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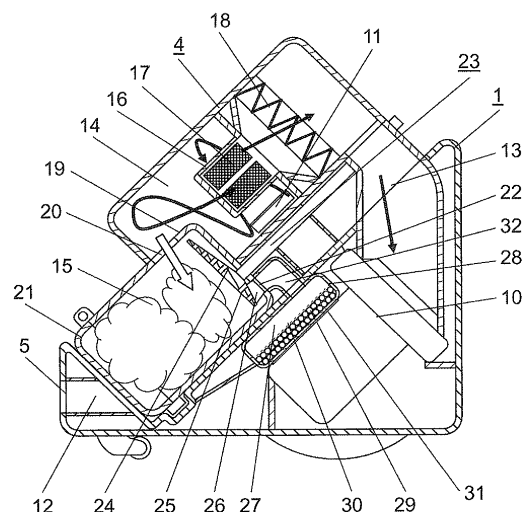
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(54) **VACUUM CLEANER**

(57) An electric vacuum cleaner includes electric blower (10) for generating a suction force; dust separating unit (14), installed on an upstream side of the electric blower (10), for separating dust from air containing the dust suctioned by electric blower (10); dust collecting chamber (15) for accumulating the dust separated by dust separating unit (14); humidifying port (22) opened to dust collecting chamber (15); and humidifying unit (27), communicating to humidifying port (22), for generating air of high humidity; wherein humidifying unit (27) supplies the air of high humidity from humidifying port (22) to the dust accumulated in dust collecting chamber (15).

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to an electric vacuum cleaner, and in particular, to a dust collecting chamber of the electric vacuum cleaner.

BACKGROUND ART

[0002] In recent years, attention is given to a so-called cyclone-type electric vacuum cleaner, which is a type of an electric vacuum cleaner that provides a whirling component to suctioned air to separate and remove dust from an airflow with a centrifugal force.

[0003] As a conventional electric vacuum cleaner, there is known an electric vacuum cleaner including an intake path enabling air containing dust to flow in from outside, an electric blower for generating intake air in the intake path, and a dust collecting chamber for separating the air containing the dust that passed through the intake path into the dust and the air by whirling and then accumulating the dust at the bottom. There is also known an electric vacuum cleaner including a water particle supplying unit for nebulizing water and supplying water particles having an average particle diameter of smaller than or equal to 50 μm to the intake path (see e.g., Patent Literature 1, Patent Literature 2).

[0004] There is also known a conventional electric vacuum cleaner including a compressing unit for compressing the dust accumulated in the dust collecting chamber (see e.g., Patent Literature 3).

[0005] As water particles are supplied from the water particle supplying unit in such a cyclone-type electric vacuum cleaner, the water particles attach to the suctioned air and dust passing through the intake path. The dust attached with the water particles flow into the dust collecting chamber, where fine dust easily attach to each other thus enhancing an effect of agglomerating the fine dust. The separating performance of the dust and the air is thus improved.

[0006] The water particles having an average particle diameter of smaller than or equal to 50 μm have a large surface area with respect to a weight of the water particles, and thus tend to easily evaporate. Therefore, even if the water particles supplied from the water particle supplying unit attach to the dust collecting chamber, the attached water particles evaporate and are removed by the whirling air.

[0007] In the dust collecting chamber of the electric vacuum cleaner described in Patent Literature 1 and Patent Literature 2, a speed of the whirling air is very high, i.e., 50 m to 100 m/second, and thus most of the supplied water particles are instantly exhausted to an outside of the dust collecting chamber while evaporating. Therefore, the fine dust (e.g., sand, dirt) that is less likely to be flowed by the whirling airflow accumulates at the bottom of the dust collecting chamber first. The rough dust (cot-

ton waste) that is likely to be flowed by the whirling airflow accumulates on the fine dust. Thus, majority of the fine dust and the rough dust are accumulated in a separated state.

[0008] The compressing unit of the electric vacuum cleaner described in Patent Literature 3 compresses the dust accumulated in the dust collecting chamber. However, the dust may not be easily compressed since there is a lot of space between the rough dust and the rough dust, or since the cotton waste or the like has a strong repulsion force. For example, if the compressing unit compressing the dust is released when starting the cleaning, the volume of the accumulated dust increases to about two to three times. The dust collecting chamber thus cannot be sufficiently miniaturized due to the increasing dust.

[0009] Furthermore, when discarding the accumulated dust by opening the bottom lid of the dust collecting chamber, the fine dust in the dust may get involved in a flow of air triggered by the opening of the bottom lid and scatter around.

[0010] In other words, in the conventional electric vacuum cleaner, the supplied water particles are useful in improving the separating performance of the dust and the air. However, the supplied water particles do not contribute to improving the compressibility of the dust or preventing the scattering of the dust when discarding the accumulated dust.

Citation List

Patent Literature

[0011]

PTL1: Japanese Unexamined Patent Publication No. 2009-039253

PTL2: Japanese Unexamined Patent Publication No. 2006-175043

PTL3: Japanese Unexamined Patent Publication No. 2002-051950

SUMMARY OF THE INVENTION

[0012] The present invention provides an electric vacuum cleaner adapted to improve compressibility of dust and prevent scattering of the dust.

[0013] An electric vacuum cleaner according to the present invention includes an electric blower for generating a suction force; a dust separating unit, installed on an upstream side of the electric blower, for separating dust from air containing the dust suctioned by the electric blower; and a dust collecting chamber for accumulating the dust separated by the dust separating unit. A humidifying port opened to the dust collecting chamber; and a humidifying unit, communicating to the humidifying port, for generating air of high humidity are further arranged, and the humidifying unit supplies the air of high humidity

from the humidifying port to the dust accumulated in the dust collecting chamber.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is an outer appearance view of an electric vacuum cleaner according to a first exemplary embodiment of the present invention.

FIG. 2 is a cross-sectional view showing a configuration of main parts during operation of the electric vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 3 is a cross-sectional view showing a configuration of the main parts after the end of cleaning of the electric vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 4 is a cross-sectional view taken along line 4-4 of FIG. 3 of the electric vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 5 is a correlation diagram of time and temperature showing a temperature change of an electric blower of the electric vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 6 is a relationship diagram of a relative humidity and a moisture absorptivity of a hygroscopic material at the time of equilibrium of the electric vacuum cleaner according to the first exemplary embodiment of the present invention.

FIG. 7 is a cross-sectional view showing a configuration of main parts immediately after the end of cleaning of an electric vacuum cleaner according to a second exemplary embodiment of the present invention.

FIG. 8 is a cross-sectional view showing a configuration of the main parts during a compressing operation after the end of cleaning of the electric vacuum cleaner according to the second exemplary embodiment of the present invention.

FIG. 9 is a cross-sectional view taken along line 9-9 of FIG. 8 of the electric vacuum cleaner according to the second exemplary embodiment of the present invention.

FIG. 10 is a cross-sectional view showing a configuration of main parts during operation of an electric vacuum cleaner according to a third exemplary embodiment of the present invention.

FIG. 11 is a cross-sectional view showing a configuration of the main parts during a compressing operation after the end of cleaning of the electric vacuum cleaner according to the third exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0015] An electric vacuum cleaner according to exemplary embodiments of the present invention will be hereinafter described with reference to the drawings. The following description is one specific example of the present invention, and the present invention is not limited thereto.

FIRST EXEMPLARY EMBODIMENT

[0016] Electric vacuum cleaner 50 according to a first exemplary embodiment of the present invention will be described. FIG. 1 is an outer appearance view of a vacuum cleaner of an electric vacuum cleaner according to the first exemplary embodiment of the present invention, and FIG. 2 is a cross-sectional view showing a configuration of main parts during operation of the electric vacuum cleaner. FIG. 3 is a cross-sectional view showing a configuration of the main parts after the end of cleaning of the electric vacuum cleaner, and FIG. 4 is a cross-sectional view taken along line 4-4 of FIG. 3. FIG. 4 is a cross-sectional view showing an arrangement of a dust separating unit and a dust collecting chamber. FIG. 5 is a correlation diagram of time and temperature showing a temperature change of an electric blower of the electric vacuum cleaner, and FIG. 6 is a relationship diagram of a relative humidity and a moisture absorptivity of a hygroscopic material at the time of equilibrium of the electric vacuum cleaner.

[0017] As shown in FIG. 1, wheel 2 and caster 3 are attached to an exterior of vacuum cleaner main body 1. Vacuum cleaner main body 1 thus freely moves on a floor surface. Vacuum cleaner main body 1 has suction hose 6, and extended tube 8 formed with handle 7 sequentially connected to suction port 5 provided on a lower side of vacuum cleaner main body 1. Suction tool 99 is attached to a distal end of extended tube 8.

[0018] As shown in FIG. 2 and FIG. 3, vacuum cleaner main body 1 incorporates electric blower 10. Dust collecting case 4 is detachably arranged with respect to vacuum cleaner main body 1. Dust collecting case 4 is communicated to suction passage 12 through intake port 11. Air flowed in from suction port 5 is passed through suction passage 12 to flow into dust collecting case 4 from intake port 11.

[0019] Dust collecting case 4 includes tubular dust separating unit 14 for taking in air containing dust and generating an whirling airflow, and dust collecting chamber 15 having a substantially tubular shape for accumulating dust.

[0020] Dust separating unit 14 includes intake port 11 opened so as to be in a tangent direction with respect to a contour inner peripheral surface of a substantially cylindrical shape of dust separating unit 14. Exhaust tube 16 is arranged at a substantially center portion of dust separating unit 14. Exhaust tube 16 has a substantially cylindrical shape and is communicated to ventilation port 13.

[0021] Ventilation unit 17 is arranged on an outer peripheral side surface of exhaust tube 16, and is configured by a filtration filter such as a mesh filter or an etching filter. Accordingly, rough dust cannot pass through exhaust tube 16. In addition, a nonwoven filter folded in a pleat form is arranged as second dust separating unit 18 between exhaust tube 16 and ventilation port 13. Accordingly, dust smaller than the mesh of ventilation unit 17 cannot pass through ventilation port 13.

[0022] Dust collecting chamber 15 accumulates the dust separated by dust separating unit 14. Dust collecting chamber 15 is a tubular body of a substantially cylindrical shape having an inner diameter substantially the same as dust separating unit 14. As shown in FIG. 3 and FIG. 4, dust collecting chamber 15 is arranged at a position where a respective center axis is shifted in parallel in a horizontal direction below dust separating unit 14. Furthermore, one part of an upper end of dust collecting chamber 15 overlaps an interior of dust separating unit 14 in a height direction.

[0023] That is, dust separating unit 14 and dust collecting chamber 15 overlap each other. Partition wall 19 having a substantially arcuate shape is arranged at a portion where dust separating unit 14 and dust collecting chamber 15 overlap each other. Flow-in port 20 is opened in partition wall 19. The air containing dust whirling in dust separating unit 14 flows into dust collecting chamber 15.

[0024] As shown in FIG. 3, bottom lid 21 axially supported in a freely rotatable manner is arranged at a bottom portion of dust collecting chamber 15, where dust collecting chamber 15 and bottom lid 21 are blocked while ensuring air tightness. Humidifying port 22 is opened at a roof surface of dust collecting chamber 15. Note that humidifying port 22 merely needs to be opened to an inside of dust collecting chamber 15, and an area of opening is not limited to the roof surface of dust collecting chamber 15.

[0025] Compressing unit 23 compresses the dust inside dust collecting chamber 15. Compressing unit 23 has flat plate-like compression plate 24. When compressing the dust of dust collecting chamber 15, compressing unit 23 is manually lowered through the inside of dust collecting chamber 15 to compress the dust. During the operation of electric vacuum cleaner 50, compressing unit 23 rises through the inside of dust collecting chamber 15 by an elastic force of an elastic body (not shown) such as a spring to be positioned at the roof surface of dust collecting chamber 15.

[0026] As shown in FIG. 4, compression plate 24 has spacing 43 of 1 mm to 3 mm with respect to an inner surface of dust collecting chamber 15. Spacing 43 between compression plate 24 and dust collecting chamber 15 merely needs to be an extent compression plate 24 does not make contact with dust collecting chamber 15 and the accumulated dust does not escape from spacing 43 at the time of compression. Compression plate 24 includes a number of communicating portions 25 or holes

having a diameter of about 1 mm to 10 mm, for example, adapted to communicate an upper surface and a lower surface of compression plate 24. Compression plate 24 includes open/close portion 26 for opening and closing humidifying port 22 projected to a circular truncated cone shape at the upper surface thereof.

[0027] A size of the hole of communicating portion 25 is desirably a diameter of about 1 mm to 3 mm since the dust cannot be compressed if the hole is large. Note that a shape of communicating portion 25 merely needs to enable the communication between the upper surface and the lower surface of compression plate 24. The shape of communicating portion 25 is not limited to a circle, and may be a polygon.

[0028] Open/close portion 26 closes humidifying port 22 when compression plate 24 is raised and accommodated at an upper part of dust collecting chamber 15. A shape of open/close portion 26 may be an arbitrary shape as long as humidifying port 22 can be closed.

[0029] As shown in FIG. 3, humidifying unit 27 includes hygroscopic material 29 and humidifying container 28 incorporating hygroscopic material 29. Humidifying container 28 incorporates hygroscopic material 29 containing 20 gram of silica gel, for example. Hygroscopic material 29 preferably has a property in which the relative humidity and the moisture absorptivity are substantially directly proportional. This is to stably carry out moisture absorption.

[0030] Hygroscopic material 29 is provided by being pushed against a bottom surface of humidifying container 28 by mesh 30. The bottom surface of humidifying container 28 is brought into contact and fixed over a wide range to a side surface or a bottom surface of electric blower 10 through heat transmitting paint 31 in which aluminum powder is kneaded on an outer surface of electric blower 10. An upper space of humidifying container 28 is communicated to humidifying port 22 through humidifying passage 32.

[0031] Next, an operation of electric vacuum cleaner 50 will be described. When electric vacuum cleaner 50 starts the operation, a fan inside electric blower 10 rotates at high speed. The air moves to the outside of electric blower 10 by rotation of the fan inside electric blower 10. The air pressure thus lowers inside electric blower 10. Electric blower 10 thereby generates a suction force, so that the air is suctioned from suction tool 99 into electric blower 10. The dust on a floor surface of a house (3 gram/day in normal household, 7 gram/day in overload) is suctioned by suction tool 99.

[0032] The suctioned dust moves to suction port 5 through extended tube 8 and suction hose 6 coupled to extended tube 8. The dust moves into vacuum cleaner main body 1 from suction port 5 for detachably joining suction hose 6 and vacuum cleaner main body 1.

[0033] The dust suctioned from suction port 5 moves to dust collecting case 4 through suction passage 12. In dust collecting case 4, the air containing the dust is whirled at high speed to centrifugally separate the dust

from the air. The microscopic dust is filtered by ventilation unit 17. The filtered air is exhausted from exhaust outlet (not shown) on a downstream of electric blower 10 (cyclone-type electric vacuum cleaner).

[0034] Next, an operation of dust collecting case 4 will be described in detail using experimental results. First, after driving of electric blower 10, compression plate 24 is raised by the spring, and thus compressing unit 23 is in a state of being accommodated at the upper part of dust collecting chamber 15. Open/close portion 26 thus enters humidifying port 22 and closes humidifying passage 32.

[0035] The air containing the dust that flowed in from intake port 11 by the suctioning action of electric blower 10 advances to flow-in port 20 while whirling through dust separating unit 14 to diagonally a lower side of intake port 11.

[0036] The air containing the dust enters dust collecting chamber 15 from flow-in port 20. The rough dust, which is relatively large, of the dust jumps into dust collecting chamber 15 from flow-in port 20 due to a centrifugal force generated by whirling. Thus, dust separating unit 14 is installed on an upstream side of electric blower 10, and the dust is separated from the air containing the dust suctioned by electric blower 10.

[0037] The dust accumulates in order from fine dust (soil, sand, and the like) to rough dust (cotton waste and the like), similar to a normal apparent specific gravity, on a bottom surface of dust collecting chamber 15. Ventilation unit 17 is positioned at a center of dust separating unit 14. The rough dust larger than the mesh of the filter of ventilation unit 17 of the dust that did not jump into dust collecting chamber 15 is not suctioned to ventilation unit 17. Thus, the rough dust again rides on the centrifugal whirling airflow to jump into dust collecting chamber 15 from flow-in port 20 and accumulates on the bottom surface of dust collecting chamber 15. The fine dust smaller than the mesh of the filter of ventilation unit 17 such as lint and having a small specific gravity of the dust that did not jump into dust collecting chamber 15 is suctioned to ventilation unit 17. Thus, the fine dust such as the lint passes through ventilation unit 17 along with the air. Thereafter, the fine dust is filtered by second dust separating unit 18 communicated to ventilation unit 17. The air having the fine dust filtered is passed through second dust separating unit 18 and guided to electric blower 10.

[0038] Here, a function of humidifying unit 27 will be described. Humidifying unit 27 includes humidifying container 28 and hygroscopic material 29 arranged in humidifying container 28. Humidifying unit 27 is communicated to humidifying port 22, and generates air of high humidity. The dust accumulated in dust collecting chamber 15 is humidified by humidifying unit 27.

[0039] As shown in FIG. 5, electric blower 10 raises a balance of about 18 degrees from room temperature when a predetermined time elapses from the start of operation. A temperature of electric blower 10 is a value

obtained by subtracting a temperature cooled by a cooling action of the passing air from a temperature raised by a heating action of an incorporated motor (not shown).

[0040] The humidifying container 28 is heated through heat transmitting paint 31 from electric blower 10 so that the temperature rises. That is, in humidifying unit 27, humidifying container 28 is brought into contact with electric blower 10, so that the relative humidity around hygroscopic material 29 is lowered by the heat of electric blower 10. Accordingly, vapor is generated from hygroscopic material 29. With use of heat of electric blower 10, a mechanism does not need to be separately arranged and miniaturization can be achieved.

[0041] When electric blower 10 is stopped at the end of cleaning, compressing unit 23 including compression plate 24 is manually lowered to compress the dust accumulated in dust collecting chamber 15, as shown in FIG. 3. Accordingly, the dust becomes compact. As shown in FIG. 5, the temperature of electric blower 10 further rises about 9 degrees after elapse of a predetermined time since electric blower 10 is stopped. The temperature of electric blower 10 rises because there is no cooling action by the passing air as electric blower 10 is stopped and because the motor incorporated in electric blower 10 has afterheat (heat capacity).

[0042] In other words, for about one hour from the end of cleaning, the temperature of electric blower 10 becomes a temperature raised from the room temperature by greater than or equal to about 18 degrees. Similarly, the bottom surface of humidifying unit 27 is heated by electric blower 10 through heat transmitting paint 31. As shown in FIG. 5, specifically, the temperature of hygroscopic material 29 and the air in humidifying container 28 rises from about 24°C to about 51°C at maximum due to the temperature rise of the bottom surface of humidifying container 28.

[0043] As shown in FIG. 6, the moisture absorptivity of hygroscopic material 29 inside humidifying unit 27 lowers due to the temperature rise. The bottom surface of humidifying container 28 is heated by the heat of electric blower 10 through heat transmitting paint 31. The moisture absorptivity of hygroscopic material 29 lowers by the temperature rise of the bottom surface of humidifying container 28. The relative humidity around hygroscopic material 29 lowers from 60% to 14%. When silica gel is used, the moisture absorptivity of hygroscopic material 29 lowers from 23% to 7% of moisture absorptivity. When releasing (atmosphere release) the vapor inside humidifying container 28 to atmosphere over time, 3.2 gram of vapor (20g x 16%) of a difference of 16%, which is from the moisture absorptivity of 23% to 7%, is moisture released by the lowering of moisture absorptivity. In the first exemplary embodiment of the present invention, hygroscopic material 29 releases moisture over time. The moisture-released vapor accumulates around hygroscopic material 29. Therefore, the relative humidity around hygroscopic material 29 is not maintained at 14% and is immediately raised by moisture release of vapor.

Therefore, humidifying unit 27 releases moisture of 1.3 gram to 0.6 gram according to the normal experiment.

[0044] Humid air generated by moisture release from hygroscopic material 29 moves by a humidity difference (substance movement) between humidifying container 28 and dust collecting chamber 15, and natural convection. The humid air passes through mesh 30 and humidifying passage 32, and flows into dust collecting chamber 15 from humidifying port 22. Accordingly, the relative humidity of dust collecting chamber 15 becomes about 80% to 95%, and the temperature rises for about 1 degree to 5 degrees, respectively.

[0045] Then, the air having high humidity is passed through ring-shaped spacing 43 between dust collecting chamber 15 and compression plate 24, and accumulated in dust collecting chamber 15 from communicating portion 25. The humid air moves into dust collecting chamber 15 through communicating portion 25. The dust compressed by compression plate 24 is humidified by the air of high humidity. The dust has an amount of about 3g, which is the dust for one day in a normal household.

[0046] By humidifying, the dust absorbs moisture of about 0.1g to 0.3g by the air of high humidity infiltrating from a gap within the dust.

[0047] Accordingly, the dust is more easily compressed. The reason therefor will be described below. The rough dust (cotton waste and the like) easily deforms softly due to moisture absorption, and hence the compressibility is improved. The rough dust deformed and stretched by the moisture absorption entangles with each other. Thus, the volume of the compressed dust is hardly restored even if compressing unit 23 is released. By carrying out moisture absorption and compression, the dust is compressed, and further entangled with each other.

[0048] The dust is thereby compressed, and miniaturization of dust collecting chamber 15 is achieved. As a result, dust collecting chamber 15 can be greatly miniaturized due to the improvement in compressibility of the dust, and waste can be suppressed from scattering around when discarding the accumulated dust.

[0049] The fine dust (dirt, sand, and the like) becomes soft by absorbing moisture, and hence a weight increases. The fine dust that absorbed moisture bond with each other, and entangles with the deformed rough dust. The fine dust that absorbed moisture becomes larger and heavier by being entangled with the deformed rough dust. When the air of high humidity enters dust collecting chamber 15, one portion escapes from flow-in port 20 to dust separating unit 14. Most of the air of high humidity stays in dust collecting chamber 15 to sufficiently absorb the moisture of the dust compressed by compression plate 24.

[0050] Due to heat radiation to the atmosphere, the temperatures of electric blower 10 and humidifying unit 27 lower to around the room temperature when two hours or more have elapsed since the end of cleaning. In this case, hygroscopic material 29 switches from the moisture releasing action to a moisture absorbing action of taking

the moisture from the air of dust collecting chamber 15 and dust separating unit 14. Hygroscopic material 29 returns to its original moisture absorbing state over time (in about one day). Therefore, in the electric vacuum cleaner of the present exemplary embodiment, a water tank and the like for moisture release is unnecessary. The miniaturization of the device is thus realized.

[0051] The dust becomes flexible due to moisture absorption. The dust that absorbed moisture entangles with each other so that the volume is reduced, and then compressed. The dust that absorbed moisture and that is compressed is dried because the moisture is taken by hygroscopic material 29 that switched to the moisture absorbing action by elapse of time. The dust that once absorbed moisture is difficult to return as in an ironed state when dried, and maintains the shape of before being dried. Therefore, the compressed state, which is a shape before being dried, is maintained. The once deformed rough dust also maintains the deformed and compressed state after being dried.

[0052] As a result, the space of dust collecting chamber 15 can be saved as the dust maintains the compressed state. The dust accumulated and compressed in dust collecting chamber 15 is discarded by opening bottom lid 21. The fine dust accumulated at the bottom of dust collecting chamber 15 and became heavy by moisture absorption is dropped straightly from dust collecting chamber 15, and the compressed rough dust is dropped thereon. Thus, the scattering of the waste can be suppressed.

[0053] As described above, in the first exemplary embodiment of the present invention, compressing unit 23 compresses the dust accumulated in dust collecting chamber 15, and thereafter, humidifying unit 27 supplies the air of high humidity from humidifying port 22. The compressed dust repeats moisture absorption and moisture release every time cleaning is carried out. Therefore, the moisture amount of the dust is not significantly increased, and is in a substantially constant state. Thus, growing of bacteria, mold, and the like can be suppressed, and generation of odor can be prevented. In this manner, the dust can be prevented from being securely attached to dust collecting chamber 15 by water droplets.

[0054] The water droplets can be supplied from atomization means such as a spray to the compressed dust accumulated in dust collecting chamber 15. However, since the water droplets greater or equal to about 1g are atomized at once with the atomization means, the fine droplets cannot be supplied in small amount. Therefore, if the atomization means is used, the dust may get locally wet, and dust collecting chamber 15 may also get wet. As a result, the dust may securely attach to dust collecting chamber 15, and problems such as growth of bacteria and mold may arise. Furthermore, since a water tank and a pump for atomization are required in the atomization means, the humidifying unit becomes difficult to miniaturize.

[0055] As described above, compressing unit 23 com-

presses the dust accumulated in dust collecting chamber 15 after electric blower 10 is stopped. When compressing unit 23 compresses the dust, open/close portion 26 opens humidifying port 22. At a timing when compressing unit 23 is lowered to compress the dust, humidifying port 22 is opened and humidifying unit 27 supplies the air of high humidity from humidifying port 22 to dust collecting chamber 15.

[0056] While electric blower 10 is being driven, humidifying unit 27 is made independent from dust collecting chamber 15 since open/close portion 26 closes humidifying port 22. Thus, the air of high humidity generated in humidifying unit 27 can be prevented from being exhausted to outside from dust collecting chamber 15. In other words, humidifying performance of humidifying unit 27 can be maintained. Compression plate 24 also serves as open/close portion 39, to be described later. Thus, simplification and lower cost of the configuration can be achieved.

[0057] In other words, the air of high humidity is supplied from humidifying unit 27 to dust collecting chamber 15 by the opening of humidifying port 22. As a result, the compressed dust absorbs moisture over time by the air of high humidity accumulated in dust collecting chamber 15.

[0058] The rough dust becomes easy to deform by moisture absorption, and thus compressibility is improved. The compressed rough dust is entangled in a deformed and stretched state, and thus the volume is hardly restored even if compressing unit 23 is released. The fine dust, on the other hand, becomes heavier and entangles with the deformed rough dust. When discarding the dust accumulated in dust collecting chamber 15, the fine dust that became heavy accumulated at the bottom is dropped directly below. The entangled rough dust is dropped thereon, and thus the scattering of the dust can be suppressed. Furthermore, dust collecting chamber 15 can be greatly miniaturized due to the improvement in the compressibility of the dust.

[0059] In the first exemplary embodiment of the present invention, compressing unit 23 compresses the dust accumulated in dust collecting chamber 15, and then humidifying unit 27 supplies the air of high humidity from humidifying port 22 to dust collecting chamber 15. Accordingly, the dust is humidified in the compressed state, and the compressed state can be easily maintained.

[0060] However, the present invention is not limited thereto, and humidifying unit 27 may supply the air of high humidity from humidifying port 22 to dust collecting chamber 15 before compressing unit 23 compresses the dust accumulated in dust collecting chamber 15. The compressibility can be similarly improved by humidifying the dust.

SECOND EXEMPLARY EMBODIMENT

[0061] Electric vacuum cleaner 50 according to a second exemplary embodiment of the present invention will

be described with reference to the drawings. FIG. 7 is a cross-sectional view showing a configuration of main parts immediately after the end of cleaning of the electric vacuum cleaner according to the second exemplary embodiment. FIG. 8 is a cross-sectional view showing a configuration of the main parts during a compressing operation after the end of cleaning of the electric vacuum cleaner. FIG. 9 is a cross-sectional view taken along line 9-9 of FIG. 8.

[0062] The same reference numerals are denoted on the same portions as the first exemplary embodiment, and the description thereof will be omitted.

[0063] A difference with the first exemplary embodiment will be described. As shown in FIG. 8 and FIG. 9, compression plate 24 includes a plurality of cutout-form communicating portions 33 that communicate the upper surface and the lower surface, and a plurality of communicating portions 25 in which a cutout length is changed. In the present exemplary embodiment, communicating portion 25 has a cutout close to a center portion of the flat plate-like surface of compression plate 24 compared to communicating portion 33. Thus, even the dust at the center portion of the dust compressed by compression plate 24 can be humidified. Communicating portion 33 is a cutout-form portion arranged at a circumference portion of compression plate 24. The air containing humidity humidifies the dust from the cutout of compression plate 24. Thus, an end portion of the dust can be more easily compressed. The air of high temperature and humidity humidifies the dust accumulated in dust collecting chamber 15 through ring-shaped spacing 43 between dust collecting chamber 15 and compression plate 24, communicating portion 25, and communicating portion 33. Accordingly, a portion close to the center portion of compression plate 24 and also the circumference portion of compression plate 24 can be sufficiently humidified. According to such results, dust collecting chamber 15 can be greatly miniaturized by the improvement in compressibility of the dust, and the scattering of waste can be suppressed when discarding the accumulated dust.

[0064] Note that communicating portion 25 or communicating portion 33 merely needs to be in a state of communicating the upper surface and the lower surface of compression plate 24. The shape of communicating portion 33 may be an arbitrary shape such as circle or polygon.

[0065] The bottom surface of humidifying container 28 is arranged to make contact with the outer surface of electric blower 10. Heating unit 34 includes an electric heater (PTC heater), and is arranged at the bottom of humidifying container 28.

[0066] For hygroscopic material 35, 20g of high silica zeolite DDZ manufactured by Union Showa K.K is used. Hygroscopic material 35 is pushed against heating unit 34 arranged at the bottom of humidifying container 28 by mesh 30. As shown in FIG. 6, the high silica zeolite DDZ has, compared to the silica gel, a property in which a high moisture absorptivity is maintained substantially con-

stant in a range of the relative humidity from 90% to 10% and the moisture absorptivity rapidly lowers when the relative humidity becomes lower than or equal to about 10%.

[0067] Thus, when moisture releasing the vapor from hygroscopic material 35 using the high silica zeolite DDZ, if the relative humidity around hygroscopic material 35 is high, i.e., 90%, the temperature of the air around hygroscopic material 35 needs to be raised to a high temperature of about 200°C to lower the relative humidity lower than or equal to 10%.

[0068] If the relative humidity around hygroscopic material 35 is low, i.e., about 20% to 40%, the temperature of the air around hygroscopic material 35 is raised to about 100°C to lower the relative humidity to lower than or equal to 10%.

[0069] Therefore, by using heating unit 34 in which a heating output can be adjusted, the temperature raise can be adjusted within a range of the temperature of the air around hygroscopic material 35 of 100°C to 200°C according to the relative humidity.

[0070] Therefore, with the use of hygroscopic material 35 using the high silica zeolite DDZ and heating unit 34 in combination, the moisture release can be stably carried out in accordance with the change in the relative humidity around hygroscopic material 35 due to environmental changes such as outside air temperature.

[0071] An example in which the temperature of the air around hygroscopic material 35 is about 100°C to 200°C has been described, but the present invention is not limited thereto, and the temperature can be selectively determined by elements such as outside temperature.

[0072] As described above, the temperature of humidifying unit 27 rises to about 100°C to 200°C from the room temperature. Thus, a zeolite which usage temperature range is wider than the silica gel and which excels in durability is desirably used as hygroscopic material 35.

[0073] Humidifying unit 27 is configured as a closed space formed by humidifying container 28 and the outer surface of electric blower 10. Furthermore, the relative humidity around hygroscopic material 35 is lowered by the heat of electric blower 10 and heating unit 34. Therefore, vapor is generated from hygroscopic material 35. Hygroscopic material 35 is directly heated by using the heat of electric blower 10 and heating unit 34. Since a heat resistance is small, heating efficiency on hygroscopic material 35 can be improved. A large amount of vapor can be generated since hygroscopic material 35 can be raised to a high temperature in a short time. Humidifying unit 27 can be miniaturized since hygroscopic material 35 exhibits a sufficient effect in small amount.

[0074] Open/close portion 36 is arranged to open/close humidifying passage 32 communicating humidifying port 22 and humidifying unit 27. Open/close portion 36 is driven by the electric motor (not shown) to open/close humidifying passage 32.

[0075] The operation of electric vacuum cleaner 50 according to the second exemplary embodiment will be de-

scribed. When electric blower 10 is driven, the electric motor is driven and compressing unit 23 is raised. As the electric motor is driven, open/close portion 36 closes humidifying passage 32. At the same time, the temperature of heating unit 34 rises to about 100°C to 200° when supplied with electricity. The outer surface of electric blower 10, which temperature is raised by the operation of electric blower 10, directly heats heating unit 34.

[0076] As a result, the relative humidity around hygroscopic material 35 lowers close to about 0% by the rise in air temperature around hygroscopic material 35. Hygroscopic material 35 releases moisture, that is, generates vapor. The air of high temperature and humidity thus accumulates in great amount in humidifying container 28.

[0077] As shown in FIG. 7, after the cleaning is finished, electric blower 10 is stopped. Thereafter, the electric motor of open/close portion 36 is driven to open humidifying passage 32. When a power supply of vacuum cleaner main body 1 is stopped, heating unit 34 stops the heating. However, the temperature around hygroscopic material 35 further rises about nine degrees from the temperature when heating unit 34 is carrying out heating by the after-heat of electric blower 10. As humidifying passage 32 is opened, the temperature of high temperature and humidity generated from hygroscopic material 35 is passed through mesh 30 and humidifying passage 32, and is flowed out from humidifying port 22 to flow into dust collecting chamber 15.

[0078] In this case, the temperature of the air of humidifying container 28 is higher than the temperature of air of dust collecting chamber 15 by about a few tens of degrees, and thus natural convection occurs from humidifying container 28 to dust collecting chamber 15 and the air of high temperature and humidity flows into dust collecting chamber 15.

[0079] The air of high temperature and humidity flows into dust collecting chamber 15 by a mass transfer action of a water vapor molecule due to the humidity difference between humidifying container 28 and dust collecting chamber 15.

[0080] The air in humidifying unit 27, in which an internal pressure is increased by the heating with open/close portion 36 closed, has its volume expanded by the opening of open/close portion 36, and the air of high temperature and humidity flows into dust collecting chamber 15 by such action.

[0081] Then, the air of high temperature and humidity humidifies the dust accumulated in dust collecting chamber 15 through ring-shaped spacing 43 between dust collecting chamber 15 and compression plate 24, and communicating portion 33. Since the dust before compression accumulated in dust collecting chamber 15 is greatly spread, the air of high temperature and humidity freely comes and goes through the dust to humidify the dust. Thus, the dust efficiently absorbs moisture in a short time until compression plate 24 is lowered. Thus, the amount of hygroscopic material 35 exhibits effects even with a small amount.

[0082] The generated vapor and the air inside warmed humidifying container 28 are supplied to dust collecting chamber 15 by the temperature difference between dust collecting chamber 15 and humidifying container 28 and the natural convection. Then, with the lowering in temperature of electric blower 10 by heat dissipation, the temperature of hygroscopic material 35 lowers and becomes a temperature close to the room temperature. Hygroscopic material 35 absorbs moisture from the surrounding air until the next cleaning starts. Thus, the supply of water to hygroscopic material 35 is unnecessary.

[0083] The amount of vapor discharged from hygroscopic material 35 can be arbitrarily set by a heating amount and a heating time of heating unit 34. The timing at which the vapor is supplied to dust collecting chamber 15 can be arbitrarily set by heating control of heating unit 34. For example, when a current flows to heating unit 34 simultaneously with the driving of electric blower 10, the temperature rises in hygroscopic material 35 or humidifying container 28 from during cleaning. Thus, the vapor can be rapidly supplied to dust collecting chamber 15 after electric blower 10 is stopped.

[0084] In the second exemplary embodiment, humidifying unit 27 supplies the air of high humidity from humidifying port 22 to dust collecting chamber 15 before compressing unit 23 compresses the dust accumulated in dust collecting chamber 15. Since the dust before the compression is greatly spread, moisture can be absorbed efficiently and entirely substantially evenly. In other words, humidifying unit 27 can be miniaturized. Thereafter, compressing unit 23 sufficiently compresses the dust accumulated in dust collecting chamber 15 to make it compact.

[0085] Thereafter, as shown in FIG. 8, compressing unit 23 lowers compression plate 24 by the electric motor (not shown). The dust accumulated in dust collecting chamber 15 humidifies the dust substantially evenly through ring-shaped spacing 43 between dust collecting chamber 15 and compression plate 24, and communicating portion 33. The humidified dust is sufficiently compressed by compression plate 24.

[0086] After elapse of two hours or longer since the end of cleaning, the temperature of electric blower 10 and humidifying unit 27 lowers greatly to around the room temperature by heat dissipation. Since the temperature of the air surrounding hygroscopic material 35 lowers, hygroscopic material 35 switches from the moisture releasing action to the moisture absorbing action in which moisture is taken from the air of dust collecting chamber 15 and dust separating unit 14. Hygroscopic material 35 returns to its original moisture absorbing state over time (in about one day), and thus, the water tank and the like for moisture release is unnecessary. Therefore, the miniaturization of the device is realized.

[0087] Accordingly, the compressed dust absorbs moisture over time from the air of high humidity accumulated in dust collecting chamber 15. The rough dust easily deforms by the moisture absorption, and the compress-

ibility is improved. The compressed rough dust is entangled in a deformed and stretched state, and thus the volume is hardly restored even if compressing unit 23 is released. The fine dust becomes heavier and entangles with the deformed rough dust. As a result, dust collecting chamber 15 is greatly miniaturized by the improvement in the compressibility of the dust, and the scattering of waste can be suppressed when discarding the accumulated dust.

THIRD EXEMPLARY EMBODIMENT

[0088] Next, electric vacuum cleaner 50 according to a third exemplary embodiment of the present invention will be described. FIG. 10 is a cross-sectional view showing a configuration of main parts during operation of the electric vacuum cleaner according to the third exemplary embodiment. FIG. 11 is a cross-sectional view showing a configuration of the main parts at the time of a compressing operation after the end of cleaning of the electric vacuum cleaner.

[0089] The same reference numerals are denoted for the same portions as the first exemplary embodiment or the second exemplary embodiment, and the description thereof will be omitted.

[0090] The third exemplary embodiment differs from the first exemplary embodiment and the second exemplary embodiment in that 10g of TAFTIC HU manufactured by Japan Exlan Co. Ltd. (material of higher moisture absorptivity than silica gel shown in FIG. 5) is used for hygroscopic material 37. Humidifying container 28 and electric blower 10 are brought into contact through heat accumulating material 38. Heat accumulating material 38 may be a latent heat type material of inorganic hydrated salt or paraffin.

[0091] Humidifying unit 27 is configured such that humidifying container 28 and electric blower 10 are brought into contact with each other through heat accumulating material 38. The relative humidity around hygroscopic material 37 is lowered by the heat accumulated in heat accumulating material 38, so that vapor is generated from hygroscopic material 37. The heat can be more efficiently added to hygroscopic material 37 by heat accumulating material 38. Therefore, hygroscopic material 37 can generate an appropriate amount of vapor. The dust thus can be humidified more efficiently.

[0092] Open/close portion 39 for opening/closing humidifying passage 32 is arranged. Open/close portion 39 is configured by flat plate-shaped valve body 40 and hinge 41. Open/close portion 39 is arranged in humidifying passage 32. Valve body 40 is arranged at an upper end of humidifying passage 32, and is connected in a freely rotating manner through hinge 41. Valve body 40 turns toward humidifying port 22 by pressure fluctuation in humidifying passage 32. Valve body 40 closes humidifying passage 32 when brought into contact with ring-shaped valve seat 42.

[0093] The operation of electric vacuum cleaner 50 ac-

cording to the third exemplary embodiment will be described. As shown in FIG. 10, when electric blower 10 is driven, the air inside humidifying passage 32 is drawn from humidifying port 22 since dust collecting chamber 15 becomes a negative pressure. Valve body 40 rotates toward humidifying port 22 with hinge 41 as the center until it makes contact with valve seat 42, thus closing humidifying passage 32.

[0094] According to such a closing action, the air inside humidifying container 28 is prevented from flowing out from humidifying port 22 to dust collecting chamber 15 through humidifying passage 32, and the moisture contained in hygroscopic material 37 is also not forcibly released.

[0095] Therefore, at the driving of electric blower 10, open/close portion 39 rotates upward until it makes contact with valve seat 42, which is an airtight member with valve body 40. Open/close portion 39 closes humidifying passage 32. On the other hand, open/close portion 39 rotates downward by its own weight to return to the original state immediately after electric blower 10 is stopped. Humidifying passage 32 is then opened, so that humidifying unit 27 supplies the air of high humidity from humidifying port 22 to dust collecting chamber 15. In other words, the driving device of open/close portion 39 is unnecessary, and the configuration can be simplified and lower cost can be achieved.

[0096] After the cleaning is finished thereafter, electric blower 10 is stopped, and thus dust collecting chamber 15 returns from the negative pressure to the atmospheric pressure, as shown in FIG. 11. Since the air pressure of dust collecting chamber 15 becomes the atmospheric pressure, open/close portion 39 rotates downward with hinge 41 as the center by its own weight to open humidifying passage 32. Heat accumulating material 38 accumulates the heat generated by electric blower 10 being driven, and the afterheat of electric blower 10 after being stopped. A heat collecting property with respect to electric blower 10 is thus improved.

[0097] Heat accumulating material 38 heats humidifying container 28 over a long period. The air containing humidity accumulates in dust collecting chamber 15, so that the compressed dust sufficiently absorbs moisture over time. The positional relationship of humidifying container 28 and electric blower 10 are relatively freely set in a range humidifying container 28 and electric blower 10 can propagate heat by heat accumulating material 38.

[0098] As described above, valve body 40 rotates according to the suction action by the air pressure of electric blower 10. The portion for driving open/close portion 39 thus becomes unnecessary. Therefore, the configuration can be simplified and lower cost can be achieved.

[0099] The compressed dust absorbs moisture over time from the air of high humidity accumulated in dust collecting chamber 15. The rough dust becomes easy to deform by moisture absorption, and the compressibility is improved. The compressed rough dust is entangled in a deformed and stretched state, and thus the volume is

hardly restored even if compressing unit 23 is released. The fine dust becomes heavier and entangles with the deformed rough dust. As a result, dust collecting chamber 15 can be greatly miniaturized by the improvement in the compressibility of the dust, and the scattering of waste can be suppressed when discarding the accumulated dust.

[0100] In the first to third exemplary embodiments, silica gel is used for hygroscopic material 29, high silica zeolite DDZ manufactured by Union Showa K.K is used for hygroscopic material 35, and TAFTIC HU manufactured by Japan Exlan Co. Ltd is used for hygroscopic material 37. However, the hygroscopic material is not limited to such configurations, and merely needs to be a physical hygroscopic material (using property that porous surface easily adsorbs water molecules) in which moisture absorption and moisture release are repeated. HASClay, molecular sieve, aluminum oxide, or the like developed by Advanced Industrial Science and Technology may also be used. A chemical hygroscopic material (using unique property (chemical reaction/deliquesce) of chemical substance) such as calcium chloride in which the moisture absorption and the moisture release are not repeated cannot be used for the hygroscopic material.

[0101] Compressing unit 23 includes flat plate-like compression plate 24 adapted to move up and down in dust collecting chamber 15, and to compress the dust accumulated in dust collecting chamber 15. Compressing unit 23 may configure compression plate 24 like a screw type or a fan type. Furthermore, the compressing unit can obtain similar effects with a combination of a motor and a gear, other than the combination of the manual movement and the spring.

[0102] Therefore, the electric vacuum cleaner of the present invention improves the compressibility of the dust accumulated in the dust collecting chamber and suppresses the scattering of the dust when discarding the compressed dust. Thus, it is particularly useful as an electric vacuum cleaner including the dust collecting chamber.

REFERENCE MARKS IN THE DRAWINGS

[0103]

1	vacuum cleaner main body
2	wheel
3	caster
4	dust collecting case
5	suction port
6	suction hose
7	handle
8	extended tube
10	electric blower
11	intake port
12	suction passage
13	ventilation port
14	dust separating unit (first)

15 dust collecting chamber
 16 exhaust tube
 17 ventilation unit
 18 second dust separating unit
 19 partition wall
 20 flow-in port
 21 bottom lid
 22 humidifying port
 23 compressing unit
 24 compression plate
 27 humidifying unit
 25, 33 communicating portion
 26, 36, 39 open/close portion
 29, 35, 37 hygroscopic material
 28 humidifying container
 31 heat transmitting paint
 32 humidifying passage
 34 heating unit
 38 heat accumulating material
 39 open/close portion
 40 valve body
 41 hinge
 42 valve seat
 43 spacing
 50 electric vacuum cleaner
 99 suction tool

Claims

1. An electric vacuum cleaner comprising:

an electric blower for generating a suction force;
 a dust separating unit, installed on an upstream side of the electric blower, for separating dust from air containing the dust suctioned by the electric blower;
 a dust collecting chamber for accumulating the dust separated by the dust separating unit;
 a humidifying port opened to the dust collecting chamber; and
 a humidifying unit, communicating to the humidifying port, for generating air of high humidity; wherein
 the humidifying unit supplies the air of high humidity from the humidifying port to the dust accumulated in the dust collecting chamber.

2. The electric vacuum cleaner according to claim 1, wherein a compressing unit for compressing the dust of the dust collecting chamber is arranged in the dust collecting chamber.

3. The electric vacuum cleaner according to claim 2, wherein the humidifying unit supplies the air of high humidity from the humidifying port to the dust collecting chamber after the compressing unit compresses the dust accumulated in the dust collecting

chamber.

4. The electric vacuum cleaner according to claim 2, wherein the humidifying unit supplies the air of high humidity from the humidifying port to the dust collecting chamber before the compressing unit compresses the dust accumulated in the dust collecting chamber.

5. The electric vacuum cleaner according to claim 1 or 2, wherein the humidifying unit includes a hygroscopic material in which a relative humidity and a moisture absorptivity have a substantially proportional relation,
 a humidifying container incorporating the hygroscopic material, and
 a heating unit for heating the hygroscopic material or the humidifying container; and
 the heating unit heats the hygroscopic material or the humidifying container and lowers a relative humidity around the hygroscopic material so that vapor the hygroscopic material generates vapor.

6. The electric vacuum cleaner according to claim 5, wherein the humidifying unit is configured to bring the humidifying container into contact with the electric blower or use an outer surface of the electric blower as one part of the humidifying container, and the relative humidity around the hygroscopic material is lowered by heat of the electric blower to generate vapor from the hygroscopic material.

7. The electric vacuum cleaner according to claim 5, wherein the humidifying unit is configured to bring the humidifying container and the electric blower into contact with each other with a heat accumulating material interposed therebetween, and the relative humidity around the hygroscopic material is lowered by heat accumulated in the heat accumulating material to generate vapor from the hygroscopic material.

8. The electric vacuum cleaner according to claim 2, wherein an open/close portion for opening/closing a humidifying passage communicating the humidifying port and the humidifying unit is arranged, the open/close portion closing the humidifying passage when driving the electric blower, and the open/close portion opening the humidifying passage when the humidifying unit supplies the air of high humidity from the humidifying port to the dust collecting chamber.

9. The electric vacuum cleaner according to claim 8, wherein the compressing unit includes a compression plate that rises and lowers in the dust collecting chamber; and
 the open/close portion is arranged projecting out at an upper surface of the compression plate to close

the humidifying port when the compression plate is accommodated at an upper end of the dust collecting chamber.

10. The electric vacuum cleaner according to claim 8, wherein the open/close portion is configured by a valve body and a hinge and is arranged in the humidifying passage, the hinge being arranged at an upper end of the humidifying passage to enable the valve body to freely rotate, and the humidifying passage is closed when the valve body is rotated toward the humidifying port.

11. The electric vacuum cleaner according to claim 9, wherein the compression plate includes a communicating portion communicating front and back surfaces of the compression plate.

Amended claims under Art. 19.1 PCT

1. (Amended) An electric vacuum cleaner comprising:

an electric blower for generating a suction force;
a dust separating unit, installed on an upstream side of the electric blower, for separating dust from air containing the dust suctioned by the electric blower;
a dust collecting chamber for accumulating the dust separated by the dust separating unit;
a humidifying port opened to the dust collecting chamber; and
a humidifying unit, communicating to the humidifying port, for generating air of high humidity; wherein
the humidifying unit includes a hygroscopic material, a humidifying container incorporating the hygroscopic material, and a heating unit;
a relative humidity around the hygroscopic material is lowered by heating of the heating unit to generate vapor from the hygroscopic material; and
the air of high humidity containing the vapor is supplied from the humidifying port to the dust accumulated in the dust collecting chamber, and then the dust is dried to maintain a state in which the dust is compressed.

2. (Cancelled)

3. (Cancelled)

4. (Amended) The electric vacuum cleaner according to claim 1, wherein the humidifying unit supplies the air of high humidity from the humidifying port to the dust collecting chamber before the compressing unit compresses the dust accumulated in the dust

collecting chamber.

5. (Cancelled)

6. (Amended) The electric vacuum cleaner according to claim 1, wherein the humidifying unit is configured to bring the humidifying container into contact with the electric blower or use an outer surface of the electric blower as a part of the humidifying container, and the relative humidity around the hygroscopic material is lowered by the heat of the electric blower to generate vapor from the Hygroscopic material.

7. (Amended) The electric vacuum cleaner according to claim 1, wherein the humidifying unit is configured to bring the humidifying container and the electric blower into contact with each other through a heat accumulating material, and the relative humidity around the hygroscopic material is lowered by the heat accumulated in the heat accumulating material to generate vapor from the hygroscopic material.

8. (Amended) The electric vacuum cleaner according to claim 1, wherein an open/close portion for opening/closing a humidifying passage communicating the humidifying port and the humidifying unit is arranged, the open/close portion closes the humidifying passage when driving the electric blower, and the open/close portion opens the humidifying passage when the humidifying unit supplies the air of high humidity from the humidifying port to the dust collecting chamber.

9. The electric vacuum cleaner according to claim 8, wherein the compressing unit includes a compression plate that rises and lowers in the dust collecting chamber; and the open/close portion is arranged projecting out at an upper surface of the compression plate to close the humidifying port when the compression plate is accommodated at an upper end of the dust collecting chamber.

10. The electric vacuum cleaner according to claim 8, wherein the open/close portion is configured by a valve body and a hinge and is arranged in the humidifying passage, the hinge is arranged at an upper end of the humidifying passage to enable the valve body to freely rotate, and the humidifying passage is closed when the valve body is rotated toward the humidifying port.

11. The electric vacuum cleaner according to claim 9, wherein the compression plate includes a communicating portion communicating front and back surfaces of the compression plate.

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12. (New) The electric vacuum cleaner according to claim 1,
wherein

the hygroscopic material has a property in which a relative humidity and a moisture absorptivity are in a substantially proportional relation.

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13. (New) The electric vacuum cleaner according to claim 1,

wherein

15

the heating unit heats at least one of the hygroscopic material and the humidifying container.

14. (New) The electric vacuum cleaner according to claim 1,

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wherein

the humidifying unit lowers a relative humidity around the hygroscopic material by using heat of the electric blower with the humidifying container as the heating unit to generate vapor from the hygroscopic material.

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FIG. 1

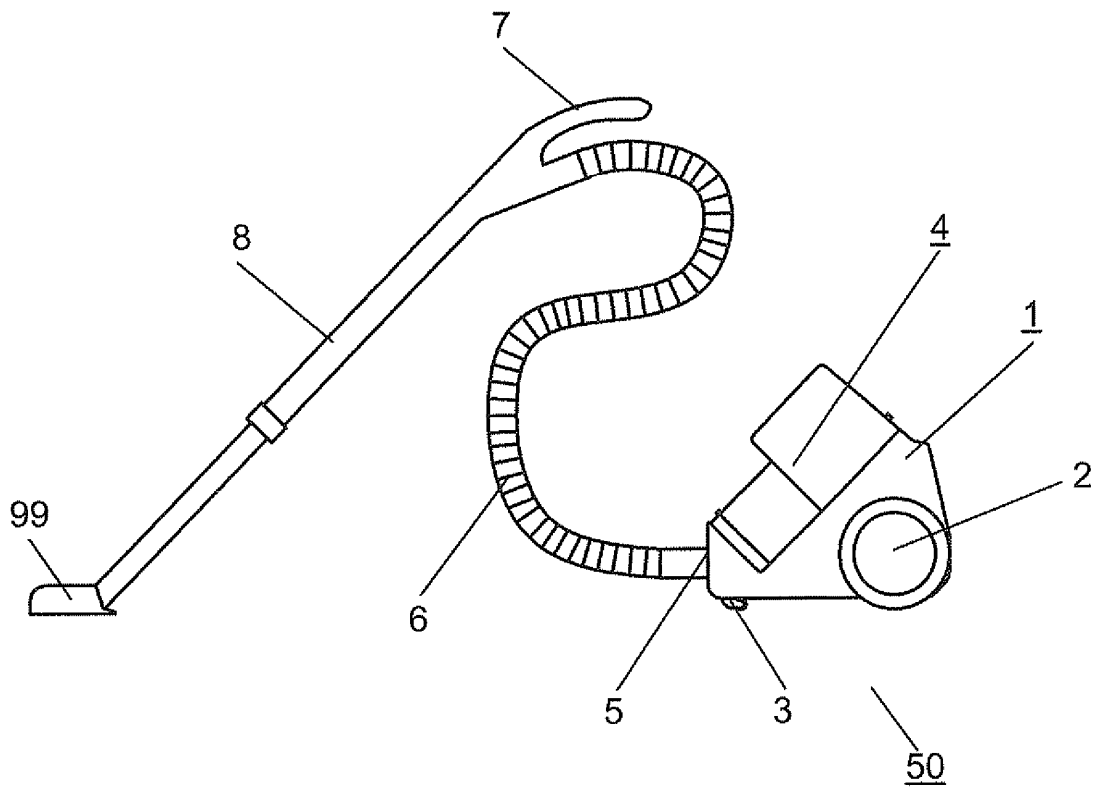


FIG. 2

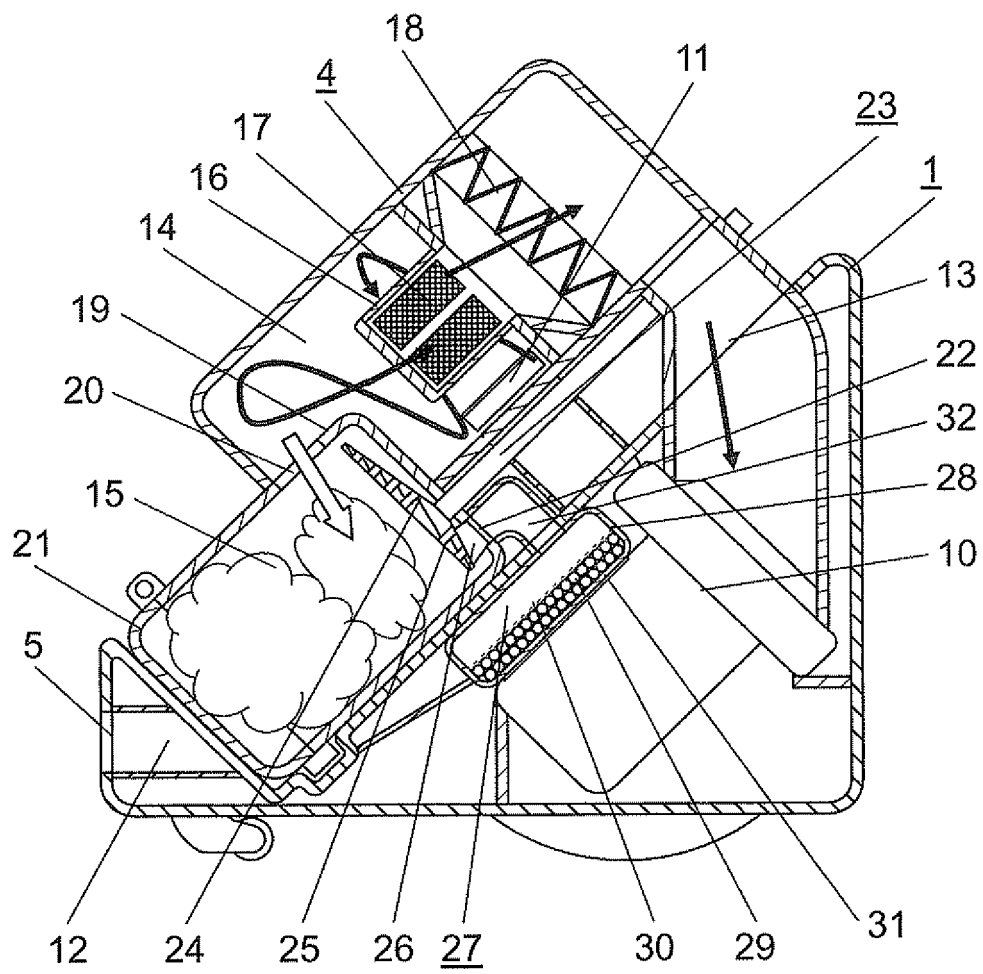


FIG. 3

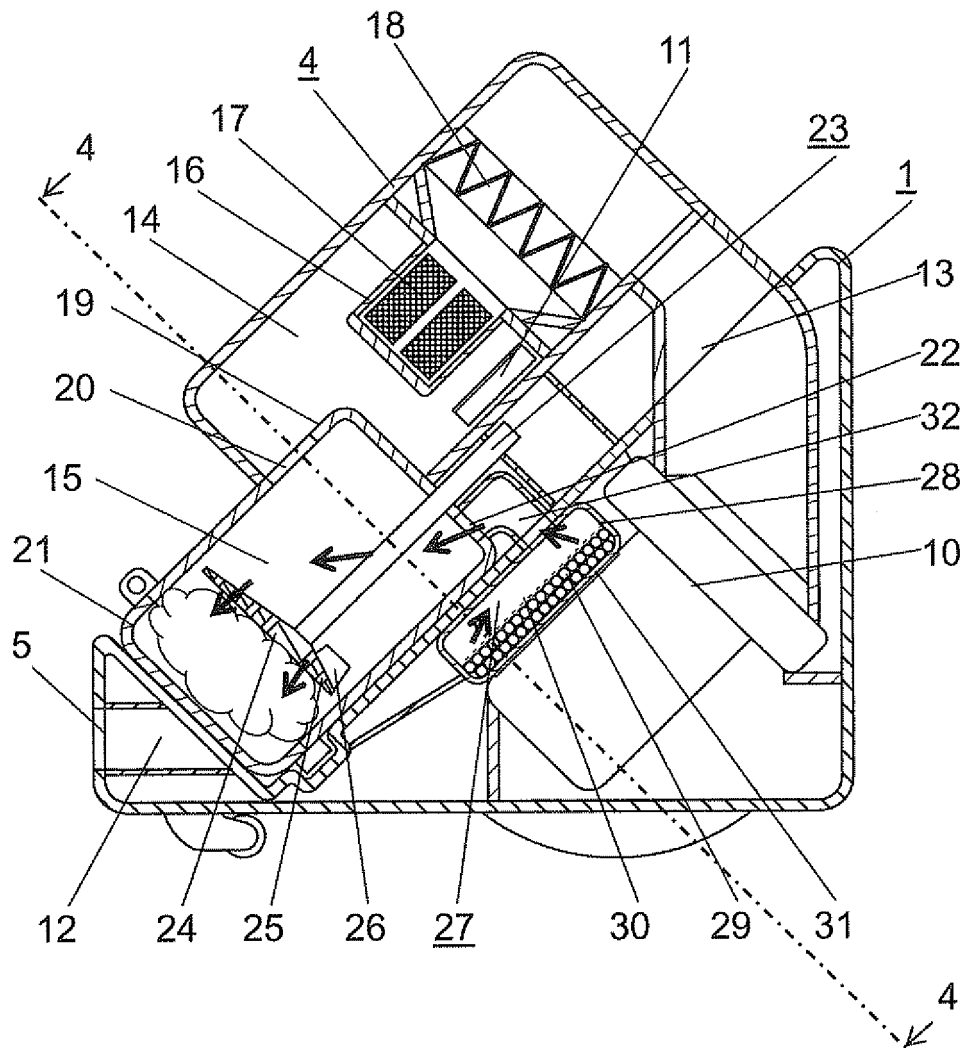


FIG. 4

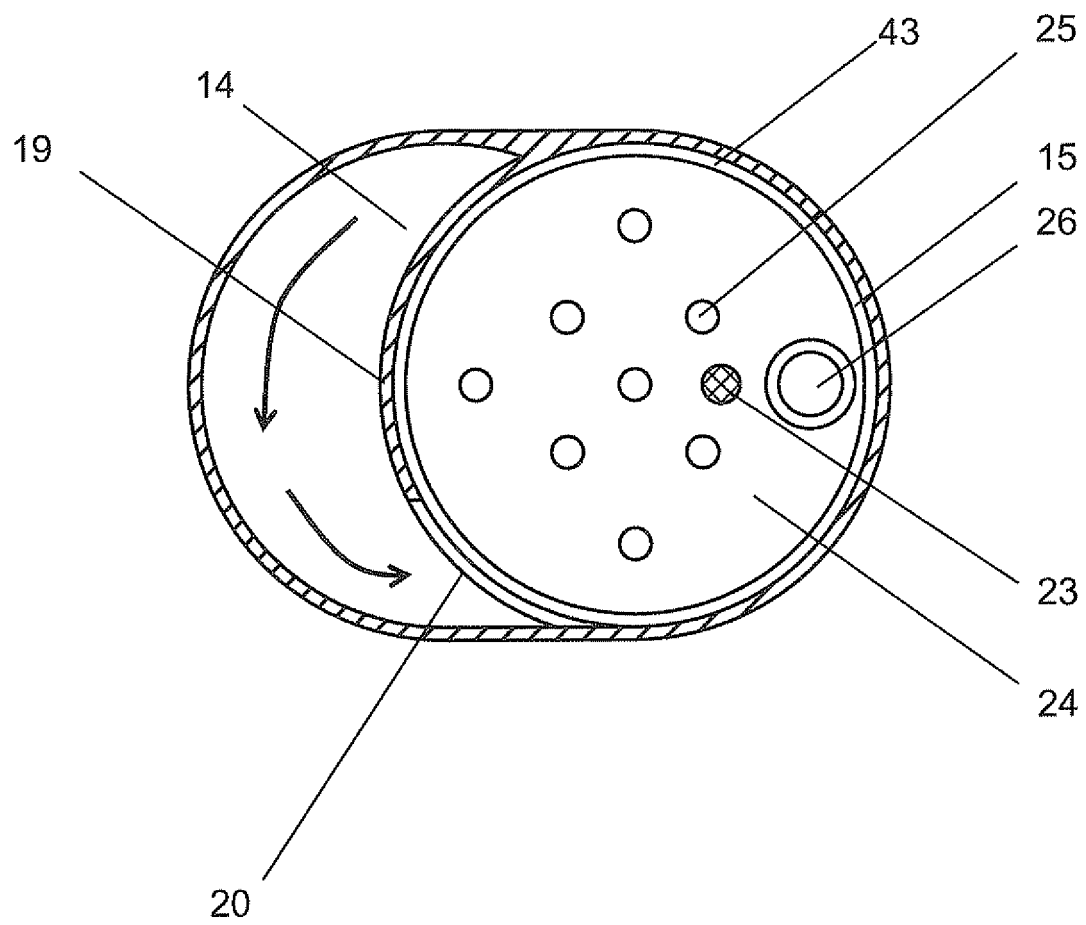


FIG. 5

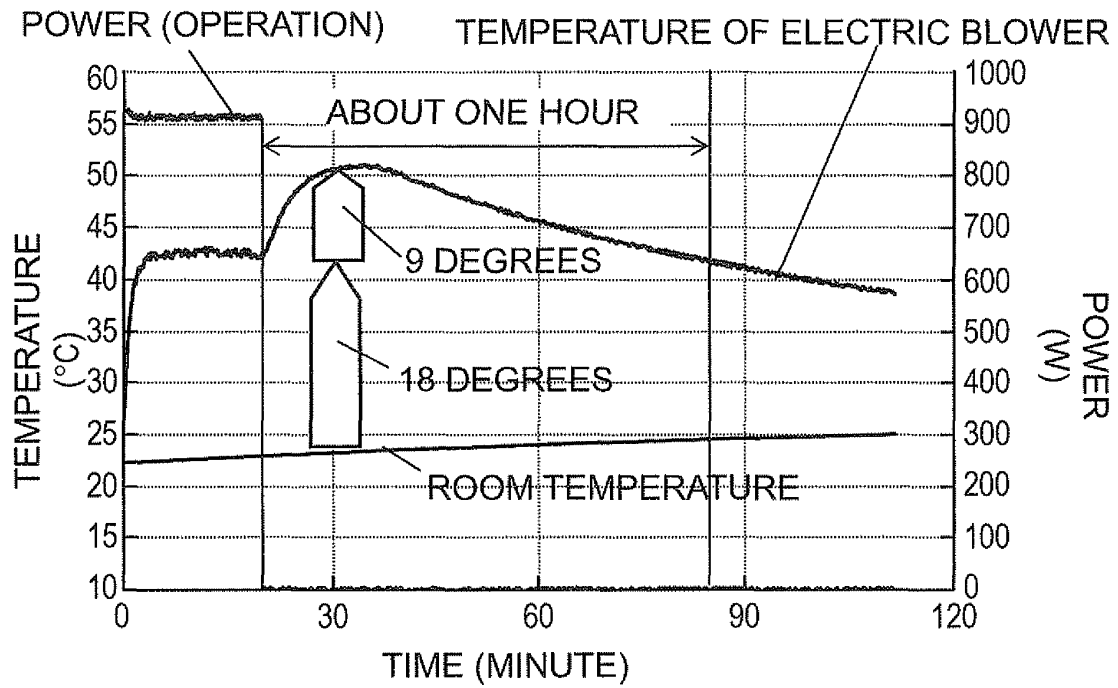


FIG. 6

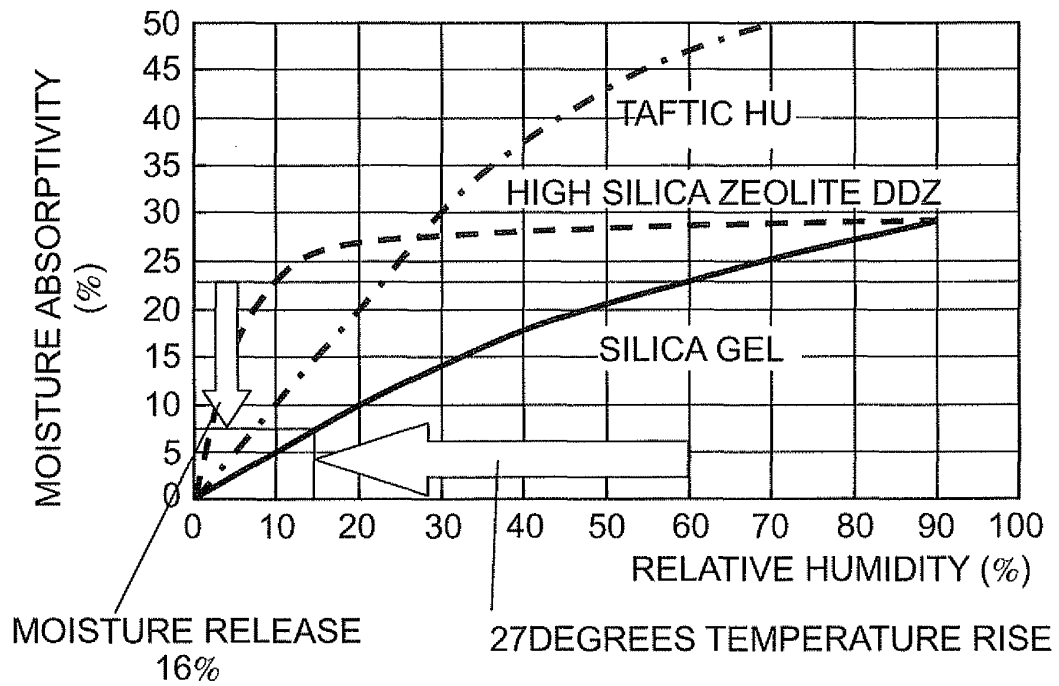


FIG. 7

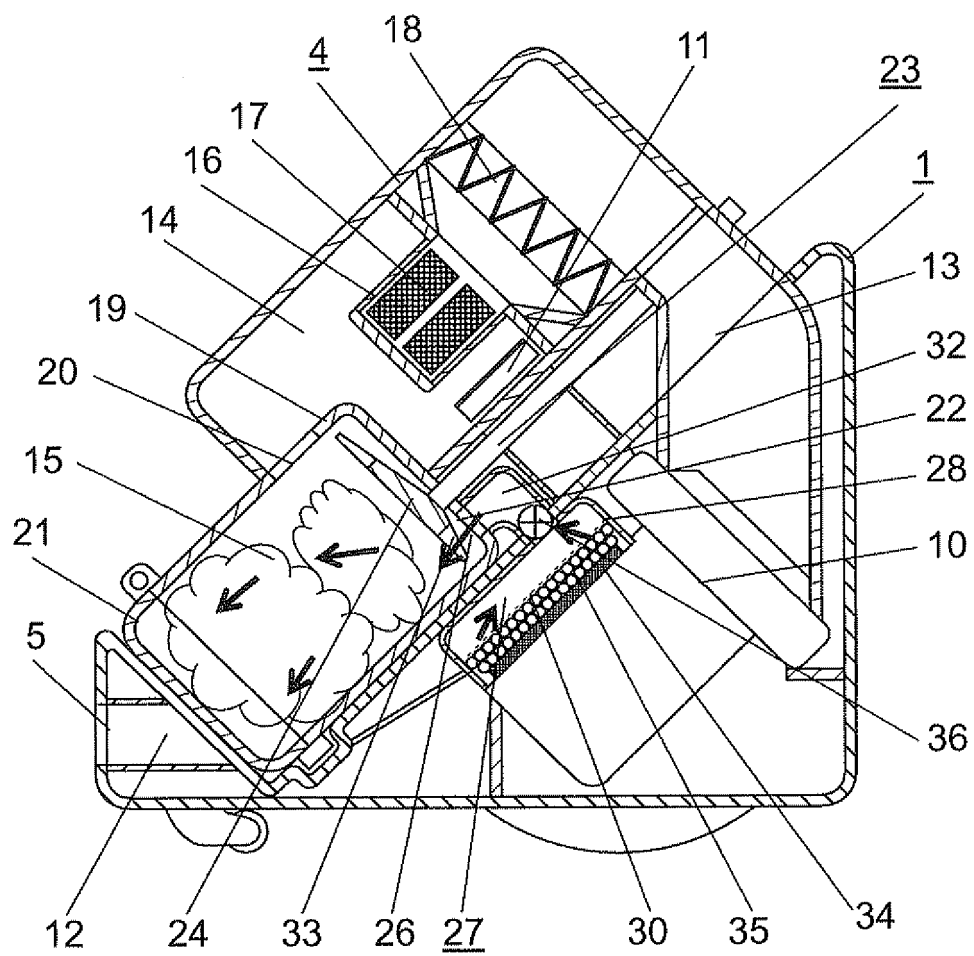


FIG. 8

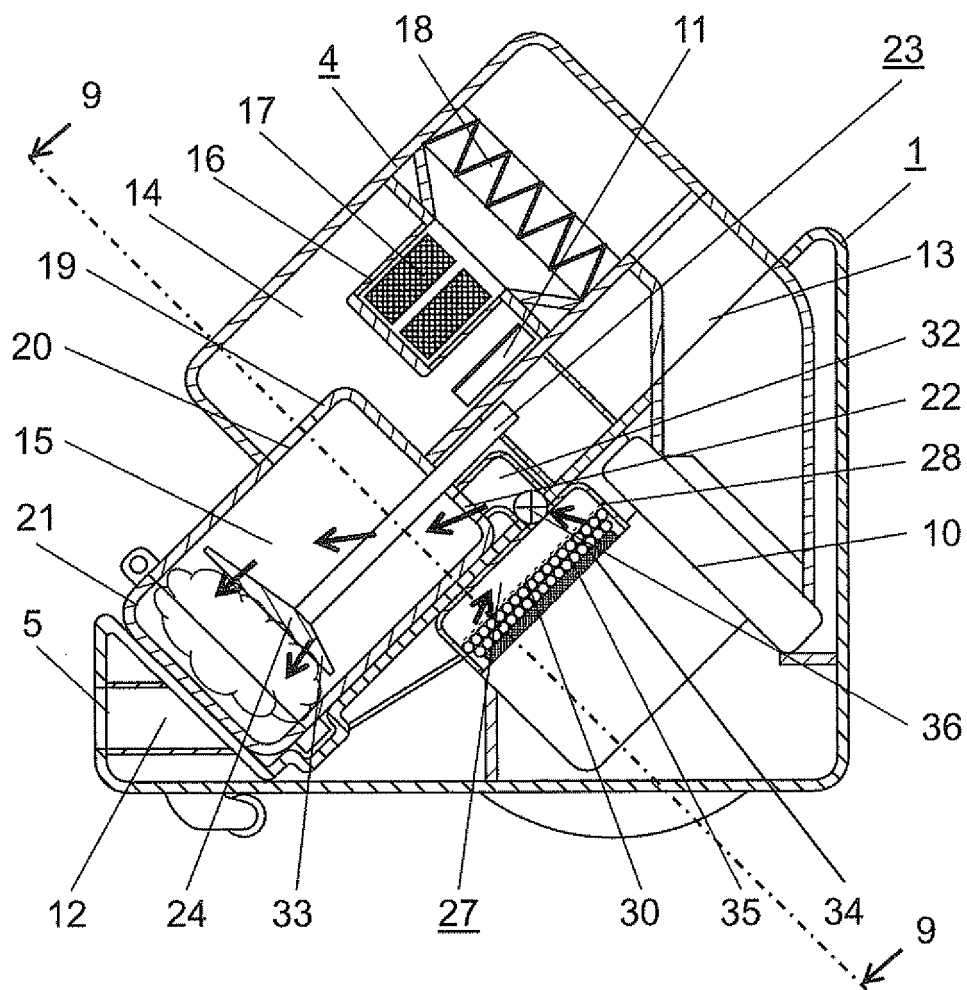


FIG. 9

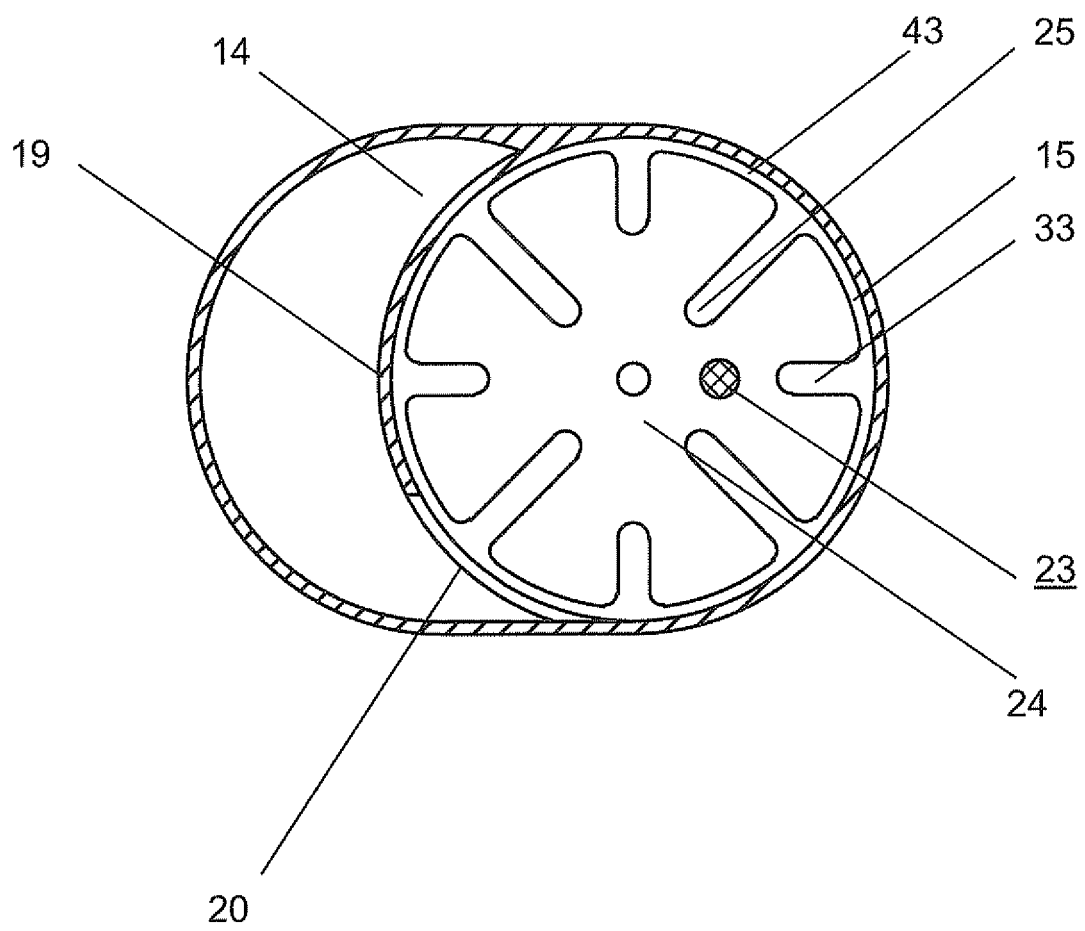


FIG. 10

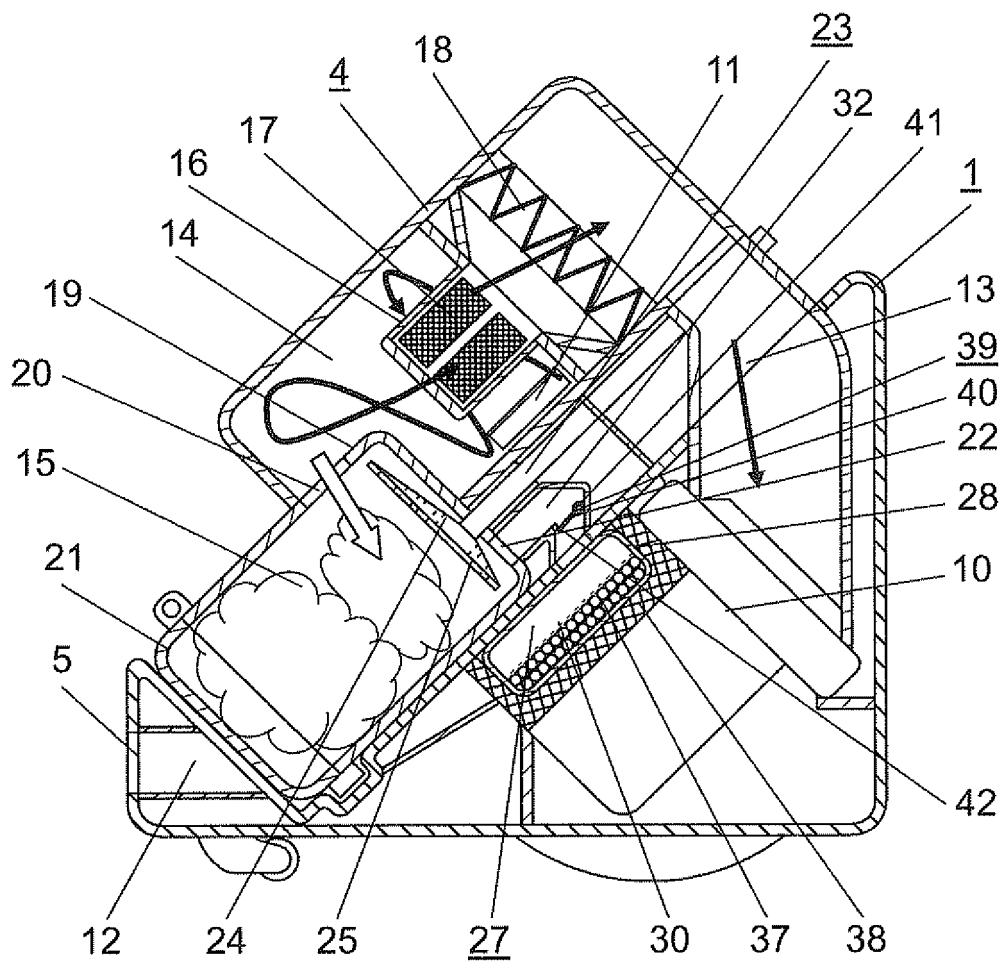
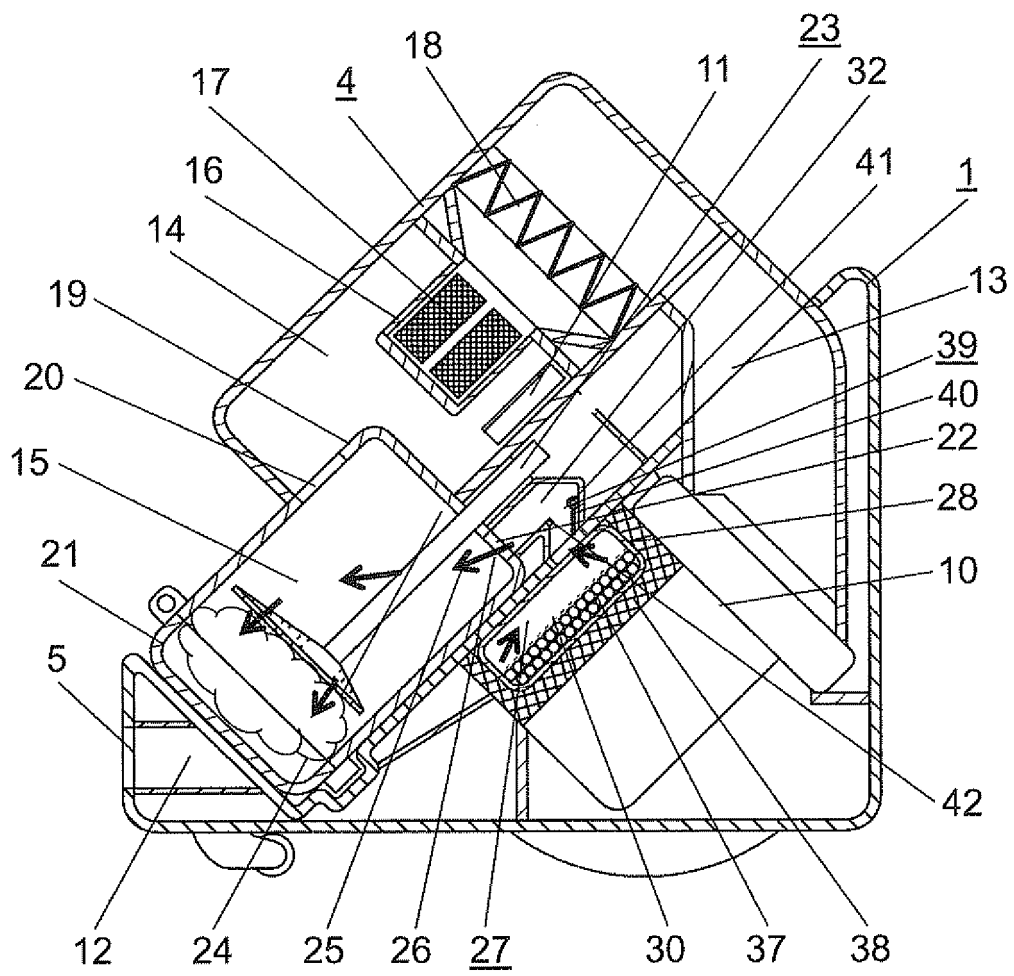


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/005040

A. CLASSIFICATION OF SUBJECT MATTER A47L9/00(2006.01)i, A47L9/10(2006.01)i, A47L9/16(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A47L9/00, A47L9/10, A47L9/16 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011 Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2007-319580 A (Matsushita Electric Industrial Co., Ltd.), 13 December 2007 (13.12.2007), paragraphs [0047] to [0053]; fig. 12 (Family: none)	1-5, 8, 10 6, 7, 9, 11
Y A	JP 2002-51950 A (Sharp Corp.), 19 February 2002 (19.02.2002), paragraphs [0002] to [0007], [0025] to [0036]; fig. 1 & US 2001/0025395 A1 & EP 1136028 A2 & DE 60121652 T & KR 10-2001-0090527 A & CN 1319372 A & CN 1545973 A & CN 1545972 A	1-5, 8, 10 6, 7, 9, 11
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed		“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family
Date of the actual completion of the international search 04 October, 2011 (04.10.11)		Date of mailing of the international search report 18 October, 2011 (18.10.11)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/005040

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2009-39253 A (Sharp Corp.), 26 February 2009 (26.02.2009), paragraphs [0029] to [0073]; fig. 2, 9 (Family: none)	1-5, 8, 10 6, 7, 9, 11
Y	JP 2011-27332 A (The Tokyo Electric Power Co., Inc.), 10 February 2011 (10.02.2011), paragraphs [0054], [0081] (Family: none)	5
Y	JP 2011-43295 A (Mitsubishi Electric Corp.), 03 March 2011 (03.03.2011), paragraphs [0023], [0025] (Family: none)	5

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

REFERENCES CITED IN THE DESCRIPTION

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