[DESCRIPTION]

[Title of Invention] BLOWER DEVICE

[Technical Field]

[0001]

The present invention relates to a blower device.

[Background Art]

[0002]

Various techniques for generating an airflow in a space have been proposed. Patent Literature 1 discloses a blower assembly for generating an aerial flow in a room.

[Citation List]

[Patent Literature]

[0003]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2012-132459

[Summary of Invention]

[Technical Problem]

[0004]

The present invention provides a blower device capable of blowing out an airflow having an excellent linearity.

[Solution to Problem]

[0005]

A blower device according to an aspect of the present invention includes: a pair of ducts that are elongated and arranged in parallel with each other; and a first blower that is positioned between the pair of ducts and blows air into each of the pair of ducts, wherein each of the pair of ducts includes a vent from which an airflow that flows in a first direction is blown out by the blowing of air, the vent being elongated along a longitudinal direction of the duct.

[Advantageous Effects of Invention]

[0006]

The blower device according to the aspect of the present invention is capable of blowing out an airflow having an excellent linearity.

[Brief Description of Drawings]

[0007]

[FIG. 1]

FIG. 1 is a diagram illustrating a blower device according to an embodiment and a space in which the blower device is provided.

[FIG. 2]

FIG. 2 is a schematic diagram for explaining an operation of the blower device according to the embodiment.

[FIG. 3]

FIG. 3 is an outer perspective view of the blower device according to the embodiment.

[FIG. 4]

FIG. 4 shows a top view, a front view, a bottom view, and a side view of the blower device according to the embodiment.

[FIG. 5]

FIG. 5 is a block diagram illustrating a functional configuration of the blower device according to the embodiment.

[FIG. 6]

FIG. 6 is a flowchart of Operation Example 1 of the blower device according to the embodiment.

[FIG. 7]

FIG. 7 is a flowchart of Operation Example 2 of the blower device according to the embodiment.

[FIG. 8]

FIG. 8 is a flowchart of Operation Example 3 of the blower device according to the embodiment.

[FIG. 9]

FIG. 9 is a flowchart of Operation Example 4 of the blower device according to the embodiment.

[FIG. 10]

FIG. 10 is a flowchart of Operation Example 5 of the blower device according to the embodiment.

[FIG. 11]

FIG. 11 is a flowchart of Operation Example 6 of the blower device according to the embodiment.

[FIG. 12]

FIG. 12 is a diagram illustrating Configuration Example 1 of an airflow control system according to the embodiment.

[FIG. 13]

FIG. 13 is a top view of a desk onto which a shape of a pair of vents is projected.

[FIG. 14]

FIG. 14 is a diagram illustrating Configuration Example 2 of the airflow control system according to the embodiment.

[FIG. 15]

FIG. 15 is a diagram illustrating Configuration Example 3 of the airflow control system according to the embodiment.

[Description of Embodiments]

[0008]

Hereinafter, embodiments will be specifically described with reference to the drawings. It should be noted that any of the embodiments described below describes a comprehensive or specific example. Numerical values, shapes, materials, constituent elements, positions at which the constituent elements are arranged, connection forms thereof, steps, an order of the steps, and the like described in the embodiments below are mere examples and are not intended to limit the present invention. Moreover, of the constituent elements in the embodiments below, the constituent elements that are not described in the independent claims are described as arbitrary constituent elements.

[0009]

It should be noted that each diagram is a schematic diagram and is not necessarily illustrated precisely. Furthermore, in each diagram, constituent elements that are substantially the same are denoted by the same reference numerals, and overlapping descriptions may be omitted or simplified.

[0010]

[Embodiment]

[Schematic configuration]

First, a configuration of a blower device according to an embodiment will be described. FIG. 1 is a diagram illustrating the

blower device according to the embodiment and a space in which the blower device is provided. FIG. 2 is a schematic diagram for explaining an operation of the blower device according to the embodiment.

[0011]

As shown in FIGS. 1 and 2, blower device 10 according to the embodiment is a device that is provided on ceiling 83 of space 80 and blows out an airflow that flows downwardly. Blower device 10 includes a pair of ducts 20 arranged to be parallel with each other, first blower 30, and second blower 40. It should be noted that in FIG. 2, illustrations of first blower 30 and second blower 40 are omitted.

[0012]

By first blower 30 and second blower 40 blowing air into the pair of ducts 20, an airflow that flows downwardly blows out from vent 23 provided in each of the pair of ducts 20. Thus, space 81 between the pair of ducts 20 becomes a negative pressure, and air of space 82 above the pair of ducts 20 is drawn into space 81. As a result, blower device 10 can downwardly blow out an airflow having an excellent linearity, which is a combination of the airflow blown out from vents 23 of the pair of ducts 20 and an airflow that is based on air that has been drawn in. By blowing out such an airflow having an excellent linearity, blower device 10 can form a so-called air curtain (sheet-like airflow) in space 80. The sheet-like airflow is schematically illustrated by an arrow in a broken line in FIG. 1, and is schematically illustrated in dots in FIG. 2.

[0013]

For example, blower device 10 is provided above household equipment such as desk 90 and blows out an airflow toward opening 91 provided on desk 90. Accordingly, an air curtain is formed between two users sitting across from each other on both sides of opening 91. By the air curtain formed by blower device 10, it is possible to suppress a situation where airborne droplets (illustrated by small circles in FIG. 2) of one of the users reach the other user.

[0014]

The airborne droplets of the one of the users may contain an

infectious substance, and thus the airborne droplets containing the infectious substance contribute to a spread of an infection. By suppressing the situation where airborne droplets of the user reach the other user by blower device 10, the spread of an infection can be suppressed. A configuration of forming an air curtain by an airflow that flows downwardly from above (downflow) like blower device 10 is less likely to cause a dispersion of airborne droplets than a configuration of forming an air curtain by an airflow that flows upwardly from below (upflow). Therefore, an effect of suppressing a spread of an infection by blower device 10 is high.

[0015]

[Configuration]

Next, a specific configuration of blower device 10 will be described. FIG. 3 is an outer perspective view of blower device 10. (a) in FIG. 4 is a top view of blower device 10, (b) in FIG. 4 is a front view of blower device 10, (c) in FIG. 4 is a bottom view of blower device 10, and (d) in FIG. 4 is a side view of blower device 10.

[0016]

Blower device 10 includes the pair of ducts 20, first blower 30, and second blower 40. It should be noted that blower device 10 only needs to include at least one blower, and may include only first blower 30 out of first blower 30 and second blower 40. First, the pair of ducts 20 will be described.

[0017]

Each of the pair of ducts 20 is elongated in a Y axis direction as a longitudinal direction. The pair of ducts 20 are arranged in an X axis direction that intersects with the Y axis direction. In other words, the pair of ducts 20 are arranged to be parallel with each other. A gap (space 81 described above) is provided between the pair of ducts 20.

[0018]

More specifically, duct 20 has a hollow rectangular parallelepiped shape. An upper surface and two side surfaces of duct 20 are closed. In other words, an opening is not provided on the upper surface and two side surfaces of duct 20. Each of the pair

of ducts 20 is formed of, for example, a resin material, but may alternatively be formed of a lightweight metal material such as aluminum.

[0019]

Of the pair of ducts 20, duct 20 positioned on a front side (plus side of X axis) does not include an opening on a front surface thereof, but includes vent hole 21 and vent hole 22 on a back surface thereof (see (b) in FIG. 4). Of the pair of ducts 20, duct 20 positioned on a back side (minus side of X axis) does not include an opening on a back surface thereof, but includes vent hole 21 and vent hole 22 on a front surface thereof.

[0020]

Vent hole 21 is connected to an inside of casing 31 of first blower 30, and first blower 30 blows air into each of the pair of ducts 20 via vent hole 21. In addition, vent hole 22 is connected to an inside of casing 41 of second blower 40, and second blower 40 blows air into each of the pair of ducts 20 via vent hole 22. Flows of air caused by the blowing of air by first blower 30 and second blower 40 are indicated by arrows in broken lines in (a) in FIG. 4.

[0021]

Vent 23 is provided on a lower surface of each of the pair of ducts 20. Vents 23 are hatched by diagonal lines in (c) in FIG. 4. Vents 23 are elongated along the longitudinal direction (Y axis direction) of ducts 20. As each of first blower 30 and second blower 40 blows air into the pair of ducts 20, an airflow that flows downwardly (minus direction of Z axis) blows out from vents 23. It should be noted that as shown in the enlarged diagram of FIG. 2, in a cross section of vents 23, a width (length in X axis direction) of vents 23 becomes smaller toward a downward direction. For example, the width of vents 23 becomes exponentially smaller toward the downward direction.

[0022]

Next, first blower 30 will be described. First blower 30 is positioned between the pair of ducts 20 at one end portion of the pair of ducts 20 in the longitudinal direction (end portion on plus side of

Y axis), and blows air into each of the pair of ducts 20. First blower 30 includes casing 31 and fan 32.

[0023]

Casing 31 has a hollow rectangular parallelepiped shape, and at least an end portion thereof on the plus side of the Y axis is opened (see (d) in FIG. 4). Moreover, a front surface of casing 31 is in contact with the back surface of front-side duct 20 out of the pair of ducts 20, and ventilation duct 31a that is in communication with vent hole 21 of front-side duct 20 is provided on the front surface of casing 31. A back surface of casing 31 is in contact with the front surface of back-side duct 20 out of the pair of ducts 20, and ventilation duct 31a that is in communication with vent hole 21 of back-side duct 20 is provided on the back surface of casing 31. Casing 31 is formed of, for example, a resin material, but may alternatively be formed of a lightweight metal material such as aluminum.

[0024]

Fan 32 is accommodated inside casing 31, takes in air from the end portion of casing 31 on the plus side of the Y axis, and blows air into each of two ventilation ducts 31a. First blower 30 includes a driving circuit (not shown) including a motor or the like in casing 31, and the driving circuit causes fan 32 to rotate about a shaft provided along the longitudinal direction of the pair of ducts 20. It should be noted that the disposition of fan 32 (orientation of rotation shaft and the like) is a mere example. Fan 32 may be disposed in any way as long as it is capable of blowing air into each of the pair of ducts 20.

[0025]

Next, second blower 40 will be described. Second blower 40 is positioned between the pair of ducts 20 at the other end portion of the pair of ducts 20 in the longitudinal direction (end portion on minus side of Y axis), and blows air into each of the pair of ducts 20. Second blower 40 includes casing 41 and fan 42.

[0026]

Casing 41 has a hollow rectangular parallelepiped shape, and at least an end portion thereof on the minus side of the Y axis is opened (illustration is omitted). Moreover, a front surface of casing

41 is in contact with the back surface of front-side duct 20 out of the pair of ducts 20, and ventilation duct 41a that is in communication with vent hole 22 of front-side duct 20 is provided on the front surface of casing 41. A back surface of casing 41 is in contact with the front surface of back-side duct 20 out of the pair of ducts 20, and ventilation duct 41a that is in communication with vent hole 22 of back-side duct 20 out of the pair of ducts 20 is provided on the back surface of casing 41. Casing 41 is formed of, for example, a resin material, but may alternatively be formed of a lightweight metal material such as aluminum.

[0027]

Fan 42 is accommodated inside casing 41, takes in air from the end portion of casing 41 on the minus side of the Y axis, and blows air into each of two ventilation ducts 41a. Second blower 40 includes a driving circuit (not shown) including a motor or the like in casing 41, and the driving circuit causes fan 42 to rotate about a shaft provided along the longitudinal direction of the pair of ducts 20. It should be noted that the disposition of fan 42 (orientation of rotation shaft and the like) is a mere example. Fan 42 may be disposed in any way as long as it is capable of blowing air into each of the pair of ducts 20.

[0028]

In blower device 10 described above, first blower 30 and second blower 40 are arranged between the pair of ducts 20. Accordingly, first blower 30 and second blower 40 also function as members that keep an interval between the pair of ducts 20 constant. In blower device 10, since space 81 is formed between the pair of ducts 20 at a portion between first blower 30 and second blower 40 in the longitudinal direction by first blower 30 and second blower 40, and air is drawn into space 81, an airflow having an excellent linearity can be blown out.

[0029]

In addition, by arranging first blower 30 and second blower 40 between the pair of ducts 20, noises emitted from first blower 30 and second blower 40 can be suppressed by the pair of ducts 20.

[0030]

Further, a portion of first blower 30 (casing 31) is positioned to be higher than the upper surfaces of the pair of ducts 20. Similarly, a portion of second blower 40 (casing 41) is positioned to be higher than the upper surfaces of the pair of ducts 20.

[0031]

As described above, in blower device 10, by drawing in air from space 82 above the pair of ducts 20, an air curtain can be formed efficiently. If a portion of each of first blower 30 and second blower 40 protrudes further upwardly than the pair of ducts 20, space 82 can be secured above the pair of ducts 20 when blower device 10 is attached to ceiling 83. It should be noted that blower device 10 may be attached to ceiling 83 by connecting the upper surfaces of first blower 30 and second blower 40 to ceiling 83, or may be hung from ceiling 83 using wires and the like. The wires in this case are connected to at least one of the upper surfaces of first blower 30 and second blower 40 and the upper surfaces of the pair of ducts 20.

[0032]

Furthermore, blower device 10 includes first blower 30 at one end portion thereof in the longitudinal direction, and includes second blower 40 at the other end portion thereof in the longitudinal direction. With such a configuration, a strength distribution (wind speed distribution) of the airflow (wind) that is blown out from the pair of ducts 20, in the longitudinal direction, can be uniformized. If the strength distribution in the longitudinal direction is uniformized, blower device 10 can uniformly draw in air in the longitudinal direction from space 82 above, and thus an air curtain can be uniformly formed in the longitudinal direction.

[0033]

It should be noted that for uniformizing the strength distribution of the airflow that is blown out from the pair of ducts 20 in the longitudinal direction, a partition plate (partition member) may be provided as necessary at center portions C (illustrated in broken lines in (a) and (b) in FIG. 4) of the pair of ducts 20 in the longitudinal direction. In addition, for uniformizing the strength distribution of the airflow that is blown out from the pair of ducts 20

in the longitudinal direction, the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 are set to be the same, for example.

[0034]

[Functional configuration]

Next, a functional configuration of blower device 10 will be described. FIG. 5 is a block diagram illustrating the functional configuration of blower device 10. In FIG. 5, information terminal 61, ranging sensor 62, human detecting sensor 63, camera 64, and microphone 65 are illustrated in addition to blower device 10. It should be noted that ranging sensor 62, human detecting sensor 63, camera 64, and microphone 65 may be provided in blower device 10, or may be built in blower device 10.

[0035]

Blower device 10 includes first blower 30, second blower 40, controller 51, and storage 52. For example, controller 51 and storage 52 are built in blower device 10.

[0036]

Controller 51 controls the strength of the blowing of air of first blower 30 (for example, rotation speeds of fan 32 and fan 42) and the strength of the blowing of air of second blower 40. The strength of the blowing of air is, in other words, an air volume or wind speed. For example, controller 51 performs control to match the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 (aligned at the same strength). Accordingly, blower device 10 can uniformize the strength distribution of the airflow that is blown out from the pair of ducts 20 in the longitudinal direction.

[0037]

Moreover, controller 51 is capable of performing wired or wireless communication with each of information terminal 61, ranging sensor 62, human detecting sensor 63, camera 64, microphone 65, and the like. Controller 51 controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on information obtained from

information terminal 61, ranging sensor 62, human detecting sensor 63, camera 64, the microphone, and the like through the communication.

[0038]

For example, controller 51 is realized by a microcomputer, but may alternatively be realized by a processor. The functions of controller 51 are realized by a microcomputer or the like constituting controller 51 executing a computer program stored in storage 52.

[0039]

Storage 52 is a storage device that stores various types of information requisite for controller 51 to control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40, computer programs, and the like. Storage 52 is realized by, for example, a semiconductor memory or the like. Storage 52 may be built in controller 51.

[0040]

Information terminal 61 is an information terminal to which a user inputs information for controlling blower device 10. Information terminal 61 is, for example, a general-purpose apparatus such as a personal computer, a smartphone, and a tablet terminal, but may alternatively be a dedicated device (for example, dedicated remote controller) of blower device 10.

[0041]

Ranging sensor 62 measures a distance between blower device 10 and a target surface and outputs distance information indicating the measured distance. The target surface is a surface that is substantially opposed to the lower surfaces of blower device 10 (surfaces on which vents 23 are provided), and is, for example, an upper surface of desk 90. Ranging sensor 62 is, for example, a TOF (Time Of Flight)-type laser ranging sensor that emits infrared laser light and detects reflected infrared laser light, but may alternatively be other ranging sensors.

[0042]

Human detecting sensor 63 senses whether there is a person staying in space 80 in which blower device 10 is provided, and

outputs information indicating whether a person is present in space 80. Human detecting sensor 63 is, for example, a pyroelectric sensor that senses infrared light emitted from a body of a person.

[0043]

Camera 64 captures an image (moving image and still image) in space 80 in which blower device 10 is provided, and outputs image information of the captured image. Camera 64 is, in other words, an image sensor. Camera 64 is, for example, a surveillance camera or the like.

[0044]

Microphone 65 acquires sound in space 80 in which blower device 10 is provided, and outputs sound information of the acquired sound. Microphone 65 is, in other words, a sound sensor.

[0045]

[Operation Example 1]

Blower device 10 can control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on the distance between blower device 10 and the target surface (for example, upper surface of desk 90). Hereinafter, Operation Example 1 of such blower device 10 will be described. FIG. 6 is a flowchart of Operation Example 1 of blower device 10.

[0046]

The user inputs a distance between blower device 10 and the target surface to information terminal 61. The user may input the distance using a numerical value, or may choose from options of distances presented by information terminal 61. It should be noted that such an input is made by a builder (worker at construction company) when installing blower device 10 on ceiling 83 of space 80, for example. In other words, the user is, for example, a builder. Information terminal 61 outputs distance information indicating the input distance to blower device 10. It should be noted that the user may also be a general user.

[0047]

Controller 51 of blower device 10 acquires the output distance information (S11) and controls the strength of the blowing of air of

first blower 30 and the strength of the blowing of air of second blower 40 based on the distance indicated by the acquired distance information (S12). Specifically, controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 as the distance indicated by the distance information becomes longer. Accordingly, blower device 10 can cause an air curtain formed by blower device 10 to reach the upper surface of desk 90.

[0048]

It should be noted that the distance information acquired in Step S11 may be distance information indicating a measurement value measured by ranging sensor 62. In other words, controller 51 may also acquire distance information from ranging sensor 62.

[0049]

Further, when the distance information acquired in Step S11 indicates the measurement value measured by ranging sensor 62, a threshold of the distance may be input to information terminal 61. In a case where the distance indicated by the distance information, that has been measured by ranging sensor 62, is determined to be larger than the threshold of the distance input to information terminal 61, controller 51 intensifies the blowing of air of first blower 30 and second blower 40 more than in a case where the distance indicated by the distance information, that has been measured by ranging sensor 62, is determined to be equal to or smaller than the threshold of the distance input to information terminal 61.

[0050]

[Operation Example 2]

Blower device 10 may control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on whether a person is present in space 80 below blower device 10. Hereinafter, Operation Example 2 of such blower device 10 will be described. FIG. 7 is a flowchart of Operation Example 2 of blower device 10.

[0051]

Human detecting sensor 63 senses infrared light emitted from a body of a person and outputs, to blower device 10, information

indicating whether a person is present in space 80 based on the sensing result.

[0052]

Controller 51 of blower device 10 acquires the output information indicating whether a person is present (S21), and controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on whether a person is present which is indicated by the acquired information (S22). Specifically, when a person is present in space 80, controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 more than in a case where there is no person in space 80. In this manner, by intensifying the blowing of air when a person is present in space 80 and a necessity of blocking airborne droplets is high, blower device 10 can be operated efficiently. It should be noted that when there is no person in space 80, controller 51 may stop the blowing of air of first blower 30 and the blowing of air of second blower 40.

[0053]

Further, controller 51 may acquire image information of an image captured in space 80, that has been output by camera 64 in Step S21, and determine whether a person is present by processing the acquired image information after Step S21. In this case, various types of existing processing for detecting a person from an image are used. In this manner, controller 51 may determine whether a person is present using camera 64 in place of human detecting sensor 63.

[0054]

[Operation Example 3]

Blower device 10 may control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on a time a person stays in space 80 below blower device 10. Hereinafter, Operation Example 3 of such blower device 10 will be described. FIG. 8 is a flowchart of Operation Example 3 of blower device 10.

[0055]

Human detecting sensor 63 senses infrared light emitted from a body of a person and outputs, to blower device 10, information indicating whether a person is present in space 80 based on the sensing result.

[0056]

Controller 51 of blower device 10 acquires the output information indicating whether a person is present (S31), and calculates a time a person stays in space 80 based on the acquired information (S32). For example, controller 51 can calculate the stay time of a person by integrating the times during which the acquired information indicates that the person is present. The stay time is reset when the acquired information indicates that there is no person.

[0057]

Next, controller 51 controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on the calculated stay time (S33). Specifically, controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 as the time the person stays in space 80 becomes longer.

[0058]

When the time the person stays in space 80 is long, it is presumed that a large amount of airborne droplets are contained in air. In this manner, by intensifying the blowing of air when a time a person stays in space 80 is long and a necessity of blocking airborne droplets is high, blower device 10 can be operated efficiently. It should be noted that when there is no person in space 80, controller 51 may stop the blowing of air of first blower 30 and the blowing of air of second blower 40.

[0059]

Further, controller 51 may acquire image information of an image captured in space 80, that has been output by camera 64 in Step S31, and calculate a stay time of a person by processing the image information in Step S32. In this case, various types of existing processing for detecting a person from an image are used.

In this manner, controller 51 may calculate the stay time of a person using camera 64 in place of human detecting sensor 63.

[0060]

[Operation Example 4]

Blower device 10 may control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on whether a person is wearing a mask in space 80 below blower device 10. Hereinafter, Operation Example 4 of such blower device 10 will be described. FIG. 9 is a flowchart of Operation Example 4 of blower device 10.

[0061]

Camera 64 captures an image in space 80 and outputs image information of the captured image to blower device 10.

[0062]

Controller 51 of blower device 10 acquires the output image information (S41) and determines whether a person present in space 80 is wearing a mask by processing the acquired image information (S42). Specifically, controller 51 can process the acquired image information to detect a person in the image and determine whether a mask is worn based on whether a nose and a mouth are captured at a face portion of the detected person. It should be noted that other existing processing (algorithms) may also be used for determining whether a mask is worn.

[0063]

Next, controller 51 controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on the determination result on whether a mask is worn (S43). Specifically, when a person present in space 80 is not wearing a mask, controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 more than in a case where the person is wearing a mask. In this manner, by intensifying the blowing of air when a person present in space 80 is not wearing a mask and a necessity of blocking airborne droplets is high, blower device 10 can be operated efficiently.

[0064]

It should be noted that in a case where a plurality of people are present in space 80, controller 51 may intensify, when even one of them is not wearing a mask, the blowing of air of first blower 30 and the blowing of air of second blower 40 more than in a case where all of them are wearing a mask. In the case where a plurality of people are present in space 80, controller 51 may intensify the blowing of air of first blower 30 and the blowing of air of second blower 40 as the number of people not wearing a mask increases.

[0065]

[Operation Example 5]

Blower device 10 may control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on a speaking amount (speaking time) of a person in space 80 below blower device 10. Hereinafter, Operation Example 5 of such blower device 10 will be described. FIG. 10 is a flowchart of Operation Example 5 of blower device 10.

[0066]

Microphone 65 acquires sound in space 80 and outputs sound information of the acquired sound to blower device 10.

[0067]

Controller 51 of blower device 10 acquires the output sound information (S51) and calculates a speaking amount of a person in space 80 based on the acquired sound information (S52). For example, controller 51 assumes a length of a period during which a volume (sound pressure level) becomes equal to or larger than a predetermined value in a unit period (for example, about several minutes to ten minutes), as the speaking amount (speaking time). It should be noted that as a method of specifying the period during which a person speaks, other existing methods such as a method of performing a waveform analysis may also be used.

[0068]

Next, controller 51 controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on the calculated speaking amount (S53). Specifically, controller 51 controls, based on a speaking amount in a

certain unit period, the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 in the next unit period. Controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 in the next unit period as the speaking amount in the certain unit period becomes larger.

[0069]

When the speaking amount of the person in space 80 is large, it is presumed that a large amount of airborne droplets are contained in air. In this manner, by intensifying the blowing of air when a speaking amount of a person in space 80 is large and a necessity of blocking airborne droplets is high, blower device 10 can be operated efficiently. It should be noted that when no one is speaking in space 80 (when a volume does not become equal to or larger than a predetermined value in a unit period), controller 51 may stop the blowing of air of first blower 30 and the blowing of air of second blower 40.

[0070]

[Operation Example 6]

Blower device 10 may control the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on a speaking volume of a person in space 80 below blower device 10. Hereinafter, Operation Example 6 of such blower device 10 will be described. FIG. 11 is a flowchart of Operation Example 6 of blower device 10.

[0071]

Microphone 65 acquires sound in space 80 and outputs sound information of the acquired sound to blower device 10.

[0072]

Controller 51 of blower device 10 acquires the output sound information (S61) and calculates a speaking volume of a person in space 80 based on the acquired sound information (S62). For example, controller 51 specifies a period during which a volume (sound pressure level) becomes equal to or larger than a predetermined value in a unit period (for example, about several

minutes to ten minutes), and assumes an average volume in the specified period as the speaking volume. It should be noted that as a method of specifying the period during which a person speaks, other existing methods such as a method of performing a waveform analysis may also be used.

[0073]

Next, controller 51 controls the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 based on the calculated speaking volume (S63). Specifically, controller 51 controls, based on a speaking volume in a certain unit period, the strength of the blowing of air of first blower 30 and the strength of the blowing of air of second blower 40 in the next unit period. Controller 51 intensifies the blowing of air of first blower 30 and the blowing of air of second blower 40 in the next unit period as the speaking volume in the certain unit period becomes larger.

[0074]

When the speaking volume of a person in space 80 is large (that is, when a person is speaking with a large voice), it is presumed that a large amount of airborne droplets are contained in air. In this manner, by intensifying the blowing of air when a speaking volume of a person in space 80 is large and a necessity of blocking airborne droplets is high, blower device 10 can be operated efficiently. It should be noted that when no one is speaking in space 80 (when a volume does not become equal to or larger than a predetermined value in a unit period), controller 51 may stop the blowing of air of first blower 30 and the blowing of air of second blower 40.

[0075]

[Configuration Example 1 of airflow control system]

The present invention may also be realized as an airflow control system including blower device 10. FIG. 12 is a diagram illustrating Configuration Example 1 of the airflow control system according to the embodiment.

[0076]

As shown in FIG. 12, airflow control system 100 according to

the embodiment includes blower device 10, cabinet fan 70, and desk 90. Desk 90 is an example of the household equipment.

[0077]

Blower device 10 is an example of a first blower device. For example, blower device 10 is provided above the household equipment such as desk 90, and blows out an airflow toward opening 91 provided on desk 90. In other words, desk 90 includes opening 91 through which an airflow that is blown out from vent 23 of each of the pair of ducts 20 passes.

[0078]

Cabinet fan 70 is an example of a second blower device. Cabinet fan 70 is provided in internal space 86 of wall 84 provided in space 80. Cabinet fan 70 sucks in air blown against floor 85 by blower device 10 via opening 84a provided at a lower portion of wall 84, and delivers it toward upper space 87 provided above ceiling 83 (that is, in upward direction). Cabinet fan 70 includes an air filter, a blast fan, and the like, and is a unit realized by accommodating these constituent elements in a casing.

[0079]

Such airflow control system 100 is capable of discharging aerosol (airborne droplets and the like) contained in air that is blown against floor 85 by blower device 10 to outside of space 80. Thus, airflow control system 100 can suppress a spread of an infection in space 80.

[0080]

It should be noted that when the airflow blown out by blower device 10 hits the upper surface of desk 90, there is a possibility that aerosol will be dispersed in the vicinity of the upper surface of desk 90. In this regard, so that the airflow does not hit the upper surface of desk 90, opening 91 is formed to be sufficiently larger than the pair of vents 23. FIG. 13 is a top view of desk 90 onto which a shape of the pair of vents 23 is projected.

[0081]

As shown in FIG. 13, when the pair of vents 23 are projected onto the upper surface of desk 90, either of the pair of vents 23 is

positioned within an area where opening 91 is provided. This projection is made vertical to the upper surface of desk 90 so that the shape of the vents appears in the actual size at the position on the upper surface of desk 90. A length of opening 91 (length in Y axis direction) is larger than that of vents 23, and a width of opening 91 (length in X axis direction) is larger than that of vents 23. Accordingly, a situation where the airflow blown out by blower device 10 hits the upper surface of desk 90 is suppressed.

[0082]

[Configuration Example 2 of airflow control system]

The airflow control system including blower device 10 is not limited to the configuration as in airflow control system 100. FIG. 14 is a diagram illustrating Configuration Example 2 of the airflow control system according to the embodiment.

[0083]

As shown in FIG. 14, airflow control system 100a includes blower device 10, cabinet fan 70, and desk 90.

[0084]

In airflow control system 100a, inlet 92 is provided on the upper surface of desk 90. In addition, airflow control system 100a includes suction path 93 (duct) that connects inlet 92 and opening 84a provided at the lower portion of wall 84. Accordingly, cabinet fan 70 can suck in air from inlet 92.

[0085]

For example, blower device 10 is provided above the household equipment such as desk 90, and blows out air toward inlet 92 provided on desk 90. In other words, the airflow blown out from vent 23 of each of the pair of ducts 20 is completely taken in from inlet 92. Therefore, airflow control system 100a is set such that an amount of air sucked in from inlet 92 becomes larger than that of air blown out from blower device 10.

[0086]

Cabinet fan 70 is provided in internal space 86 of wall 84 provided in space 80. Cabinet fan 70 sucks in air from inlet 92 via suction path 93 and opening 84a provided at the lower portion of wall

84, and delivers it toward upper space 87 provided above ceiling 83 (that is, in upward direction). Cabinet fan 70 includes an air filter, a blast fan, and the like, and is a unit realized by accommodating these constituent elements in a casing.

[0087]

Such airflow control system 100a is capable of discharging aerosol (airborne droplets and the like) generated from a person to outside of space 80 by blower device 10. Thus, airflow control system 100a can suppress a spread of an infection in space 80.

[0088]

It should be noted that an opening area of inlet 92 does not need to be larger than a projection area of the pair of vents 23. By making a setting such that the amount of air sucked in from inlet 92 becomes larger than that of air blown out from blower device 10, a situation where aerosol is dispersed from the upper surface of desk 90 can be suppressed.

[0089]

[Configuration Example 3 of airflow control system]

FIG. 15 is a diagram illustrating Configuration Example 3 of the airflow control system according to the embodiment. As shown in FIG. 15, airflow control system 100b according to the embodiment includes blower device 10, cabinet fan 70, and desk 90.

[0090]

In airflow control system 100b, inlet 92 is provided on the upper surface of desk 90. In addition, airflow control system 100b includes suction path 93 (duct) that connects inlet 92 and cabinet fan 70 disposed right below inlet 92. Inlet 92 includes high-efficiency filter 94 that is capable of collecting particulates. High-efficiency filter 94 is, for example, a HEPA (High Efficiency Particulate Air) filter. High-efficiency filter 94 has a function of collecting aerosol contained in air sucked in from inlet 92 and thus cleaning air. By providing high-efficiency filter 94 in the vicinity of inlet 92, the user can easily replace high-efficiency filter 94 and perform maintenance of high-efficiency filter 94.

[0091]

For example, blower device 10 is provided above the household equipment such as desk 90, and blows out an airflow toward inlet 92 provided on desk 90. In other words, the airflow blown out from vent 23 of each of the pair of ducts 20 is completely taken in from inlet 92. Therefore, airflow control system 100b is set such that an amount of air sucked in from inlet 92 becomes larger than that of air blown out from blower device 10.

[0092]

Cabinet fan 70 is provided below desk 90. Cabinet fan 70 sucks in air from inlet 92 via suction path 93, and delivers air that has been cleaned by passing through high-efficiency filter 94, to the inside of space 80. Cabinet fan 70 includes a blast fan and the like, and is a unit realized by accommodating these constituent elements in a casing.

[0093]

Such airflow control system 100b is capable of cleaning aerosol (airborne droplets and the like) generated from a person and returning it to inside of space 80 by blower device 10, to thus clean air in space 80. Thus, airflow control system 100b can suppress a spread of an infection in space 80.

[0094]

It should be noted that the opening area of inlet 92 does not need to be larger than the projection area of the pair of vents 23. By making a setting such that the amount of air sucked in from inlet 92 becomes larger than that of air blown out from blower device 10, a situation where aerosol is dispersed from the upper surface of desk 90 can be suppressed.

[0095]

[Modified Example]

In the embodiment described above, blower device 10 is provided on ceiling 83 and blows out an airflow downwardly. However, blower device 10 may be provided on wall 84 so as to blow out an airflow in a lateral direction (for example, front-rear left-right directions). Blower device 10 only needs to blow out an airflow in an arbitrary direction according to its installation state. Hereinafter,

this arbitrary direction will be referred to as a first direction. A direction opposite to the first direction will be referred to as a second direction.

[0096]

[Effects etc.]

As described above, blower device 10 includes a pair of ducts 20 that are elongated and arranged in parallel with each other, and first blower 30 that is positioned between the pair of ducts 20 and blows air into each of the pair of ducts 20. Each of the pair of ducts 20 includes vent 23 from which an airflow that flows in a first direction is blown out by the blowing of air, vent 23 being elongated along a longitudinal direction of the duct 20.

[0097]

In such blower device 10, space 81 is formed between the pair of ducts 20 by first blower 30, and air is drawn into space 81, so that an airflow having an excellent linearity can be blown out. Moreover, in such blower device 10, first blower 30 can be caused to also function as a member that keeps the interval between the pair of ducts 20 constant. In addition, noises emitted from first blower 30 can be suppressed by the pair of ducts 20.

[0098]

Further, for example, a portion of first blower 30 protrudes further in a second direction than the pair of ducts 20, the second direction being opposite to the first direction.

[0099]

In such blower device 10, it becomes easy to form a space (for example, space 82) in a direction opposite to vents 23 of the pair of ducts 20. By air being drawn into space 81 from the formed space, blower device 10 can blow out an airflow having a high linearity.

[0100]

Further, for example, blower device 10 further includes second blower 40 that is positioned between the pair of ducts 20 and blows air into each of the pair of ducts 20. First blower 30 is positioned between the pair of ducts 20 at one end portion of the pair of ducts 20, and second blower 40 is positioned between the pair of ducts 20

at another end portion of the pair of ducts 20.

[0101]

Such blower device 10 can uniformize the strength distribution of the airflow that is blown out from the pair of ducts 20, in the longitudinal direction.

[0102]

Further, for example, each of first blower 30 and second blower 40 includes a fan (fan 32 and fan 42) that rotates about a shaft provided along the longitudinal direction.

[0103]

By each of first blower 30 and second blower 40 blowing air along the longitudinal direction of the pair of ducts 20, such blower device 10 can uniformize the strength distribution of the airflow that is blown out from vents 23, in the longitudinal direction.

[0104]

Further, for example, blower device 10 further includes controller 51 that performs control to match a strength of the blowing of air of first blower 30 and a strength of the blowing of air of second blower 40.

[0105]

Such blower device 10 can uniformize the strength distribution of the airflow that is blown out from the pair of ducts 20, in the longitudinal direction.

[0106]

Further, for example, the airflow that is blown out from vent 23 of each of the pair of ducts 20 flows downward.

[0107]

Such blower device 10 can downwardly blow out an airflow having an excellent linearity.

[0108]

Further, for example, the airflow that is blown out from vent 23 of each of the pair of ducts 20 flows toward desk 90, and desk 90 includes opening 91 through which an airflow that is blown out from vent 23 of each of the pair of ducts 20 passes. Desk 90 is an example of the household equipment.

[0109]

Such blower device 10 can form an air curtain (wall of airflow) above desk 90.

[0110]

Further, for example, when a shape of vent 23 of each of the pair of ducts 20 is projected toward desk 90, the shape of vents 23 is positioned within an area where opening 91 is provided.

[0111]

Such blower device 10 can suppress a situation where the airflow that is blown out by blower device 10 hits the upper surface of desk 90.

[0112]

Further, for example, the airflow that is blown out from vent 23 of each of the pair of ducts 20 flows toward a target surface. Blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on a distance between blower device 10 and the target surface. The target surface is, for example, the upper surface of desk 90, but may also be an upper surface of floor 85 or the like.

[0113]

Such blower device 10 can operate such that the airflow that blows out from blower device 10 reaches the target surface.

[0114]

Further, for example, controller 51 intensifies the blowing of air of first blower 30 as the distance increases.

[0115]

Such blower device 10 can cause the airflow that blows out from blower device 10 to reach the target surface. In other words, blower device 10 can stably form an air curtain.

[0116]

Further, for example, blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on whether a person is present in space 80 in which blower device 10 is provided.

[0117]

By intensifying the blowing of air when a person is present in space 80 (that is, when a necessity of blocking airborne droplets by an airflow blown out from blower device 10 is high), such blower device 10 can be operated efficiently.

[0118]

Further, for example, blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on a time a person stays in space 80 in which blower device 10 is provided.

[0119]

By intensifying the blowing of air when the stay time of a person is long (that is, when a necessity of blocking airborne droplets by an airflow blown out from blower device 10 is high), such blower device 10 can be operated efficiently.

[0120]

Further, for example, blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on whether a person is wearing a mask in space 80 in which blower device 10 is provided.

[0121]

By intensifying the blowing of air when a person is not wearing a mask (that is, when a necessity of blocking airborne droplets by an airflow blown out from blower device 10 is high), such blower device 10 can be operated efficiently.

[0122]

Further, for example, blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on a speaking amount of a person in space 80 in which blower device 10 is provided.

[0123]

By intensifying the blowing of air when a speaking amount of a person large (that is, when a necessity of blocking airborne droplets by an airflow blown out from blower device 10 is high), such blower device 10 can be operated efficiently.

[0124]

Further, for example, blower device 10 further includes controller 51 that controls a strength of the blowing of air of first blower 30 based on a speaking volume of a person in space 80 in which blower device 10 is provided.

[0125]

By intensifying the blowing of air when a speaking volume of a person is large (that is, when a necessity of blocking airborne droplets by an airflow blown out from blower device 10 is high), such blower device 10 can be operated efficiently.

[0126]

[Other embodiments]

Heretofore, the embodiment has been described, but the present invention is not limited to the embodiment described above.

[0127]

For example, although the blower device includes the pair of long ducts arranged in parallel with each other in the embodiment described above, the blower device may alternatively include three or more long ducts arranged in parallel with one another. In other words, the blower device only needs to include at least two ducts.

[0128]

Further, the order of the processing described in the embodiment above is a mere example. The order of the plurality of processing may be changed, or the plurality of processing may be executed in parallel. Moreover, processing to be executed by a particular processing unit may be executed by another processing unit.

[0129]

Furthermore, the respective constituent elements may be realized by executing software programs appropriate to the respective constituent elements in the embodiment described above. The respective constituent elements may be realized by a program execution unit such as a CPU and a processor reading software programs recorded onto a recording medium such as a hard disk and a semiconductor memory and executing them.

[0130]

Alternatively, the respective constituent elements may be realized by hardware. For example, each constituent element may be a circuit (or integrated circuit). These circuits may constitute a single circuit as a whole or may be different circuits. In addition, these circuits may each be a general-purpose circuit, or may be a dedicated circuit.

[0131]

Further, an overall or specific aspect of the present invention may be realized by a system, an apparatus, a method, an integrated circuit, a computer program, or a computer-readable recording medium such as a CD-ROM, or may be realized by an arbitrary combination of the system, apparatus, method, integrated circuit, computer program, and recording medium. For example, the present invention may also be realized as a building to which the airflow control system according to the embodiment described above is applied. Further, the present invention may also be realized as a control method of a blower device that is executed by a computer such as the controller of the embodiment described above, or may be realized as a program for causing a computer to execute such a control method. Moreover, the present invention may also be realized as a non-transitory computer-readable recording medium onto which such a program is recorded.

[0132]

In addition, configurations obtained by adding various modifications conceivable by persons skilled in the art to the respective embodiments, or configurations realized by arbitrarily combining the constituent elements and functions of the respective embodiments without departing from the spirit and scope of the present invention are also included in the present invention.

[Reference Signs List]

[0133]

10 blower device

20 duct

23 vent

30 first blower

40 second blower
51 controller
80 space
90 desk (household equipment)
91 opening
C center portion

[CLAIMS]

[Claim 1]

A blower device comprising:

a pair of ducts that are elongated and arranged in parallel with each other; and

a first blower that is positioned between the pair of ducts and blows air into each of the pair of ducts,

wherein each of the pair of ducts includes a vent from which an airflow that flows in a first direction is blown out by the blowing of air, the vent being elongated along a longitudinal direction of the duct.

[Claim 2]

The blower device according to claim 1, wherein

a portion of the first blower protrudes further in a second direction than the pair of ducts, the second direction being opposite to the first direction.

[Claim 3]

The blower device according to claim 1 or 2, further comprising:

a second blower that is positioned between the pair of ducts and blows air into each of the pair of ducts,

wherein the first blower is positioned between the pair of ducts at one end portion of the pair of ducts, and

the second blower is positioned between the pair of ducts at another end portion of the pair of ducts.

[Claim 4]

The blower device according to claim 3, wherein

each of the first blower and the second blower includes a fan that rotates about a shaft provided along the longitudinal direction.

[Claim 5]

The blower device according to claim 3 or 4, further comprising:

a controller that performs control to match a strength of the blowing of air of the first blower and a strength of the blowing of air of the second blower.

[Claim 6]

The blower device according to any one of claims 1 to 5, wherein

the airflow that is blown out from the vent of each of the pair of ducts flows downward.

[Claim 7]

The blower device according to any one of claims 1 to 6, wherein

the airflow that is blown out from the vent of each of the pair of ducts flows toward household equipment, and

the household equipment includes an opening through which the airflow blown out from the vent of each of the pair of ducts passes.

[Claim 8]

The blower device according to claim 7, wherein

when a shape of the vent of each of the pair of ducts is projected toward the household equipment, the shape is positioned within an area where the opening is provided.

[Claim 9]

The blower device according to any one of claims 1 to 8, wherein

the airflow that is blown out from the vent of each of the pair of ducts flows toward a target surface, and

the blower device further comprises:

a controller that controls a strength of the blowing of air of the first blower based on a distance between the blower device and the target surface.

[Claim 10]

The blower device according to claim 9, wherein

the controller intensifies the blowing of air of the first blower as the distance increases.

[Claim 11]

The blower device according to any one of claims 1 to 8, further comprising:

a controller that controls a strength of the blowing of air of the first blower based on whether a person is present in a space in which the blower device is provided.

[Claim 12]

The blower device according to any one of claims 1 to 8, further comprising:

a controller that controls a strength of the blowing of air of the first blower based on a time a person stays in a space in which the blower device is provided.

[Claim 13]

The blower device according to any one of claims 1 to 8, further comprising:

a controller that controls a strength of the blowing of air of the first blower based on whether a person is wearing a mask in a space in which the blower device is provided.

[Claim 14]

The blower device according to any one of claims 1 to 8, further comprising:

a controller that controls a strength of the blowing of air of the first blower based on a speaking amount of a person in a space in which the blower device is provided.

[Claim 15]

The blower device according to any one of claims 1 to 8,

further comprising:

a controller that controls a strength of the blowing of air of the first blower based on a speaking volume of a person in a space in which the blower device is provided.