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(54) **METHOD FOR SELECTING ADDITIONAL VENTILATOR, METHOD FOR SELECTING ADDITIONAL VENTILATOR AND AIR CONDITIONER, AND AIR-CONDITIONING VENTILATION SYSTEM**

(57) A method for selecting a second ventilation device (20) is a method for selecting a second ventilation device (20) in newly installing, in an indoor space (SI) where an existing first ventilation device (10) is placed, another ventilation device as the second ventilation device (20). The existing first ventilation device (10) has a first amount of ventilation as an amount of ventilation per hour. A first step includes calculating a second amount of ventilation, based on a size of the indoor space. The second amount of ventilation is an amount of ventilation per hour to be required as a measure against pathogenic infection. A second step includes calculating a difference between the second amount of ventilation and the first amount of ventilation, as an additional amount of ventilation. A third step includes selecting a ventilation device that enables ventilation corresponding to the additional amount of ventilation, as the second ventilation device (20).

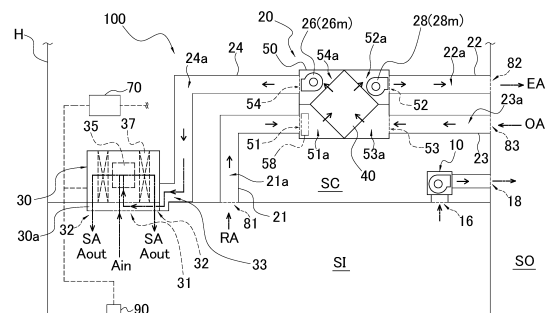


FIG. 1A

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Description

TECHNICAL FIELD

[0001] Embodiments disclosed herein relate to an additional ventilation device selecting method, an additional ventilation device and air conditioning apparatus selecting method, and an air-conditioning and ventilation system.

BACKGROUND ART

[0002] Ventilation devices have widely been used for exhausting indoor air from a room and supplying outdoor air to the room (refer to, for example, Patent Literature 1 (JP 2005-300112 A)).

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] Ventilation devices have been installed in many existing buildings to provide ventilation to some extent.

[0004] Meanwhile, it has recently been required to increase an amount of ventilation as one of measures against infection owing to pathogens such as viruses and bacteria (hereinafter, such infection will be referred to as pathogenic infection).

[0005] Replacing an existing ventilation device with a new one, however, needs high device costs and high installation costs.

<Solution to Problem>

[0006] A first aspect is directed to an additional ventilation device selecting method in newly installing, in an indoor space where an existing first ventilation device is placed, another ventilation device as an additional ventilation device. The existing first ventilation device has a first amount of ventilation as an amount of ventilation per hour. The additional ventilation device selecting method according to the first aspect includes a first step, a second step, and a third step. The first step includes calculating a second amount of ventilation, based on a size of the indoor space. Examples of the size of the indoor space may include, but not limited to, a floor area of the indoor space, a volumetric capacity of the indoor space, and an occupant capacity of the indoor space. The second amount of ventilation is an amount of ventilation per hour to be required as a measure against pathogenic infection. The second step includes calculating a difference between the second amount of ventilation and the first amount of ventilation, as an additional amount of ventilation. The third step includes selecting a ventilation device that enables ventilation corresponding to the additional amount of ventilation, as the additional ventilation device.

[0007] According to the first aspect, an additional ven-

tilation device is selected based on a novel and excellent idea of utilizing the first amount of ventilation by the existing first ventilation device as it is and compensating ventilation corresponding to an insufficient amount of ventilation (i.e., the additional amount of ventilation) with the additional ventilation device. This configuration achieves ventilation corresponding to the second amount of ventilation to be required as a measure against pathogenic infection while keeping costs low.

[0008] A second aspect is directed to an additional ventilation device and air conditioning apparatus selecting method for selecting an additional ventilation device by the additional ventilation device selecting method according to the first aspect, and selecting an air conditioning apparatus. The air conditioning apparatus is an apparatus configured to condition air in the indoor space. The additional ventilation device and air conditioning apparatus selecting method according to the second aspect includes a fourth step and a fifth step in addition to the first step, the second step, and the third step. The fourth step includes calculating a sum of a first air conditioning load, a second air conditioning load, and a third air conditioning load, as a total air conditioning load. The first air conditioning load is determined based on the size of the indoor space. The second air conditioning load is an air conditioning load resulting from ventilation by the existing first ventilation device. The third air conditioning load is an air conditioning load resulting from ventilation by the additional ventilation device selected in the third step. The fifth step includes selecting an air conditioning apparatus having an air conditioning capacity capable of handling the total air conditioning load, from among a plurality of candidate air conditioning apparatuses that are different in air conditioning capacity from one another.

[0009] In a case where the additional ventilation device is installed in the indoor space in addition to the existing first ventilation device, it is predicted that the ventilation by the additional ventilation device increases an air conditioning load in the indoor space. Taking this prediction into no consideration may result in deterioration of a thermal environment in the indoor space. In view of this, the additional ventilation device and air conditioning apparatus selecting method according to the second aspect is capable of selecting an air conditioning apparatus that can handle the total air conditioning load including the air conditioning load resulting from the ventilation by the additional ventilation device.

[0010] A third aspect is directed to the additional ventilation device and air conditioning apparatus selecting method according to the second aspect, in which the third step includes selecting, as the additional ventilation device, a ventilation device including a heat exchange unit. The heat exchange unit is configured to perform heat exchange between outside air corresponding to supply air to the indoor space and return air corresponding to exhaust air from the indoor space. The fourth step includes calculating the third air conditioning load in consideration of an amount of heat exchange by the heat

exchange unit of the additional ventilation device selected.

[0011] According to the third aspect, the ventilation device including the heat exchange unit configured to perform heat exchange between the supply air and the exhaust air is selected as the additional ventilation device. This configuration therefore reduces the deterioration of a thermal environment in the indoor space owing to the ventilation by the additional ventilation device. In addition, the third air conditioning load is calculated in consideration of the amount of heat exchange by the heat exchange unit. Therefore, there is no possibility to excessively calculate the total air conditioning load. This configuration thus enables correct recognition of a required air conditioning capacity of an air conditioning apparatus and appropriate selection of an air conditioning apparatus.

[0012] A fourth aspect is directed to the additional ventilation device and air conditioning apparatus selecting method according to the second or third aspect, further including a sixth step and a seventh step. The sixth step includes determining whether a volume of air at a maximum amount of ventilation by the additional ventilation device selected in the third step is equal to or less than 30% of a rated volume of air of the air conditioning apparatus selected in the fifth step. The seventh step includes reviewing the selection of the additional ventilation device and air conditioning apparatus when it is determined in the sixth step that the volume of air at the maximum amount of ventilation by the additional ventilation device is more than 30% of the rated volume of air of the air conditioning apparatus.

[0013] In the case where the volume of air at the maximum amount of ventilation by the additional ventilation device is more than 30% of the rated volume of air of the air conditioning apparatus, the air conditioning apparatus operates at poor efficiency although the air conditioning apparatus can handle the total air conditioning load with its air conditioning capacity, which may increase running costs. In view of this, the additional ventilation device and air conditioning apparatus selecting method according to the fourth aspect further performs the sixth step and the seventh step for reviewing the selection of the additional ventilation device and air conditioning apparatus. This configuration thus enables selection of, for example, an air conditioning apparatus having a higher rated volume of air and a higher air conditioning capacity, and thereby enables reduction in running costs of air conditioning and ventilation.

[0014] A fifth aspect is directed to the additional ventilation device and air conditioning apparatus selecting method according to any of the second to fourth aspects, in which the third step includes selecting the additional ventilation device from among a plurality of candidate ventilation devices that are different in maximum amount of ventilation from one another. In addition, the candidate air conditioning apparatuses in the fifth step are larger in number than the candidate ventilation devices in the third

step.

[0015] According to the fifth aspect, a more appropriate air conditioning apparatus is selectable from among many candidate air conditioning apparatuses prepared, in accordance with a selected additional ventilation device. This configuration thus enables reduction in device and apparatus costs and installation costs.

[0016] A sixth aspect is directed to an air-conditioning and ventilation system to be installed in an indoor space which has a floor area from 70 m² or more to 95 m² or less and where an existing first ventilation device having a first amount of ventilation as an amount of ventilation per hour is placed. The air-conditioning and ventilation system includes an air conditioning apparatus having a rated cooling capacity of approximately 12.5 kW, and a ventilation device having a maximum amount of ventilation of 250 m³/h.

[0017] When this air-conditioning and ventilation system is installed in an indoor space in an existing building, such as the indoor space which has the foregoing floor area and where the first amount of ventilation is secured, the air-conditioning and ventilation system ensures a required amount of ventilation as a measure against pathogenic infection, and the air conditioning apparatus handles a total air conditioning load in the indoor space, the total air conditioning load including an air conditioning load based on the increased amount of ventilation.

[0018] A seventh aspect is directed to an air-conditioning and ventilation system to be installed in an indoor space which has a floor area from 40 m² or more to 60 m² or less and where an existing first ventilation device having a first amount of ventilation as an amount of ventilation per hour is placed. The air-conditioning and ventilation system includes an air conditioning apparatus having a rated cooling capacity of approximately 7.1 kW, and a ventilation device having a maximum amount of ventilation of 150 m³/h.

[0019] When this air-conditioning and ventilation system is installed in an indoor space in an existing building, such as the indoor space which has the foregoing floor area and where the first amount of ventilation is secured, the air-conditioning and ventilation system ensures a required amount of ventilation as a measure against pathogenic infection, and the air conditioning apparatus handles a total air conditioning load in the indoor space, the total air conditioning load including an air conditioning load based on the increased amount of ventilation.

[0020] An eighth aspect is directed to the air-conditioning and ventilation system according to the sixth or seventh aspect, in which the air conditioning apparatus includes an air supply port. The air supply port takes in supply air outside the indoor space. The ventilation device includes an air supply fan. The air supply fan is a fan configured to feed outside air as the supply air to the air conditioning apparatus. The air-conditioning and ventilation system according to the eighth aspect further includes an air supply path forming member. The air supply path forming member is connected to the ventilation de-

vice and the air conditioning apparatus to form an air supply path. The air supply path is an air flow path through which the supply air is guided from the ventilation device to the air supply port of the air conditioning apparatus.

[0021] This air-conditioning and ventilation system is constituted of the packaged ventilation device, air conditioning apparatus, and air supply path forming member. The air-conditioning and ventilation system therefore contributes to reduction in introduction costs including installation construction costs, as compared with a case where the ventilation device and the air conditioning apparatus are connected with a component such as a local-content duct. In addition, since the supply air from the ventilation device is taken in the air conditioning apparatus, the supply air of which the temperature has been changed by the air conditioning apparatus can be supplied to the indoor space.

[0022] A ninth aspect is directed to the air-conditioning and ventilation system according to the eighth aspect, in which the ventilation device further includes a casing, an air exhaust fan, and a heat exchanger. The casing accommodates the air supply fan and the air exhaust fan. The air exhaust fan is a fan configured to feed air in the indoor space as exhaust air to an outside of the indoor space. The heat exchanger causes the outside air to exchange heat with return air corresponding to the exhaust air. The casing includes a first opening, a second opening, a third opening, and a fourth opening. The third opening is an opening for taking in the outside air. The air supply path forming member is connected to the fourth opening. The first opening is an opening for taking in the air in the indoor space as the return air. The second opening is an opening for feeding the return air as the exhaust air to the outside of the indoor space. The air-conditioning and ventilation system according to the ninth aspect further includes a pressure adjustment unit. The pressure adjustment unit is configured to adjust a pressure of air to reduce a difference between a pressure of the return air flowing from the first opening to the second opening in the ventilation device and a pressure of the outside air flowing from the third opening to the fourth opening in the ventilation device.

[0023] According to the ninth aspect, when the air exhaust fan operates, the air in the indoor space is taken as the return air in the casing through the first opening, and is fed as the exhaust air to the outside of the indoor space through the second opening. When the air supply fan operates, the outside air is taken in the casing through the third opening. The outside air flows from the third opening to the fourth opening, and fed to the air conditioning apparatus from the fourth opening via air supply path. The heat exchanger performs heat exchange between the return air taken in the casing through the first opening and the outside air taken in the casing through the third opening. This configuration thus suppresses increase in air conditioning load in the indoor space owing to the ventilation.

[0024] The air-conditioning and ventilation system ac-

cording to the ninth aspect further includes the pressure adjustment unit configured to reduce the difference between the pressure of the outside air and the pressure of the return air to be subjected to heat exchange with the outside air. This configuration thus suppresses disadvantageous mixing of the outside air with the return air in, for example, the heat exchanger.

[0025] A tenth aspect is directed to the air-conditioning and ventilation system according to any of the sixth to ninth aspects, further includes a remote controller configured to control the air conditioning apparatus and the ventilation device.

[0026] According to the tenth aspect, for example, the remote controller is capable of operating or stopping the air conditioning apparatus and the ventilation device in an associated manner. The remote controller is also capable of causing the ventilation device not to provide the ventilation during a stop of the air conditioning apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1A is a diagram illustrating a state of a building in which a first ventilation device and an air-conditioning and ventilation system are installed.

FIG. 1B is a diagram illustrating a state of the building before additional installation of a second ventilation device.

FIG. 2 is a perspective view for assembly illustrating an air-conditioning indoor unit, a supply air intake member to be mounted on the air-conditioning indoor unit, and a supply air duct.

FIG. 3 is a control block diagram illustrating the air-conditioning and ventilation system.

FIG. 4A is a diagram illustrating a state of ventilation in a room by the first ventilation device before installation of the second ventilation device.

FIG. 4B is a diagram illustrating a state of ventilation in the room in a case where an amount of ventilation is increased by opening a window without installing the second ventilation device.

FIG. 4C is a diagram illustrating a state of ventilation in the room in a case where the second ventilation device is additionally installed.

FIG. 5 is a table showing various numerical values obtained from a combination of a candidate second ventilation device with a candidate air-conditioning indoor unit.

DESCRIPTION OF EMBODIMENTS

(1) General configurations of first ventilation device and air-conditioning and ventilation system

[0028] FIG. 1A illustrates a state in which a first ventilation device 10 and an air-conditioning and ventilation system 100 are installed in a building H. The first venti-

lation device 10 and the air-conditioning and ventilation system 100 are installed in a predetermined indoor space SI in the building H. The air-conditioning and ventilation system 100 mainly includes a second ventilation device 20, an air-conditioning indoor unit 30, ducts 21 to 24, and a remote controller 90.

[0029] The first ventilation device 10 is a ventilation device which has already been installed in the indoor space SI before installation of the second ventilation device 20.

[0030] The air-conditioning indoor unit 30 of the air-conditioning and ventilation system 100 is a unit which has also already been installed in the indoor space SI before installation of the second ventilation device 20.

[0031] FIG. 1B illustrates a state of the building H before installation of the second ventilation device 20.

[0032] The second ventilation device 20 and ducts 21 to 24 of the air-conditioning and ventilation system 100 are additionally installed later in the indoor space SI in which the first ventilation device 10 and the air-conditioning indoor unit 30 have already been installed.

[0033] In an embodiment disclosed herein, a description will be given on the assumption that the first ventilation device 10 and air-conditioning indoor unit 30 illustrated in FIGS. 1A and 1B have already been installed while the second ventilation device 20 and ducts 21 to 24 illustrated in FIG. 1A are under design and examination as will be installed from now.

(2) Details of first ventilation device

[0034] The first ventilation device 10 is a ventilator including a propeller fan or a ventilation device including a sirocco fan. The first ventilation device 10 illustrated in FIGS. 1A and 1B is configured to suck in indoor air in the indoor space SI and to discharge the indoor air to the outside of the building H (i.e., to an outdoor space SO). The first ventilation device 10 includes an intake port connected to a first return air port 16 provided in the ceiling defining the indoor space SI. The first ventilation device 10 includes an outlet port connected to a first exhaust air port 18 bored in an external wall of the building H. The first ventilation device 10 has an amount of ventilation of, for example, 500 m³/h.

(3) Details of air-conditioning indoor unit

[0035] The air-conditioning indoor unit 30 is a unit constituting an air conditioning apparatus, together with an air-conditioning outdoor unit (not illustrated) to be installed outdoors or on the roof of the building H. The air conditioning apparatus is an apparatus configured to cool or heat air in the indoor space SI by a vapor compression refrigeration cycle. As illustrated in FIG. 1A or 1B, the air-conditioning indoor unit 30 includes, for example, a heat exchanger 37 constituting a refrigeration cycle, and an indoor fan 35 configured to provide indoor air to the heat exchanger 37 and to send the indoor air back to the indoor

space SI. The air-conditioning indoor unit 30 includes a casing having a quadrilateral shape in plan view. The casing has a suction port 31 bored at a center of a lower face of the casing, and four blow-out ports 32 respectively extending along the four sides of the lower face. Indoor air is sucked through the suction port 31 (see an arrow Ain in FIG. 1A). Conditioned air is returned to the indoor space SI through the blow-out ports 32 (see arrows Aout in FIG. 1A).

[0036] A supply air intake member 30a illustrated in FIG. 2 is optionally mounted on the air-conditioning indoor unit 30 illustrated in FIG. 1A. The supply air intake member 30a forms an air flow path. Air taken in inlet 33 of the supply air intake member 30a flows near the suction port 31 of the casing of the air-conditioning indoor unit 30.

(4) Details of second ventilation device and ducts cooperating with air-conditioning indoor unit to constitute air-conditioning and ventilation system

[0037] The second ventilation device 20 is placed in a space SC in the attic of the room defining the indoor space SI, in the building H. The second ventilation device 20 is configured to provide ventilation of air in the indoor space SI. The second ventilation device 20 is also configured to perform heat exchange between outside air OA corresponding to supply air SA and return air RA corresponding to exhaust air EA.

[0038] The ducts 21 to 24 are a return air duct 21, an exhaust air duct 22, an outside air guide duct 23, and a supply air duct 24.

[0039] The second ventilation device 20 includes a casing 50, an air supply fan 26, an air exhaust fan 28, a heat exchange element 40 having a substantially quadrangular prism shape, and a ventilation control unit 70.

[0040] The casing 50 accommodates the heat exchange element 40, the air supply fan 26, the air exhaust fan 28, and the like. The casing 50 includes a first opening 51 to which the return air duct 21 is connected, a second opening 52 to which the exhaust air duct 22 is connected, a third opening 53 to which the outside air guide duct 23 is connected, and a fourth opening 54 to which the supply air duct 24 is connected.

[0041] The casing 50 has a first space 51a defined between the first opening 51 and the heat exchange element 40, a second space 52a defined between the second opening 52 and the heat exchange element 40, a third space 53a defined between the third opening 53 and the heat exchange element 40, and a fourth space 54a defined between the fourth opening 54 and the heat exchange element 40.

[0042] The air supply fan 26 is disposed in the fourth space 54a, and includes an air supply fan motor 26m. The air exhaust fan 28 is disposed in the second space 52a, and includes an air exhaust fan motor 28m.

[0043] The return air duct 21 connects the first opening 51 of the second ventilation device 20 and a second re-

turn air port 81 provided in the ceiling defining the indoor space SI, to form a return air path 21a through which return air RA flows.

[0044] The exhaust air duct 22 connects the second opening 52 of the second ventilation device 20 and a second exhaust air port 82 bored in the external wall of the building H, to form an exhaust air path 22a through which exhaust air EA flows.

[0045] The outside air guide duct 23 connects the third opening 53 of the second ventilation device 20 and an outside air guide port 83 bored in the external wall of the building H, to form an outside air guide path 23a through which outside air OA flows.

[0046] The supply air duct 24 connects the fourth opening 54 of the second ventilation device 20 and the inlets 33 of the supply air intake member 30a additionally provided in the air-conditioning indoor unit 30, to form an air supply path 24a through which supply air SA flows. The supply air duct 24 is bifurcated and connected to the two inlets 33. This bifurcated configuration enables increase in an area of an air path and also enables reduction in pressure loss at the supply air duct.

[0047] As illustrated in FIG. 3, the ventilation control unit 70 is connected to the air supply fan motor 26m, the air exhaust fan motor 28m, the remote controller 90, and the like. The ventilation control unit 70 is practicable using a computer. The ventilation control unit 70 includes a control processing device and a storage device. The control processing device may be a processor such as a central processing unit (CPU) or a graphics processing unit (GPU). The control processing device reads a program from the storage device, and executes predetermined image processing and arithmetic processing in accordance with this program. In addition, the control processing device writes a result of the arithmetic processing into the storage device, and reads information from the storage device, in accordance with this program. The ventilation control unit 70 performs ON/OFF control on the air supply fan 26 and the air exhaust fan 28 in accordance with, for example, a command from the remote controller 90 to be described later.

[0048] Although not described herein with reference to the drawings, sensor values may be used for control in such a manner that the ventilation control unit 70 is connected to an outside air temperature sensor and an indoor temperature sensor.

(5) Details of remote controller

[0049] The remote controller 90 is used by a user in the indoor space SI. The user makes various settings on the air-conditioning indoor unit 30 and the second ventilation device 20. The remote controller 90 is practicable using a computer, which is similar to the ventilation control unit 70 in this respect.

[0050] The remote controller 90, the ventilation control unit 70, and a control unit (not illustrated) of the air-conditioning indoor unit 30 are connected via communication

lines.

(6) Details of ventilation by air-conditioning and ventilation system

[0051] The remote controller 90 operates the second ventilation device 20 during operation of the indoor fan 35 of the air-conditioning indoor unit 30. In other words, the remote controller 90 operates the air-conditioning indoor unit 30 in a case where the second ventilation device 20 needs to operate. When the air supply fan 26 and air exhaust fan 28 of the second ventilation device 20 operate, outside air OA in the outdoor space SO flows into the heat exchange element 40 through the outside air guide path 23a. The air, when passing through the heat exchange element 40, passes the air supply fan 26. The air is then supplied as fresh supply air SA to the indoor space SI. Indoor air in the indoor space SI flows through the return air path 21a and then flows as return air RA into the heat exchange element 40. The air, when passing through the heat exchange element 40, passes the air exhaust fan 28. The air is then discharged as exhaust air EA to the outdoor space SO.

[0052] The heat exchange element 40 performs heat exchange between the outside air OA and the return air RA in order to suppress increase in air conditioning load owing to the ventilation by the second ventilation device 20.

(7) Second ventilation device selecting method for selecting second ventilation device to be additionally installed for increasing amount of ventilation in indoor space, and air-conditioning indoor unit selecting method

[0053] It is assumed herein that it is required, as one of measures against infection owing to pathogens such as viruses and bacteria, to increase an amount of ventilation in the indoor space SI in the building H where the first ventilation device 10 and the air-conditioning indoor unit 30 have already been installed as illustrated in FIG. 1B. For example, an amount of ventilation by the first ventilation device 10 has been determined with the amount of ventilation designed at 20 m³/h per person. However, it is predicted that an amount of ventilation of 30 m³/h in total is required, which corresponds to a sum of the foregoing amount of ventilation of 20 m³/h and an additional amount of ventilation of 10 m³/h. In other words, the current amount of ventilation is required to be increased 1.5 times. In this case, a second ventilation device 20 to be additionally installed is selected through the following steps.

(7-1) Second ventilation device selecting method

[0054] First, in a first step, a second amount of ventilation that is required of a second ventilation device 20 to be additionally installed is calculated based on a size of the indoor space SI. In this embodiment, the first step

includes a step of calculating a maximum occupant capacity of the indoor space SI, and a step of calculating, from the maximum occupant capacity, an amount of ventilation required for the indoor space SI. Specifically, the amount of ventilation required for the indoor space SI is obtained by multiplying a value, which is obtained by dividing a floor area (m^2) of the indoor space SI by an exclusive area (m^2) per person determined based on use (e.g., use as a typical store, use as an office) of the indoor space SI (i.e., the room), by an amount of ventilation per hour (m^3/h) to be required per person. The exclusive area (m^2) per person to be determined in accordance with the use of the indoor space SI is determined as 3 m^2 , 5 m^2 , or the like in accordance with, for example, the use. The required amount of ventilation may be calculated using a volumetric capacity (m^3) of the indoor space SI or a required frequency of ventilation of air in the room.

[0055] The first amount of ventilation (m^3/h) is an amount of ventilation required for the indoor space SI based on, for example, an amount of carbon dioxide which a person breathes out. The second amount of ventilation (m^3/h) is an amount of ventilation per hour required for the indoor space SI as a measure against pathogenic infection. Examples of a pathogen as a target for a measure against infection may include viruses or bacterium such as an influenza virus, a norovirus, a coronavirus, and a tubercle bacillus. The second amount of ventilation (m^3/h) is larger in value than the first amount of ventilation (m^3/h).

[0056] Next, in a second step, a difference between the second amount of ventilation and the first amount of ventilation is calculated as an additional amount of ventilation (m^3/h). The first amount of ventilation (m^3/h) is an amount of ventilation by the first ventilation device 10 which has already been installed in the indoor space SI.

[0057] Next, in a third step, a ventilation device that enables ventilation corresponding to the additional amount of ventilation is selected as a second ventilation device 20 to be added. In the third step, the second ventilation device 20 is selected from among candidate ventilation devices V1 to V6 to be described below in (7-2).

(7-2) Candidate ventilation devices V1 to V6

[0058] The candidate ventilation devices are:

- a ventilation device V1 having an amount of ventilation of $150 \text{ m}^3/\text{h}$;
- a ventilation device V2 having an amount of ventilation of $250 \text{ m}^3/\text{h}$;
- a ventilation device V3 having an amount of ventilation of $350 \text{ m}^3/\text{h}$;
- a ventilation device V4 having an amount of ventilation of $500 \text{ m}^3/\text{h}$;
- a ventilation device V5 having an amount of ventilation of $650 \text{ m}^3/\text{h}$; and
- a ventilation device V6 having an amount of ventilation of $800 \text{ m}^3/\text{h}$.

(7-3) Air-conditioning indoor unit selecting method

[0059] After the selection of the second ventilation device 20 in the third step, next, a fourth step is carried out. In the fourth step, a sum of a first air conditioning load, a second air conditioning load, and a third air conditioning load is calculated as a total air conditioning load. The first air conditioning load is an air conditioning load to be determined based on the size of the indoor space SI. The first air conditioning load is calculated by summing a thermal load from a person or a device in the room, a solar heat entering the room through a window or a wall, a thermal load based on a difference between a temperature inside the room and a temperature outside the room, and the like. A cooling or heating load per unit floor area (i.e., the first air conditioning load) is publicly known in accordance with the use (e.g., the use as a typical store, the use as an office) of the indoor space SI (i.e., the room) in the building H. The second air conditioning load is an air conditioning load resulting from ventilation by the existing first ventilation device 10. During the ventilation, outside air is taken in the indoor space SI through a duct or an opening left by a door open. At this time, a load is occurred for keeping the outside air at indoor temperature and humidity. This load corresponds to the second air conditioning load resulting from the ventilation. The third air conditioning load is an air conditioning load resulting from ventilation by the second ventilation device 20 selected in the third step.

[0060] In the fourth step, the third air conditioning load is calculated in consideration of an amount of heat exchange between outside air OA and return air RA performed by the heat exchange element 40 of the second ventilation device 20. The heat exchange element 40 is provided for recovering total heat (sensible heat and latent heat) of air conditioning energy lost by ventilation. In the fourth step, the amount of recovered total heat is taken into consideration.

[0061] In a fifth step, an air-conditioning indoor unit 30 having an air conditioning capacity capable of handling the total air conditioning load is selected from among a plurality of candidate air-conditioning indoor units that are different in air conditioning capacity from one another. In this embodiment, an air-conditioning indoor unit 30 is selected from among candidate air-conditioning indoor units A1 to A9 to be described below in (7-4).

(7-4) Candidate air-conditioning indoor units A1 to A9

[0062] The candidate air-conditioning indoor units for the indoor space SI to be used for a typical store are:

- a 1.5 horsepower (3.6 kW) air-conditioning indoor unit A1 suitable for a floor area from 22 to 25 m^2 ;
- a 1.8 horsepower (4.0 kW) air-conditioning indoor unit A2 suitable for a floor area from 25 to 28 m^2 ;
- a 2 horsepower (4.5 kW) air-conditioning indoor unit A3 suitable for a floor area from 28 to 31 m^2 ;

a 2.3 horsepower (5.0 kW) air-conditioning indoor unit A4 suitable for a floor area from 31 to 35 m²;
 a 2.5 horsepower (5.6 kW) air-conditioning indoor unit A5 suitable for a floor area from 35 to 39 m²;
 a 3 horsepower (7.1 kW) air-conditioning indoor unit A6 suitable for a floor area from 44 to 50 m²;
 a 4 horsepower (10.0 kW) air-conditioning indoor unit A7 suitable for a floor area from 62 to 70 m²;
 a 5 horsepower (12.5 kW) air-conditioning indoor unit A8 suitable for a floor area from 78 to 88 m²; and
 a 6 horsepower (14.0 kW) air-conditioning indoor unit A9 suitable for a floor area from 89 to 100 m².

[0063] The candidate air-conditioning indoor units A1 to A9 are larger in number than the foregoing candidate ventilation devices V1 to V6.

(7-5) Review of selection of second ventilation device and air-conditioning indoor unit

[0064] In a sixth step, a determination is made whether a volume of air at a maximum amount of ventilation by the second ventilation device 20 selected in the third step is equal to or less than 30% of a rated volume of air of the air-conditioning indoor unit 30 selected in the fifth step.

[0065] Next, in a seventh step, the selection of the second ventilation device and air-conditioning indoor unit is reviewed when it is determined in the sixth step that the volume of air at the maximum amount of ventilation by the second ventilation device 20 is more than 30% of the rated volume of air of the air-conditioning indoor unit 30. In reviewing the selection, an air-conditioning indoor unit 30 is newly selected from among the candidate air-conditioning indoor units larger in rated volume of air than the air-conditioning indoor unit 30 selected in the fifth step or a second ventilation device 20 is newly selected from among the candidate ventilation devices smaller in maximum amount of ventilation than the second ventilation device 20 selected in the third step.

(7-6) Specific examples of selection

[0066] With reference to FIGS. 4A to 4C, next, a description will be given of a specific example of how to select a second ventilation device 20 in additionally installing the second ventilation device 20 in an indoor space SI in a building H where a first ventilation device 10 has already been installed, in order to increase an amount of ventilation.

[0067] As illustrated in FIG. 4A, it is assumed herein that a 5 horsepower air-conditioning indoor unit 30 and a first ventilation device 10 having an amount of ventilation of 500 m³/h are installed in an indoor space SI in, for example, a certain store. As to a certain store, an exclusive area (m²) per person to be determined in accordance with use of an indoor space SI is 3 m². With regard to a store having an indoor space SI whose floor

area is 75 m² and whose occupant capacity is 25 persons, in a case where the store was designed in the past to have an amount of ventilation of 20 m³/h per person, a first ventilation device 10 installed in the indoor space SI has an amount of ventilation of 500 m³/h. In a typical store, a 5 horsepower air-conditioning indoor unit 30 having an air conditioning capacity of 12.5 kW is capable of conditioning air in a room having a floor area of 83 m³. In the case where the current amount of ventilation is 500 m³/h, an air conditioning capacity to be required for the indoor space SI, whose floor area is 75 m², in the typical store is 11.3 kW. Therefore, the 5 horsepower air-conditioning indoor unit 30 has a margin of approximately 10% with respect to the current indoor space SI whose floor area is 75 m².

[0068] In a case where it is considered, as a measure against pathogenic infection, to secure an amount of ventilation of 30 m³/h in total (per person) for the indoor space SI in the store, by increasing the current amount of ventilation (20 m³/h per person), ventilation of air by opening a window is proposed as a candidate for a simple solution.

[0069] In providing ventilation of air by opening a window, as illustrated in FIG. 4B, it is required to additionally take outside air by an amount of 250 m³/h in the indoor space SI through an opening left by the window open. However, opening the window causes some disadvantages such as increased noise, bugs intruding into the indoor space SI, and variations in temperature in the indoor space SI. These disadvantages impair the comfortability of a customer in the store. In addition, the introduction of outside air increases an air conditioning load. For example, a load resulting from outside air increases by 1.5 kW on conditions that an outside air temperature is 35°C and an indoor temperature is 27°C. As a result, an air conditioning capacity to be required for the indoor space SI, whose floor area is 75 m², is 12.8 kW (= 11.3 kW + 1.5 kW). The existing 5 horsepower air-conditioning indoor unit 30 having the air conditioning capacity (12.5 kW) is insufficient to meet this. Therefore, the store where the ventilation of air is provided by opening the window has a necessity of replacing the 5 horsepower air-conditioning indoor unit 30 with a new 6 horsepower (14.0 kW) air-conditioning indoor unit.

[0070] In view of this, the selecting methods described above in (7-1) to (7-5) are employed as a method for securing the amount of ventilation of 30 m³/h in total for the indoor space SI, thereby securing the amount of ventilation in the indoor space SI and handling the air conditioning load while keeping initial costs and running costs low.

[0071] According to the foregoing selecting methods, in the first step, a second amount of ventilation to be required for the indoor space SI as a measure against pathogenic infection is calculated based on the size (i.e., the floor area of 75 m², the occupant capacity of 25 persons) of the indoor space SI. The second amount of ventilation to be required as a measure against pathogenic

infection is 30 m³/h per person. Therefore, the second amount of ventilation is 750 m³/h (25 × 30 m³/h).

[0072] Next, in the second step, a difference between the second amount of ventilation and the first amount of ventilation is calculated as an additional amount of ventilation (m³/h). The additional amount of ventilation is 250 m³/h (750 m³/h: the second amount of ventilation - 500 m³/h: the first amount of ventilation by the first ventilation device 10).

[0073] Next, in the third step, a ventilation device capable of providing ventilation corresponding to the additional amount of ventilation is selected from among the foregoing candidate ventilation devices V1 to V6, and this ventilation device is selected as a second ventilation device 20. In this embodiment, the ventilation device V2 having the amount of ventilation of 250 m³/h is selected as a second ventilation device 20.

[0074] Next, in the fourth step, a sum of a first air conditioning load, a second air conditioning load, and a third air conditioning load is calculated as a total air conditioning load. As described above, the second air conditioning load is an air conditioning load resulting from ventilation by the existing first ventilation device 10. A sum of the first air conditioning load and the second air conditioning load resulting from the ventilation (the volume of ventilation: 500 m³/h) by the existing first ventilation device 10 is 11.3 kW in the case of the indoor space SI, whose floor area is 75 m², in the typical store. The third air conditioning load is an additional air conditioning load resulting from the ventilation by the second ventilation device 20 that is additionally installed. In the case where the ventilation device V2 having the amount of ventilation of 250 m³/h is selected as the second ventilation device 20, the additional air conditioning load (the third air conditioning load) is 0.6 kW on conditions that the outside air temperature is 35°C and the indoor temperature is 27°C. In the case where the ventilation of air is provided by opening the window, the additional air conditioning load is 1.5 kW on the same conditions. When the second ventilation device 20 is employed, the heat exchange element 40 performs total heat exchange. Therefore, the additional air conditioning load is 0.6 kW. As a result, the total air conditioning load is 11.9 kW (11.3 kW + 0.6 kW).

[0075] For reference, FIG. 5 illustrates additional air conditioning loads and other numerical values obtained from various combinations of the candidate second ventilation devices 20 with the candidate air-conditioning indoor units 30.

[0076] Next, in the fifth step, an air-conditioning indoor unit 30 having an air conditioning capacity capable of handling the total air conditioning load is selected from among the foregoing candidate air-conditioning indoor units A1 to A9. In this embodiment, the 5 horsepower (12.5 kW) air-conditioning indoor unit A8, which has already been installed in the indoor space SI, is selected as an air-conditioning indoor unit 30. The 5 horsepower (12.5 kW) air-conditioning indoor unit A8 is selected since

the total air conditioning load (11.9 kW) can be handled with 5 horsepower (12.5 kW).

[0077] Next, in the sixth step, a determination is made whether a volume of air at a maximum amount of ventilation by the second ventilation device 20 selected in the third step is equal to or less than 30% of a rated volume of air of the air-conditioning indoor unit 30 selected in the fifth step. In this embodiment, the volume of air at the maximum amount of ventilation by the second ventilation device 20 is equal to or less than 30% of the rated volume of air of the air-conditioning indoor unit 30. Therefore, the seventh step is not carried out for reviewing the selection of the second ventilation device and air-conditioning indoor unit.

[0078] In this embodiment, as described above, the air-conditioning and ventilation system 100 is constituted of the existing 5 horsepower air-conditioning indoor unit 30 and the additionally installed second ventilation device 20 including the heat exchange element 40 configured to perform total heat exchange (see FIG. 4C).

[0079] In the case where the ventilation of air is provided by opening the window as a measure against pathogenic infection, as described above, the 5 horsepower air-conditioning indoor unit 30 should be replaced with a new 6 horsepower (14.0 kW) air-conditioning indoor unit. On the other hand, when the second ventilation device 20 including the heat exchange element 40 configured to perform total heat exchange is additionally installed, the existing 5 horsepower air-conditioning indoor unit 30 is usable as it is.

(8) Features of second ventilation device selecting method

[0080] (8-1)

The second ventilation device selecting method described above in (7) involves selecting a second ventilation device 20, based on a novel and excellent idea of utilizing the first amount of ventilation by the existing first ventilation device 10 as it is and compensating ventilation corresponding to an insufficient additional amount of ventilation with the second ventilation device 20. This configuration achieves ventilation corresponding to a second amount of ventilation to be required as a measure against pathogenic infection while keeping costs low.

[0081] (8-2)

In a case where the second ventilation device 20 is installed in the indoor space SI in addition to the existing first ventilation device 10, it is predicted that ventilation by the second ventilation device 20 increases an air conditioning load in the indoor space SI. Taking this prediction into no consideration may result in deterioration of a thermal environment in the indoor space SI. In view of this, the foregoing method for selecting a second ventilation device 20 and an air-conditioning indoor unit 30 involves selecting an air-conditioning indoor unit 30 capable of handling a total air conditioning load including the air conditioning load resulting from the ventilation.

This configuration makes it possible to determine whether the air-conditioning indoor unit 30, which has already been installed in the indoor space SI, is usable as it is or whether this existing air-conditioning indoor unit 30 needs to be replaced with a new air-conditioning indoor unit 30 higher in air conditioning capacity than the existing air-conditioning indoor unit 30.

[0082] (8-3)

The second ventilation device selecting method described above in (7) involves selecting, as an additional ventilation device, the second ventilation device 20 including the heat exchange element 40 configured to perform heat exchange between supply air SA and exhaust air EA. This configuration therefore reduces the deterioration of a thermal environment in the indoor space SI owing to the ventilation by the second ventilation device 20. The second ventilation device selecting method described above in (7) also involves calculating a third air conditioning load (i.e., the air conditioning load resulting from the additional ventilation), in consideration of the amount of heat exchange by the heat exchange element 40. Therefore, there is no possibility to excessively calculate the total air conditioning load. This configuration thus achieves correct recognition of a required air conditioning capacity and appropriate selection of an air-conditioning indoor unit 30.

[0083] (8-4)

In a case where a volume of air at a maximum amount of ventilation by a second ventilation device 20 to be added as a measure against pathogenic infection is more than 30% of a rated volume of air of the air-conditioning indoor unit 30, the air conditioning apparatus operates at poor efficiency although the air-conditioning indoor unit 30 can handle a total air conditioning load with its air conditioning capacity, which may increase running costs. In view of this, the second ventilation device and air-conditioning indoor unit selecting method according to this embodiment involves reviewing the selection of a second ventilation device and an air-conditioning indoor unit through the sixth step and the seventh step. This configuration thus enables selection of, for example, an air-conditioning indoor unit having a higher rated volume of air and a higher air conditioning capacity, and thereby enables reduction in running costs of air conditioning and ventilation.

[0084] (8-5)

According to the foregoing embodiment, a more appropriate air-conditioning indoor unit 30 is selectable from among the many candidate air-conditioning indoor units described above in (7-4), in accordance with a selected second ventilation device 20. This configuration thus enables reduction in running costs and installation costs of the air-conditioning and ventilation system 100.

(9) Variations and features of air-conditioning and ventilation system

[0085] (9-1)

In the air-conditioning and ventilation system 100 described above in (1) to (6), the air-conditioning indoor unit 30 has already been installed. Alternatively, the air-conditioning and ventilation system 100 may be constituted of the packaged second ventilation device 20, air-conditioning indoor unit 30, and ducts 21 to 24 such as the supply air duct 24 defining the flow path through which supply air SA flows. The ducts 21 to 24 are connected to the second ventilation device 20 such that a volume of air to be supplied to the room becomes equal to a target amount of ventilation when the fan of the second ventilation device 20 is driven at a predetermined number of rotations. The ducts 21 to 24 and the supply air intake member 30a each have a certain flow path resistance. A packaged system refers to a system that achieves a target amount of ventilation without calculating a flow path resistance on site since the ducts 21 to 24 and the supply air intake member 30a each have a desired flow path resistance only by connecting the ducts 21 to 24 and the supply air intake member 30a to the air-conditioning indoor unit 30 and the second ventilation device 20. Employing the packaged air-conditioning and ventilation system 100 achieves reduction in introduction costs including installation construction costs, as compared with a case where the ventilation device and the indoor unit of the air conditioning apparatus are connected with a component such as a local-content duct.

[0086] (9-2)

Also in the air-conditioning and ventilation system 100, supply air SA from the second ventilation device 20 flows into the air-conditioning indoor unit 30. Therefore, the supply air SA whose temperature or humidity has been adjusted by the air-conditioning indoor unit 30 is supplied to the indoor space SI.

[0087] (9-3)

The air-conditioning and ventilation system 100 includes the remote controller 90 configured to control the air-conditioning indoor unit 30 and the second ventilation device 20. The remote controller 90 is capable of operating or stopping the air-conditioning indoor unit 30 and the second ventilation device 20 in an associated manner. The remote controller 90 is also capable of causing the second ventilation device 20 not to provide ventilation during a stop of the air-conditioning indoor unit 30.

[0088] In the air-conditioning and ventilation system 100, if the second ventilation device 20 provides ventilation during a stop of the air-conditioning indoor unit 30, dust adhering to an intake filter of the air-conditioning indoor unit 30 may disadvantageously drop into the indoor space SI. This disadvantage is avoidable by the remote controller 90 that controls the air-conditioning indoor unit 30 and the second ventilation device 20 in an associated manner.

(10) Specific examples of air-conditioning and ventilation system

[0089] (10-1)

In the specific example of the selection of a second ventilation device described above in (7-6), on the assumption that the 5 horsepower air-conditioning indoor unit 30 and the first ventilation device 10 having the amount of ventilation of 500 m³/h are installed in the indoor space SI (the floor area: 75 m²) in the certain store, the current amount of ventilation (20 m³/h per person) is increased as a measure against pathogenic infection so as to secure the amount of ventilation of 30 m³/h in total per person, for the indoor space SI.

[0090] In a case where a second ventilation device 20 is selected based on the similar idea to that in this specific example, an air-conditioning and ventilation system to be installed in an indoor space having a floor area from 70 m² or more to 95 m² or less preferably includes an air-conditioning indoor unit having a rated cooling capacity of approximately 12.5 kW, and a second ventilation device having a maximum amount of ventilation of 250 m³/h.

[0091] When the air-conditioning and ventilation system is installed in an indoor space in an existing building, such as the indoor space which has the foregoing floor area and where a first amount of ventilation (e.g., an amount of ventilation twice as large as a maximum amount of ventilation by a second ventilation device) is secured, the air-conditioning and ventilation system ensures a required amount of ventilation as a measure against pathogenic infection, and the air conditioning apparatus handles a total air conditioning load in the indoor space, the total air conditioning load including an air conditioning load based on the increased amount of ventilation.

[0092] (10-2)

In the specific example of the selection of a second ventilation device described above in (7-6), on the assumption that the 5 horsepower air-conditioning indoor unit 30 and the first ventilation device 10 having the amount of ventilation of 500 m³/h are installed in the indoor space SI (the floor area: 75 m²) in the certain store, the current amount of ventilation (20 m³/h per person) is increased as a measure against pathogenic infection so as to secure the amount of ventilation of 30 m³/h in total per person, for the indoor space SI.

[0093] In a case where a second ventilation device 20 is selected based on the similar idea to that in this specific example, an air-conditioning and ventilation system to be installed in an indoor space having a floor area from 40 m² or more to 60 m² or less preferably includes an air-conditioning indoor unit having a rated cooling capacity of approximately 7.1 kW, and a second ventilation device having a maximum amount of ventilation of 150 m³/h.

[0094] When the air-conditioning and ventilation system is installed in an indoor space in an existing building, such as the indoor space which has the foregoing floor area and where a first amount of ventilation (e.g., an amount of ventilation twice as large as a maximum amount of ventilation by a second ventilation device) is

secured, the air-conditioning and ventilation system ensures a required amount of ventilation as a measure against pathogenic infection, and the air conditioning apparatus handles a total air conditioning load in the indoor space, the total air conditioning load including an air conditioning load based on the increased amount of ventilation.

(11) Modifications

[0095] (11-1)

In the air-conditioning and ventilation system 100 according to the foregoing embodiment, indoor air in the indoor space SI flows through the return air path 21a and then flows as return air RA into the heat exchange element 40. The air, when passing through the heat exchange element 40, passes the air exhaust fan 28. The air is then discharged as exhaust air EA to the outdoor space SO. On the other hand, outside air OA in the outdoor space SO flows into the heat exchange element 40 through the outside air guide path 23a. The air, when passing through the heat exchange element 40, passes the air supply fan 26. The air is then supplied as fresh supply air SA to the indoor space SI. However, the supply air SA needs a static pressure to a certain degree such that the supply air SA passes through the narrow flow path in the air-conditioning indoor unit 30 to which the supply air intake member 30a is mounted. This may result in a pressure difference between the flow path with small flow path resistance, through which the return air RA and the exhaust air EA flow, and the flow path with large flow path resistance, through which the outside air OA and the supply air SA flow.

[0096] Therefore, in a case where the pressure loss of the supply air SA is considerably large, preferably, the air-conditioning and ventilation system 100 additionally includes a pressure adjustment unit.

[0097] An example of the pressure adjustment unit is a decompression member 58, such as a baffle plate or a damper, to be provided in the first space 51a in the second ventilation device 20 illustrated in FIG. 1A so as to increase the flow path resistance of the return air RA and exhaust air EA. This configuration thus reduces the foregoing pressure difference and hardly causes disadvantageous mixing of the outside air with the return air in the heat exchange element 40.

[0098] (11-2)

While various embodiments of the present disclosure have been described herein above, it is to be appreciated that various changes in form and detail may be made without departing from the spirit and scope of the present disclosure presently or hereafter claimed.

REFERENCE SIGNS LIST

[0099]

10: first ventilation device

20: second ventilation device (ventilation device, additional ventilation device)
 24: air supply path forming member
 24a: air supply path
 26: air supply fan
 28: air exhaust fan
 30: air-conditioning indoor unit (air conditioning apparatus)
 30a: supply air intake member
 33: inlet of supply air intake member (air supply port)
 40: heat exchange element
 50: casing
 51: first opening
 52: second opening
 53: third opening
 54: fourth opening
 58: decompression member (pressure adjustment unit)
 90: remote controller (controller)
 100: air-conditioning and ventilation system
 EA: exhaust air
 OA: outside air
 RA: return air
 SA: supply air
 SI: indoor space
 SO: outdoor space (outside of indoor space)

CITATION LIST

PATENT LITERATURE

[0100] Patent Literature 1: JP 2005-300112 A

Claims

1. An additional ventilation device selecting method in newly installing, in an indoor space (SI) where an existing first ventilation device (10) having a first amount of ventilation as an amount of ventilation per hour is placed, another ventilation device as an additional ventilation device (20), the additional ventilation device selecting method comprising:
 - a first step of calculating a second amount of ventilation as an amount of ventilation per hour to be required as a measure against pathogenic infection, based on a size of the indoor space (SI);
 - a second step of calculating a difference between the second amount of ventilation and the first amount of ventilation, as an additional amount of ventilation; and
 - a third step of selecting a ventilation device that enables ventilation corresponding to the additional amount of ventilation, as the additional ventilation device (20).

2. An additional ventilation device and air conditioning apparatus selecting method for selecting an additional ventilation device (20) by the additional ventilation device selecting method according to claim 1, and selecting an air conditioning apparatus (30) configured to condition air in the indoor space, the additional ventilation device and air conditioning apparatus selecting method comprising:

a fourth step of calculating, as a total air conditioning load, a sum of a first air conditioning load determined based on the size of the indoor space (SI), a second air conditioning load resulting from ventilation by the existing first ventilation device, and a third air conditioning load resulting from ventilation by the additional ventilation device selected in the third step; and
 a fifth step of selecting an air conditioning apparatus (30) having an air conditioning capacity capable of handling the total air conditioning load, from among a plurality of candidate air conditioning apparatuses that are different in air conditioning capacity from one another.

3. The additional ventilation device and air conditioning apparatus selecting method according to claim 2, wherein

the third step includes selecting, as the additional ventilation device (20), a ventilation device including a heat exchange unit (40) configured to perform heat exchange between outside air (OA) corresponding to supply air (SA) to the indoor space and return air (RA) corresponding to exhaust air (EA) from the indoor space, and the fourth step includes calculating the third air conditioning load in consideration of an amount of heat exchange by the heat exchange unit (40) of the additional ventilation device selected.

4. The additional ventilation device and air conditioning apparatus selecting method according to claim 2 or 3, further comprising:

a sixth step of determining whether a volume of air at a maximum amount of ventilation by the additional ventilation device selected in the third step is equal to or less than 30% of a rated volume of air of the air conditioning apparatus selected in the fifth step; and
 a seventh step of reviewing the selection of the additional ventilation device and air conditioning apparatus when it is determined in the sixth step that the volume of air at the maximum amount of ventilation by the additional ventilation device is more than 30% of the rated volume of air of the air conditioning apparatus.

5. The additional ventilation device and air conditioning apparatus selecting method according to any one of claims 2 to 4, wherein

the third step includes selecting the additional ventilation device from among a plurality of candidate ventilation devices that are different in maximum amount of ventilation from one another, and
the candidate air conditioning apparatuses in the fifth step are larger in number than the candidate ventilation devices in the third step.

6. An air-conditioning and ventilation system to be installed in an indoor space which has a floor area from 70 m² or more to 95 m² or less and where an existing first ventilation device (10) having a first amount of ventilation as an amount of ventilation per hour is placed,
the air-conditioning and ventilation system comprising:

an air conditioning apparatus having a rated cooling capacity of approximately 12.5 kW; and
a ventilation device (20) having a maximum amount of ventilation of 250 m³/h.

7. An air-conditioning and ventilation system to be installed in an indoor space which has a floor area from 40 m² or more to 60 m² or less and where an existing first ventilation device (10) having a first amount of ventilation as an amount of ventilation per hour is placed,
the air-conditioning and ventilation system comprising:

an air conditioning apparatus having a rated cooling capacity of approximately 7.1 kW; and
a ventilation device (20) having a maximum amount of ventilation of 150 m³/h.

8. The air-conditioning and ventilation system according to claim 6 or 7, wherein

the air conditioning apparatus includes an air supply port (33) for taking in supply air (SA) outside the indoor space, and
the ventilation device (20) includes an air supply fan (26) configured to feed outside air (OA) as the supply air (SA) to the air conditioning apparatus,
the air-conditioning and ventilation system further comprising
an air supply path forming member (24) connected to the ventilation device and the air conditioning apparatus to form an air supply path (24a) through which the supply air (SA) is guided from the ventilation device to the air supply port

of the air conditioning apparatus.

9. The air-conditioning and ventilation system according to claim 8, wherein

the ventilation device (20) further includes:

a casing (50) accommodating the air supply fan (26);
an air exhaust fan (28) accommodated in the casing and configured to feed air in the indoor space (SI) as exhaust air (EA) to an outside (SO) of the indoor space; and
a heat exchanger (40) configured to cause the outside air (OA) to exchange heat with return air (RA) corresponding to the exhaust air (EA), and

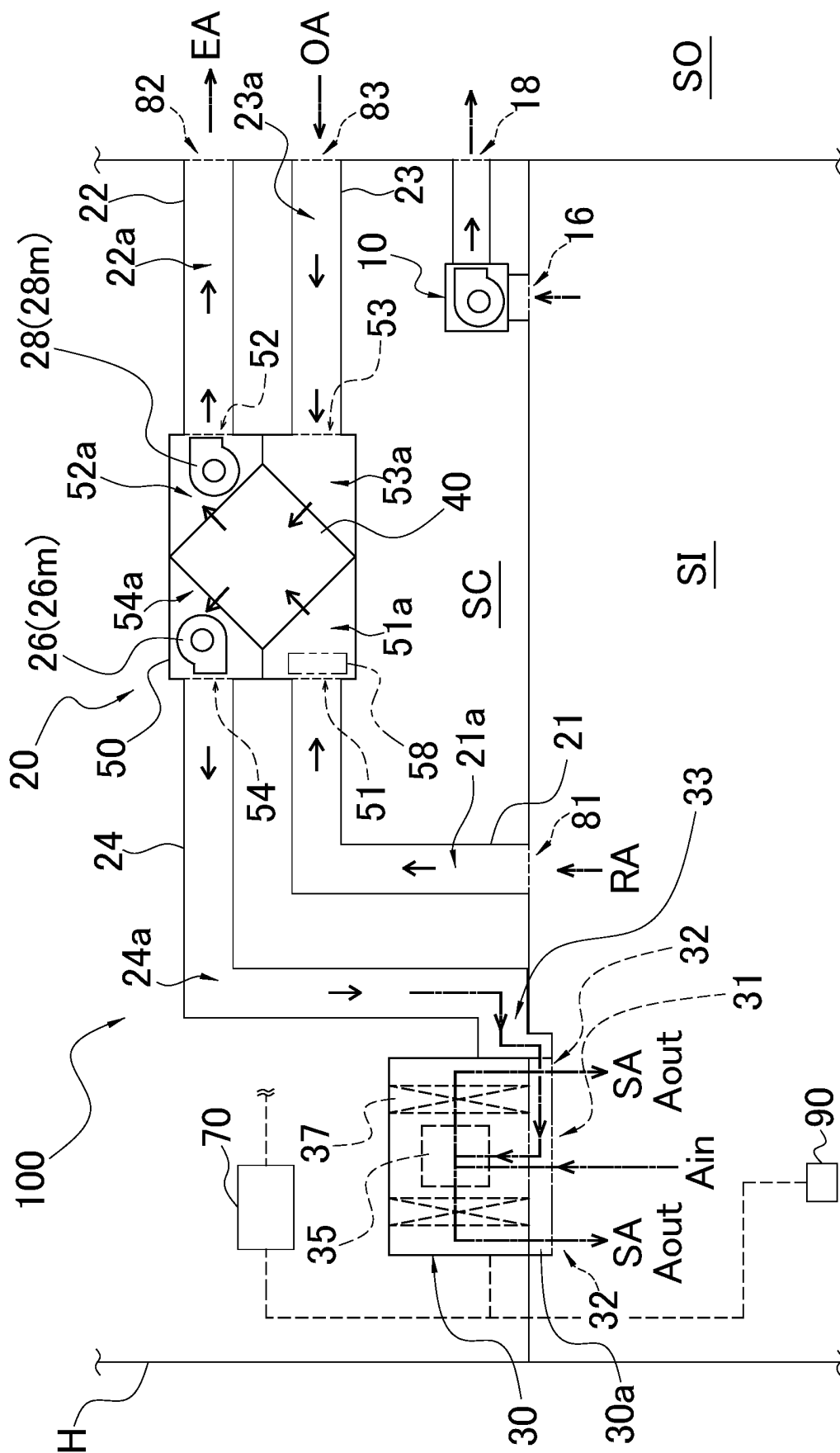
the casing includes:

a first opening (51) for taking in air in the indoor space as the return air (RA);
a second opening (52) for feeding the return air (RA) as the exhaust air (EA) to the outside of the indoor space;
a third opening (53) for taking in the outside air (OA); and
a fourth opening (54) to which the air supply path forming member is connected,

the air-conditioning and ventilation system further comprising

a pressure adjustment unit (58) configured to adjust a pressure of air to reduce a difference between a pressure of the return air (RA) flowing from the first opening (51) to the second opening (52) in the ventilation device and a pressure of the outside air (OA) flowing from the third opening (53) to the fourth opening (54) in the ventilation device.

10. The air-conditioning and ventilation system according to any one of claims 6 to 9, further comprising a remote controller (90) configured to control the air conditioning apparatus and the ventilation device.



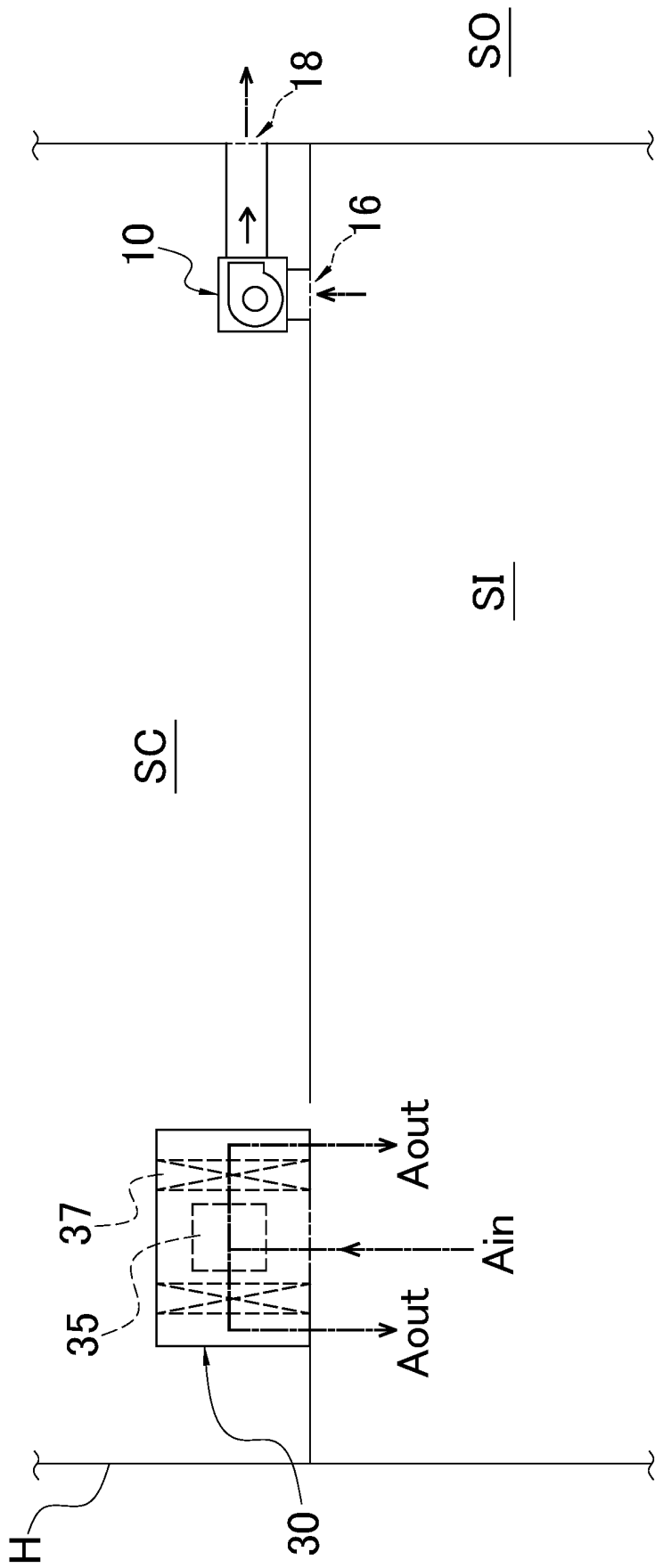


FIG. 1B

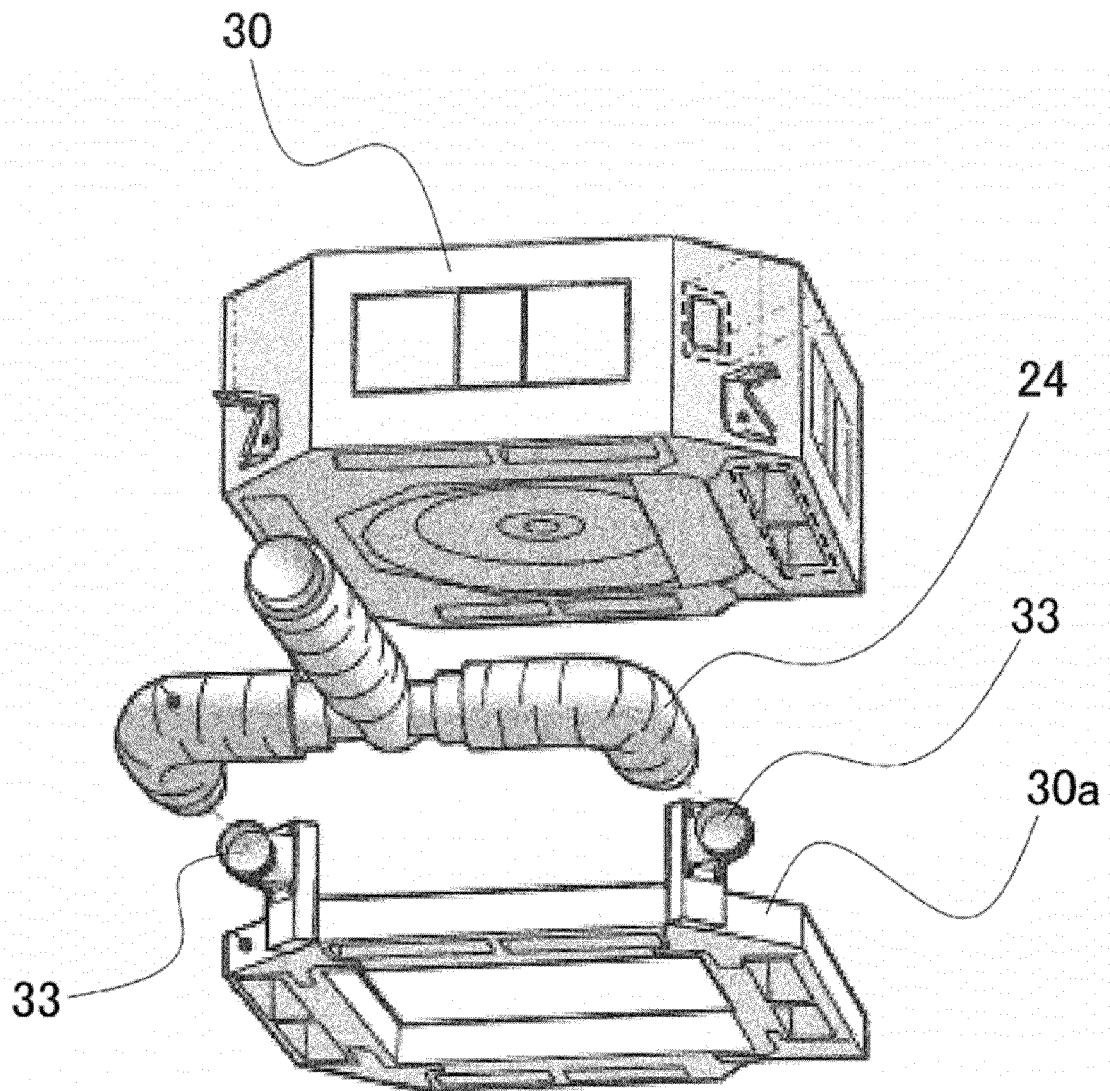


FIG. 2

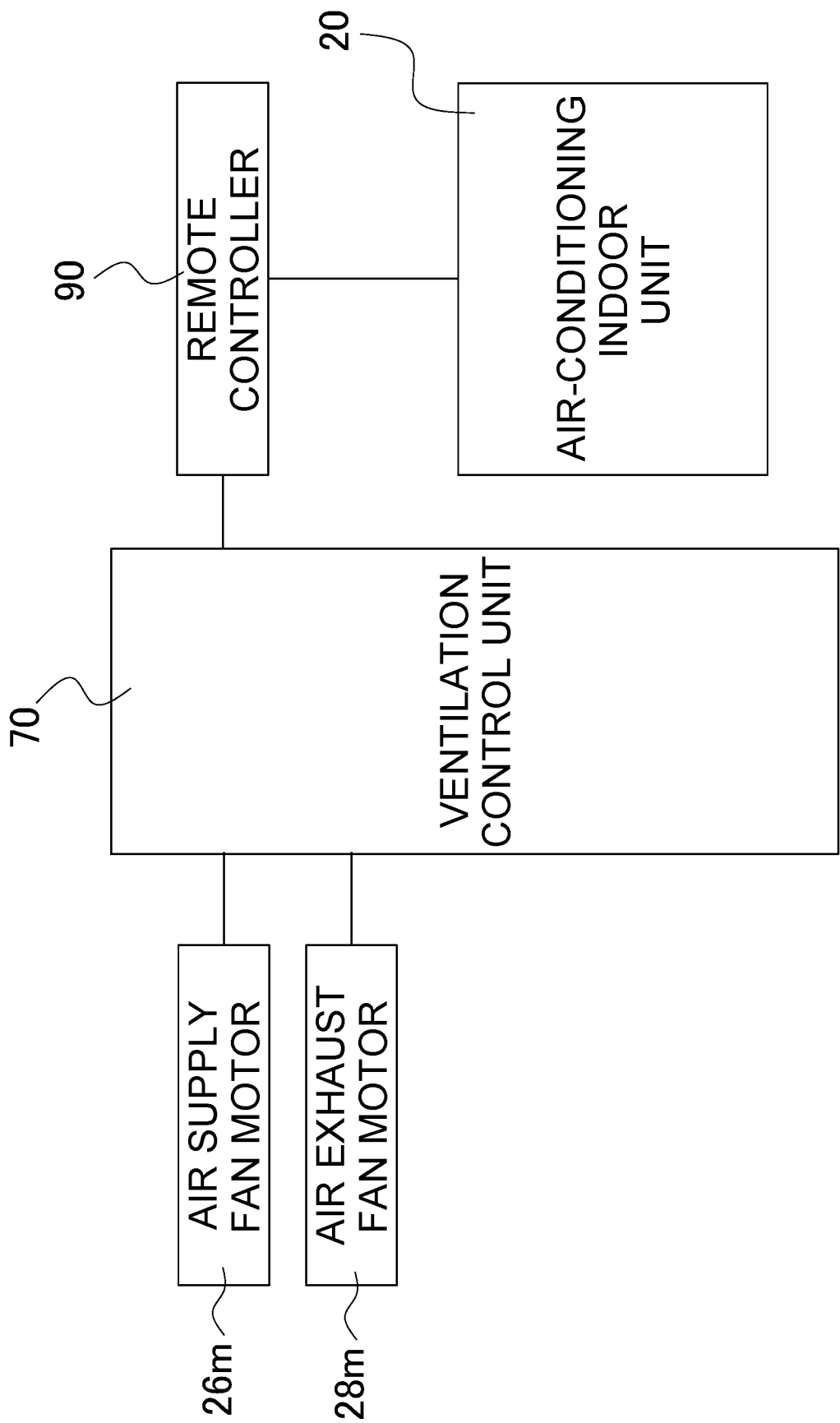


FIG. 3

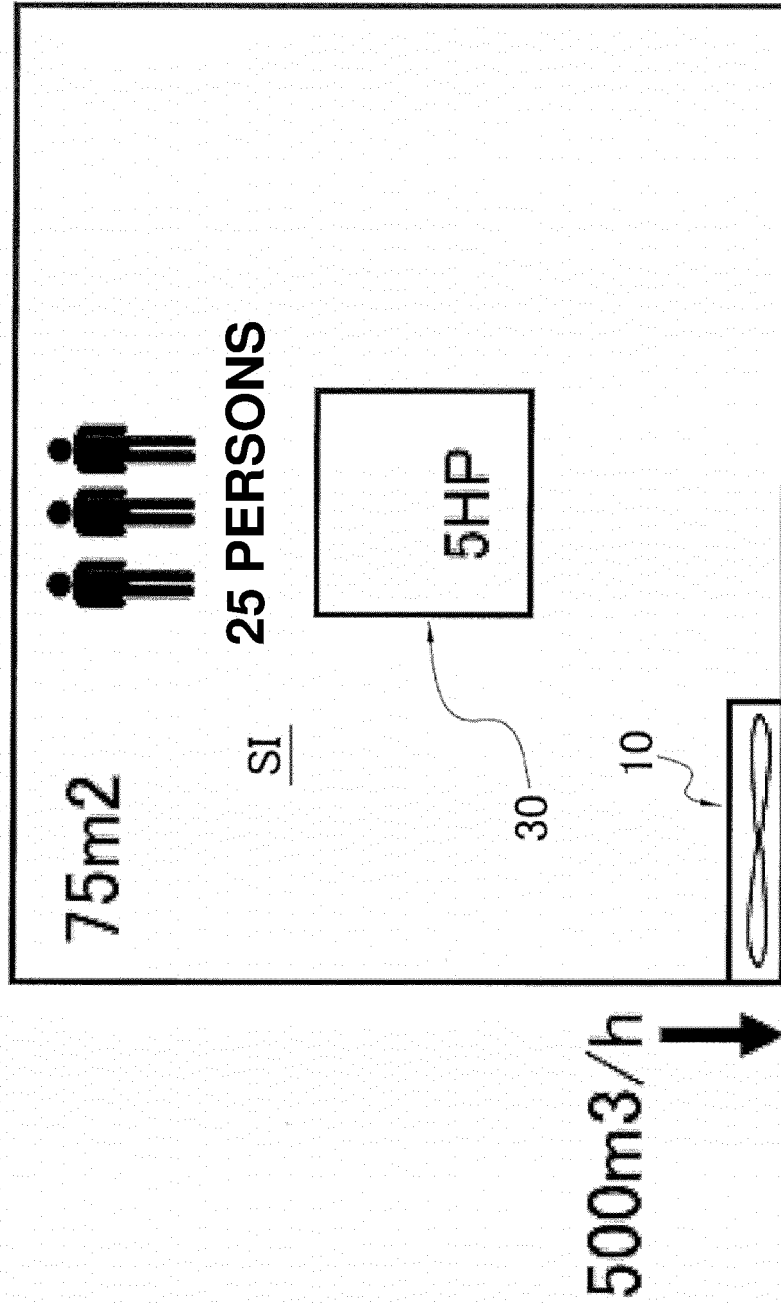


FIG. 4A

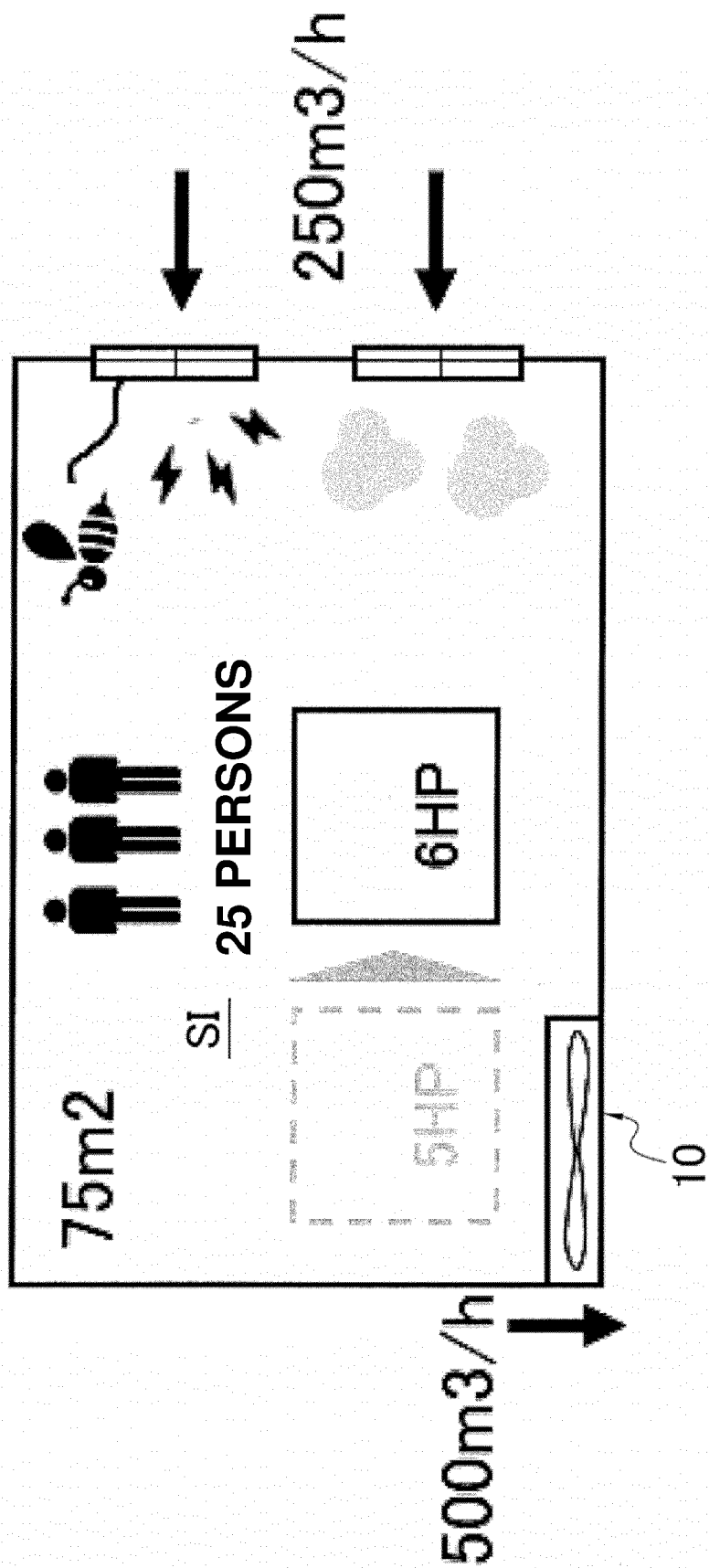


FIG. 4B

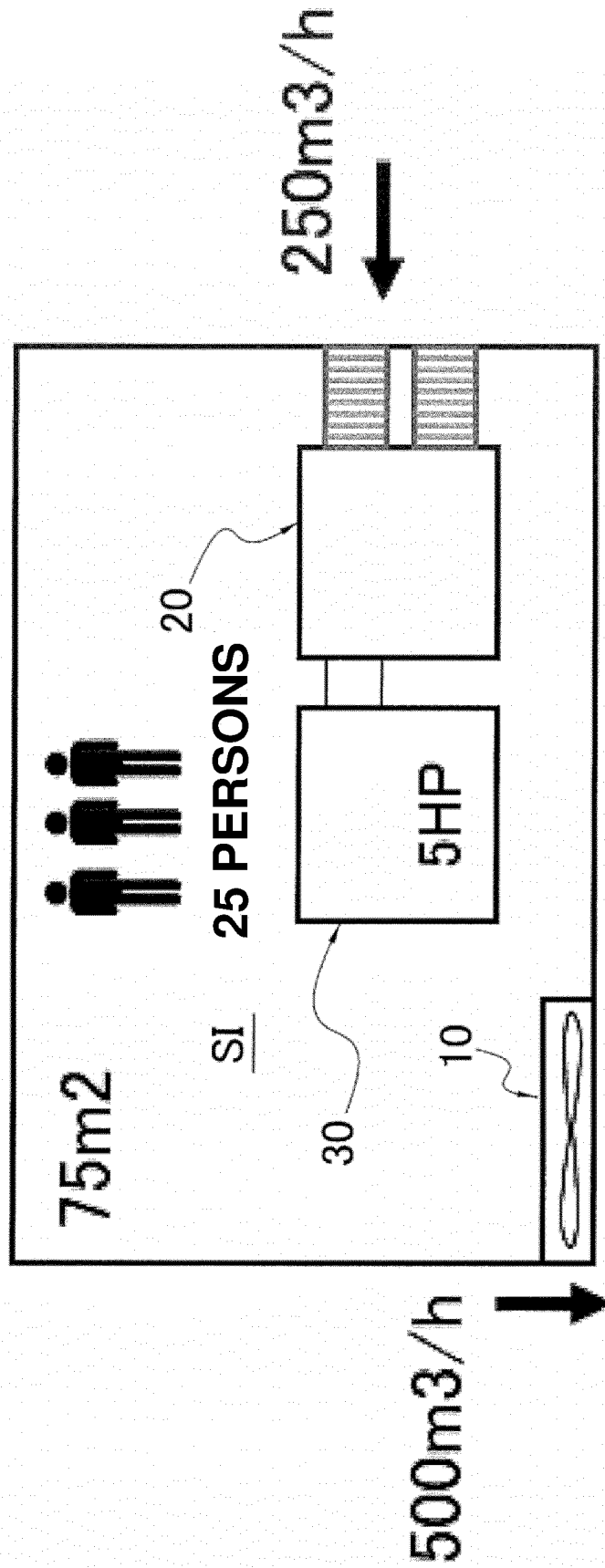


FIG. 4C

AIR-CONDITIONING INDOOR UNIT	A1	A2	A3	A4	A5	A6	A7	A8	A9
RATED CAPACITY	3.6	4.0	4.5	5.0	5.6	7.1	10.0	12.5	14.0
H-TAP AIR VOLUME[m3/min]	16	16	16	16	18.5	20.5	34	36.5	36.5
L-TAP AIR VOLUME[m3/min]	11	11	11	11	11.5	12.5	19	21	21
MAXIMUM AMOUNT OF VENTILATION BY SECOND VENTILATION DEVICE[m3/h]	150	150	150	150	150	150	250	250	250
AIR VOLUME OF SECOND VENTILATION DEVICE[m3/min]	2.5	2.5	2.5	2.5	2.5	2.5	4.2	4.2	4.2
AIR VOLUME RATE OF SECOND VENTILATION DEVICE (H TAP)[%]	15.6%	15.6%	15.6%	15.6%	13.5%	12.2%	12.3%	11.4%	11.4%
(AIR VOLUME OF SECOND VENTILATION DEVICE/H-TAP AIR VOLUME)									
AIR VOLUME RATE OF SECOND VENTILATION DEVICE (L TAP)[%]	22.7%	22.7%	22.7%	22.7%	21.7%	20.0%	21.9%	19.8%	19.8%
(AIR VOLUME OF SECOND VENTILATION DEVICE/L-TAP AIR VOLUME)									
ADDITIONAL AIR CONDITIONING LOAD BY SECOND VENTILATION DEVICE[kW]	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.6	0.6
ADDITIONAL LOAD RATE BY SECOND (ADDITIONAL AIR CONDITIONING LOAD/RATED CAPACITY)	11.1%	10.0%	8.9%	8.0%	7.1%	5.6%	6.0%	4.8%	4.3%

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/033750

A. CLASSIFICATION OF SUBJECT MATTER

F24F 7/007(2006.01)i; **F24F 7/00**(2021.01)i; **F24F 7/08**(2006.01)i; **F24F 11/72**(2018.01)i; **F24F 110/30**(2018.01)n
FI: F24F7/007 B; F24F7/00 Z; F24F7/08 101J; F24F11/72; F24F110/30

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)

F24F7/00-7/10; F24F11/00-11/89; F24F110/30

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

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 A	JP 2011-137595 A (MITSUBISHI ELECTRIC CORP.) 14 July 2011 (2011-07-14) paragraphs [0011], [0014], [0026]-[0036], fig. 5, 6	1-3, 5-10 4
Y A	「換気の悪い密閉空間」を改善するための換気の方法, 厚生労働省, 03 April 2020, pp. 1-2, Internet: <URL: https://www.mhlw.go.jp/content/10900000/000618969.pdf >, non-official translation ("Ventilation Methods to Improve Poorly-Ventilated Closed Spaces. Ministry of Health, Labour and Welfare.) in particular, p. 1, "Recommended Ventilation Methods"	1-3, 5-10 4
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-175229 A (MITSUBISHI ELECTRIC CORP.) 12 August 2010 (2010-08-12) paragraph [0040]	2-3, 5-10 4
Y	WO 2020/003405 A1 (MITSUBISHI ELECTRIC CORP.) 02 January 2020 (2020-01-02) paragraphs [0012]-[0017], fig. 1	8-10
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2011-137595 A	14 July 2011	(Family: none)	
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JP 4-13038 A	17 January 1992	(Family: none)	

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REFERENCES CITED IN THE DESCRIPTION

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