

DESCRIPTION

Title of the Invention: AIR PURIFIER

Technical Field

[0001] The present invention relates to an air purifier provided with a dust collector that collects dust in air.

Background Art

[0002] Patent Document 1 identified below discloses a conventional air purifier. The air purifier has a suction port and a blowout port open in a housing placed on a floor surface in a room or the like, and has inside the housing an air passage that connects between the suction port and the blowout port. The suction port is open in the front face of the casing, and the blowout port is open from a left-end part to a right-end part of a rear part of the top face of the casing. Inside the air passage, a blower is disposed, and on the upstream side of the blower in the air passage, a pre-filter (dust collector) for collecting dust in air is disposed upright.

[0003] In the air purifier structured as described above, when its operation is started, the blower is operated so that air is sucked in through the suction port. The air sucked in through the suction port is, after dust in it is collected by the pre-filter, discharged through the blowout port out into the room. Thus, the air in the room can be purified.

List of Citations

Patent Literature

[0004] Patent Document 1: Japanese Patent Application published as No. 2006-289235 (pages 3 to 5; Figs. 1 and 3)

Summary of the Invention

Technical Problem

[0005] With the conventional air purifier mentioned above, the larger the room it is installed in, the less evenly distributed the current of air discharged out through the blowout port. Thus, the air in the room cannot be stirred sufficiently; air far away from

the air purifier does not flow into the casing, resulting in the problem of insufficient purification of the air in the room. On the other hand, using a larger blower leads to the problem of an increased size of the air purifier.

[0006] An object of the present invention is to provide an air purifier that can purify the air in a large room while suppressing an increase in its size.

Means for Solving the Problem

[0007] To achieve the above object, according to one aspect of the present invention, an air purifier includes:

- a casing which is placed on a floor;

- a suction port which is open in a circumferential face of a lower part of the casing;

- a first blowout port and a second blowout port which are open in opposite side parts, respectively, of an upper part of the casing;

- an air passage which has:

- a first branch passage that is disposed in one side part of the casing to extend in an up-down direction and that lets the suction port communicate with the first blowout port; and

- a second branch passage that is disposed in an opposite side part of the casing to extend in the up-down direction and that lets the suction port communicate with the second blowout port; and

- a dust collector which is disposed in the air passage and which collects dust in air.

[0008] With this structure, air flows into the air passage through the suction port in the lower part of the casing, and dust in the air is collected by the dust collector. The air, having undergone dust collection, passes through the first and second branch passages and is discharged through the first and second blowout ports respectively.

[0009] According to another aspect of the present invention, in the air purifier structured as described above, the first and second blowout ports may be open to be vertically elongate.

[0010] According to another aspect of the present invention, the air purifier structured as described above may further include: a first blower which passes air through the first branch passage; and a second blower which passes air through the second branch passage. Here, the dust collector may include: a pre-filter which is disposed opposite

the suction port and which collects dust; a first dust-collecting filter which is disposed upright between the suction port and the first blower inside the casing and which collects dust finer than the dust that the pre-filter collects; and a second dust-collecting filter which is disposed upright between the suction port and the second blower inside the casing and which collects dust finer than the dust that the pre-filter collects. The air purifier may further includes: a dust remover which is disposed in a space between the first and second branch passages outside the air passage and which removes dust on the pre-filter.

[0011] According to another aspect of the present invention, in the air purifier structured as described above, the dust remover may be disposed over the first and second dust-collecting filters, and may perform dust removal with the pre-filter moved upward.

[0012] According to another aspect of the present invention, in the air purifier structured as described above, the dust remover may be disposed over the first and second dust-collecting filters, and may perform dust removal while moving along the suction face of the pre-filter.

[0013] According to another aspect of the present invention, in the air purifier structured as described above, the first and second dust-collecting filters may have their respective suction faces disposed opposite each other with such inclinations as to be increasingly far from each other toward the suction port.

[0014] According to another aspect of the present invention, the air purifier structured as described above may further include: an illuminance sensor which senses the illuminance in a room; and a human sensor which senses a human in the room. Here, the air purifier may operate in either of: a first purification mode in which the dust remover is operated when the illuminance in the room is higher than a predetermined starting illuminance and no human is detected; and a second purification mode in which the dust remover is operated when the illuminance in the room is lower than the starting illuminance and no human is detected.

[0015] According to another aspect of the present invention, the air purifier structured as described above may further include: a contamination sensor which senses the concentration of odoriferous components or dust in air; an illuminance sensor which senses the illuminance in a room; and a human sensor which senses a human in the room. Here, based on the concentration of odoriferous components or dust, the degree

of contamination may be ranked at one of a plurality of levels. The first and second blowers may be operated at an increasingly high number of revolutions for an increasingly high level of the degree of contamination. The air purifier may be settable to operate in either of: a first sensitivity mode in which the degree of contamination is ranked at one of levels demarcated at predetermined border values; and a second sensitivity mode in which the degree of contamination is determined with higher sensitivity so as to be ranked at the same level as or a higher level than in the first sensitivity mode. Even if the air purifier is set to operate, and is operating, in the first sensitivity mode, when the illuminance in the room is higher than a predetermined mode switching illuminance and no human is detected, the first sensitivity mode may be overridden by the second sensitivity mode.

[0016] According to another aspect of the present invention, in the air purifier structured as described above, the dust remover may be operated when the cumulated value of the degrees of contamination determined at predetermined time intervals has exceeded a predetermined value.

Advantageous Effects of the Invention

[0017] According to the present invention, there are provided a first branch passage that is disposed in one side part of a casing to extend in the up-down direction and that lets a suction port communicate with a first blowout port; and a second branch passage that is disposed in the opposite side part of the casing to extend in the up-down direction and that lets the suction port communicate with a second blowout port. Thus, outside the casing, the current of the air that is discharged out through the first and second blowout ports involves the air between the first and second blowout ports, resulting in an increased mount of air being sent forward. It is thus possible to purify the air in a large room while suppressing an increase in size.

Brief Description of Drawings

[0018] Fig. 1 is a front view showing an air purifier according to a first embodiment of the present invention;

Fig. 2 is a rear view showing an air purifier according to the first embodiment of the present invention;

Fig. 3 is a top sectional view showing an air purifier according to the first embodiment of the present invention;

Fig. 4 is a side sectional view showing an air purifier according to the first embodiment of the present invention;

Fig. 5 is a top view showing an air purifier according to the first embodiment of the present invention;

Fig. 6 is a block diagram showing the configuration of an air purifier according to the first embodiment of the present invention;

Fig. 7 is a flow chart showing the operation of an air purifier of the first embodiment of the present invention;

Fig. 8 is a flow chart showing the dust removal operation of an air purifier of the first embodiment of the present invention;

Fig. 9 is a front view showing an air purifier according to a second embodiment of the present invention; and

Fig. 10 is a side sectional view showing an air purifier according to the second embodiment of the present invention.

Description of Embodiments

[0019] <First Embodiment>

Embodiments of the present invention will be described below with reference to the drawings. Figs. 1 and 2 are a front view and a rear view, respectively, of an air purifier according to a first embodiment. In Fig. 1, hollow arrows indicate currents of air. The air purifier 1 has a housing 2, in which a suction port 4 and blowout ports 51 and 52 (a first and second blowout port) are open and which is placed on a floor in a room. Inside the housing 2, there are provided, as will be described later, a blower 11 (first blower), a blower 12 (a second blower), a pre-filter 8, a dust-collecting filter 91 (first dust-collecting filter), a dust-collecting filter 92 (second dust-collecting filter), and a dust remover 20. The pre-filter 8 and the dust-collecting filters 91 and 92 together constitute a dust collector.

[0020] The suction port 4 is open in a lower part of the rear face of the housing 2, and the blowout ports 51 and 52 are open in a left-side part and a right-side part, respectively, of an upper part of the front face of the housing 2. The blowout ports 51 and 52 are

each open to be vertically elongate. At the suction port 4, a cover member (unillustrated) with a grid is removably fitted to the housing 2. At the blowout ports 51 and 52 respectively, grids 51a and 52a are provided.

[0021] In a middle part of a top end part of the front face of the housing 2, a human sensor 14 is provided. The human sensor 14 comprises, for example, an infrared sensor, and detects a human in the room.

[0022] Fig. 3 is a top sectional view of the air purifier 1. In Fig. 3, hollow arrows indicate currents of air. Inside the housing 2, there is provided an air passage 7 through which the suction port 4 communicates with the blowout ports 51 and 52. Inside the air passage 7, the pre-filter 8 is disposed opposite the suction port 4, and on the downstream side of the pre-filter 8, the air passage 7 branches into a branch passage 71 (first branch passage) and a branch passage 72 (second branch passage) that extend in the up-down direction in a left-side part and a right-side part, respectively, of the housing 2. The branch passages 71 and 72 communicate with the blowout ports 51 and 52 respectively.

[0023] Inside the branch passage 71, there are disposed the dust-collecting filter 91, the blower 11, and an ion generating device 17 (see Fig. 1) in this order from the suction port 4 toward the blowout port 51 (from upstream to downstream with respect to the current of air). Likewise, inside the branch passage 72, there are disposed the dust-collecting filter 92, the blower 12, and an ion generating device 17 (see Fig. 1) in this order from the suction port 4 toward the blowout port 52.

[0024] Thus, the blowers 11 and 12 are disposed in a left-side part and a right-side part, respectively, of the housing 2. The blowers 11 and 12 comprise sirocco fans that are driven by motors 11a and 12a respectively; they suck air in the axial direction and discharge it in the radial direction. As the blowers 11 and 12 are operated, air is sucked in through the suction port 4 to pass through the branch passages 71 and 72 respectively.

[0025] The pre-filter 8 is disposed upright opposite the suction port 4. The pre-filter 8 is formed by fusing a mesh 8b (see Fig. 2) of polypropylene to a rectangular frame 8a (see Fig. 2) of a synthetic resin such as ABS having a matrix of windows in a plurality of rows and a plurality of columns. The pre-filter 8 can collect coarse dust in air.

[0026] The dust-collecting filters 91 and 92 comprise HIEPA filters, and have frame

members 91c and 92c fused with hot-melt adhesive to filtering members 91b and 92b so as to cover these. Preferably, the filtering members 91b and 92b can be pleated; this helps increase the filtering area of the filtering members 91b and 92b. The dust-collecting filters 91 and 92 can collect fine dust, finer than that collected by the pre-filter 8, such as PM 2.5 particles (ultrafine particulate substances).

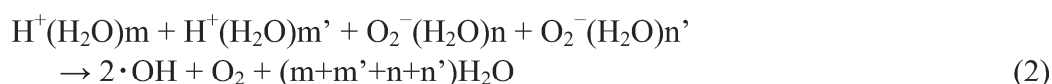
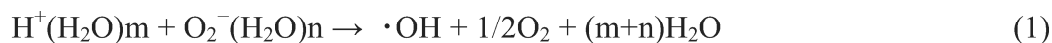
[0027] The dust-collecting filters 91 and 92 are disposed in a middle part of the housing 2 in its left-right direction so as to be located between the blowers 11 and 12. The dust-collecting filters 91 and 92 have their respective suction faces 91a and 92a disposed opposite each other with such inclinations as to be increasingly far from each other toward the suction port 4.

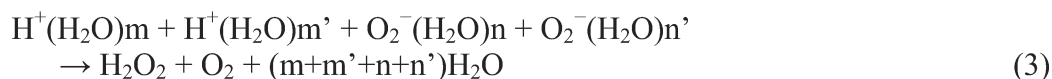
[0028] Between the pre-filter 8 and the dust-collecting filters 91 and 92, there is disposed a deodorant filter (unillustrated) containing an absorbent material such as activated carbon. This makes it possible to absorb odoriferous components in air and deodorize it.

[0029] The ion generating device 17 (see Fig. 1) has electrodes (unillustrated) that are disposed in, so as to face, the branch passages 71 and 72 respectively. To the electrodes, a voltage with an alternating-current waveform or an impulse waveform is applied. Applying a positive voltage to the electrodes generates positive ions (cations) chiefly comprising $H^+(H_2O)_m$; applying a negative voltage to the electrodes generates negative ions (anions) chiefly comprising $O_2^-(H_2O)_n$. Here, m and n are each an integer. The ions $H^+(H_2O)_m$ and $O_2^-(H_2O)_n$ clump together on the surface of airborne microorganisms and odoriferous components in air and enclose them.

[0030] Then, as formulated by formulae (1) to (3) below, through impact, the ions cohere to generate active species such as $[•OH]$ (hydroxyl radical) and H_2O_2 (hydrogen peroxide) on the surface of microbes and the like, and thereby destroy airborne microorganisms and the like. Here, m' and n' are each an integer. Thus, the air purifier 1 can, by generate positive and negative ions and sending them out through the blowout ports 51 and 52, sterilize and deodorize the room.

[0031]





[0032] Near the suction port 4, there is provided an odor sensor 18 (contamination sensor; see Fig. 6) which senses the concentration of odoriferous components (odor concentration) in air. The odor sensor 18 includes a circuit comprising, for example, a metal-oxide semiconductor, and senses odor concentration based on the change in the resistance value of the metal-oxide semiconductor as it absorbs odoriferous components.

[0033] Fig. 4 is a side sectional view of the air purifier 1. Hollow arrows indicate currents of air. As shown in Fig. 1, outside the air passage 7, in a space S between the branch passages 71 and 72 over the dust-collecting filters 91 and 92, the dust remover 20 is disposed which removes dust from the pre-filter 8. The dust remover 20 includes a rotary brush 21, a dust box 22, a guide frame 23, and a pinion 24.

[0034] The pinion 24 meshes with a rack (unillustrated) provided at each side end of the pre-filter 8, and is coupled to a filter motor 27 (see Fig. 6). As the pinion 24 rotates by being driven by the filter motor 27, the pre-filter 8 reciprocate between a collecting position A, where the pre-filter 8 faces the suction port 4, and a retracted position B, where the pre-filter 8 is retracted from the collecting position A. Meanwhile, the pre-filter 8 is guided by the guide frame 23 which is disposed in the space S.

[0035] The dust box 22 is disposed along the guide frame 23, and is removably fitted to the housing 2. The dust box 22 can be attached to and detached from the housing 2 through an opening 29 (see Fig. 2) in the rear face of the housing 2.

[0036] The rotary brush 21 is disposed inside the dust box 22, and is driven to rotate by a brush motor 28 (see Fig. 6). The rotary brush 21 has a rotary shaft 21a which extends in the left-right direction of the housing 2 and brush bristles (unillustrated) of nylon. The brush bristles stand erect from the outer circumference of the rotary shaft 21a, and are fitted to it in a plurality of rows. At each end of the rotary shaft 21a, a gear (unillustrated) is provided, and the rotary brush 21 is removably fitted to the brush motor 28 with which the rotary brush 21 is coupled via the gear. Via the gear, the brush motor 28 makes the rotary brush 21 rotate counter-clockwise in Fig. 4. As will be described later, the dust removed from the pre-filter 8 by the rotary brush 21 is

collected in the dust box 22.

[0037] Fig. 5 is a top view of the air purifier 1. Hollow arrows indicate currents of air. In a front part of the top face of the housing 2, an operation panel 6 is provided. The operation panel 6 has a plurality of buttons 6a, and by operating these buttons 6a, the user can make settings as to the operation of the air purifier 1. By operating the buttons 6a, the user can turn on and off the operation of the air purifier 1, change the volume of air sent by the blowers 11 and 12, turn on and off the ion generating device 17, select among different sensitivity modes as will be described later, switch between a standard-purifying mode and an office-purifying mode as will be described later, and so forth.

[0038] On the top face of the housing 2, there are provided an illuminance sensor 15 which senses the illuminance in the room and also an indicator (alarm) 30 which comprises, for example, an LED. The indicator 30 may instead comprise a loudspeaker.

[0039] Fig. 6 is a block diagram showing the configuration of the air purifier 1. The air purifier 1 includes a controller 100 which assumes overall control. To the controller 100 are connected the operation panel 6, the blowers 11 and 12, the ion generating device 17, the illuminance sensor 15, the indicator 30, the human sensor 14, the odor sensor 18, the memory 19, the filter motor 27, and the brush motor 28. A memory 19 stores a control program for the air purifier 1, and also stores the results of data processing by the controller 100 and the results of detection by the odor sensor 18 and the like.

[0040] The air purifier 1 operates in one of a low-sensitivity mode (first sensitivity mode), a standard-sensitivity mode (first sensitivity mode), and a high-sensitivity mode (second sensitivity mode). In the following description, the low-sensitivity, standard-sensitivity, and high-sensitivity modes are referred to collectively as “sensitivity modes”. As mentioned earlier, by operating the operation panel 6, the user can select among different sensitivity modes.

[0041] Table 1 shows the correspondence between the degree of contamination, which is ranked into different levels according to odor concentration, and the volume of air sent by the blowers 11 and 12. The odor concentration sensed by the odor sensor 18 is normalized, taking, within the sensing range, the lowest odor concentration as 1 and

the highest odor concentration equals as 0. The degree of contamination is ranked into four levels, namely 0 to 3, and for an increasingly high level of the degree of contamination, the volume of air sent by the blowers 11 and 12 (their number of revolutions) is set increasingly high.

[0042] [Table 1]

Degree of Contamination	Low-Sensitivity Mode	Standard-Sensitivity Mode	High-Sensitivity Mode	Blowing level
0	1.00 to 0.70	1.00 to 0.91	1.00 to 0.94	Faint
1	0.69 to 0.50	0.90 to 0.80	0.93 to 0.90	Low
2	0.49 to 0.30	0.79 to 0.70	0.89 to 0.85	Medium
3	0.29 to 0.00	0.69 to 0.00	0.84 to 0.00	High

[0043] What odor concentration is ranked at what level of the degree of contamination differs from one sensitivity mode to another. Specifically, the normalized border values of odor concentration at which the different levels of the degree of contamination are demarcated are larger in the standard-sensitivity mode than in the low-sensitivity mode, and are larger in the high-sensitivity mode than in the standard-sensitivity mode. Thus, the degree of contamination is evaluated with higher sensitivity in the high-sensitivity mode than in the standard-sensitivity mode, and is evaluated with higher sensitivity in the standard-sensitivity mode than in the low-sensitivity mode.

[0044] Based on the degree of contamination, the blowers 11 and 12 are switched among a plurality of blowing levels, namely “faint”, “low”, “medium”, and “high”. The blowers 11 and 12 rotate at an increasingly high number of revolutions in the order “faint”, “low”, “medium”, and “high”. That is, the blowers 11 and 12 are driven at an increasingly high blowing level with an accordingly high number of revolutions for an increasingly high level of the degree of contamination. Thus, when the degree of contamination is low, the blowers 11 and 12 rotate at a low number of revolutions, and this helps prevent increases in noise and electric power consumption. On the other hand, when the degree of contamination is high, the blowers 11 and 12 rotate at a high

number of revolutions so that a large amount of air in the room passes through the deodorant filter quickly and the amount of ions in the room increases quickly. This helps remove odoriferous components from air quickly.

[0045] For example, if the normalized value of odor concentration equals 0.86, the degree of contamination is evaluated as “0”, “1”, and “2” in the low-, standard-, and high-sensitivity modes respectively, and the blowers 11 and 12 are operated at the “faint”, “low”, and “medium” blowing levels.

[0046] With respect to dust removal on the pre-filter 8, the air purifier 1 operates in either of a standard-purifying mode (first purifying mode) and an office-purifying mode (second purifying mode). By operating the operation panel 6, the user can switch between the standard-purifying mode and the office-purifying mode. The standard-purifying mode is selected when the air purifier 1 is installed at a site, as in a private house, where people are likely to be present at night. The office-purifying mode is selected when the air purifier 1 is installed at a site, as in a business office, where people are likely to be absent at night. The standard- and office-purifying modes will be described in detail later.

[0047] Fig. 7 is a flow chart showing the operation of the air purifier 1. When the operation panel 6 is so operated as to instruct the air purifier 1 to operate, at step #11, the human sensor 14, the illuminance sensor 15, and the odor sensor 18 are started. At step #12, the blowers 11 and 12 are started. Now the air purifier 1 performs blowing operation: air in the room is sucked in through the suction port 4 to pass through the branch passages 71 and 72. Meanwhile, the pre-filter 8 collects coarse dust in the air, and the dust-collecting filters 91 and 92 collect fine dust in the air.

[0048] At step #13, the ion generating device 17 is started. Now ions are mixed with the air that passes on the downstream side of the blowers 11 and 12 inside the branch passages 71 and 72. The air containing ions is discharged through the blowout ports 51 and 52 out into the room. In this way, the air in the room is purified.

[0049] Meanwhile, near the front face of the housing 2, the current of the air discharged out through the blowout ports 51 and 52 involves the air between the blowout ports 51 and 52, and this increases the amount of air that is sent forward. In this way, even in a large room, the air in the room can be stirred sufficiently, so that air far away from the air purifier 1 flows into the housing 2 through the suction port 4. It is thus possible to

purify air in a large room while suppressing an increase in the size of the air purifier 1.

[0050] At step #14, it is checked whether or not the high-sensitivity mode is in effect. If the high-sensitivity mode is in effect, the flow proceeds to step #18; otherwise, the flow proceeds to step #15.

[0051] At step #15, it is checked whether or not the illuminance I in the room is higher than a predetermined mode switching illuminance I_t . Here, the mode switching illuminance I_t is set at, for example, an illuminance observed at night with the indoor lighting device (unillustrated) in the room extinguished. If the illuminance I in the room is higher than the mode switching illuminance I_t , the flow proceeds to step #16; otherwise, the flow proceeds to step #17.

[0052] At step #16, it is checked whether or not a human is present in the room. If a human is present, the flow proceeds to step #17; otherwise, the flow proceeds to step #18. At step #18, the high-sensitivity mode is put into effect. In the high-sensitivity mode, since the degree of contamination is evaluated with higher sensitivity than in the standard- or low-sensitivity mode, the blowers 11 and 12 are likely to rotate at a higher number of revolutions than in the standard- or low-sensitivity mode. Thus, in the high-sensitivity mode, it is possible to purify the air in the room more quickly than in the standard- or low-sensitivity mode.

[0053] Moreover, since the high-sensitivity mode is put into effect when no human is present in the room, it is possible to reduce the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52. Moreover, since the high-sensitivity mode is put into effect when the illuminance I is higher than the mode switching illuminance I_t , it is possible to reduce, for example for the user sleeping at night, the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52.

[0054] At step #17, it is checked whether or not the standard-sensitivity mode is in effect. If the standard-sensitivity mode is in effect, the flow proceeds to step #19; otherwise (if the low-sensitivity mode is in effect), the flow proceeds to step #20.

[0055] At step #19, the standard-sensitivity mode is put into effect. In the standard-sensitivity mode, since the degree of contamination is evaluated with lower sensitivity than in the high-sensitivity mode, the blowers 11 and 12 are likely to rotate at a lower number of revolutions than in the high-sensitivity mode. Thus, even if a human is

present in the room, it is possible to reduce the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52. Moreover, since the standard-sensitivity mode is put into effect when the illuminance I in the room is not higher than the mode switching illuminance I_t , it is possible to reduce, for example for the user sleeping at night, the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52.

[0056] At step #20, the low-sensitivity mode is put into effect. In the low-sensitivity mode, since the degree of contamination is evaluated with lower sensitivity than in the standard-sensitivity mode, the blowers 11 and 12 are likely to rotate at a lower number of revolutions than in the standard-sensitivity mode. Thus, even if a human is present in the room, it is possible to further reduce the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52. Moreover, since the low-sensitivity mode is put into effect when the illuminance I in the room is not higher than the mode switching illuminance I_t , it is possible to further reduce, for example for the user sleeping at night, the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51 and 52.

[0057] After any of steps #18 to #20, the flow proceeds to step #21. At step #21, it is checked whether or not an instruction to end the blowing operation of the air purifier 1 has been given. If an instruction to end has been given, the flow proceeds to step #22; otherwise, the flow returns to step #14 so that steps #14 through #21 will be repeated.

[0058] At step #22, the blowers 11 and 12 are stopped. At step #23, the ion generating device 17 is stopped.

[0059] At step #24, it is checked whether or not a cumulative value D of the degrees of contamination evaluated at predetermined time intervals (for example, every one hour) with the blowers 11 and 12 operated has exceeded a predetermined upper-limit value D_u (for example, "20"). If the cumulative value D has exceeded the upper-limit value D_u , the flow proceeds to step #25; otherwise, the flow proceeds to step #26, where the human sensor 14, the illuminance sensor 15, and the odor sensor 18 are stopped, the air purifier 1 ending its operation.

[0060] In the high-sensitivity mode, the degree of contamination is evaluated with higher sensitivity than in the standard-sensitivity mode, and is ranked into one of different degrees of contamination that are equal to or higher than those in the standard-

sensitivity mode. Accordingly, in the high-sensitivity mode, the cumulative value D tends to be larger than in the standard-sensitivity mode. In the high-sensitivity mode, the blowers 11 and 12 tend to rotate at a higher number of revolutions than in the standard-sensitivity mode, and thus the pre-filter 8 is likely to collect more dust. Accordingly, a large cumulative value D is likely to indicate more dust on the pre-filter 8.

[0061] Fig. 8 is a flow chart showing the dust removal operation at step #25 in Fig. 7. At step #31, it is checked whether or not an instruction to start blowing operation has been given. If an instruction to start blowing operation has been given, the flow jumps to step #12 in Fig. 7; otherwise, the flow proceeds to step #32.

[0062] At step #32, it is checked whether or not a predetermined period of time (for example, five minutes) has elapsed. If the predetermined period has not yet elapsed, the flow proceeds to step #33; if the predetermined period has elapsed, the flow jumps to step #26 in Fig. 7, the air purifier 1 ending its operation.

[0063] At step #33, it is checked whether or not a human is present in the room. If no human is present in the room, the flow proceeds to step #34; if a human is present, the flow returns to step #31.

[0064] At step #34, it is checked whether or not the illuminance I in the room is lower than a predetermined starting illuminance I_u . The starting illuminance I_u is set at, for example, an illuminance observed at night with the indoor lighting device (unillustrated) in the room extinguished, and may or may not have a value equal to that of the mode switching illuminance I_t (see Fig. 7). If the illuminance I is lower than the starting illuminance I_u , the flow proceeds to step #35; otherwise, the flow proceeds to step #35.

[0065] At step #35, it is checked whether or not the standard-purifying mode is in effect. If the standard-purifying mode is not in effect, the flow proceeds to step #37; if the standard-purifying mode is in effect, the flow returns to step #31. That is, if the illuminance I in the room is lower than the starting illuminance I_u and the office-purifying mode is in effect, step #37 and the following steps are performed.

[0066] At step #36, it is checked whether or not the standard-purifying mode is in effect. If the standard-purifying mode is in effect, the flow proceeds to step #37; if the standard-purifying mode is not in effect, the flow returns to step #31. That is, if the

illuminance I in the room is higher than the starting illuminance I_u and the standard-purifying mode is in effect, step #37 and the following steps are performed.

[0067] At step #37, the brush motor 28 is started, so that the rotary brush 21 rotates counter-clockwise in Fig. 4. At step #38, the filter motor 27 is started, so that the pinion 24, which meshes with the rack on the pre-filter 8, rotates. Thus, the dust remover 20 is started, so that the pre-filter 8 slides upward from the collecting position A (see Fig. 4), where it collects dust.

[0068] As the pre-filter 8, moving upward from the collecting position A, passes by the rotary brush 21, the brush bristles remove the dust on the pre-filter 8. The dust removed from the pre-filter 8 is collected in the dust box 22.

[0069] When a sensor (unillustrated) detects the pre-filter 8 having reached the retracted position B (see Fig. 4), the flow proceeds to step #39, where the brush motor 28 is stopped.

[0070] At step #40, the filter motor 27 rotates reversely, so that the pre-filter 8 returns from the retracted position B to the collecting position A. When a sensor (unillustrated) detects the pre-filter 8 having reached the collecting position A, the filter motor 27 is stopped. Thus, the dust remover 20 stops operating.

[0071] The pre-filter 8 reciprocates once between the collecting position A and the retracted position B, taking about five minutes. Accordingly, the sensors may be omitted, in which case the filter motor 27 can be reversed and stopped at the lapse of predetermined periods of time. When the pre-filter 8 returns from the retracted position B to the collecting position A, the brush motor 28 may be rotated reversely; this helps remove the dust on the pre-filter 8 more effectively.

[0072] At step #41, the cumulative value D is reset. At step #42, it is checked whether or not the number of times N that the brush motor 28 has ever been driven (the number of times that cleaning has ever been performed) has exceeded an upper-limit number of times N_c . If the driven number of times N has exceeded the upper-limit number of times N_c , the flow proceeds to step #43; otherwise, the flow returns to step #26 in Fig. 7, the air purifier 1 ending its operation.

[0073] At step #43, the indicator 30 gives an indication (alarm). This allows the user to know readily when to dispose of the dust in the dust box 22. After step #43, the flow returns to step #26 in Fig. 7, the air purifier 1 ending its operation.

[0074] As described above, in the standard-purifying mode, when the illuminance I in the room is higher than the starting illuminance I_u and no human is detected, the dust remover 20 is operated to remove dust from the pre-filter 8. Thus, in a case where the air purifier 1 is installed, for example, in a bed room in a private house or the like and the user selects the standard-purifying mode, when the cumulative value D exceeds the upper-limit value D_u (a condition for starting clearing is fulfilled), if the room is light and no human is detected, the dust remover 20 is operated. It is thus possible to reduce, for the user sleeping at night, the discomfort of the noise from the dust remover 20.

[0075] On the other hand, in the office-purifying mode, when the illuminance I in the room is lower than the starting illuminance I_u and no human is detected, the dust remover 20 is operated to remove dust from the pre-filter 8. Thus, in a case where the air purifier 1 is installed, for example, in a business office where no human is likely to be present at night and the user selects the office-purifying mode, when the condition for starting clearing is fulfilled, if the room is dark and no human is detected, the dust remover 20 is operated. It is thus possible to reduce, for the user working in the office during the day, the discomfort of the noise from the dust remover 20.

[0076] According to this embodiment, there are provided a branch passage 71 (first branch passage) that extends in the up-down direction in one side part of a housing 2 and through which a suction port 4 communicates with a blowout port 51 and a branch passage 72 (second branch passage) that extends in the up-down direction in the opposite side part of the housing 2 and through which the suction port 4 communicates with a blowout port 52. Thus, near the front face of the housing 2, the current of the air discharged out through the blowout ports 51 and 52 involves the air between the blowout ports 51 and 52, resulting in an increased amount of area being sent forward. Thus, even in a large room, the air in the room can be stirred sufficiently, and air far away from the air purifier 1 flows into the housing 2 through the suction port 4. It is thus possible to purify the air in a large room while suppressing an increase in the size of the air purifier 1.

[0077] The blowout ports 51 and 52 are each formed to be vertically elongate. This gives, at the front face of the housing 2, an increased distance between the blowout ports 51 and 52. Thus, the current of the air discharged out through the blowout ports 51 and 52

can involve more air near the front face of the housing 2.

[0078] There are provided a blower 11 (first blower) and a blower 12 (second blower) that pass air through the branch passages 71 and 72 respectively, and between the suction port 4 and the blower 11 and between the suction port 4 and the blower 12, there are disposed a dust-collecting filter 91 (first dust-collecting filter) and a dust-collecting filter 92 (second dust-collecting filter) respectively. Thus, a large amount of purified air can be sent into the room quickly.

[0079] In a space S between the branch passages 71 and 72 over the dust-collecting filters 91 and 92, a dust remover 20 is disposed. This helps prevent a drop in the volume of air resulting from the pre-filter 8 clogging up. The dust remover 20 is not disposed inside the air passage 7, and this helps prevent the dust remover 20 from resisting the current of air and reducing blowing efficiency. The area needed on the floor to install the air purifier 1 can also be reduced. It is thus possible to reduce the footprint of the air purifier 1 and prevent a drop in blowing efficiency.

[0080] The dust-collecting filters 91 and 92 have their respective suction faces 91a and 92a disposed opposite each other with such inclinations as to be increasingly far from each other toward the suction port 4. Thus, the air sucked in through the suction port 4 can be directed smoothly to the suction faces 91a and 92a of the dust-collecting filters 91 and 92. It is thus possible to reduce the pressure loss in the air purifier 1.

[0081] In a standard-sensitivity mode (first sensitivity mode) or a low-sensitivity mode (first sensitivity mode), when the illuminance I in the room is higher than a predetermined mode switching illuminance I_t and no human is detected, despite the standard- or low -sensitivity mode being selected, a high-sensitivity mode (second sensitivity mode) is put into effect. This makes it possible, while purifying the air in the room quickly, to reduce the discomfort of the noise from the blowers 11 and 12 and of the air sent from the blowout ports 51, 52. It is thus possible to make the air purifier 1 more comfortable to use.

[0082] There are provided a standard-purifying mode (first purifying mode) in which the dust remover 20 is operated when the illuminance I in the room is higher than the starting illuminance I_u and no human is detected and an office-purifying mode (second purifying mode) in which the dust remover 20 is operated when the illuminance I in the room is lower than the starting illuminance I_u and no human is

detected. Thus, in a case where the air purifier 1 is installed, for example, in a bed room in a private house or the like and the user selects the standard-purifying mode, when a condition for starting cleaning is fulfilled, if the room is light and a human is detected, the dust remover 20 is operated. It is thus possible to reduce, for the user sleeping at night, the discomfort of the noise from the dust remover 20.

[0083] On the other hand, in a case where the air purifier 1 is installed, for example, in a business office where no human is likely to be present at night and the user selects the office-purifying mode, when a condition for starting clearing is fulfilled, if the room is dark and no human is detected, the dust remover 20 is operated. It is thus possible to reduce, for the user working in the office during the day, the discomfort of the noise from the dust remover 20.

[0084] With a configuration where, as conventionally practiced, a dust remover is operated when the cumulated operating time of an air purifier 1 has reached a predetermined length of time, it can occur that the dust remover is operated with still a small amount of dust collected on a pre-filter. Thus, the dust remover is operated unnecessarily, possibly leading to increased wear on the dust remover and the pre-filter.

[0085] According to this embodiment, the dust remover 20 is operated when the cumulative value D of the degrees of contamination evaluated at predetermined intervals of time has exceeded the upper-limit value D_u . This prevents the dust remover 20 from being operated unnecessarily. It is thus possible to suppress wear on the dust remover 20 and the pre-filter, and to prolong the lifetime of the air purifier 1.

[0086] <Second Embodiment>

Next, a second embodiment of the present invention will be described. Figs. 9 and 10 are a front view and a side sectional view, respectively, of an air purifier according to this embodiment. For the sake of convenience of description, such parts as find their counterparts in the first embodiment shown in Figs. 1 to 8 referred to thus far are identified by common reference signs. In this embodiment, the structure of the dust remover 20 differs from that in the first embodiment. Also, here, steps #38 and #40 in Fig. 8 differ from those in the first embodiment. Otherwise, the second embodiment is similar to the first embodiment.

[0087] The dust remover 20 is disposed in a space S outside the air passage 7, and

includes a rotary brush 21, a dust box 22, and an actuating motor (unillustrated). The actuating motor is disposed in the dust box 22, and is coupled to a gear (unillustrated) that meshes with a rack (unillustrated) provided on the housing 2. The brush motor 28 is disposed in the dust box 22.

[0088] At step #38 in Fig. 8, the actuating motor is started, and the gear that meshes with the rack on the housing 2 rotates. Thus, the dust remover 20 is started, so that the dust box 22 moves from a stored position C (see Fig. 10), where the dust box 22 is retracted from the pre-filter 8, downward along the suction face of the pre-filter 8.

[0089] Meanwhile, the brush bristles on the rotary brush 21 remove the dust on the pre-filter 8. The dust removed from the pre-filter 8 is collected in the dust box 22.

[0090] When a sensor (unillustrated) detects the dust box 22 having reached the bottom end of the pre-filter 8, the flow proceeds to step #39.

[0091] At step #40, the actuating motor rotates reversely, so that the dust box 22 returns from the bottom end of the pre-filter 8 to the stored position C. When a sensor (unillustrated) detects the pre-filter 8 having reached the stored position C, the actuating motor is stopped. Thus, the dust remover 20 stops operating.

[0092] The dust box 22 reciprocates once between the stored position C and the bottom end of the pre-filter 8, taking about five minutes. Accordingly, the sensors may be omitted, in which case the actuating motor can be reversed and stopped at the lapse of predetermined periods of time. When the dust box 22 returns from the bottom end of the pre-filter to the stored position C, the brush motor 28 may be rotated reversely; this helps remove the dust on the pre-filter 8 more effectively.

[0093] This embodiment provides effects similar to those obtained with the first embodiment. In addition, owing to the pre-filter 8 not being moved, it is possible to reduce wear on the pre-filter 8.

[0094] <Third Embodiment>

Next, a third embodiment of the present invention will be described. This embodiment differs from the first embodiment in that it includes, in place of the odor sensor 18, a dust sensor (contamination sensor). Otherwise, the third embodiment is similar to the first embodiment.

[0095] Near the suction port 4, the dust sensor (unillustrated) is provided. The dust sensor is an optical sensor comprising a light-emitting element and a light-receiving element,

and senses the concentration of dust (dust concentration) in air based on the width of pulses fed out from the light-receiving element.

[0096] As in Table 1, the dust concentration sensed by the dust sensor is normalized, taking, within the sensing range, the lowest dust concentration as 1 and the highest dust concentration equals as 0. The degree of contamination is ranked into four levels, namely 0 to 3, and for an increasingly high level of the degree of contamination, the volume of air sent by the blowers 11 and 12 (their number of revolutions) is set increasingly high.

[0097] What dust concentration is ranked at what level of the degree of contamination differs from one sensitivity mode to another. Specifically, the normalized border values of dust concentration at which the different levels of the degree of contamination are demarcated are larger in the standard-sensitivity mode than in the low-sensitivity mode, and are larger in the high-sensitivity mode than in the standard-sensitivity mode. Thus, the degree of contamination is evaluated with higher sensitivity in the high-sensitivity mode than in the standard-sensitivity mode, and is evaluated with higher sensitivity in the standard-sensitivity mode than in the low-sensitivity mode.

[0098] In the high-sensitivity mode, at step #24 in Fig. 7, the cumulative value D more easily exceeds the upper-limit value D_u than in the standard- or low-sensitivity mode. That is, the higher the frequency of the high-sensitivity mode, the higher the frequency of dust removal operation in the air purifier 1. However, in the high-sensitivity mode, the blowers 11 and 12 tend to rotate at a higher number of revolutions than in the standard- or low-sensitivity mode, and the pre-filter 8 tends to collect more dust.

[0099] Thus, according to this embodiment, compared with a configuration where, as conventionally practiced, dust removal operation is performed when the cumulated operating time of an air purifier has reached a predetermined length of time, it is possible to make the dust remover 20 less likely to be operated with still a small amount of dust on the pre-filter 8.

[0100] On the other hand, in the standard- and low-sensitivity modes, at step #24 in Fig. 7, the cumulative value D less tends to exceed the upper-limit value D_u than in the high-sensitivity mode. That is, in the standard- and low-sensitivity modes, even when a large amount of dust is collected on the pre-filter 8, the air purifier 1 performs dust

removal operation less often than in the high-sensitivity mode. Accordingly, when blowing operation is stopped in the standard- or low-sensitivity mode and the check result of step #24 in Fig. 7 is “YES”, after the dust removal operation at step #25 in Fig. 7, the dust removal operation is performed once again. It is thus possible to remove the dust on the pre-filter 8 more effectively.

[0101] This embodiment provides effects similar to those obtained with the first embodiment. Moreover, different dust concentrations in air are ranked into a plurality of levels of the degree of contamination, and for an increasingly high level of the degree of contamination, the blowers 11 and 12 rotate at an increasingly high number of revolutions. Thus, when the dust concentration is low, the blowers 11 and 12 rotate at a low number of revolutions, and this helps prevent increases in noise and electric power consumption; when the dust concentration is high, the blowers 11 and 12 rotate at a high number of revolutions, and this helps remove dust from air quickly.

[0102] In this embodiment, an odor sensor 18 like the one in the first embodiment may be provided so that different odor concentrations and different dust concentrations in air are ranked into a plurality of levels of the degree of contamination.

[0103] <Fourth Embodiment>

Next, a fourth embodiment of the present invention will be described. In this embodiment, whether to switch to the low-sensitivity mode is determined by a criterion different from the one in the first embodiment. Also, the amounts of ions generated in different sensitivity modes differ. Otherwise, the fourth embodiment is similar to the first embodiment.

[0104] In this embodiment, at step #17 in Fig. 7, it is checked, instead of whether or not the standard-sensitivity mode is selected, whether or not the current time falls in a time zone from late at night to early in the morning, for example, from 11:00 pm to 5:00 am. If the current time falls in a small-hours time zone, the flow proceeds to step #20; otherwise, the flow proceeds to step #19.

[0105] Thus, in a time zone from late at night to early in the morning, when the user is highly likely to be sleeping, the low-sensitivity mode is put into effect. It is thus possible to further reduce the discomfort of noise and of the air sent toward the user.

[0106] Moreover, in the high-sensitivity mode at step #18 in Fig. 7, in the standard-sensitivity mode at step #19, and in the low-sensitivity mode at step #20, the

frequency of electric discharge in the ion generating device 17 is set for 50 times a second, 70 times a second, and 100 times a second respectively.

[0107] Thus, compared with the amount of ions in the high-sensitivity mode at step #18, a larger amount of ions are generated in the standard-sensitivity mode at step #19 or in the low-sensitivity mode at step #20. It is thus possible, while suppressing noise and air sent toward the user as when a human is present in the room or during the night, to purify the air in the room quickly. The amount of ions generated in the low-sensitivity mode may or may not be equal to that in the standard-sensitivity mode.

[0108] This embodiment provides effects similar to those obtained with the first embodiment.

[0109] <Fifth Embodiment>

Next, a fifth embodiment of the present invention will be described. This embodiment differs from the first embodiment in that it includes a wind speed sensor. Otherwise, the fifth embodiment is similar to the first embodiment.

[0110] Inside the air passage 7, near the suction port 4, a wind speed sensor is provided which senses the speed of wind. When the check result of step #24 in Fig. 7 is "NO", it is checked whether or not the speed of wind near the suction port 4 is lower than a predetermined lower-limit speed. If the wind speed is lower than the lower-limit speed, the flow proceeds to step #25; otherwise, the flow proceeds to step #26, the air purifier 1 ending its operation.

[0111] This embodiment provides effects similar to those obtained with the first embodiment. Moreover, inside the air passage 7, near the suction port 4, the wind speed sensor is provided so that, when the wind speed near the suction port 4 is lower than the predetermined lower-limit speed, the dust remover 20 is operated. It is thus possible to remove the dust on the pre-filter 8 effectively.

[0112] In this embodiment, as in the fourth embodiment, it is possible to proceed, when the current time falls in a time zone from late at night to early in the morning, to step #20 in Fig. 7 and otherwise to step #19 in Fig. 7. In this embodiment, as in the fourth embodiment, it is possible to generate a larger amount of ions in the standard-sensitivity mode at step #19 or in the low-sensitivity mode at step #20 in Fig. 7 than in the high-sensitivity mode at step #18 in Fig. 7.

[0113] In the fourth and fifth embodiments, as in the third embodiment, it is possible to

provide, in place of an odor sensor 18, a dust sensor (contamination sensor), or to provide both an odor sensor 18 and a dust sensor.

[0114] In the third to fifth embodiments, it is possible to use, instead of the dust remover 20 in the first embodiment, a dust remover 20 similar to the one in the second embodiment.

Industrial Applicability

[0115] The present invention finds applications in air purifiers provided with a dust collector for collecting dust in air.

List of Reference Signs

[0116]	1	air purifier
	2	housing
	4	suction port
	6	operation panel
	7	air passage
	11	blower (first blower)
	12	blower (second blower)
	14	human sensor
	15	illuminance sensor
	17	ion generating device
	18	odor sensor (contamination sensor)
	19	memory
	20	dust remover
	21	rotary brush
	22	dust box
	23	guide frame
	24	pinion
	30	indicator
	51	blowout port (first blowout port)
	52	blowout port (second blowout port)
	71	branch passage (first branch passage)

- 72 branch passage (second branch passage)
- 91 dust-collecting filter (first dust-collecting filter)
- 92 dust-collecting filter (second dust-collecting filter)

CLAIMS

1. An air purifier comprising:

- a casing placed on a floor;
 - a suction port open in a circumferential face of a lower part of the casing;
 - a first blowout port and a second blowout port open in opposite side parts, respectively, of an upper part of the casing;
 - an air passage having:
 - a first branch passage disposed in one side part of the casing to extend in an up-down direction, the first branch passage letting the suction port communicate with the first blowout port; and
 - a second branch passage disposed in an opposite side part of the casing to extend in the up-down direction, the second branch passage letting the suction port communicate with the second blowout port; and
 - a dust collector disposed in the air passage, the dust collector collecting dust in air;
 - a first blower passing air through the first branch passage; and
 - a second blower passing air through the second branch passage,
- wherein
- the dust collector includes:
 - a pre-filter disposed opposite the suction port, the pre-filter collecting dust;
 - a first dust-collecting filter disposed upright between the suction port and the first blower inside the casing, the first dust-collecting filter collecting dust finer than the dust that the pre-filter collects; and
 - a second dust-collecting filter disposed upright between the suction port and the second blower inside the casing, the second dust-collecting filter collecting dust finer than the dust that the pre-filter collects, and
 - the air purifier further comprises:
 - a dust remover disposed in a space between the first and second branch passages outside the air passage, the dust remover removing dust on the pre-filter.

2. The air purifier according to claim 1, wherein

the first and second dust-collecting filters have respective suction faces thereof disposed opposite each other with such inclinations as to be increasingly far from each other toward the suction port.

3. The air purifier according to claim 1 or 2, further comprising:

an illuminance sensor sensing illuminance in a room; and

a human sensor sensing a human in the room,

wherein

the air purifier operates in either of:

a first purification mode in which the dust remover is operated when the illuminance in the room is higher than a predetermined starting illuminance and no human is detected; and

a second purification mode in which the dust remover is operated when the illuminance in the room is lower than the starting illuminance and no human is detected.

4. The air purifier according to claim 1 or 2, further comprising:

a contamination sensor sensing concentration of odoriferous components or dust in air;

an illuminance sensor sensing illuminance in a room; and

a human sensor sensing a human in the room,

wherein

based on the concentration of odoriferous components or dust, a degree of contamination is ranked at one of a plurality of levels,

the first and second blowers are operated at an increasingly high rotation number of revolutions for an increasingly high level of the degree of contamination,

the air purifier is settable to operate in either of:

a first sensitivity mode in which the degree of contamination is ranked at one of levels demarcated at predetermined border values; and

a second sensitivity mode in which the degree of contamination is

determined with higher sensitivity so as to be ranked at a same level as or a higher level than in the first sensitivity mode, and

even if the air purifier is set to operate, and is operating, in the first sensitivity mode, when the illuminance in the room is higher than a predetermined mode switching illuminance and no human is detected, the first sensitivity mode is overridden by the second sensitivity mode.

5. The air purifier according to claim 4, wherein

the dust remover is operated when a cumulated value of the degree of contamination determined at predetermined time intervals has exceeded a predetermined value.