

DESCRIPTION

Title of Invention

DUST COLLECTING DEVICE AND AIR-CONDITIONING APPARATUS INCLUDING DUST COLLECTING DEVICE

5 Technical Field

[0001]

The present invention relates to a dust collecting device that generates static electricity by friction to collect dust contained in air and an air-conditioning apparatus including the dust collecting device.

10 Background Art

[0002]

Related-art dust collecting devices of this type include a device including collecting plates spaced apart from each other in a direction intersecting with an air passing direction and brushes that are fitted in spaces between the collecting plates and are in contact with surfaces of the collecting plates (see, for example, Patent Literature 1). Patent Literature 1 describes that the collecting plates are rotated and rubbed with the brushes such that static electricity is generated on the surfaces of the collecting plates to electrostatically collect dust contained in air passing through the collecting plates.

20 Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 61-227860

25 Summary of Invention

Technical Problem

[0004]

Patent Literature 1 does not describe the posture of each of the brushes, which are fitted in the spaces between the collecting plates, relative to the collecting plates.

30 An air passage between adjacent collecting plates may become narrow depending on

the posture of the brush, resulting in an increase in air flow resistance. Sufficient dust collecting performance may fail to be achieved.

[0005]

The present invention has been made to achieve the above-described problem and aims to provide a dust collecting device that exhibits low air flow resistance and high dust collecting performance and an air-conditioning apparatus including the dust collecting device.

Solution to Problem

[0006]

A dust collecting device according to an embodiment of the present invention includes a plurality of collecting plates spaced apart in an air passage, the plurality of collecting plates being arranged in a direction intersecting with an air passing direction in which air passes, the plurality of collecting plates being electrically charged by friction; and a plurality of brushes fitted in spaces, through which the air passes, between the plurality of collecting plates, the plurality of brushes being rubbed against surfaces of the plurality of collecting plates and removing dust collected by the plurality of collecting plates, wherein the plurality of brushes are in a posture extending in the air passing direction and are fitted in the spaces between the plurality of collecting plates.

Advantageous Effects of Invention

[0007]

According to the embodiment of the present invention, the brushes in a posture extending in the air passing direction reduce or eliminate the likelihood that an air passage between adjacent collecting plates may become narrow, thus allowing the dust collecting device to exhibit low air flow resistance and high dust collecting performance.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a schematic diagram illustrating a section of an air-conditioning apparatus including a dust collecting device according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a perspective view of the dust collecting device according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a perspective view of a brush in Fig. 2.

[Fig. 4] Fig. 4 is a flowchart explaining an operation of the air-conditioning apparatus including the dust collecting device according to Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 is a perspective view illustrating the configuration of a dust collecting device according to Embodiment 2 of the present invention.

[Fig. 6] Fig. 6 is a flowchart explaining an operation of an air-conditioning apparatus including the dust collecting device according to Embodiment 2 of the present invention.

[Fig. 7] Fig. 7 is a perspective view illustrating the configuration of a dust collecting device according to Embodiment 3 of the present invention.

[Fig. 8] Fig. 8 is a flowchart explaining an operation of an air-conditioning apparatus including the dust collecting device according to Embodiment 3 of the present invention.

[Fig. 9] Fig. 9 is a perspective view illustrating the configuration of a dust collecting device according to Embodiment 4 of the present invention.

Description of Embodiments

[0009]

Preferred embodiments of a dust collecting device according to the present invention will be described below with reference to the drawings. In the following description, the same components or equivalents in the figures are designated by the same reference signs.

[0010]

Embodiment 1.

A dust collecting device according to Embodiment 1 and an air-conditioning apparatus including the dust collecting device will be described with reference to Figs. 1 to 4.

[0011]

Fig. 1 is a schematic diagram illustrating a section of the air-conditioning apparatus including the dust collecting device according to Embodiment 1 of the present invention. In Fig. 1 and other figures, which will be described later, blank arrows represent the flow of air.

5 The air-conditioning apparatus includes the dust collecting device, 1, and a heat exchange ventilator 10, and is installed in a lowered ceiling 20 of a room in a building. The lowered ceiling 20 is a lowered portion of the ceiling as illustrated in Fig. 1. To enhance the beauty of the interior of a room, an air-conditioning apparatus and another air-conditioning system are often installed collectively in such a lowered ceiling 20 in a building as illustrated in Fig. 1. The lowered ceiling 20 used as an installation space can provide a larger space for installation than a typical room provides.

[0012]

Referring to Fig. 1, an exterior wall has an exterior air supply opening 21 and an exterior air discharge opening 22. Furthermore, the lowered ceiling 20 of the room has an interior air supply opening 23 and an interior air discharge opening 24. In addition, the lowered ceiling 20 contains an air supply passage 30 and an air discharge passage 40. The air supply passage 30 is an air passage through which outdoor air is taken into the lowered ceiling 20 through the exterior air supply opening 21 and is sent into the room through the interior air supply opening 23. The air discharge passage 40 is an air passage through which indoor air is taken into the lowered ceiling 20 through the interior air discharge opening 24 and is discharged out of the room through the exterior air discharge opening 22.

[0013]

In the air supply passage 30, the dust collecting device 1 and the heat exchange ventilator 10 are arranged in the named order from an upstream side in an air passing direction. Furthermore, the heat exchange ventilator 10 is disposed in the air discharge passage 40. In the air supply passage 30, the exterior air supply opening 21 and the interior air supply opening 23 are connected by a duct 31 via the dust collecting device 1 and the heat exchange ventilator 10. Additionally, in the air discharge

passage 40, the interior air discharge opening 24 and the exterior air discharge opening 22 are connected by a duct 41 via the heat exchange ventilator 10.

[0014]

The heat exchange ventilator 10 is a ventilator having a ventilation function and an air-conditioning assist function. The ventilation function is to supply outdoor air into an indoor space and discharge indoor air to an outdoor space. The heat exchange ventilator 10 includes, as components to achieve the ventilation function, a fan (not illustrated) that sends air from the outdoor space to the indoor space through the air supply passage 30 and a fan (not illustrated) that sends air from the indoor space to the outdoor space through the air discharge passage 40.

[0015]

The air-conditioning assist function is to assist in an air-conditioning operation of an apparatus adjusting an indoor temperature, such as an air-conditioning apparatus, by recovering heat from indoor air to be discharged and giving the recovered heat to air to be supplied. The air-conditioning assist function, which is a function to reduce an energy load on the apparatus, can also be regarded as an energy-saving function. The heat exchange ventilator 10 includes, as components to achieve the air-conditioning assist function, a heat exchanger (not illustrated) that exchanges heat between air passing through the air discharge passage 40 and air passing through the air supply passage 30.

[0016]

The dust collecting device 1 is a device that collects dust contained in the outdoor air flowing into the lowered ceiling 20 through the exterior air supply opening 21. The dust collecting device 1 will be described in detail later. The dust collecting device 1 includes a particle sensor 11a and a particle sensor 11b that sense the density of dust in air, and the particle sensor 11a is disposed in upstream part of the dust collecting device 1 in the air passing direction and the particle sensor 11b is disposed in downstream part thereof. The particle sensor 11a in the upstream part senses the density of dust in the outdoor air and the particle sensor 11b in the downstream part senses the density of

dust in the air subjected to dust removal. The particle sensors 11a and 11b output detection signals to a coordinating control unit 25, which will be described below.

[0017]

The air-conditioning apparatus further includes the coordinating control unit 25 that causes the dust collecting device 1 and the heat exchange ventilator 10 to be operatively connected to each other. The coordinating control unit 25 is electrically connected to the dust collecting device 1 and the heat exchange ventilator 10. Furthermore, the coordinating control unit 25 controls, based on the detection signals from the particle sensors 11a and 11b, operations of the dust collecting device 1 and the heat exchange ventilator 10. The coordinating control unit 25 can be configured by hardware, such as circuit devices that achieve the functions, or can be configured by an arithmetic unit, such as a microcomputer or a central processing unit (CPU), and software that is executed on the arithmetic unit.

[0018]

Fig. 2 is a perspective view of the dust collecting device according to Embodiment 1 of the present invention. Fig. 3 is a perspective view of a brush in Fig. 2.

The dust collecting device 1 includes a plurality of collecting plates 2, a plurality of brushes 3, a dust box 4, and a casing 15 containing these components. The casing 15 has an air inlet 13, an air outlet 14, and an air passage 16, through which air taken into the casing from the air inlet 13 is discharged out of the casing from the air outlet 14. The dust collecting device 1, which is disposed in the air supply passage 30 as illustrated in Fig. 1, allows the outdoor air flowing from the exterior air supply opening 21 to pass therethrough.

[0019]

The collecting plates 2 are circular plastic plates of polypropylene (PP), which tends to be triboelectrically charged negatively, and have a thickness of, for example, 1 mm, and a diameter of, for example, 300 mm. The collecting plates 2 are spaced, for example, 3 mm apart in a direction intersecting with the air passing direction in which

the outdoor air passes through the casing 15. The collecting plates 2 are connected and combined by a first shaft 8 extending through the centers of the collecting plates 2.
[0020]

The brushes 3 are rubbed against surfaces of the collecting plates 2 to
5 electrostatically charge the surfaces of the collecting plates 2 and remove dust collected by the collecting plates 2 from the surfaces. Each of the brushes 3 includes a rectangular aluminum supporting plate 3a having a thickness of, for example, 1 mm, and a nonwoven web 3b made of a material that tends to be triboelectrically charged positively, for example, polyamide 6 (PA 6) fibers, and is configured such that the
10 nonwoven web 3b is bonded to the supporting plate 3a. The supporting plate 3a has two attachment holes 3c, through each of which a second shaft 9 extends to combine and fix the brushes 3 such that the brushes 3 are not movable.

[0021]

The brushes 3 are fitted in spaces between the collecting plates 2 such that the
15 nonwoven webs 3b are in contact with the surfaces of the collecting plates 2, and are located downstream of the collecting plates 2 in the air passing direction. Furthermore, the brushes 3 are arranged in a posture extending in the air passing direction, in which the outdoor air passes through the casing 15, between the collecting plates 2 to provide lower resistance to the flow of the outdoor air. In this illustration, the brushes 3 are
20 arranged in a horizontal posture. The above-described arrangement of the brushes 3 is effective in reducing the air flow resistance. Each of the brushes 3 is connected to the ground.

[0022]

In the casing 15, the dust box 4 to collect an aggregate 17, or a mass of dust
25 deposited on the collecting plates 2 and removed with the brushes 3, is disposed under the brushes 3.

[0023]

The casing 15 further contains a first baffle plate 18 and a second baffle plate 19 facing each other such that the collecting plates 2 are interposed therebetween. The
30 first baffle plate 18 and the second baffle plate 19 regulate the outdoor air flowing into

the casing 15 such that the outdoor air passes through the collecting plates 2. The first baffle plate 18 is disposed on an inner surface of a top plate 15a of the casing 15, and has a surface extending along outer circumferential surfaces of the collecting plates 2. The second baffle plate 19 is disposed on an inner surface of a bottom plate 15b of the casing 15, and has a flat surface. Furthermore, the second baffle plate 19 reduces or eliminates rattle of the dust box 4 caused by collision between the air and the dust box and also prevents the dust collected in the dust box 4 from being scattered by air flowing into the dust box 4. Therefore, it is preferred that the second baffle plate 19 be disposed to have a height greater than or equal to that of an upstream end 4a of the dust box 4.

[0024]

The dust collecting device 1 further includes a motor 6 and a drive control unit 7 that controls the motor 6, and the motor 6 and the drive control unit 7 are arranged outside the casing 15. The motor 6 is connected to the first shaft 8 via a gear mechanism. Rotating the motor 6 rotates the first shaft 8. The rotation of the first shaft 8 rotates the collecting plates 2 fixed to the first shaft 8.

[0025]

An operation of the dust collecting device 1 according to Embodiment 1 of the present invention will now be described.

When the dust collecting device 1 is operated for the first time or after a long idle period of time of one month or more, a triboelectric charging operation is performed to electrostatically charge the surfaces of the collecting plates 2. Specifically, the drive control unit 7 of the dust collecting device 1 gives an instruction to the motor 6 to rotate the collecting plates 2. In this case, the collecting plates 2 are rotated forward (or rotated in a direction represented by an arrow 12 in Fig. 2) at a speed of 1 rpm for 20 seconds. The collecting plates 2 are rotated and the surfaces of the collecting plates 2 are rubbed with the brushes 3, thus generating negative static electricity on the surfaces of the collecting plates 2. When the rotation of the collecting plates 2 is stopped, triboelectric charging is completed, thus terminating triboelectric charging operation.

The above-described rotation speed and rotation time are merely illustrative examples,

and may be appropriately set depending on actual use conditions, for example, as long as the collecting plates 2 be rotated to generate static electricity.

[0026]

After the triboelectric charging operation, when outdoor air is taken into the dust collecting device 1, the outdoor air passes through central parts of the collecting plates 2 while being regulated by the first baffle plate 18 and the second baffle plate 19. While the outdoor air is passing through the central parts of the collecting plates 2, dust 5 contained in the outdoor air is attracted to and collected on the surfaces of the collecting plates 2 with static electricity generated on the surfaces of the collecting plates 2.

[0027]

The brushes 3 in a posture extending in the air passing direction, for example, in a posture parallel to the air passing direction, are arranged between the collecting plates 2. Therefore, the brushes 3 do not greatly interfere with the flow of the outdoor air passing through the collecting plates 2, and thus exhibit low air flow resistance. This leads to high dust collecting performance.

[0028]

Operations of the dust collecting device 1 include an operation (hereinafter, referred to as a cleaning and charging operation) of automatically cleaning the surfaces of the collecting plates 2 and automatically recharging the surfaces. In the cleaning and charging operation, the collecting plates 2 are rotated forward at a speed of 1 rpm for 20 seconds in response to an instruction given to the motor 6 by the drive control unit 7 of the dust collecting device 1 in a manner similar to the above-described initial triboelectric charging operation. The collecting plates 2 are rotated and the surfaces of the collecting plates 2 are rubbed with the brushes 3, thus removing dust deposited on the surfaces of the collecting plates 2 with the brushes 3 and triboelectrically charging the collecting plates 2. In other words, the rotation of the collecting plates 2 causes the deposited dust to be removed and also causes the collecting plates 2 to be triboelectrically charged. Some of the dust deposit as aggregates 17 on lower sides of

the brushes 3. A predetermined size or more of aggregate 17 falls by gravity, so that the aggregate 17 is collected into the dust box 4 disposed under the brushes 3.

[0029]

Furthermore, in the cleaning and charging operation, the collecting plates 2 are rotated backward a half turn (hereinafter, referred to as backward half-turn rotation) at a speed of 1 rpm to remove the aggregates 17 accumulated between the collecting plates 2 and the brushes 3. The backward half-turn rotation of the collecting plates 2 causes the aggregates 17 accumulated between the collecting plates 2 and the brushes 3 to experience a downward frictional force, so that the aggregates 17 are dropped and collected into the dust box 4.

[0030]

The rotation speed of the collecting plates 2 and the rotation time in the above-described cleaning and charging operation are merely illustrative examples, and may be appropriately set depending on actual use conditions, for example.

[0031]

Fig. 4 is a flowchart explaining an operation of the air-conditioning apparatus including the dust collecting device according to Embodiment 1 of the present invention. The operation of the air-conditioning apparatus will be described below with reference to Fig. 4.

When the above-described initial triboelectric charging operation of the dust collecting device 1 is needed (step S1), the coordinating control unit 25 stops the fans (not illustrated) of the heat exchange ventilator 10 and instructs the drive control unit 7 to perform the above-described initial triboelectric charging operation while the fans are in a stopped state (step S2). Upon completion of the initial triboelectric charging operation, ventilation is started. Specifically, the coordinating control unit 25 actuates or operates the fans (not illustrated) of the heat exchange ventilator 10 (step S3). Thus, the outdoor air, taken from the outdoor space, passes through the dust collecting device 1 and dust contained in the outdoor air is removed. The air subjected to dust removal is supplied to the heat exchange ventilator 10. The outdoor air supplied to the heat exchange ventilator 10 exchanges heat with indoor air flowing into the heat

exchange ventilator 10 through the interior air discharge opening 24 to recover heat and is then supplied into the indoor space through the interior air supply opening 23.

[0032]

The coordinating control unit 25 determines, based on detection signals from the particle sensors 11a and 11b arranged in the dust collecting device 1, whether the dust collecting performance of the dust collecting device 1 is degraded (step S4). If the coordinating control unit 25 detects, based on the detection signals, a degradation in dust collecting performance of the dust collecting device 1, the coordinating control unit 25 stops the fans (not illustrated) of the heat exchange ventilator 10 (step S5). While the flow of air is stopped in the above-described manner, the dust collecting device 1 is caused to perform the cleaning and charging operation (step S6). The dust collecting performance of the collecting plates 2 is restored by the cleaning and charging operation, and after that, the collecting plates 2 collect dust again. The above-described operations in steps S3 to S6 are repeated until the operation of the air-conditioning apparatus is stopped.

[0033]

Detection of a degradation in dust collecting performance of the dust collecting device 1 based on detection signals from the particle sensors 11a and 11b may be performed in the following manner, for example. If the difference in density of dust between the air to pass through the dust collecting device 1 and the air passing through the dust collecting device 1 is a predetermined density or less, a degradation in dust collecting performance of the dust collecting device 1 may be determined.

[0034]

As described above, in the dust collecting device 1 according to Embodiment 1, the brushes 3 are fitted in the spaces between the collecting plates 2 in a posture extending in the air passing direction. This arrangement allows the dust collecting device 1 to exhibit low air flow resistance and high dust collecting performance. The term "posture extending in the air passing direction" as used herein refers to a posture at a rotation angle about an axis extending in the direction in which the collecting plates 2 are spaced apart and the rotation angle is in the range of -45 degrees to +45 degrees

relative to the air passing direction being 0 degrees. A posture in this range of angles is effective enough to reduce the air flow resistance, leading to high dust collecting performance of the dust collecting device 1. Fig. 2 illustrates the brushes 3 in a posture at a rotation angle of 0 degrees.

5 [0035]

The first baffle plate 18 and the second baffle plate 19 facing each other with the collecting plates 2 interposed therebetween are arranged to regulate the air in the air passage 16 such that the air flows through the central parts of the collecting plates 2, leading to high dust collecting performance of the dust collecting device 1. The shapes of the first baffle plate 18 and the second baffle plate 19 are not limited to those illustrated in Fig. 2 as long as the air is regulated to flow through the central parts of the collecting plates 2.

10 [0036]

Although Embodiment 1 has been described with a case where the collecting plates 2 are negatively charged, the collecting plates 2 may be positively charged by, for example, using PA 6 fibers as a material for the collecting plates 2 or using polytetrafluoroethylene (PTFE), which is highly likely to be negatively charged, as a material for rubbing parts with which the collecting plates 2 are rubbed.

15 [0037]

Although Embodiment 1 has been described with a case where the fibers contained in the brushes 3 are PA 6 fibers, for example, polyacrylonitrile (PAN) fibers may be used. To reduce or eliminate the likelihood that the brushes 3 is charged to saturation, the rubbing parts are preferably highly conductive. For example, a material obtained by adding carbon to the above-described material may be used for the rubbing parts so that the rubbing parts are conductive. Instead of the nonwoven web, each brush 3 may include bristle-like components, a sponge-like component, or a plate-shaped component.

20 [0038]

In the illustrated configuration of Embodiment 1, the brushes 3 are arranged downstream of the collecting plates 2 such that the brushes 3 extending upstream are

fitted in the spaces between the collecting plates 2. The brushes 3 may be arranged upstream of the collecting plates 2 such that the brushes 3 extending downstream are fitted in the spaces between the collecting plates 2. In such a configuration, the dust box 4 may be disposed under the brushes 3 in a manner similar to the above configuration.

[0039]

Embodiment 2.

In Embodiment 1 described above, the timing of cleaning and charging of the dust collecting device 1 is controlled based on detection signals from the particle sensors. In Embodiment 2, this timing is controlled by using a timer. A dust collecting device 1 according to Embodiment 2 basically has the same configuration as that of the dust collecting device 1 according to Embodiment 1 but differs from the dust collecting device 1 according to Embodiment 1 in that the device includes a timer. The following description will focus on the difference between Embodiment 2 and Embodiment 1.

The components that are not mentioned in Embodiment 2 are the same as those in Embodiment 1.

[0040]

Fig. 5 is a perspective view illustrating the configuration of the dust collecting device according to Embodiment 2 of the present invention.

As illustrated in Fig. 5, the dust collecting device 1 according to Embodiment 2 includes a timer 50. The timer 50 is disposed outside the casing 15 and is connected to the motor 6 and the drive control unit 7. The timer 50 outputs a signal to the drive control unit 7 when a predetermined period of time has elapsed since start of time measurement.

[0041]

Fig. 6 is a flowchart explaining an operation of an air-conditioning apparatus including the dust collecting device according to Embodiment 2 of the present invention. The operation of the air-conditioning apparatus will be described below with reference to Fig. 6. The same processes as those in Embodiment 1 illustrated in Fig. 4 are

designated by the same step numbers. The following description will focus on operations different from those in Embodiment 1.

[0042]

In Embodiment 2, the timer 50 starts time measurement just after the initial triboelectric charging operation (step S11). The fans of the heat exchange ventilator 10 are operated to continue ventilation until a predetermined period of time (24 hours in this case, for example) elapses after the start of time measurement (step S12, step S3). If 24 hours have elapsed since the start of time measurement (step S12), the timer 50 outputs a signal. In response to receiving the signal, the drive control unit 7 stops the fans of the heat exchange ventilator 10 (step S5). Then, the drive control unit 7 drives the motor 6 to cause cleaning and charging (step S6). The operation then returns to step S11, and the timer 50 again starts time measurement. Thus, the cleaning and charging operation is repeated every 24 hours until the operation of the air-conditioning apparatus is stopped.

[0043]

As described above, Embodiment 2 offers the same advantageous effects as those in Embodiment 1 and further offers the following advantageous effects. Since the timer 50 controls the timing of cleaning and charging, expensive devices, such as the particle sensors in Embodiment 1, are not needed. This allows the dust collecting device 1 exhibiting high performance that can be maintained for a long term to be achieved at low cost.

[0044]

Although the predetermined period of time set in the timer 50 is 24 hours in Embodiment 2, the predetermined period of time may be appropriately determined depending on the actual environmental conditions of outdoor air to be used. If the density of dust contained in the outdoor air is high, the predetermined period of time may be set to less than 24 hours. If the density of dust contained in the outdoor air is low, the predetermined period of time may be set to greater than 24 hours.

[0045]

Embodiment 3.

Embodiment 3 relates to a dust collecting device 1 constantly having little motor noise. The dust collecting device 1 according to Embodiment 3 basically has the same configuration as that of the dust collecting device 1 according to Embodiment 1 but differs from the dust collecting device 1 according to Embodiment 1 in that the device includes a load sensor. The following description will focus on the difference between Embodiment 3 and Embodiment 1. The components that are not mentioned in Embodiment 3 are the same as those in Embodiment 1.

[0046]

Fig. 7 is a perspective view illustrating the configuration of the dust collecting device according to Embodiment 3 of the present invention.

As illustrated in Fig. 7, the dust collecting device 1 according to Embodiment 3 includes a load sensor 51 that measures a load on the motor 6. The load sensor 51 includes a current measuring element that measures a current flowing through the motor 6. The load sensor 51 is disposed outside the casing 15 and is connected to the motor 6 and the drive control unit 7. For the load sensor 51 measuring a load on the motor 6, the current measuring element is used in this configuration. A torque sensor that detects a torque of the motor 6 may be used instead.

[0047]

Fig. 8 is a flowchart explaining an operation of an air-conditioning apparatus including the dust collecting device according to Embodiment 3 of the present invention. The operation of the air-conditioning apparatus will be described below with reference to Fig. 8. The same operations as those in Embodiment 1 illustrated in Fig. 4 are designated by the same step numbers. The following description will focus on operations different from those in Embodiment 1.

[0048]

Repeated use of the dust collecting device 1 causes the aggregates 17 to accumulate little by little between the collecting plates 2 and the brushes 3 even if automatic surface cleaning is performed. The accumulated aggregates 17 between the collecting plates 2 and the brushes 3 become resistance to rotation of the collecting

plates 2, causing a gradual increase in current flowing through the motor 6. This results in an increase in motor noise.

[0049]

The load sensor 51 measures a load on the motor 6. If the measured load is a predetermined load or more (step S21), the drive control unit 7 causes the collecting plates 2 to perform an operation of eliminating accumulation of the aggregates 17 (step S22). Specifically, the load sensor 51 measures a current flowing through the motor 6. In a case where the measured value increases to, for example, 1.2 times an initial value or more, the drive control unit 7 starts the operation of eliminating accumulation of the aggregates 17.

[0050]

In the operation of eliminating accumulation of the aggregates 17, the drive control unit 7 causes backward half-turn rotation of the collecting plates 2 to drop the aggregates 17 between the collecting plates 2 and the brushes 3 and then causes the collecting plates 2 to rotate forward a one-quarter turn. The drive control unit 7 repeats the operation of eliminating accumulation of the aggregates 17 until the accumulation is eliminated (step S22, step S23). Specifically, backward half-turn rotation and forward one-quarter-turn rotation of the collecting plates 2 are alternately repeated until a current measured by the load sensor 51 decreases to be substantially equal to the initial value.

[0051]

If the accumulation of the aggregates 17 is eliminated, the operation returns to step S3. The coordinating control unit 25 actuates or operates the fans of the heat exchange ventilator 10 to resume ventilation.

[0052]

As described above, Embodiment 3 offers the same advantageous effects as those of Embodiment 1 and further offers the following advantageous effects. When accumulation of the aggregates 17 is detected based on a load measured by the load sensor 51, the collecting plates 2 are caused to perform the operation of eliminating

accumulation of the aggregates 17, thus eliminating the accumulation of the aggregates 17. This allows the dust collecting device 1 to constantly have little motor noise.

[0053]

For a trigger of the operation of eliminating accumulation of the aggregates 17, the case where a current flowing through the motor 6 increases to 1.2 times the initial value or more has been described as an example in Embodiment 3. The trigger is not limited to this example. A threshold current as a trigger may be appropriately determined depending on the characteristics of a motor actually used.

[0054]

For the operation of eliminating accumulation of the aggregates 17, a case where backward half-turn rotation and forward one-quarter-turn rotation of the collecting plates 2 are alternately repeated has been described as an example. These amounts of rotation are merely illustrative examples. Any configuration may be applicable as long as backward rotation and forward rotation be alternately repeated. Furthermore, another example of the operation of eliminating accumulation of the aggregates 17 may be an operation of causing the collecting plates 2 to continuously rotate backward until a current flowing through the motor 6 falls below the threshold. Briefly, the operation of eliminating accumulation of the aggregates 17 may differ from at least the cleaning and charging operation.

[0055]

Embodiment 4.

A dust collecting device 1 according to Embodiment 4 basically has the same configuration as that of the dust collecting device 1 according to Embodiment 1 but differs from the dust collecting device 1 according to Embodiment 1 in that the device includes an air filter. The following description will focus on the difference between Embodiment 4 and Embodiment 1. The components that are not mentioned in Embodiment 4 are the same as those in Embodiment 1.

[0056]

Fig. 9 is a perspective view illustrating the configuration of the dust collecting device according to Embodiment 4 of the present invention. As illustrated in Fig. 9, the

dust collecting device 1 according to Embodiment 4 includes an air filter 52, which collects dust, disposed downstream of the casing 15.

[0057]

For the air filter 52, a pleated, high efficiency particulate air (HEPA) filter comprising an electrically-charged nonwoven web of PP melt-blown fibers is used in this configuration. The HEPA filter has a high density of fibers and a high dust collection rate.

[0058]

The air filter 52 disposed downstream of the casing 15 enables air subjected to removal of, for example, dust contained in the air, by the collecting plates 2 to be further cleaned, leading to higher dust collecting performance.

[0059]

As described above, Embodiment 4 offers the same advantageous effects as those of Embodiment 1 and further offers the following advantageous effects. The air filter 52 enables air subjected to removal of, for example, dust contained in the air, by the dust collecting device 1 to be further cleaned, leading to higher dust collecting performance.

[0060]

The HEPA filter, which is used as the air filter 52 and has a high density of fibers, may be relatively quickly clogged with collected dust, resulting in an increase in pressure loss. Therefore, maintenance (filter change) every several months is recommended. The dust collecting device 1 according to Embodiment 4 includes the collecting plates 2 arranged upstream of the HEPA filter from another perspective point of view. In such a configuration, dust is removed upstream of the HEPA filter, thus reducing a dust load on the HEPA filter. This results in a gradual increase in pressure loss caused by clogging of the HEPA filter. This prolongs time intervals between maintenance operations for the HEPA filter and achieves both high dust collecting performance and long-term dust collection.

[0061]

Although Embodiments 1 to 4 have been described as different embodiments, the features of these embodiments may be appropriately combined into a dust collecting device. For example, Embodiment 2 and Embodiment 3 may be combined such that the load sensor 51 is added to the configuration of Fig. 4. Additionally, for example, Embodiment 2 and Embodiment 4 may be combined such that the air filter 52 is added to the configuration of Fig. 4.

Reference Signs List

[0062]

1 dust collecting device 2 collecting plate 3 brush 3a supporting plate
3b nonwoven web 3c attachment hole 4 dust box 4a upstream end 5 dust
6 motor 7 drive control unit 8 first shaft 9 second shaft 10 heat exchange
ventilator 11a particle sensor 11b particle sensor 12 arrow 13 air inlet 14
air outlet 15 casing 15a top plate 15b bottom plate 16 air passage 17
aggregate 18 first baffle plate 19 second baffle plate 20 ceiling 21 exterior
air supply opening 22 exterior air discharge opening 23 interior air supply opening
24 interior air discharge opening 25 coordinating control unit 30 air supply
passage 31 duct 40 air discharge passage 41 duct 50 timer 51 load
sensor 52 air filter

CLAIMS

[Claim 1]

A dust collecting device comprising:

5 a plurality of collecting plates spaced apart in an air passage, the plurality of collecting plates being arranged in a direction intersecting with an air passing direction in which air passes, the plurality of collecting plates being electrically charged by friction; and

10 a plurality of brushes fitted in spaces, through which the air passes, between the plurality of collecting plates, the plurality of brushes being rubbed against surfaces of the plurality of collecting plates and removing dust collected by the plurality of collecting plates,

wherein the plurality of brushes are in a posture extending in the air passing direction and are fitted in the spaces between the plurality of collecting plates.

[Claim 2]

15 The dust collecting device of claim 1, wherein the plurality of brushes are arranged in a posture at a rotation angle about an axis extending in the direction in which the plurality of collecting plates are spaced apart and the rotation angle is in a range of -45 degrees to +45 degrees relative to the air passing direction being 0 degrees.

[Claim 3]

The dust collecting device of claim 1 or 2, further comprising:

20 a first baffle plate and a second baffle plate facing each other such that the plurality of collecting plates are interposed between the first and second baffle plates, the first and second baffle plates regulating the air in the air passage such that the air passes through the plurality of collecting plates.

[Claim 4]

The dust collecting device of any one of claims 1 to 3, further comprising:

an air filter disposed downstream of the plurality of collecting plates in the air passing direction.

[Claim 5]

The dust collecting device of any one of claims 1 to 4, further comprising:
a motor rotating the plurality of collecting plates to cause friction between the plurality of collecting plates and the plurality of brushes; and
a drive control unit controlling the motor to rotate the plurality of collecting plates,
5 wherein the drive control unit causes the plurality of collecting plates to rotate such that the plurality of collecting plates are triboelectrically charged to attract and collect dust contained in the air.

[Claim 6]

The dust collecting device of claim 5, wherein the drive control unit performs a
10 cleaning and charging operation in which the plurality of collecting plates are rotated to remove the dust deposited on the plurality of collecting plates by friction between the plurality of collecting plates and the plurality of brushes and electrically charge the surfaces of the plurality of collecting plates, and after that, the plurality of collecting plates are rotated backward to remove the dust in the spaces between the plurality of
15 collecting plates.

[Claim 7]

The dust collecting device of claim 6, further comprising:
a timer outputting a signal upon a passage of a predetermined period of time,
wherein the drive control unit performs the cleaning and charging operation in
20 response to outputting the signal by the timer.

[Claim 8]

The dust collecting device of claim 6 or 7, further comprising:
a load sensor measuring a load on the motor,
wherein, in a case where the load measured by the load sensor is a
25 predetermined load or more, the drive control unit performs an operation that differs from the cleaning and charging operation and in which the plurality of collecting plates are caused to perform an operation of eliminating accumulation of the dust between the plurality of collecting plates and the plurality of brushes.

[Claim 9]

The dust collecting device of claim 8, wherein the load sensor is a current measuring element measuring a current flowing through the motor or a torque sensor detecting a torque of the motor.

[Claim 10]

- 5 An air-conditioning apparatus including the dust collecting device of any one of claims 1 to 9.