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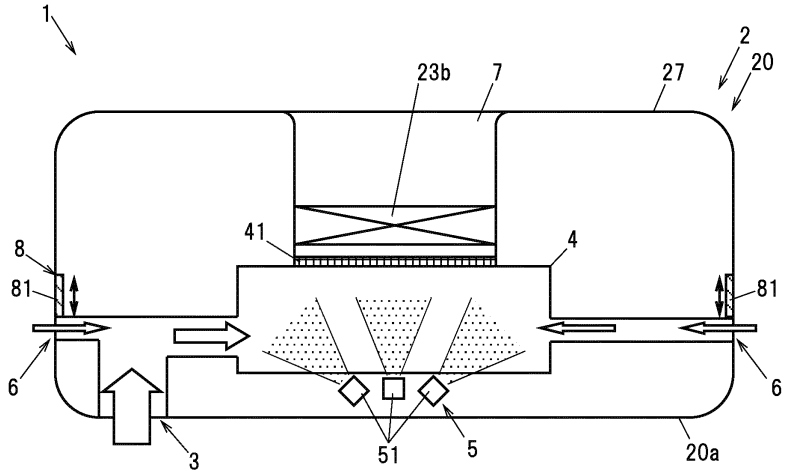
(54) FLOOR VACUUM CLEANER

(57) A floor vacuum cleaner 1 comprises a body section 2 having a suction port 3 for sucking in dust in a bottom surface 20a, a dust box 4 that stores dust sucked in through the suction port 3, a light source 5 for radiating ultraviolet light into the dust box 4 to inactivate bacteria and viruses within the dust box 4, and one or more side holes 6 that are provided in the body section 2 separately from the suction port 3 and that suck in dust raised around the body section 2 and guiding the dust to the dust box 4.

FIG. 3B



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Description

TECHNICAL FIELD

[0001] The present invention relates to a floor vacuum cleaner.

BACKGROUND OF THE INVENTION

[0002] A self-propelled floor vacuum cleaner that self-propels and cleans indoor spaces is known (see, e.g., Patent Literature 1). The self-propelled floor vacuum cleaner has a side brush provided on a bottom surface of a vacuum cleaner main body to sweep out dirt and dust from corners, etc. of a room out of reach of a suction opening and guide the dirt and dust to the suction opening. The side brush is provided so as to protrude outward from the vacuum cleaner main body in plan view, has a rotation axis in a substantially up-and-down direction (i.e., a direction substantially along the vertical direction during cleaning), and is driven to rotate about the rotation axis.

CITATION LIST

PATENT LITERATURES

[0003] Patent Literature 1: JP 2019-162542A

SUMMARY OF THE INVENTION

[0004] By the way, floors in hospitals, etc., are at relatively high risk of microbiological contamination since there may be a case where, e.g., disposal of vomit from infected patients is not sufficient. Therefore, when cleaning floors in hospitals, etc., it is required to reduce the risk of infection spreading due to microbiological contamination, etc., of the floor.

[0005] For example, in case of the self-propelled floor vacuum cleaner described above, dirt and dust on the floor are stirred up as the vacuum cleaner main body travels or the side brush is driven, which may increase the risk of infection spreading due to microbiological contamination, etc., of the floor. Also in case of a hand-supported floor vacuum cleaner, dirt and dust on the floor is inevitably stirred up during cleaning, and measures are needed.

[0006] Therefore, it is an object of the invention to provide a floor vacuum cleaner that can reduce the risk of infection spreading due to dirt and dust on the floor being stirred up.

[0007] A floor vacuum cleaner in an embodiment of the invention comprises:

a main body comprising a suction port provided on a bottom surface to suck in dirt and dust;
a dust box to store dirt and dust sucked in through the suction port;
a light source to irradiate the inside of the dust box with ultraviolet light to inactivate bacteria and viruses in the dust box; and
not less than one side hole being provided on the main body separately from the suction port, sucking in dirt and dust stirred up around the main body, and guiding the dirt and dust to the dust box.

Advantageous Effects of the Invention

[0008] According to the invention, it is possible to provide a floor vacuum cleaner that can reduce the risk of infection spreading due to dirt and dust on the floor being stirred up.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1A is a perspective view showing a floor vacuum cleaner in an embodiment of the present invention.
Fig. 1B is a perspective view showing the floor vacuum cleaner in the embodiment of the invention.
Fig. 2 is a functional block diagram illustrating the floor vacuum cleaner.
Fig. 3A is a plan view showing the floor vacuum cleaner.
Fig. 3B is a schematic diagram illustrating a cross-sectional structure of the floor vacuum cleaner.
Fig. 4A is an explanatory diagram illustrating a result of a simulation to verify the effect of a side hole.
Fig. 4B is an explanatory diagram illustrating a result of a simulation to verify the effect of the side hole.
Fig. 5A is an explanatory diagram illustrating a result of a simulation to verify the effect of the side hole.
Fig. 5B is an explanatory diagram illustrating a result of a simulation to verify the effect of the side hole.
Fig. 6A is a schematic diagram illustrating a cross-sectional structure of the floor vacuum cleaner in a modification of the invention.
Fig. 6B is a schematic diagram illustrating a cross-sectional structure of the floor vacuum cleaner in a modification of the invention.
Fig. 7 is a schematic diagram illustrating the floor vacuum cleaner in a modification of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiment

[0010] An embodiment of the invention will be described below in conjunction with the appended drawings.

[0011] Figs. 1A and 1B are perspective views showing a floor vacuum cleaner in an embodiment of the invention, and Fig. 2 is a functional block diagram thereof. Fig. 3A is a plan view showing the floor vacuum cleaner, and Fig. 3B is a schematic diagram illustrating a cross-sec-

tional structure thereof.

[0012] As shown in Figs. 1A, 1B, 2, 3A and 3B, a floor vacuum cleaner 1 includes a main body 2 having a suction port 3 provided on a bottom surface 20a to suck in dirt and dust, a dust box 4 to store dirt and dust sucked in through the suction port 3, and a light source 5 to irradiate the inside of the dust box 4 with ultraviolet light to inactivate bacteria and viruses in the dust box 4.

[0013] A case where the floor vacuum cleaner 1 is a self-propelled floor vacuum cleaner will be described in the present embodiment. In this case, the main body 2 corresponds to a self-propelled floor vacuum cleaner main body 20 having a travel mechanism 24 allowing for self-propulsion. The floor vacuum cleaner main body 20, which is the main body 2, includes a camera 21, an obstacle detection sensor 22, a dust collection mechanism 23, the travel mechanism 24, the light source 5, a control unit 26, and a case 27 that houses these components. However, the invention is not limited thereto and can also be applied to floor vacuum cleaners which are moved manually, such as a hand-supported type. In this case, a main body having the dust box 4 may be provided separately from the main body 2. This point will be described later.

[0014] The camera 21 is to capture images of the surroundings of the floor vacuum cleaner main body 20 and is used to acquire, e.g., a floor map (described later) or to acquire the position of the floor vacuum cleaner main body 20. The floor vacuum cleaner main body 20 may be provided with plural cameras 21, and may be configured to capture images of the surroundings of the floor vacuum cleaner main body 20 with the plural cameras 21. The camera 21 is not shown in Figs. 1A, 1B, 3A and 3B.

[0015] The obstacle detection sensor 22 is to detect whether or not an obstacle is present near the floor vacuum cleaner main body 20, so that collision of the floor vacuum cleaner main body 20 with the obstacle can be suppressed. For example, an infrared sensor or an ultrasonic sensor can be used as the obstacle detection sensor 22. The obstacle detection sensor 22 is not shown in Figs. 1A, 1B, 3A and 3B.

[0016] Although not shown in the drawings, the floor vacuum cleaner main body 20 may include various sensors other than the obstacle detection sensor 22, and may include, e.g., a gyroscope sensor that detects a rotation angle when the floor vacuum cleaner main body 20 travels, a travel sensor that detects a travelled distance of the floor vacuum cleaner main body 20, a floor distance sensor that detects level differences, etc. by detecting the distance between the floor vacuum cleaner main body unit 20 and the floor, and a particle sensor that detects the amount of dirt and dust, etc. sucked in through the suction port 3.

[0017] The dust collection mechanism 23 is a mechanism to suck in dirt and dust on the floor and collect the dirt and dust into the floor vacuum cleaner main body 20, and has a rotating brush 23a rotatably provided at the suction port 3 which opens on the bottom surface 20a of the floor vacuum cleaner main body 20 toward the floor (i.e. opens downward), a brush drive unit (not shown) to scrape off dirt from the floor by rotationally driving the rotating brush 23a, a fan 23b (see Fig. 3B) which serves as a suction member to suck in dirt and dust through the suction port 3, and the dust box 4 (see Fig. 3B) to store the dirt and dust, etc. sucked in through the suction port 3.

[0018] The dust collection mechanism 23 also has a side brush 23c that is provided on the bottom surface 20a of the floor vacuum cleaner main body 20 so as to protrude from the floor vacuum cleaner main body 20 and is driven to rotate about a rotation axis substantially perpendicular to the floor (i.e., substantially along the vertical direction). The side brush 23c serves to sweep out dirt and dust from the corners of the room where the rotating brush 23a cannot reach, and to guide the dirt and dust to the suction port 3. As shown in Fig. 3A, the side brush 23c is provided so as to protrude outside from the floor vacuum cleaner main body 20 in plan view (i.e., when viewed from above).

[0019] The travel mechanism 24 is a mechanism to make the floor vacuum cleaner main body 20 travel or self-propel, and has wheels 24a (see Fig. 1B) provided on the bottom surface 20a of the floor vacuum cleaner main body 20, and a motor (not shown) to drive the wheels 24a. The case where two wheels 24a are arranged opposite to each other so that their rotation axes are aligned in a straight line is shown here, but the number and arrangement of the wheels 24a are not particularly limited.

[0020] The light source 5 serves to irradiate the inside of the dust box 4 with ultraviolet light and thereby inactivate bacteria and viruses sucked into the dust box 4. In the present embodiment, the light source 5 is composed of light-emitting diodes 51 that emit ultraviolet light. For example, an ultraviolet lamp can be used as the light source 5, but many of ultraviolet lamps use mercury and this poses a safety problem in the event of being damaged. In addition, since ultraviolet light lamps emit not only ultraviolet light with a wavelength suitable for inactivating bacteria, etc. but also light in a very wide range of wavelengths including infrared light, it is wasteful and power consumption is also high. In addition, if the output is increased, infrared may heat and scorch the floor. By using the light-emitting diode 51 as the light source 5 as in the present embodiment, it is possible to ensure safety in the event of being damaged, keep power consumption down, and suppress problems such as scorching of the floor. Furthermore, the start-up time of ultraviolet lamps is long at the beginning of irradiation with ultraviolet light, but it is possible to reduce the start-up time at the beginning of irradiation with ultraviolet light by using the light-emitting diodes 51.

[0021] As the light-emitting diode 51 used for the light source 5, it is desirable to use the light-emitting diode 51 that emits deep ultraviolet light which is highly effective in inactivating bacteria, etc. In more particular, as the light-emitting diode 51 used for the light source 5, the light-

emitting diode 51 which emits deep ultraviolet light with a wavelength of not less than 250 nm and not more than 280 nm may be used. Although three light-emitting diodes 51 are used in the present embodiment, the number of light-emitting diodes 51 used as the light source 5 is not limited thereto and can be changed as appropriate according to the size, etc. of the dust box 4.

[0022] In the present embodiment, the light source 5 is arranged below the dust box 4 on the outside of the dust box 4 so as to emit ultraviolet light upward from below. Therefore, the dust box 4 is preferably made of a material transparent to ultraviolet light. In this regard, however, the dust box 4 when made of, e.g., quartz glass may break by impact, etc., hence, it is more desirable that the dust box 4 be made of a resin transparent to ultraviolet light. For example, a fluorine-based resin composition can be used as the resin transparent to ultraviolet light. In addition, to suppress degradation caused by ultraviolet light emitted from the light source 5, it is possible to use the dust box 4 made of a resin composition containing an anti-UV agent. In this regard, the dust box 4 does not need to be entirely made of a material transparent to ultraviolet light. The dust box 4 may be configured such that only at least the surface on the light source 5 side (i.e., the bottom surface) is made of a material transparent to ultraviolet light, or the dust box 4 may be configured such that a window made of a material transparent to ultraviolet light is provided on the surface on the light source 5 side (i.e., the bottom surface) and ultraviolet light is emitted into the dust box 4 through the window. It is more desirable that the light source 5 be positioned so as to emit ultraviolet light toward the upper corners of the dust box 4 since the airflow tends to stagnate at the upper corners of the dust box 4.

[0023] The light source 5 may be intermittently driven so as to repeatedly turn on and off at predetermined time intervals. This reduces the time for driving the light source 5, thereby suppressing degradation of the light source 5 and reducing power consumption. In addition, degradation of the dust box 4 can be suppressed and the service life of the floor vacuum cleaner 1 can be improved.

[0024] In the present embodiment, the floor vacuum cleaner 1 further includes light sources 25 for floor irradiation to irradiate the floor with ultraviolet light. The light source 25 for floor irradiation serves to irradiate the floor with ultraviolet light and thereby inactivate bacteria or viruses present on the floor. In the present embodiment, the light source 25 for floor irradiation is composed of a light-emitting diode that emits deep ultraviolet light with a wavelength of not less than 250 nm and not more than 280 nm, in the same manner as the light source 5. The light sources 25 for floor irradiation are provided on the bottom surface 20a of the floor vacuum cleaner main body 20 so as to face the floor. The case where two light sources 25 for floor irradiation are arranged so as to sandwich the side brush 23c is shown in the present embodiment, but the number and arrangement of the light sources 25 for floor irradiation can be changed as appropriate. Moreover, the light source 25 for floor irradiations do not need to be included.

[0025] The control unit 26 controls the dust collection mechanism 23 and the travel mechanism 24 based on information from the camera 21 or the obstacle detection sensor 22, also controls the light source 5, etc. and is realized by appropriately combining an arithmetic element, a memory, interface, software and a storage device, etc. The control unit 26 has a map acquisition unit 261, a position acquisition unit 262, a contamination status detection unit 263, a drive control unit 264, a dust collection control unit 265, a light source control unit 266, and a storage unit 267.

[0026] The map acquisition unit 261 performs a test run at the time of cleaning for the first time, performs mapping of the floor to be cleaned, and acquires a floor map. Since various methods for test run and mapping process are known and public knowledge, the description thereof will be omitted here. The map acquisition unit 261 stores the acquired floor map in the storage unit 267.

[0027] The position acquisition unit 262 acquires position information indicating where in the floor map the floor vacuum cleaner main body 20 is located. The position acquisition unit 262 acquires the position information of the floor vacuum cleaner main body 20 (i.e., position coordinates in the floor map) based on, e.g., images obtained from the camera 21 or information from a gyroscope sensor or a travel sensor, etc.

[0028] The contamination status detection unit 263 detects the contamination status of the floor to be cleaned. The contamination status detection unit 263 detects the contamination status of the floor based on, e.g., the dust collection amount detected by a particle sensor. When the drive control unit 264 or the dust collection control unit 265 (both described later) is configured to be capable of changing the travel speed or the suction strength level according to the dust collection amount, the contamination status detection unit 263 can be configured to detect the contamination status of the floor based on the travel speed or the suction strength level.

[0029] The drive control unit 264 make the floor vacuum cleaner main body 20 travel by controlling the drive of the travel mechanism 24. The drive control unit 264 sets a route so that the cleaner travels thoroughly within the set cleaning area, and causes the floor vacuum cleaner main body 20 to travel along the set route. In addition, using the obstacle detection sensor 22, etc., the drive control unit 264 performs drive control so that the floor vacuum cleaner main body 20 does not collide with an obstacle, etc. The drive control unit 264 may be configured to be capable of changing the travel speed according to the dust collection amount. It is possible to collect dust efficiently, e.g., by decreasing the travel speed in case of a large dust collection amount and increasing the travel speed in case of a small dust collection amount.

[0030] The dust collection control unit 265 controls the

dust collection mechanism 23. The dust collection mechanism 23 may be configured to be capable of changing the suction strength level according to the dust collection amount. For example, by increasing the suction strength level in case of a large dust collection amount and decreasing the suction strength level in case of a small dust collection amount, it is possible to suppress power consumption and collect dust efficiently. The suction strength level can be adjusted, e.g., by increasing or decreasing the rotation speed of the fan 23b.

[0031] The light source control unit 266 performs drive control of the light source 5 and the light sources 25 for floor irradiation. The light source control unit 266 may control so that the light source 5 and the light sources 25 for floor irradiation are continuously on, or so that light source 5 and the light sources 25 for floor irradiation blink (i.e., repeat on and off alternately). The light source control unit 266 may also control the emission intensity of ultraviolet light from the light source 5 according to the dust collection amount. Furthermore, the light source control unit 266 may control the emission intensity of ultraviolet light from the light sources 25 for floor irradiation according to the material of the floor and the contamination status of the floor. The emission intensity of the ultraviolet light from the light source 5 and the light sources 25 for floor irradiation can be controlled by the magnitude of the drive current. In case of blinking the light source 5 and the light sources 25 for floor irradiation, the emission intensity of the ultraviolet light can also be controlled by blinking time intervals or the ratio of the lighting time and the blinking time.

[0032] The storage unit 267 stores the floor map acquired by the map acquisition unit 261 and the contamination status of the floor detected by the contamination status detection unit 263, etc. Although not shown in the drawings, the floor vacuum cleaner 1 may be configured so that floor material setting can be made. The floor material setting may be made by user input, or an appropriate sensor capable of identifying the material of the floor (e.g., a floor detection sensor using the intensity of reflected light when emitting light onto the floor or using distortion of the wheels 24a, etc.) may be provided on the floor vacuum cleaner main body 20 to automatically identify the material of the floor.

Side hole 6 and Side hole opening/closing mechanism 8

[0033] The floor vacuum cleaner 1 in the present embodiment includes not less than one side hole 6 that sucks in dirt and dust stirred up around the floor vacuum cleaner main body 20 and guides the dirt and dust to the dust box 4. As shown in Fig. 1A, the side holes 6 are provided on the floor vacuum cleaner main body 20 and serve to suck in dirt and dust stirred up by the travel of the floor vacuum cleaner main body 20 or the morion of the side brush 23c and thereby suppress scattering of dirt and dust near the floor to the surroundings. For example, floors in hospitals, etc. are at relatively high risk of microbiological contamination. However, even when cleaning floors in hospitals, etc., it is possible to reduce the risk of infection spreading due to microbiological contamination, etc., of the floor since providing the side holes 6 on the floor vacuum cleaner main body 20 suppresses stirring-up and scattering of dirt and dust to the surroundings.

[0034] When using the self-propelled floor vacuum cleaner 1, dirt and dust are likely to be stirred up by the motion of the side brush 23c. Therefore, it is desirable that the side holes 6 be provided so as to open at least in the vicinity of the side brush 23c. In more particular, it is desirable that at least one of the side holes 6 be provided so as to open above the driving range of the side brush 23c indicated by the dash-dot line A in Fig. 3A.

[0035] In the present embodiment, the floor vacuum cleaner main body 20 is formed in a substantially cylindrical shape, and plural side holes 6 are provided on a side surface (i.e., the circumferential side surface) of the floor vacuum cleaner main body 20 at substantially equal intervals. Then, each side hole 6 is provided so as to open toward the side of the floor vacuum cleaner main body 20. This makes it possible to efficiently suck in dirt and dust stirred up around the floor vacuum cleaner main body 20. However, the configuration of the side hole 6 is not limited thereto as long as it is possible to suck in dirt and dust stirred up around the floor vacuum cleaner main body 20. For example, the side holes 6 may be formed so as to open diagonally downward or facing downward.

[0036] As shown in Figh. 3B, the floor vacuum cleaner 1 is configured so that suction through the suction port 3 and suction through each side hole 6 are performed by the fan 23b which is the common suction member. Air and dirt and dust sucked in through the suction port 3 and the side holes 6 are introduced into the dust box 4, and the dirt and dust are trapped and collected by a filter 41 provided at the outlet of the dust box 4. A photocatalytic filter can be used as the filter 41. In this case, it is possible to break organic matters (i.e., malodorous components) in the exhaust air down and to deodorize by activating the photocatalyst with ultraviolet light from the light source 5. The filter 41 may be composed of plural filters including one photocatalytic filter.

[0037] Exhaust air which has passed through filter 41 passes through the fan 23b and is discharged from an exhaust port 7 to the outside of the floor vacuum cleaner main body 20. In the present embodiment, the exhaust port 7 is provided at the center of the floor vacuum cleaner main body 20 in plan view so that the air is exhausted upward (i.e., upward in the vertical direction, or in a direction perpendicular to the floor). This suppresses stirring-up of dirt and dust on the floor by the exhaust air, and it is thereby possible to further reduce the risk of infection spreading due to microbiological contamination, etc., of the floor.

[0038] The floor vacuum cleaner 1 also includes the side hole opening/closing mechanism 8 that controls opening and closing of the side holes 6. The side hole

opening/closing mechanism 8 has shutters 81 (see Fig. 3B) capable of opening and closing the side holes 6, and a side hole opening/closing control unit 82 (see Fig. 2) that controls opening and closing of the side holes 6 by driving the shutters 81. In this regard, the mechanism to open and close the side hole 6 is not limited to the shutter 81 and may be another mechanism such as solenoid valve. The side hole opening/closing control unit 82 is mounted on the control unit 26 and controls the suction power at the suction port 3 and the suction power at the side holes 6 by controlling opening and closing of the side holes 6.

[0039] In the present embodiment, three operating modes, "cleaning mode", "sterilization mode" and "cleaning and sterilization mode", can be set, and the side hole opening/closing control unit 82 is configured to control opening and closing of the side holes 6 according to the operation mode set by the user. In particular, when the "cleaning mode" is set, the side hole opening/closing control unit 82 fully closes the side holes 6 by the shutters 81. This maximizes the suction power at the suction port 3, which increases cleaning efficiency. Meanwhile, when the "sterilization mode" is set, the side hole opening/closing control unit 82 fully opens the side holes 6 by retracting the shutters 81. This maximizes the suction power at the side holes 6, which increases efficiency of sucking in dirt and dust stirred up from the floor. As a result, it is possible to significantly reduce the risk of infection spreading due to microbiological contamination, etc., of the floor. Then, when the "cleaning and sterilization mode" is set, the side hole opening/closing control unit 82 half-opens the side holes 6 by advancing the shutters 81 halfway. This makes it possible to maintain both the suction power at the suction port 3 and the suction power at the side holes 6, and it is possible to reduce the risk of infection spreading due to microbiological contamination, etc., of the floor by sucking in dirt and dust stirred up from the floor while cleaning efficiently to some extent.

[0040] In addition, the side hole opening/closing control unit 82 may be configured to adjust the degree of opening or closing of the side holes 6 according to the travel speed of the floor vacuum cleaner main body 20, the material of the floor, or the dust collection amount, etc. For example, it may be configured such that when the travel speed of the floor vacuum cleaner main body 20 is faster, the side holes 6 are opened more since more microorganisms, etc., are stirred up from the floor. In addition, it may be configured such that side holes 6 are closed more when the material of the floor is softer.

Description of Simulation results

[0041] The present inventors performed simulations to verify the effect of forming the side holes 6. First, how the behavior of dirt and dust changes by suction through the side holes 6 was examined for the case where dirt and dust are radially stirred up from the floor vacuum cleaner main body 20 as shown in Fig. 4A. The simulation was performed using airflow analysis software. The result of the simulation is shown in Fig. 4B. As shown in Fig. 4B, it was confirmed that dirt and dust were sucked into the side holes 6 by suction through the side holes 6 and scattering of the dirt and dust to the surroundings was suppressed.

[0042] Similarly, to examine the influence of dirt and dust stirred up by the side brush 23c, how the behavior of dirt and dust changes by suction through the side holes 6 was examined for the case where dirt and dust are ejected outward from one location near the floor vacuum cleaner main body 20 as shown in Fig. 5A. As a result, as shown in Fig. 5B, it was confirmed that dirt and dust were sucked into the side holes 6 by suction through the side holes 6 and scattering of dirt and dust to the surroundings was suppressed. These simulation results confirm that scattering of dirt and dust stirred up from the floor to the surroundings can be suppressed by providing the side holes 6.

Functions and Effects of the embodiment

[0043] As described above, the floor vacuum cleaner 1 in the present embodiment includes the light source 5 to irradiate the inside of the dust box 4 with ultraviolet light to inactivate bacteria and viruses in the dust box 4, and not less than one side hole 6 being provided on the floor vacuum cleaner main body 20 separately from the suction port 3, sucking in dirt and dust stirred up around the floor vacuum cleaner main body 20 and guiding the dirt and dust to the dust box 4. With this configuration, dirt and dust stirred up around the floor vacuum cleaner main body 20 can be sucked in through the side holes 6 and the air can be exhausted after inactivating bacteria or viruses using the light source 5. As a result, scattering of dirt and dust containing bacteria or viruses to the surroundings is suppressed, and even when cleaning floors in hospitals, etc., it is possible to reduce the risk of infection spreading due to microbiological contamination, etc., of the floor.

Modifications

[0044] The light source 5 in the above embodiment is configured to emit ultraviolet light upward from below the dust box 4, but the light source 5 may further include upper-side light-emitting diodes 52 that emit ultraviolet light downward from above as shown in Fig. 6A. In the illustrated example, the upper-side light-emitting diodes 52 are arranged so as to emit ultraviolet light obliquely downward from the upper corners of the dust box 4 toward the center of the dust box 4. However, the arrangement of the upper-side light-emitting diodes 52 is not limited thereto. The effect of inactivating bacteria or viruses can be obtained sufficiently by having the upper-side light-emitting diodes 52 even if debris accumulates at the lower portion of the dust box 4 and blocks the ultraviolet light emitted upward from below.

[0045] Furthermore, a reflector 53, which reflects part of the emitted ultraviolet light and is transparent to the rest

of the light, may be provided between the lower-side light-emitting diodes 51 and the dust box 4 as shown in Fig. 6B. As a result, the floor is irradiated with the ultraviolet light reflected by the reflector 53, hence, the light source 5 can also serve as a light source for floor irradiation and the light sources 25 for floor irradiation can thus be omitted. In addition, the reflector 53 may be configured to be retractable from above the lower-side light-emitting diodes 51 or to be detachable, so that irradiating or not irradiating the floor with ultraviolet light can be selected by the presence or absence of the reflector 53. Advancing and retreating of the reflector 53 to and from above the light-emitting diodes 51, or attaching and detaching of the reflector 53, may be performed automatically or may be performed manually.

[0046] In addition, although the self-propelled floor vacuum cleaner 1 has been described in the above embodiment, the invention is also applicable to non-self-propelled floor vacuum cleaners. The invention can also be applied to, e.g., a hand-supported floor vacuum cleaner 1 that has the main body 2, a handle 91, and a connecting portion 9 that connects the main body 2 and the handle 91, as shown in Fig. 7. The dust box 4 is provided in the connecting portion 9 in the illustrated example, but the dust box 4 may be provided in the main body 2. The side holes 6 are to suck in dirt and dust stirred up from the floor and thus need to be formed separately from the suction port 3 provided to suck in dirt and dust on the floor and need to be formed at a distance from the floor. For example, there may be a case where the suction port 3 partially opens to the side in a cutout manner, and such a cutout on the side is part of the suction port 3 and is different from the side hole 6 provided to suck in dirt and dust stirred up from the floor.

Summary of the embodiment

[0047] Technical ideas understood from the embodiment will be described below citing the reference signs, etc., used for the embodiment. However, each reference sign, etc., described below is not intended to limit the constituent elements in the claims to the members, etc., specifically described in the embodiment.

(1) A floor vacuum cleaner 1, comprising: a main body 2 comprising a suction port 3 provided on a bottom surface 20a to suck in dirt and dust; a dust box 4 to store dirt and dust sucked in through the suction port 3; a light source 5 to irradiate the inside of the dust box 4 with ultraviolet light to inactivate bacteria and viruses in the dust box 4; and not less than one side hole 6 being provided on the main body 2 separately from the suction port 3, sucking in dirt and dust stirred up around the main body 2, and guiding the dirt and dust to the dust box 4.

(2) The floor vacuum cleaner 1 as defined by (1), comprising; a side brush 23c that is provided on the bottom surface 20c of the main body 2 so as to protrude from the main body 2 and is driven to rotate about a rotation axis perpendicular to a floor, wherein at least one said side hole 6 is provided so as to open above a driving range A of the side brush 23c.

(3) The floor vacuum cleaner 1 as defined by (1) or (2), wherein suction through the suction port 3 and suction through the side hole 6 are performed by a common suction member (23b), and wherein a side hole opening/closing mechanism 8 is provided to control suction power at the suction port 3 and suction power at the side hole 6 by controlling opening and closing of the side hole 6.

(4) The floor vacuum cleaner 1 as defined by any one of (1) to (3), wherein the side hole 6 is provided on a side surface of the main body 2 so as to open to the side.

(5) The floor vacuum cleaner 1 as defined by any one of (1) to (4), wherein the light source 5 is intermittently driven so as to repeatedly turn on and off at predetermined time intervals.

(6) The floor vacuum cleaner 1 defined as any one of (1) to (5), further comprising: a light source 25 for floor irradiation that irradiates the floor with ultraviolet light.

(7) The floor vacuum cleaner 1 as defined by any one of (1) to (6), wherein the main body 2 comprises a self-propelled floor vacuum cleaner main body 20 comprising a travel mechanism 24 allowing for self-propulsion.

(8) The floor vacuum cleaner 1 as defined by (7), wherein the floor vacuum cleaner main body 20 comprises an exhaust port 7 provided at the center in plan view to exhaust air upward in a direction perpendicular to the floor.

Additional note

[0048] Although the embodiment of the invention has been described, the invention according to claims is not to be limited to the embodiment described above. Further, please note that not all combinations of the features described in the embodiment are necessary to solve the problem of the invention. In addition, the invention can be appropriately modified and implemented without departing from the gist thereof.

REFERENCE SIGNS LIST

[0049]

1 floor vacuum cleaner
2 main body
20 floor vacuum cleaner main body
20a bottom surface
3 suction port
4 dust box
5 light source
6 side hole

7 exhaust port
8 side hole opening/closing mechanism
23b fan (suction member)
23c side brush

Claims

1. A floor vacuum cleaner, comprising:

a main body comprising a suction port provided on a bottom surface to suck in dirt and dust;
a dust box to store dirt and dust sucked in through the suction port;
a light source to irradiate the inside of the dust box with ultraviolet light to inactivate bacteria and viruses in the dust box; and
not less than one side hole being provided on the main body separately from the suction port, sucking in dirt and dust stirred up around the main body, and guiding the dirt and dust to the dust box.

2. The floor vacuum cleaner according to claim 1, comprising;

a side brush that is provided on the bottom surface of the main body so as to protrude from the main body and is driven to rotate about a rotation axis perpendicular to a floor,
wherein at least one said side hole is provided so as to open above a driving range of the side brush.

3. The floor vacuum cleaner according to claim 1 or 2, wherein suction through the suction port and suction through the side hole are performed by a common suction member, and wherein a side hole opening/-closing mechanism is provided to control suction power at the suction port and suction power at the side hole by controlling opening and closing of the side hole.

4. The floor vacuum cleaner according to claim 1 or 2, wherein the side hole is provided on a side surface of the main body so as to open to the side.

5. The floor vacuum cleaner according to claim 1 or 2, wherein the light source is intermittently driven so as to repeatedly turn on and off at predetermined time intervals.

6. The floor vacuum cleaner according to claim 1 or 2, further comprising:
a light source for floor irradiation that irradiates the floor with ultraviolet light.

7. The floor vacuum cleaner according to claim 1 or 2, wherein the main body comprises a self-propelled floor vacuum cleaner main body comprising travel mechanism allowing for self-propulsion.

8. The floor vacuum cleaner according to claim 7, wherein the floor vacuum cleaner main body comprises an exhaust port provided at the center in plan view to exhaust air upward in a direction perpendicular to the floor.

FIG. 1A

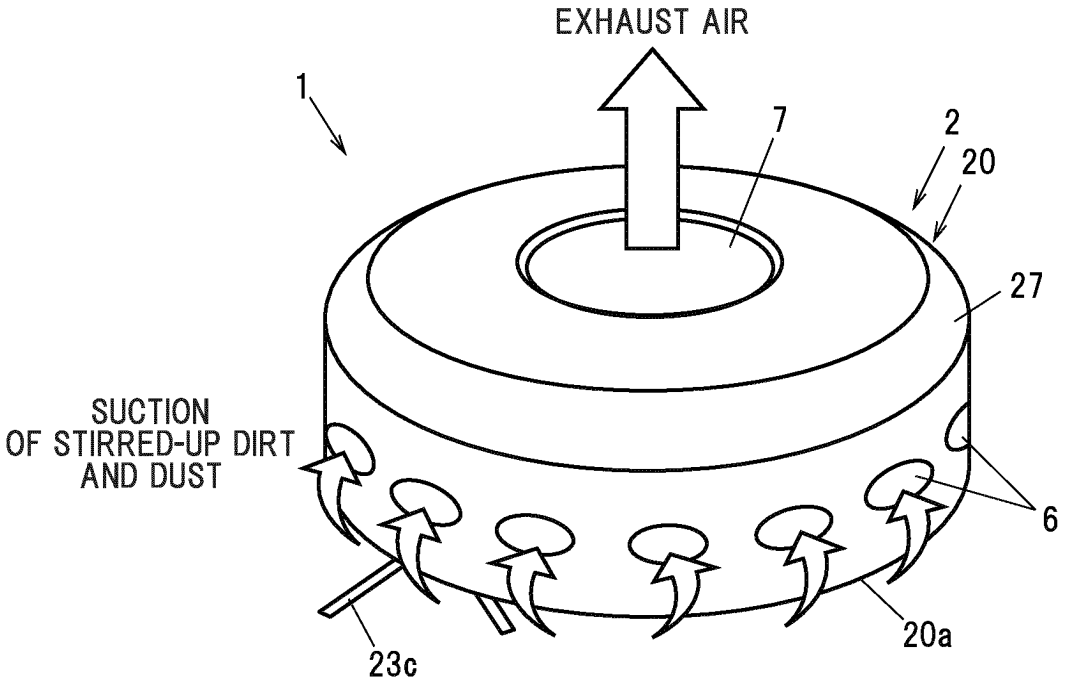

EXHAUST AIR
1
7
2
20
27
SUCTION
OF STIRRED-UP DIRT
AND DUST
6
20a
23c

FIG. 1B

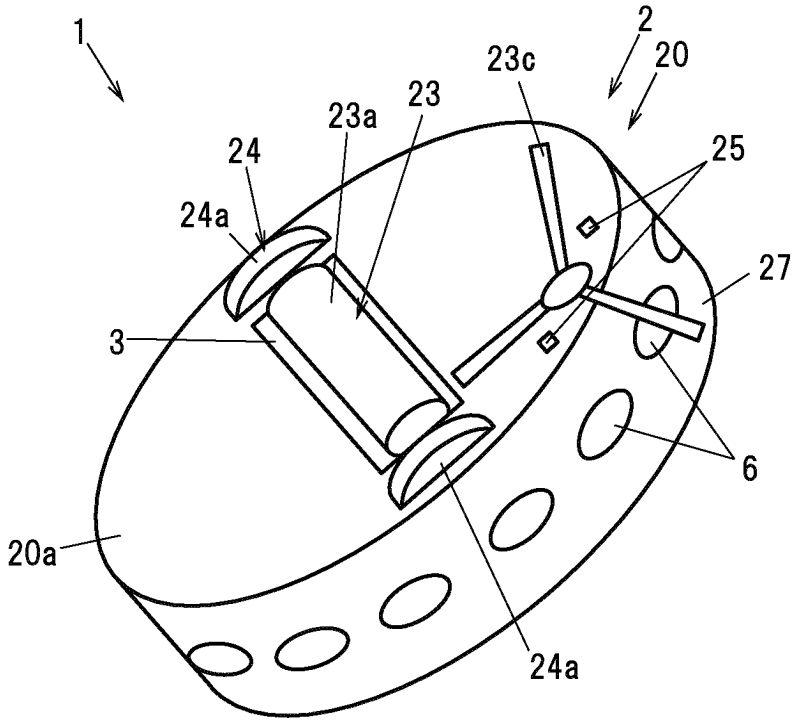

1
2
20
23c
23
23a
24
25
24a
27
3
6
20a
24a

FIG. 2

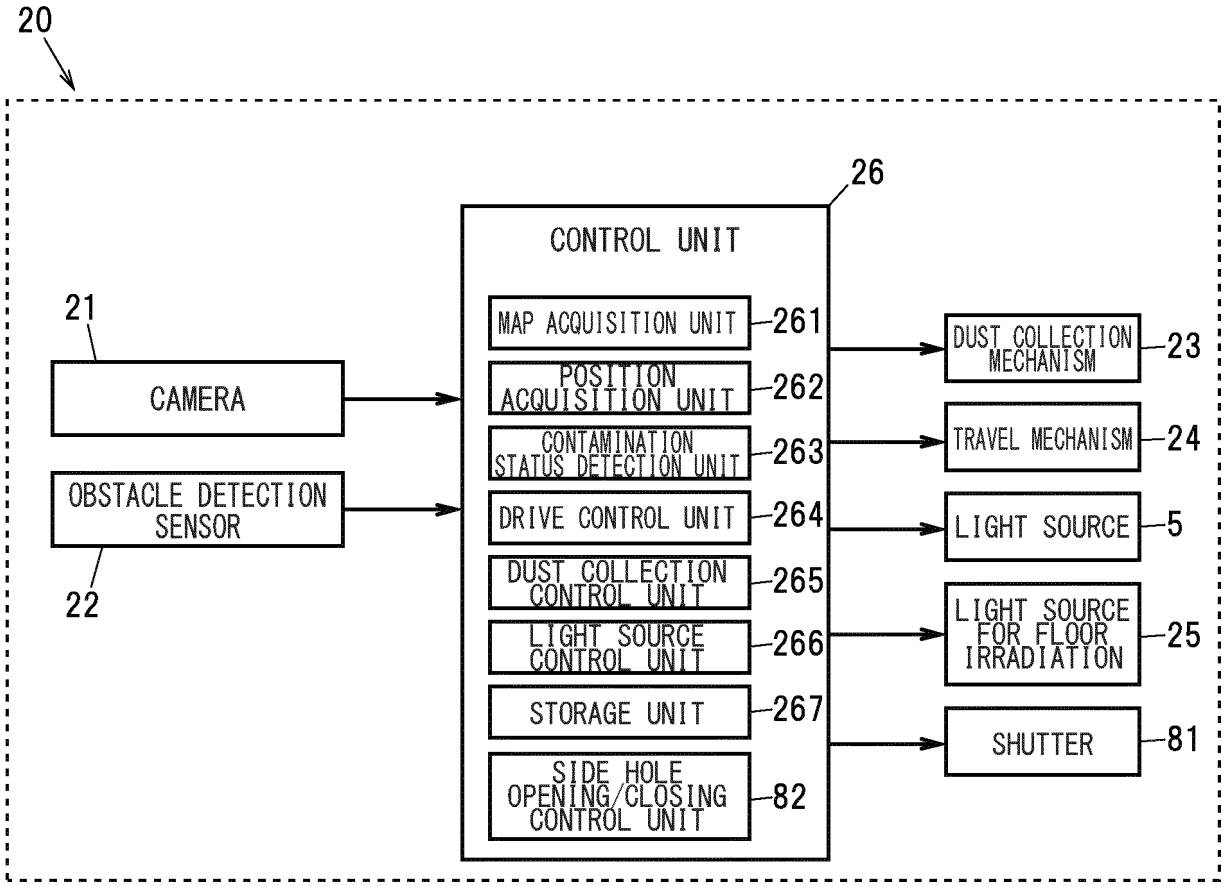

20
26
CONTROL UNIT
21
CAMERA
OBSTACLE DETECTION SENSOR
22
MAP ACQUISITION UNIT
261
POSITION ACQUISITION UNIT
262
CONTAMINATION STATUS DETECTION UNIT
263
DRIVE CONTROL UNIT
264
DUST COLLECTION CONTROL UNIT
265
LIGHT SOURCE CONTROL UNIT
266
STORAGE UNIT
267
SIDE HOLE OPENING/CLOSING CONTROL UNIT
82
DUST COLLECTION MECHANISM
23
TRAVEL MECHANISM
24
LIGHT SOURCE
5
LIGHT SOURCE FOR FLOOR IRRADIATION
25
SHUTTER
81

FIG. 3A

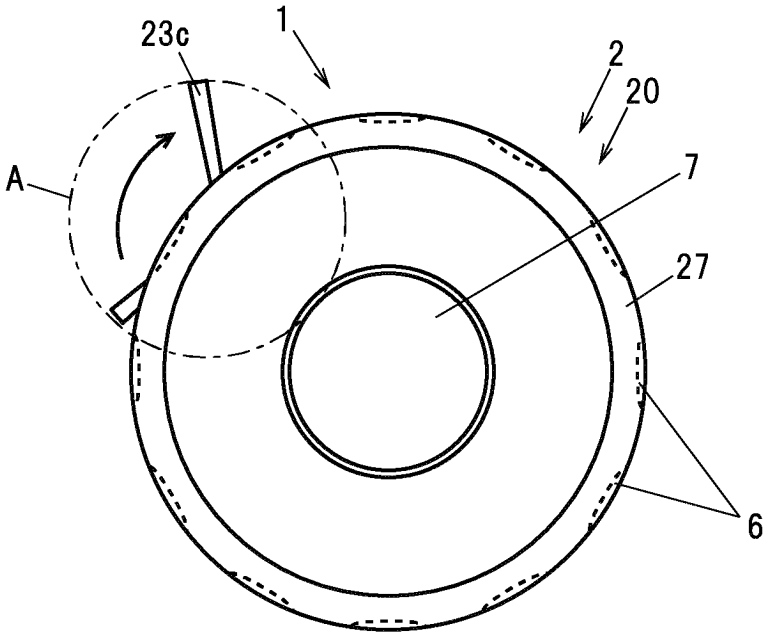


FIG. 3B

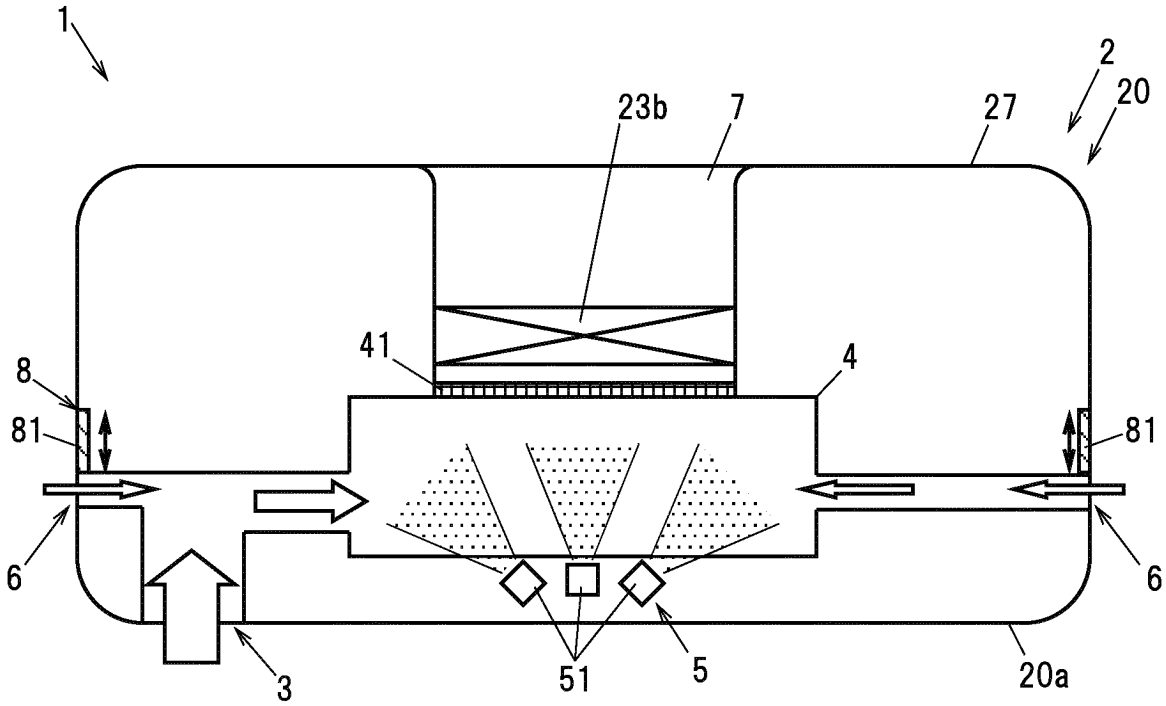


FIG. 4A

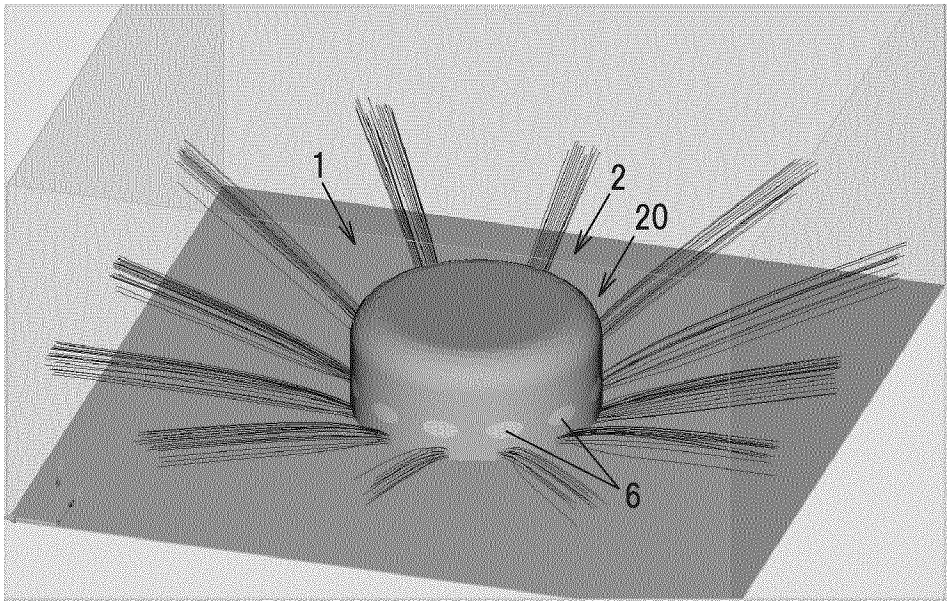


FIG. 4B

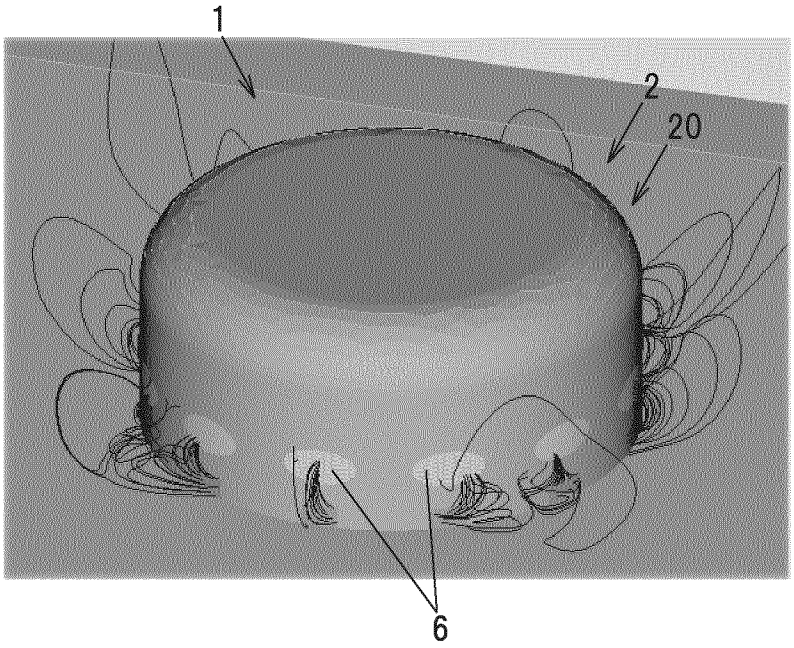


FIG. 5A

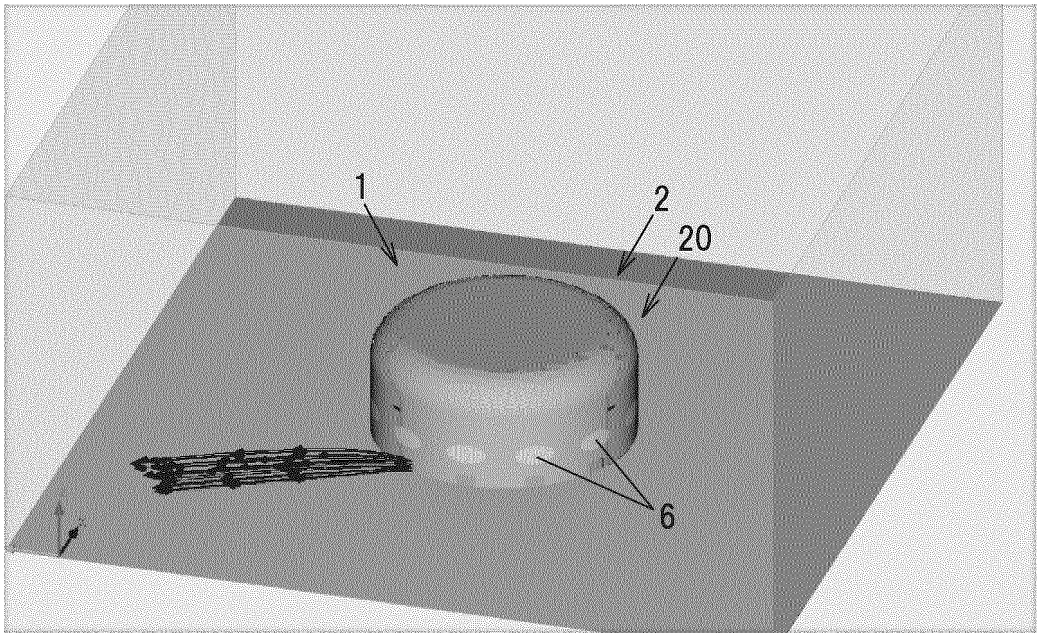


FIG. 5B

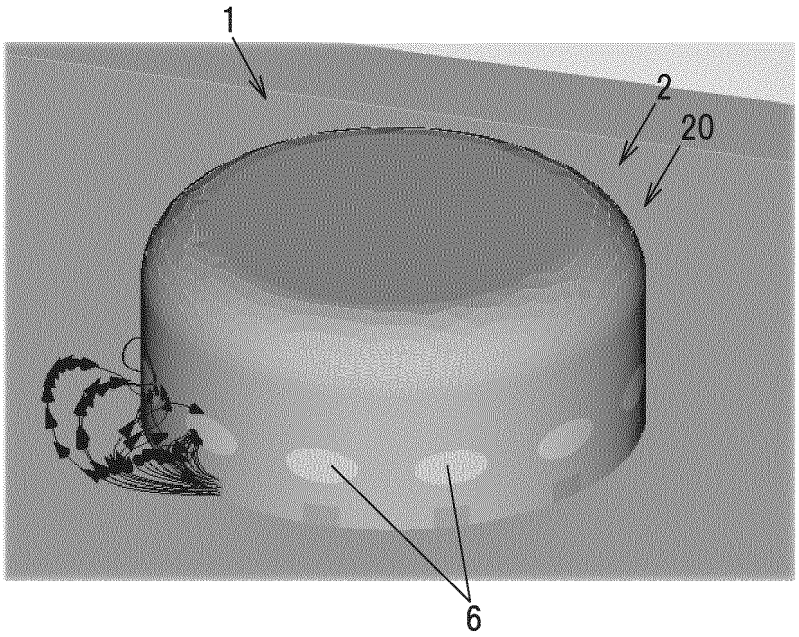


FIG. 6A

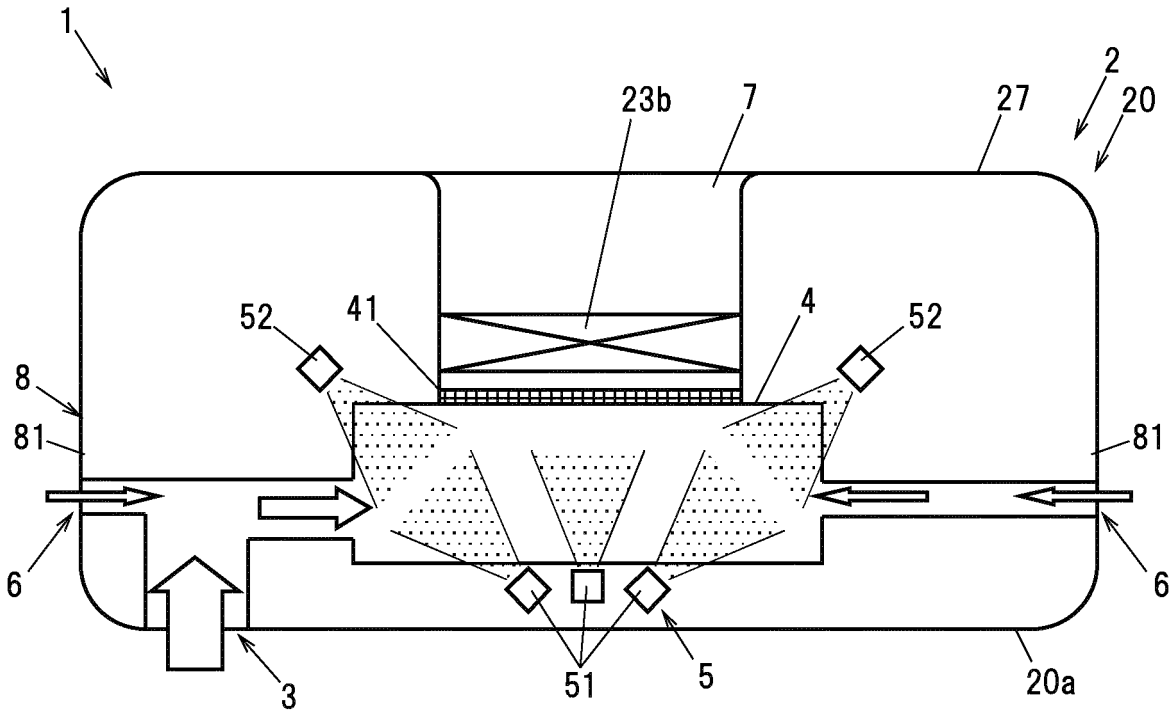

1
2
20
23b
7
27
52
41
4
52
8
81
81
6
6
3
51
5
20a

FIG. 6B

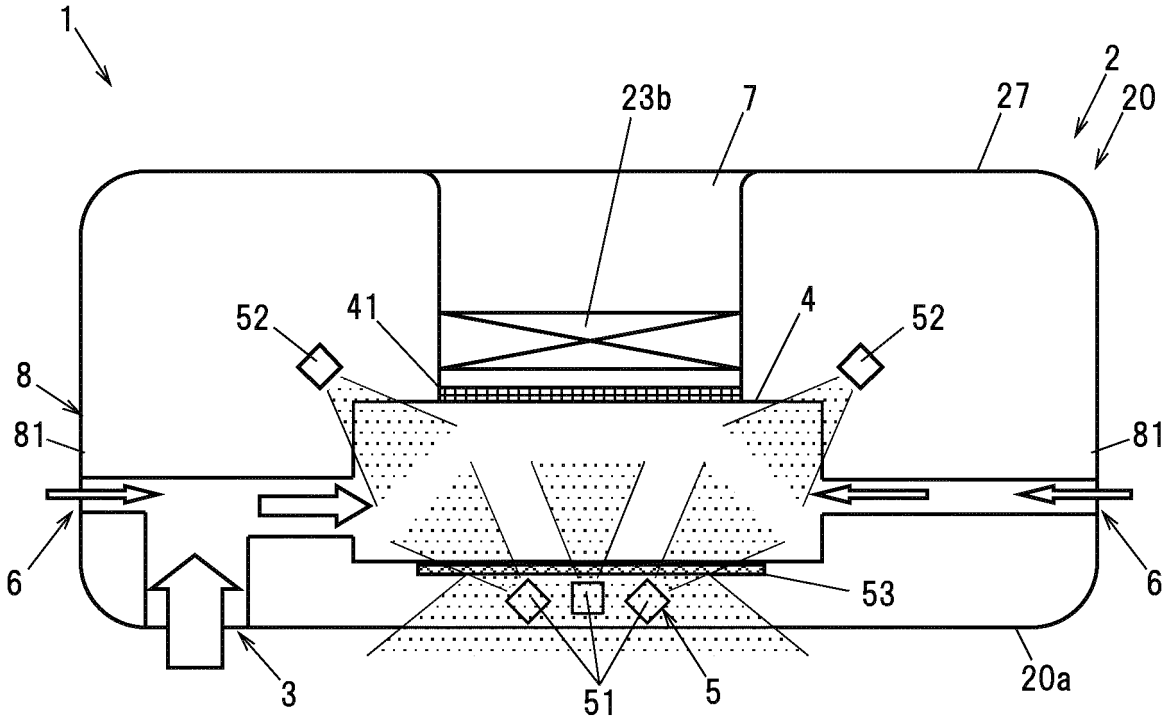
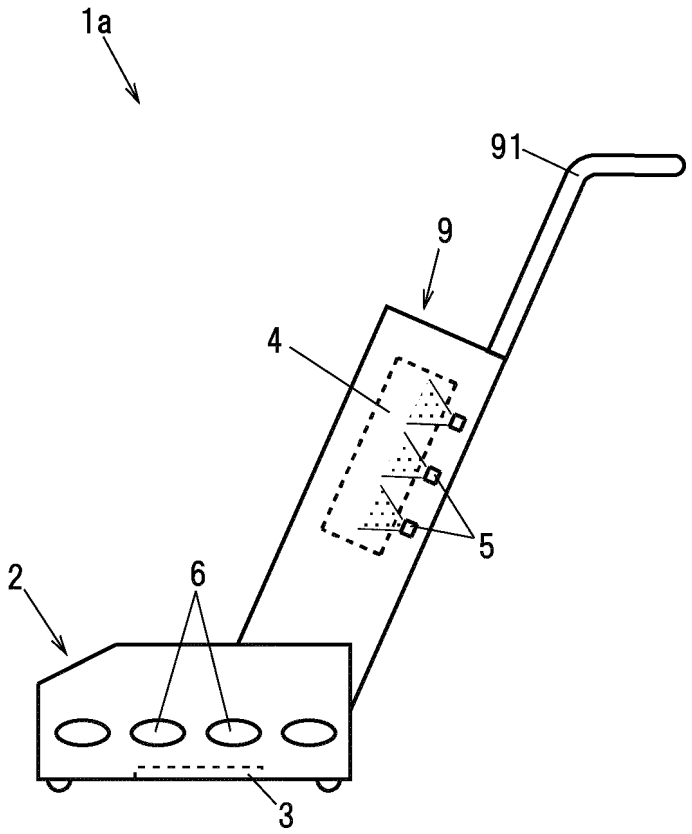

1
2
20
23b
7
27
52
41
4
52
8
81
81
6
6
53
3
51
5
20a

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/019640

A. CLASSIFICATION OF SUBJECT MATTER

A47L 9/28(2006.01)i; ***A47L 9/30***(2006.01)i
FI: A47L9/28 E; A47L9/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47L9/28; A47L9/30

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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	JP 2021-29710 A (PANASONIC IP MANAGEMENT CORP.) 01 March 2021 (2021-03-01) paragraphs [0011]-[0087], fig. 1, 2	1-8
Y	KR 10-2006-0032879 A (LG ELECTRONICS INC.) 18 April 2006 (2006-04-18) pages 1-3, fig. 3	1-8
Y	JP 2017-29667 A (EGENPOWER INC.) 09 February 2017 (2017-02-09) paragraphs [0011]-[0020], fig. 1-4	1-8
Y	KR 10-0812285 B1 (WOORI TECHNOLOGIES CORPORATION) 13 March 2008 (2008-03-13) paragraphs [15]-[80], fig. 1-8	3, 8
Y	JP 2001-370 A (MATSUSHITA ELECTRIC IND. CO., LTD.) 09 January 2001 (2001-01-09) paragraphs [0038]-[0046], fig. 3	5

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 July 2023	**18 July 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/019640

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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KR 10-2006-0032879 A	18 April 2006	(Family: none)	
JP 2017-29667 A	09 February 2017	US 2017/0035262 A1 paragraphs [0014]-[0024], fig. 1-4 EP 3127462 A1 TW 201705889 A CN 106419738 A KR 10-2017-0016772 A	
KR 10-0812285 B1	13 March 2008	(Family: none)	
JP 2001-370 A	09 January 2001	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2019162542 A **[0003]**