 4 correspond to "variable devices" of one embodiment of the present invention.

[0021] In this configuration, various information including the human body factor and an operation mode are entered into the console display terminal 1 by a (current) user, and when a plurality of current environmental factors in the air-conditioned space is detected by the environmental factor detection unit 2, the information collection unit 3 refers to the comfort range in the storage unit based on the information from the console display terminal 1 and the information from the environmental factor detection unit 2, whereby values of the plurality of environmental factors that satisfy the comfort of the current user are set as target values. The plurality of environmental factor variable devices 4 are controlled according to differences between these target values and the values detected by the environmental factor detection unit 2 to keep the environment comfortable.

[0022] Fig. 2 is a diagram showing an initial registration screen displayed on a display unit of the console display terminal 1 of the air-conditioning system according to Embodiment 1 of the present invention, Fig. 3 is a diagram showing an operation mode selection screen displayed on the display unit of the console display terminal 1 of the air-conditioning system according to Embodiment 1 of the present invention, and Fig. 4 is a diagram showing a heating mode screen displayed on the display unit of the console display terminal 1 of the air-conditioning system according to Embodiment 1 of the present invention.

[0023] A method of operation of the console display terminal 1 when performing an automatic operation mode of the air-conditioning system according to Embodiment 1 will now be described.

[0024] The air-conditioning system according to Embodiment 1 is provided with the automatic operation mode, which is a mode for automatically controlling the environmental factor variable devices 4 so that the environment is comfortable for the current user. This automatic operation mode may be set at an initial setting or may be set for each operation of the air-conditioning system.

[0025] When the automatic operation mode is selected, the initial registration screen shown in Fig. 2 is displayed on the display unit of the console display terminal 1 and a parameter of the human body factor that determines the comfort of the user is entered according to the screen to register the parameter of the human body factor. In Embodiment 1, ages of three users, A, B, and C are registered as shown in Fig. 2. The registered information on the human body factor is stored in the storage

unit of the information collection unit 3.

[0026] A predetermined default value may be set for the parameter of the human body factor of the user prior to the initial registration. The initial registration screen shown in Fig. 2 may be hidden when the initial registration has already been completed, and the next screen may be displayed.

[0027] The operation mode selection screen as shown in Fig. 3 is then displayed, and the operation mode is selected. In Embodiment 1, "heating" mode is selected. In Embodiment 1, the types of operation modes include, but are not limited to, "heating," "cooling," "dehumidification," "humidification," and "air purification" as shown in Fig. 3. Other modes may be provided, or there may be less modes.

[0028] When the "heating" mode is selected, the heating mode screen as shown in Fig. 4 is displayed. For the control unit, the value(s) of the environmental factor(s) that satisfy the comfort of the current user are set as the target value(s) based on the registered information on the human body factor and the information on the environmental factors detected by the environmental factor detection unit 2.

[0029] In Embodiment 1, the environmental factors are the air temperature and the floor temperature, and as shown in Fig. 4, the target values for the air temperature and the floor temperature are set respectively to 20 degrees C and 28 degrees C to satisfy the comfort of the current user.

[0030] It should be noted that a water temperature of the floor heating 4b, not the floor temperature, may be set. Additionally, although in Fig. 4, images of the environmental factor variable devices 4 to be operated, the air temperature, and the floor temperature are displayed, other elements such as information detected by the environmental factor detection unit 2 may also be displayed. The set target values may also be changed by the current user.

[0031] Fig. 5 is a diagram showing the relationship between the floor temperature, air temperature, and comfort ranges depending on age of the air-conditioning system according to Embodiment 1 of the present invention. The fine line in Fig. 5 indicates the change in the air temperature and the floor temperature when the room air conditioner 4a is controlled alone, and the bold lines therein indicate the changes in the air temperature and the floor temperature when the room air conditioner 4a and the floor heating 4b are controlled.

[0032] In Embodiment 1, the target values for the air temperature and the floor temperature are determined by priority based on age. As shown in Fig. 5, the comfort range of the air temperature and the floor temperature is different depending on age, requiring the target values for the air temperature and the floor temperature to be determined according to the age of the current user.

[0033] When the current user is young or all current users are young, values in the comfort range for the young are determined as the target values, and when

the current user is old or all current users are old, values in the comfort range for the old are determined as the target values. When the current users include both a young person and an old person, an order of priority is determined in advance, and according to the priority, the values in the comfort range of the higher priority are determined as the target values.

**[0034]** In Embodiment 1, people in their thirties are young and people in their seventies are old.

**[0035]** As a method for identifying the current user, for example, the current user may be entered for each operation of the air-conditioning system, the current user may be identified based on the life patterns (time table) of each user set in advance by the user, or the current user may be identified by a person detection unit (image sensor, infrared sensor, etc.) that is unitary or a person detection unit incorporated into the environmental factor variable devices 4.

**[0036]** The method for identifying the current user is not limited to those described above.

**[0037]** When the room air conditioner 4a, which is one of the environmental factor variable devices 4, is controlled alone, the air temperature and the floor temperature can only be changed along the fine line shown in Fig. 5. In contrast, when the room air conditioner 4a and the floor heating 4b, which are the environmental factor variable devices 4, are controlled, the air temperature and floor temperature can be changed along the bold lines shown in Fig. 5. The comfort range for when the plurality of environmental factor variable devices 4 are controlled is thus greater than the comfort range for when a single environmental factor variable device 4 is controlled. Consequently, controlling the plurality of environmental factor variable devices 4 as in Embodiment 1 facilitates control of the environmental factors within the comfort range.

**[0038]** According to the differences between the target values determined as above and the values detected by the environmental factor detection unit 2, the room air conditioner 4a and the floor heating 4b, which are the environmental factor variable devices 4, are controlled so that the air temperature and the floor temperature detected by the environmental factor detection unit 2 both reach the target values. This ensures that the current user obtains a comfortable environment.

**[0039]** Fig. 6 is a diagram illustrating a method of determining the target values for the air temperature and the floor temperature of the air-conditioning system according to Embodiment 1 of the present invention.

**[0040]** In Embodiment 1, the room air conditioner 4a and the floor heating 4b are controlled, but since the room air conditioner 4a has a better operating efficiency compared with the floor heating 4b, energy can be saved by keeping the environment comfortable by increasing an operating ratio of the room air conditioner 4a as much as possible.

**[0041]** Points P in Fig. 6 indicate current air temperatures and floor temperatures (i.e., initial states) of the air-conditioned space detected by the environmental factor

detection unit 2, point Q indicates a position at which the operating ratio of the room air conditioner 4a is the highest within the comfort range, and point R indicates a position at which the operating ratio of the room air conditioner 4a is the lowest within the comfort range.

**[0042]** When a floor temperature Tf0 of initial state point P is less than a floor temperature Tf1 of point Q, the target point is point Q. Although it is necessary to operate both the floor heating 4b and the room air conditioner 4a, the operating ratio of the room air conditioner 4a can be increased as much as possible by setting the target to point Q, thereby saving energy.

**[0043]** When the floor temperature Tf0 of the initial state point P is equal to or higher than a floor temperature Tf2 of point R, the target point is point R. Since the floor temperature is already high, there is no need to operate the floor heating 4b, and heating only to a minimum necessary air temperature Ta1 is required by the room air conditioner 4a alone. Setting the target point to point R thus enables a comfortable state to be achieved by minimum power consumption.

**[0044]** When the floor temperature Tf0 of the initial state point P is equal to or higher than Tf1 and less than Tf2, the target point is set to between point Q and point R. For instance, the floor temperature of target point S is kept at the same temperature as the floor temperature Tf0 of the initial state and only the air temperature is raised. This eliminates the need of the floor heating 4b and only the room air conditioner 4a is operated, thus achieving comfort with minimum power consumption.

**[0045]** As described above, the air-conditioning system according to Embodiment 1 is capable of improving comfort without impairing the same since the plurality of environmental factors can be easily controlled within the comfort range by controlling the plurality of environmental factor variable devices 4.

**[0046]** Energy savings can also be achieved by determining the target values of the environmental factors such that the operating ratio of the environmental factor variable device 4 with greater power consumption among the plurality of environmental factor variable devices 4 is reduced.

**[0047]** Although Embodiment 1 uses predetermined values for the comfort range, it should not be limited thereto, and a learning function may be provided to change the values based on the user's past use.

**[0048]** For instance, if the user always sets a higher temperature in the heating mode, the comfort range may be changed to a value higher than the predetermined value, and conversely, if the user always sets a lower temperature, the comfort range may be changed to a value lower than the predetermined value.

Embodiment 2.

**[0049]** Embodiment 2 will now be described, but components identical to those of Embodiment 1 are not described and identical reference characters are used to

refer to the same or equivalent parts as Embodiment 1.

**[0050]** Fig. 7 is a block diagram of the air-conditioning system according to Embodiment 2 of the present invention, and Fig. 8 is a diagram showing the relationship between wall temperature, air temperature, and comfort ranges depending on age of the air-conditioning system according to Embodiment 2 of the present invention. The fine line in Fig. 8 indicates the change in the air temperature and the wall temperature when the room air conditioner 4a is controlled alone, and the bold lines therein indicate the changes in the air temperature and the wall temperature when the room air conditioner 4a and a radiant cooling panel 4c are controlled.

**[0051]** In Embodiment 2, as shown in Fig. 7, the plurality of environmental factor variable devices 4 includes at least the room air conditioner 4a that mainly changes the air temperature and the radiant cooling panel 4c that mainly changes the wall temperature. "Cooling" mode is selected as the operation mode.

**[0052]** In Embodiment 2, the target values for the air temperature and the wall temperature are determined by priority based on age. As shown in Fig. 8, the comfort range of the air temperature and the wall temperature is different depending on age, requiring the target values for the air temperature and the wall temperature to be determined according to the age of the current user.

**[0053]** When the current user is young or all the current users are young, values in the comfort range for the young are determined as the target values, and when the current user is old or all the current users are old, values in the comfort range for the old are determined as the target values. When the current users include both a young person and an old person, an order of priority is determined in advance, and according to the priority, values in the comfort range of the higher priority are determined as the target values.

**[0054]** In Embodiment 2, people in their thirties are young and people in their seventies are old.

**[0055]** According to the differences between the target values determined as above and the values detected by the environmental factor detection unit 2, the room air conditioner 4a and the radiant cooling panel 4c, which are the environmental factor variable devices 4, are controlled so that the environment is comfortable.

#### Embodiment 3.

**[0056]** Embodiment 3 will now be described, but elements overlapping with those of Embodiment 1 are omitted and identical reference characters are used to refer to the same or equivalent parts as Embodiment 1.

**[0057]** Fig. 9 is a block diagram of the air-conditioning system according to Embodiment 3 of the present invention, and Fig. 10 is a diagram showing the relationship between absolute humidity, air temperature, and comfort ranges depending on sex of the air-conditioning system according to Embodiment 3 of the present invention. The fine line in Fig. 10 indicates the change in the absolute

humidity and the air temperature when the room air conditioner 4a is controlled alone, and the bold lines therein indicate the changes in the absolute humidity and the air temperature when the room air conditioner 4a and a dehumidifier 4d are controlled.

**[0058]** In Embodiment 3, as shown in Fig. 9, the plurality of environmental factor variable devices 4 includes at least the room air conditioner 4a that mainly changes the air temperature and the dehumidifier 4d that mainly changes the absolute humidity. "Dehumidification" mode is selected as the operation mode. The room air conditioner 4a may be the radiant cooling panel 4c instead.

**[0059]** In Embodiment 3, the target values for the absolute humidity and the air temperature are determined by priority based on sex. As shown in Fig. 10, the comfort range of the absolute humidity and the air temperature is different depending on sex, requiring the target values for the absolute humidity and the air temperature to be determined according to the sex of the current user.

**[0060]** When the current user is a woman or all the current users are women, values in the comfort range for women are determined as the target values, and when the current user is a man or all the current users are men, values in the comfort range for men are determined as the target values. When the current users include both a woman and a man, an order of priority is determined in advance, and according to the priority, values in the comfort range of the higher priority are determined as the target values.

**[0061]** According to the differences between the target values determined as above and the values detected by the environmental factor detection unit 2, the room air conditioner 4a and the dehumidifier 4d, which are the environmental factor variable devices 4, are controlled so that the environment is comfortable.

**[0062]** In Embodiment 3, as shown in Fig. 10, it is not possible to bring both of the absolute humidity and the air temperature to values within the comfort range by controlling the room air conditioner 4a alone.

#### Embodiment 4.

**[0063]** Embodiment 4 will now be described, but elements overlapping with those of Embodiment 1 are omitted and identical reference characters are used to refer to the same or equivalent parts as Embodiment 1.

**[0064]** Fig. 11 is a block diagram of the air-conditioning system according to Embodiment 4 of the present invention, and Fig. 12 is a diagram showing the relationship between absolute humidity, air temperature, and comfort ranges depending on sex of the air-conditioning system according to Embodiment 4 of the present invention. The fine line in Fig. 12 shows the change in the absolute humidity and the air temperature when the room air conditioner 4a is controlled alone, and the bold lines therein show the changes in the absolute humidity and the air temperature when the room air conditioner 4a and a humidifier 4e are controlled.

**[0065]** In Embodiment 4, as shown in Fig. 11, the plurality of environmental factor variable devices 4 includes at least the room air conditioner 4a that mainly changes the air temperature and the humidifier 4e that mainly changes the absolute humidity. "Humidification" mode is selected as the operation mode. The room air conditioner 4a may be the floor heating 4b instead.

**[0066]** In Embodiment 4, the target values for the absolute humidity and the air temperature are determined by priority based on sex. As shown in Fig. 12, the comfort range of the absolute humidity and the air temperature is different depending on sex, requiring the target values for the absolute humidity and the air temperature to be determined according to the sex of the current user.

**[0067]** When the current user is a woman or all current users are women, values in the comfort range for women are determined as the target values, and when the current user is a man or all current users are men, values in the comfort range for men are determined as the target values. When the current users include both a woman and a man, an order of priority is determined in advance, and according to the priority, values in the comfort range of the higher priority are determined as the target values.

**[0068]** According to the differences between the target values determined as above and the values detected by the environmental factor detection unit 2, the room air conditioner 4a and the humidifier 4e, which are the environmental factor variable devices 4, are controlled so that the environment is comfortable.

**[0069]** In Embodiment 4, as shown in Fig. 12, it is not possible to bring both of the absolute humidity and the air temperature to values within the comfort range by controlling the room air conditioner 4a alone.

#### Embodiment 5.

**[0070]** Embodiment 5 will now be described, but elements overlapping with those of Embodiment 1 are omitted and identical reference characters are used to refer to the same or equivalent parts as Embodiment 1.

**[0071]** Fig. 13 is a block diagram of the air-conditioning system according to Embodiment 5 of the present invention, and Fig. 14 is a diagram showing the relationship between wind velocity, dust concentration, and comfort ranges depending on physical constitution of the air-conditioning system according to Embodiment 5 of the present invention. The fine line in Fig. 14 indicates the change in the dust concentration and the wind velocity when the room air conditioner 4a is controlled alone, and the bold lines therein indicate the changes in the dust concentration and the wind velocity when the room air conditioner 4a and an air purifier 4f are controlled.

**[0072]** In Embodiment 5, as shown in Fig. 13, the plurality of environmental factor variable devices 4 includes at least the room air conditioner 4a that mainly changes the wind velocity (sense of air flow, noise) and the air purifier 4f that mainly changes the dust concentration. "Air purification" mode is selected as the operation mode.

**[0073]** In Embodiment 5, the target values for the wind velocity and the dust concentration are determined by priority based on physical constitution. As shown in Fig. 14, the comfort range of the wind velocity and the dust concentration is different depending on the physical constitution, requiring the target values for the wind velocity and the dust concentration to be determined according to the physical constitution of the current user.

**[0074]** When the current user does not have hay fever or none of the current users have hay fever, values in the comfort range for people without hay fever are determined as the target values, and when the current user has hay fever or all of the current users have hay fever, values in the comfort range for people with hay fever are determined as the target values. When the current users include both a person without hay fever and a person with hay fever, an order of priority is determined in advance, and according to the priority, values in the comfort range of the higher priority are determined as the target values.

**[0075]** According to the differences between the target values determined as above and the values detected by the environmental factor detection unit 2, the room air conditioner 4a and the air purifier 4f, which are the environmental factor variable devices 4, are controlled so that the environment is comfortable.

**[0076]** While Embodiments 1 to 5 have been described with reference to keeping the environment comfortable by controlling two environmental factor variable devices 4, the combinations of the two environmental factor variable devices 4 are not limited to those of the combinations of Embodiments 1 to 5 and any suitable combination may be used.

**[0077]** While Embodiments 1 to 5 have been described with reference to keeping the environment comfortable by controlling two environmental factor variable devices 4 to control two environmental factors within the comfort range, they should not be limited thereto, and the environment may be kept comfortable by controlling two or more (for example, three) environmental factor variable devices 4 to control two or more (for example, three) environmental factors within the comfort range.

#### Reference Signs List

#### **[0078]**

1 console display terminal 2 environmental factor detection unit 3 information collection unit 4 environmental factor variable device 4a room air conditioner 4b floor heating 4c radiant cooling panel 4d dehumidifier 4e humidifier 4f air purifier

#### **Claims**

1. An air-conditioning system comprising:

- an input unit configured to receive at least information on a human body factor and an operation mode, the human body factor being an element for identifying a person;  
 a plurality of variable devices configured to change at least one environmental factor, which is an element for identifying an environment; and  
 a control unit configured to control the plurality of variable devices based on the information received from the input unit and cause a plurality of the environmental factors to be within a comfort range.
2. The air-conditioning system of claim 1, further comprising a detection unit configured to detect an environmental factor, and  
 wherein the air-conditioning system determines a target value for each of the plurality of the environmental factors to be a value within the comfort range based on the information received from the input unit, controls the plurality of variable devices according to the target values and values detected by the detection unit, and brings each value of the environmental factors to the target value.
  3. The air-conditioning system of claim 2, further comprising a display unit configured to display at least a registration screen of a parameter of the human body factor of a user, a setting screen of the operation mode, and a display screen of the target values.
  4. The air-conditioning system of claim 2 or 3, further comprising a storage unit configured to store information on comfort ranges corresponding to an environmental factor for each human body factor, and  
 wherein the air-conditioning system selects an optimum comfort range based on the information received from the input unit and determines a value in the selected comfort range as the target values.
  5. The air-conditioning system of claim 4, wherein the air-conditioning system selects a comfort range corresponding to a parameter of the human body factor of a current user.
  6. The air-conditioning system of claim 5, wherein the air-conditioning system selects a comfort range based on a predetermined order of priority when there is a plurality of the comfort ranges corresponding to a parameter of the human body factor of the current user.
  7. The air-conditioning system of any one of claims 4 to 6, wherein the air-conditioning system determines a value with the least power consumption in the optimum comfort range as the target value.
  8. The air-conditioning system of any one of claims 4
  9. The air-conditioning system of any one of claims 4 to 8, wherein the air-conditioning system operates a heating mode included in the operation mode,  
 includes a room air conditioner and a floor heating as the plurality of variable devices,  
 detects an air temperature and a floor temperature with the detection unit or a plurality of the detection units,  
 when the heating mode is selected, selects the comfort range corresponding to an air temperature and a floor temperature corresponding to a parameter of the human body factor of the current user,  
 determines values of an air temperature and a floor temperature within the comfort range as the target values of the air temperature and the floor temperature, and  
 controls the room air conditioner and the floor heating according to the target values and the air temperature and the floor temperature detected by the detection unit to bring the values of the air temperature and the floor temperature to the target values.
  10. The air-conditioning system of any one of claims 4 to 9, wherein the air-conditioning system operates a cooling mode included in the operation mode,  
 includes the room air conditioner and a radiant cooling panel as the plurality of variable devices,  
 detects an air temperature and a wall temperature with the detection unit or a plurality of the detection units,  
 when the cooling mode is selected, selects the comfort range corresponding to an air temperature and a wall temperature corresponding to the parameter of a human body factor of the current user,  
 determines values of an air temperature and a wall temperature within the comfort range as the target values of the air temperature and the wall temperature,  
 controls the room air conditioner and the radiant cooling panel according to the target values and the air temperature and the wall temperature detected by the detection unit to bring the values of the air temperature and the wall temperature to the target values.
  11. The air-conditioning system of any one of claims 4 to 10, wherein the air-conditioning system operates a dehumidification mode included in the operation mode,  
 includes a room air conditioner or a radiant cooling panel and a dehumidifier as the plurality of variable

devices,  
 detects absolute humidity and an air temperature  
 with the detection unit or a plurality of the detection  
 units,  
 when the dehumidification mode is selected, selects 5  
 the comfort range corresponding to an absolute hu-  
 midity and an air temperature corresponding to a pa-  
 rameter of the human body factor of the current user,  
 determines values of an absolute humidity and an  
 air temperature within the comfort range as the target 10  
 values of the absolute humidity and the air temper-  
 ature,  
 controls the room air conditioner or the radiant cool-  
 ing panel and the dehumidifier according to the target  
 values and the absolute humidity and the air temper- 15  
 ature detected by the detection unit to bring the  
 values of the absolute humidity and the air temper-  
 ature to the target values.

12. The air-conditioning system of any one of claims 4 20  
 to 11, wherein the air-conditioning system  
 operates a humidification mode included in the op-  
 eration mode,  
 includes a room air conditioner or a floor heating and  
 a dehumidifier as the plurality of variable devices, 25  
 detects an absolute humidity and an air temperature  
 with the detection unit or a plurality of the detection  
 units,  
 when the humidification mode is selected, selects  
 the comfort range corresponding to an absolute hu- 30  
 midity and an air temperature corresponding to a pa-  
 rameter of the human body factor of the current user,  
 determines values of an absolute humidity and an  
 air temperature within the comfort range as the target  
 values of the absolute humidity and the air temper- 35  
 ature,  
 controls the room air conditioner or the floor heating  
 and the dehumidifier according to the target values  
 and the absolute humidity and the air temperature  
 detected by the detection unit to bring the values of 40  
 the absolute humidity and the air temperature to the  
 target values.

13. The air-conditioning system of any one of claims 4 45  
 to 12, wherein the air-conditioning system  
 operates an air purification mode included in the op-  
 eration mode,  
 includes a room air conditioner and an air purifier as  
 the plurality of variable devices,  
 detects dust concentration and wind velocity with the 50  
 detection unit or a plurality of the detection units,  
 when the air purification mode is selected, selects  
 the comfort range corresponding to a dust concen-  
 tration and the wind velocity corresponding to a pa-  
 rameter of the human body factor of the current user, 55  
 determines values of a dust concentration and a wind  
 velocity within the comfort range as the target values  
 of the dust concentration and the wind velocity,

controls the room air conditioner and the air purifier  
 according to the target values and the dust concen-  
 tration and the wind velocity detected by the detec-  
 tion unit to bring the values of the dust concentration  
 and the wind velocity to the target values.

FIG. 1

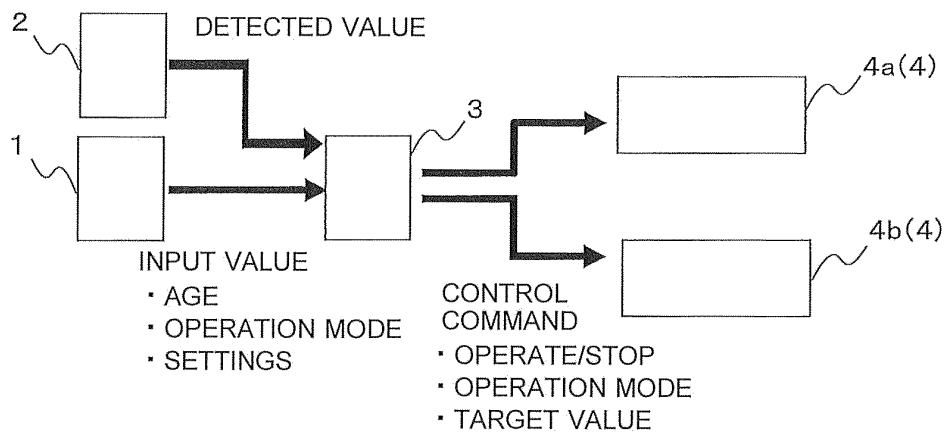


FIG. 2

INPUT SCREEN

AGE

|        |                                                                             |
|--------|-----------------------------------------------------------------------------|
| USER A | <div style="border: 1px solid black; padding: 2px 10px;">35 YEARS OLD</div> |
| USER B | <div style="border: 1px solid black; padding: 2px 10px;">30 YEARS OLD</div> |
| USER C | <div style="border: 1px solid black; padding: 2px 10px;">70 YEARS OLD</div> |

REGISTER

FIG. 3

OPERATION MODE

|                  |   |
|------------------|---|
| HEATING          | ✓ |
| COOLING          |   |
| DEHUMIDIFICATION |   |
| HUMIDIFICATION   |   |
| AIR PURIFICATION |   |

SET

FIG. 4

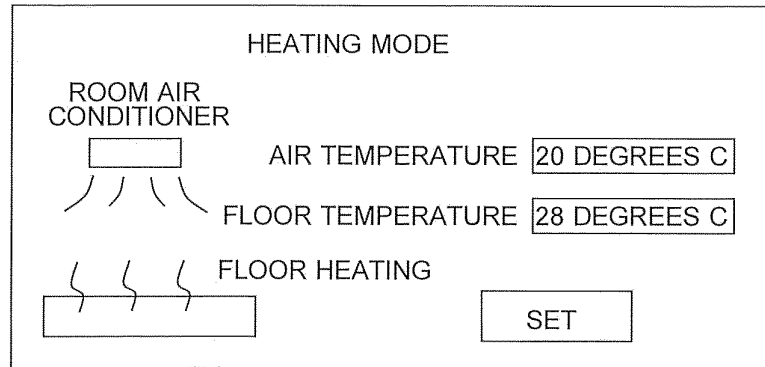


FIG. 5

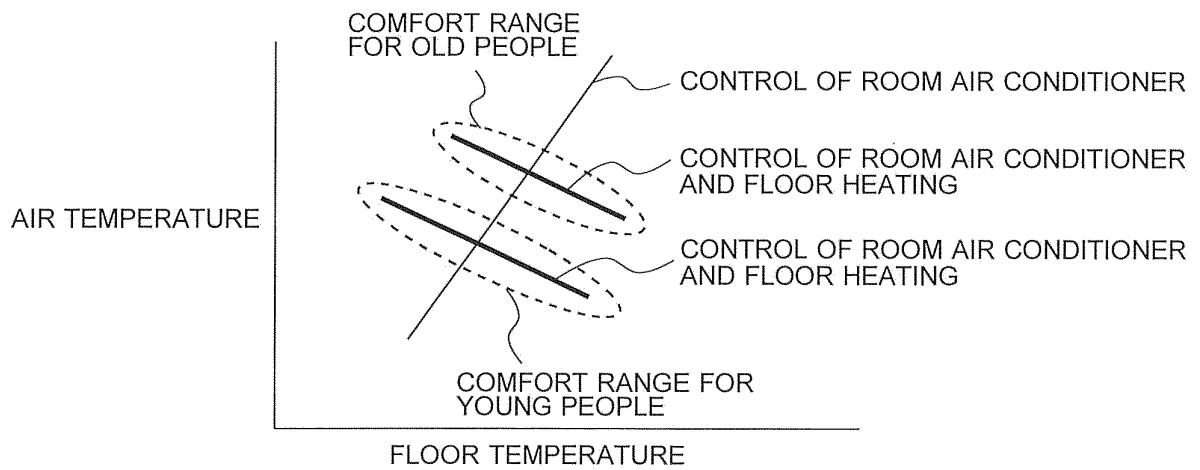


FIG. 6

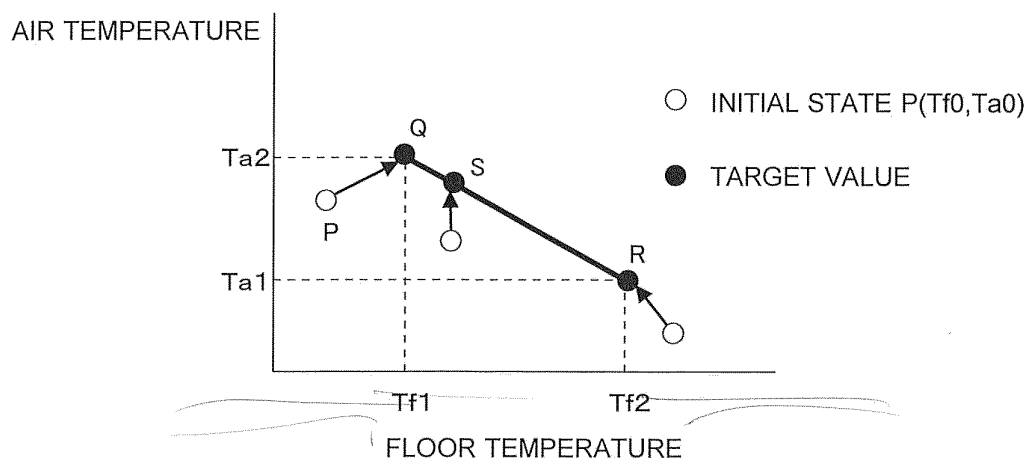


FIG. 7

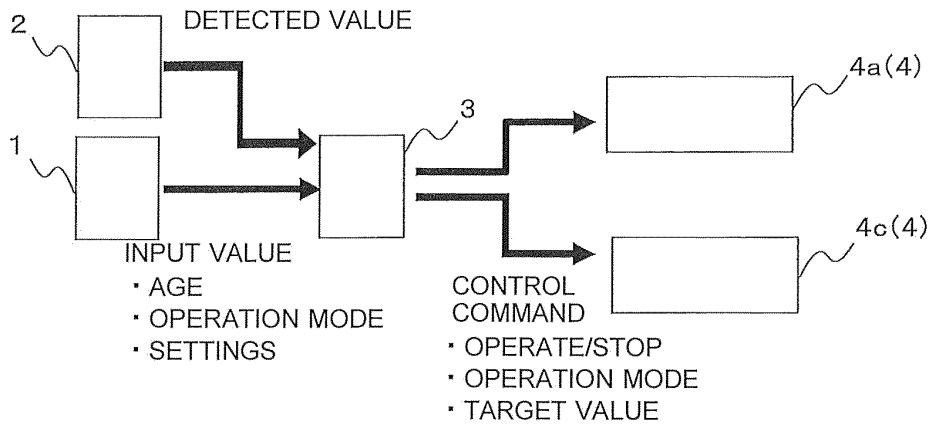


FIG. 8

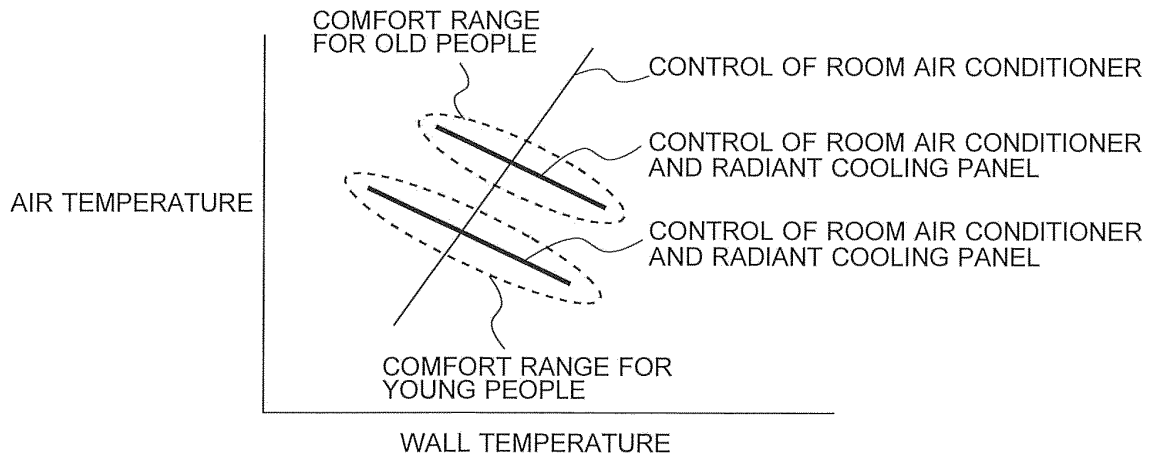


FIG. 9

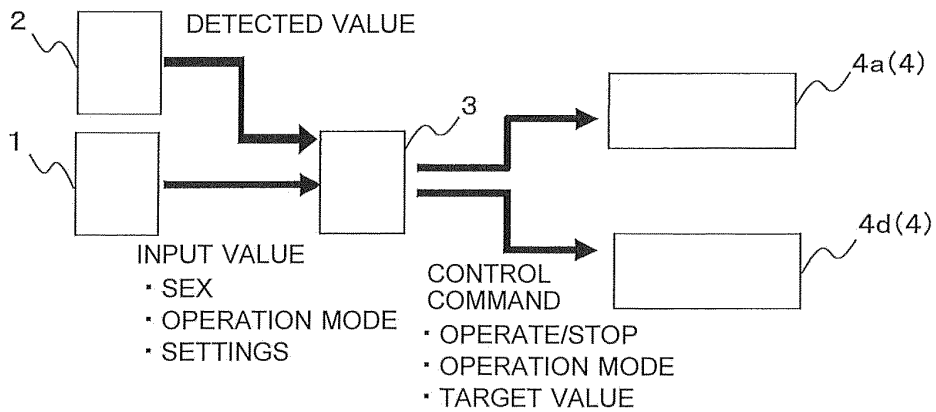


FIG. 10

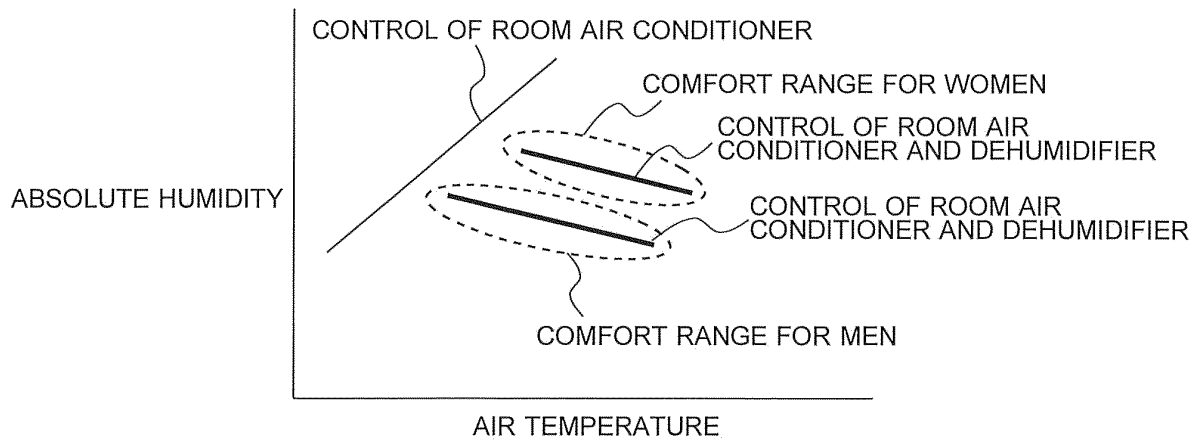


FIG. 11

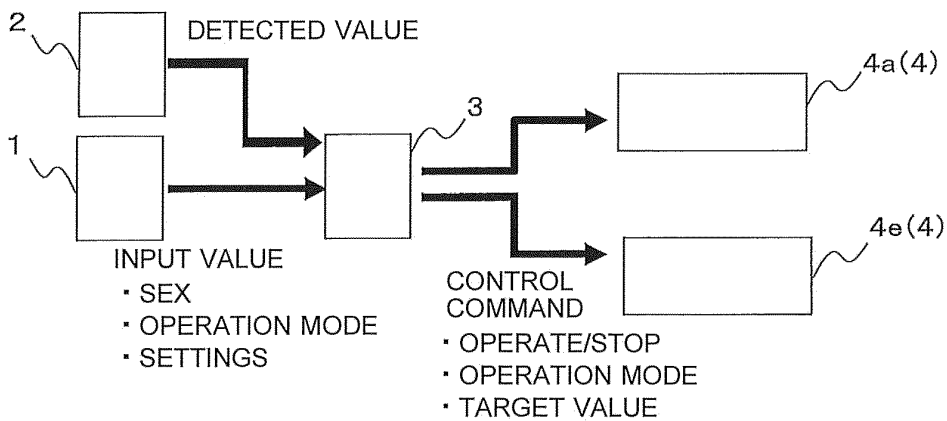


FIG. 12

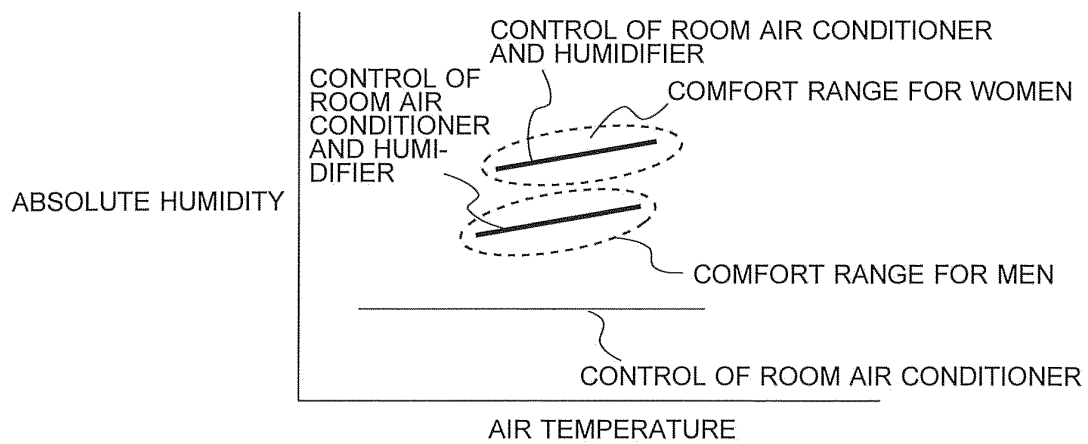


FIG. 13

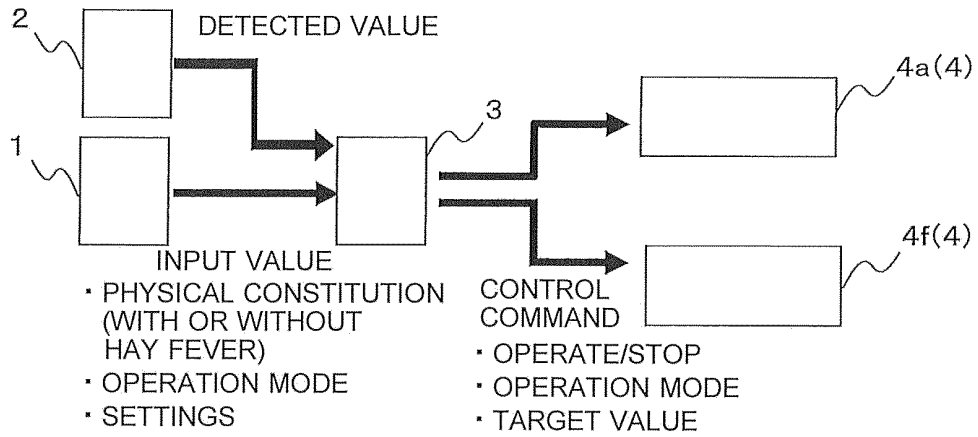
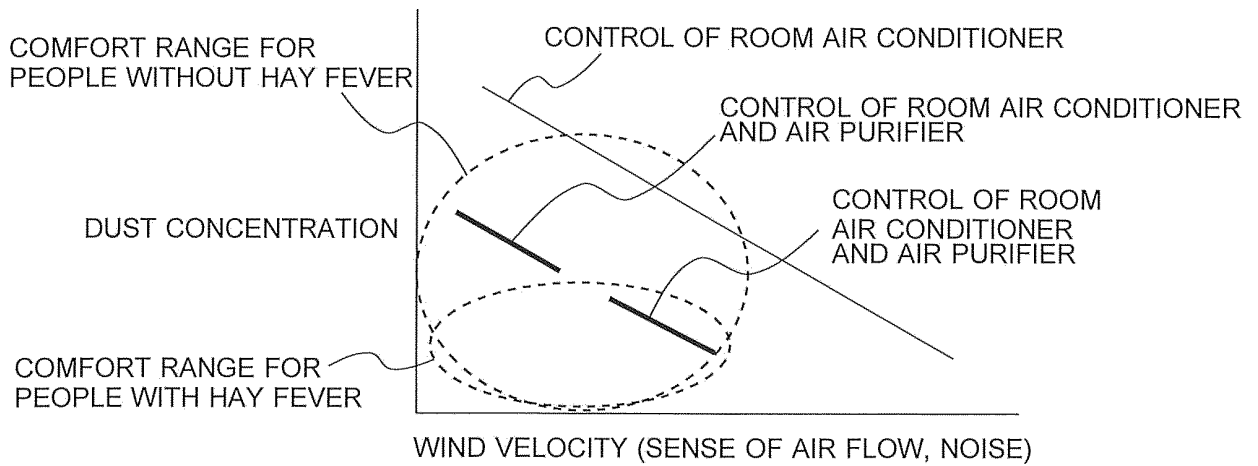


FIG. 14



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/067384

## A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                            | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | JP 62-268944 A (Matsushita Electric Industrial Co., Ltd.),<br>21 November 1987 (21.11.1987),<br>entire text<br>(Family: none)                 | 1-13                  |
| Y         | JP 2004-301380 A (Toho Gas Co., Ltd., Rinnai Corp.),<br>28 October 2004 (28.10.2004),<br>claim 3; paragraphs [0025], [0038]<br>(Family: none) | 1-13                  |
| Y         | JP 2007-192418 A (Matsushita Electric Works, Ltd.),<br>02 August 2007 (02.08.2007),<br>paragraphs [0029], [0061] to [0069]<br>(Family: none)  | 4-13                  |

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

\* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search  
19 September, 2014 (19.09.14)Date of mailing of the international search report  
30 September, 2014 (30.09.14)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/067384

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                           | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 2013-249991 A (Mitsubishi Electric Building Techno-Service Co., Ltd., Mitsubishi Electric Corp.),<br>12 December 2013 (12.12.2013),<br>paragraph [0072]<br>(Family: none) | 1                     |

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP H0816538 B [0004]