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(54) SUCTION OPENING BODY AND ELECTRIC CLEANER

(57) To provide a cleaner head and an electric cleaner (1), which can quickly remove dust having entered between the brush hairs of the roller brushbar using the rotation of the roller brushbar. A cleaner head (26) includes: a cleaner-head body (32) having a suction opening (28) that is provided in the bottom face, a suction chamber (63) that connects to the suction port (28), and a relay pipe (66) that connects to the suction port (28) through the suction chamber (63); a brushbar (29) that is disposed in the suction chamber (63) that is rotatably supported by the cleaner-head body (32), and that has brush hairs (65) extending in a normal direction; an electric motor (31) contained in the cleaner-head body (32); a power transmission mechanism (51) that transmits drive force from the electric motor (31) to the brushbar (29); and a brush-hair dust-remover (55) that protrudes from the inner wall face (71) of the suction chamber (63) to be in contact with the brush hairs (65) and restricts air sucked into the relay pipe (66).

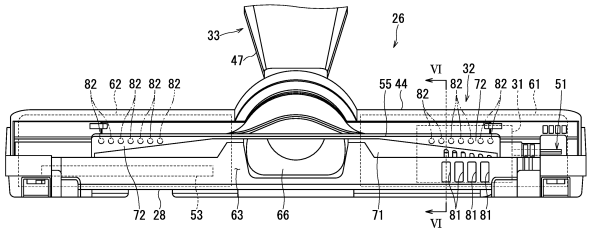

FIG. 5

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Description

FIELD

[0001] Embodiments according to the present invention relate to a cleaner head and an electric vacuum cleaner.

BACKGROUND

[0002] A known cleaner head includes a roller brushbar. This roller brushbar includes a brush base and a cloth blade that is provided on the outer peripheral face of the brush base, and the tip of the cloth blade is folded back and protrudes along the radial direction of the roller brushbar. A hole is provided at the tip of the cloth blade. The tip of the brush protrudes from the hole of the cloth blade toward the outside of the cloth blade.

[0003] In the above-described conventional cleaner head, the cloth blade provided as a cleaning member prevents dust from entering the root of the brush and winding around the roller brushbar.

Prior Art Document

Patent Document

[0004] [Patent Document 1] JP 2005-087644 A

SUMMARY

Problems to be solved by Invention

[0005] Although the cloth blade of the conventional cleaner head prevents dust from entering the base of the brush and winding around the roller brushbar, the conventional cleaner head cleans the surface to be cleaned (for example, the floor surface) in the state in which the dust is entangled with the brush.

[0006] Accordingly, it is an object of the present invention to provide a cleaner head and an electric vacuum cleaner, each of which can quickly remove dust having entered between the brush hairs of the roller brushbar using the rotation of the roller brushbar.

Means for solving Problem

[0007] To achieve the above object, a cleaner head includes: a cleaner-head body that includes a suction port disposed at a bottom face of the cleaner-head body, a suction chamber spatially connected with the suction port, and a discharge port spatially connected with the suction port through the suction chamber; a brushbar that is disposed in the suction chamber, is rotatably supported by the cleaner-head body, and is provided with plurality of brush hairs extending in a normal direction of the brushbar; an electric motor accommodated in the cleaner-head body; a power transmission mechanism that transmits driving force from the electric motor to the brushbar; and a brush-hair dust-remover that protrudes from an inner wall face of the suction chamber to be in contact with part of the plurality of brush hairs and restricts air to be sucked into the discharge port.

[0008] It may be desired that amount of the plurality of brush hairs is to such an extent that flow rate of air to be sucked into the discharge port is increased.

[0009] It may be desired that the brush-hair dust-remover has an arc-shaped contact surface that follows an external form of the brushbar.

[0010] It may be desired that the contact surface is an uneven surface.

[0011] It may be desired that the brush-hair dust-remover covers and blocks a portion of the discharge port that is far from the suction port.

[0012] It may be desired that the plurality of brush hairs have a coating of polytetrafluoroethylene.

[0013] It may be desired that the plurality of brush hairs include long brush hairs that have long legs and sequentially contacts the brush-hair dust-remover in association with rotation of the brushbar, and short brush hairs that have short legs and is spaced apart from the brush-hair dust-remover.

[0014] It may be desired that the brush-hair dust-remover is provided with a hole.

[0015] It may be desired that the cleaner-head body includes: a machine chamber that accommodates the electric motor; and a motor cooling-air vent that spatially connects the machine chamber with the suction chamber.

[0016] To achieve the above object, an electric vacuum cleaner including: a cleaner body; an electric blower accommodated in the cleaner body and configured to generate negative pressure; and the cleaner head to be fluidly connected to the electric blower.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

Fig. 1 is a perspective view of an electric vacuum cleaner according to one embodiment of the present invention.

Fig. 2 is a perspective view illustrating a cleaner head according to the embodiment of the present invention from the right front side.

Fig. 3 is a longitudinal cross-sectional view of the cleaner head according to the embodiment of the present invention.

Fig. 4 is a perspective view illustrating the cleaner head according to the embodiment of the present invention from the left front side.

Fig. 5 is a front view of the cleaner head according to the embodiment of the present invention.

Fig. 6 is another longitudinal cross-sectional view of the cleaner head according to the embodiment of the present invention.

DETAILED DESCRIPTION

[0018] Embodiments of a cleaner head and an electric vacuum cleaner according to the present invention will be described by referring to Fig. 1 to Fig. 6.

[0019] Fig. 1 is a perspective view of the electric vacuum cleaner according to the embodiment of the present invention.

[0020] As shown in Fig. 1, the electric vacuum cleaner 1 according to the present embodiment is a so-called canister type. The electric vacuum cleaner 1 includes: a cleaner body 2 that can travel on the surface to be cleaned; and a tubular part 3 that is attachable to and detachable from the cleaner body 2.

[0021] The cleaner body 2 includes: a housing 5; a pair of wheels 6 provided on the respective right and left sides of the housing 5; a detachable dust separator 7 disposed in the front half of the housing 5; an electric blower 8 accommodated in the rear half of the housing 5; a cleaner controller 9 mainly for controlling the electric blower 8, and a power cord 11 for feeding power to the electric blower 8.

[0022] The cleaner body 2 drives the electric blower 8 using the power to be supplied via the power cord 11. The negative pressure to be generated by driving the electric blower 8 acts on the tubular part 3. The electric vacuum cleaner 1 sucks in dust-containing air from the surface to be cleaned using the suction vacuum pressure acting on the tubular part 3, separates dust from the dust-containing air, collects and accumulates the dust after separation, and exhausts the clean air from which the dust has been removed.

[0023] In the front of the housing 5, a connection port 12 is provided. The connection port 12 is a fluid inlet of the cleaner body 2. The connection port 12 has a joint structure to which the tubular part 3 can be attached and from which the tubular part 3 can be detached. The connection port 12 fluidly connects the tubular part 3 to the dust separator 7.

[0024] The wheels 6 are large-diameter traveling wheels that support the cleaner body 2. The cleaner body 2 includes casters (not shown) provided on the bottom of the housing 5 in addition to the wheels 6.

[0025] The dust separator 7 separates, collects, and accumulates the dust from the dust-containing air flowing into the cleaner body 2 while sending the dust-removed clean air to the electric blower 8. The dust separator 7 accumulates dust using a filter for filtering and collecting dust or using inertial separation such as centrifugal separation (i.e., cyclone separation) and straight-flow type separation (i.e., separation method in which dust and air are separated by difference in inertia force between dust and air flowing straight).

[0026] The electric blower 8 sucks in air from the dust separator 7 so as to generate negative pressure (i.e., suction vacuum pressure).

[0027] The cleaner controller 9 includes a microprocessor (not shown) and a storage device (not shown) for storing, for example, various operation programs to be executed using the microprocessor and parameters of these operation programs. The storage device stores a plurality of operation modes to be set in advance. The plurality of operation modes to be set in advance correspond to a user's input to be received using the tubular part 3. Different input values (i.e., input values of the electric blower 8) are set for the respective operation modes. In response to the user's input received using the tubular part 3, the cleaner controller 9 alternatively selects the operation mode corresponding to the input received using the tubular part 3 from among the plurality of preset operation modes. The cleaner controller 9 reads out setting contents of the selected operation mode from the storage device so as to drive the electric blower 8 on the basis of the setting contents having been read out.

[0028] The power cord 11 supplies power to the cleaner body 2 from a plug-in connector for wiring (not shown, so-called AC outlet, socket). A plug 14 is provided at the free end of the power cord 11.

[0029] The tubular part 3 sucks in dust-containing air from the surface to be cleaned by the negative pressure that acts from the cleaner body 2, and sends the inhaled dust-containing air to the cleaner body 2. The tubular part 3 is provided with: a connecting tube 19 as a joint detachably connected to the connection port 12 of the cleaner body 2; a dust collecting hose 21 fluidly connected to the connecting tube 19; a hand operation tube 22 fluidly connected to the dust collecting hose 21; a grip 23 protruding from the hand operation tube 22; an input unit 24 provided on the grip 23; an extension tube 25 detachably connected to the hand operation tube 22; and a cleaner head 26 detachably connected to the extension tube 25.

[0030] The connecting tube 19 is fluidly connected to the dust separator 7 through the connection port 12.

[0031] The dust collecting hose 21 is a long, flexible, and substantially cylindrical hose. One end (i.e., the rear end in this case) of the dust collecting hose 21 is fluidly connected to the connecting tube 19. The dust collecting hose 21 is fluidly connected to the dust separator 7 through the connecting tube 19.

[0032] The hand operation tube 22 has an air passage that connects the dust collecting hose 21 and the extension tube 25. One end (i.e., the rear end in this case) of the hand operation tube 22 is fluidly connected to the other end (i.e., the front end in this case) of the dust collecting hose 21. The hand operation tube 22 is fluidly connected to the dust separator 7 sequentially through the dust collecting hose 21 and the connecting tube 19.

[0033] The grip 23 is a portion to be gripped by a user's hand for operating the electric vacuum cleaner 1. The grip 23 protrudes from the hand operation tube 22 in an appropriate shape that can be readily grasped by the user's hand.

[0034] The input unit 24 includes at least one switch that receives an operation selected from the plurality of operation modes. Specifically, the input unit 24 includes: a stop switch 24a for receiving the operation of stopping

the electric blower 8; and a start switch 24b for receiving the operation of starting the electric blower 8. The stop switch 24a and the start switch 24b are electrically connected to the cleaner controller 9. A user of the electric vacuum cleaner 1 can operate the input unit 24 to alternatively select one of the operation modes of the electric blower 8. The start switch 24b also functions as a selection switch of the operation modes during operation of the electric blower 8. Each time the cleaner controller 9 receives an operation signal from the start switch 24b during operation of the electric blower 8, the cleaner controller 9 switches the operation mode in order of strong → medium → weak → strong → .... Instead of the start switch 24b, the input unit 24 may be individually provided with a plurality of operation-mode selection switches, for example, a weak-operation-mode switch (not shown), a medium-operation-mode switch (not shown), and a strong-operation-mode switch (not shown).

[0035] The extension tube 25 has a telescopic structure in which a plurality of tubular bodies are overlaid, and is an elongated cylindrical tube that can be expanded and contracted. A joint structure is provided at one end (i.e., the rear end in this case) of the extension tube 25, and this joint structure is attachable to and detachable from the other end (i.e., the front end in this case) of the hand operation tube 22. The extension tube 25 is fluidly connected to the dust separator 7 sequentially through the hand operation tube 22, the dust collecting hose 21, and the connecting tube 19.

[0036] The cleaner head 26 can run or slide on the surface to be cleaned such as a wooden floor or a carpet. The cleaner head 26 includes a suction port 28 on its bottom face opposed to the surface to be cleaned in a running state or a sliding state. In addition, the cleaner head 26 includes: a rotatable brushbar (i.e., roller brushbar, rotatable brush, brush roller) 29 disposed at the suction port 28; and an electric motor 31 for rotationally driving the brushbar 29. A joint structure is provided on one end (i.e., the rear end in this case) of the cleaner head 26, and this joint structure is attachable to and detachable from the other end (i.e., the front end in this case) of the extension tube 25. This joint structure is a universal joint. The cleaner head 26 is fluidly connected to the dust separator 7 sequentially through the extension tube 25, the hand operation tube 22, the dust collecting hose 21, and the connecting tube 19. That is, the cleaner head 26, the extension tube 25, the hand operation tube 22, the dust collecting hose 21, the connecting tube 19, and the dust separator 7 constitute a suction air-passage from the electric blower 8 to the suction port 28.

[0037] When the electric vacuum cleaner 1 receives the user's operation using the start switch 24b under the state where the electric blower 8 is stopped, the electric vacuum cleaner 1 starts the electric blower 8. For example, when the start switch 24b is operated under the state where the electric blower 8 is stopped, first, the electric vacuum cleaner 1 starts the electric blower 8 in the strong operation mode. When the start switch 24b is operated again in the strong operation mode, the electric vacuum cleaner 1 drives the electric blower 8 in the medium operation mode. When the start switch 24b is operated three times, the electric vacuum cleaner 1 drives the electric blower 8 in the weak operation mode. In this manner, every time the start switch 24b is operated, the above-described switching of the operation modes is repeated. The strong operation mode, the medium operation mode, and the weak operation mode are operation modes to be set in advance. The input value to the electric blower 8 is small in the order of the strong operation mode, the medium operation mode, and the weak operation mode. The electric blower 8 having started up sucks in air from the dust separator 7 so as to reduces the pressure inside of the dust separator 7 into a negative pressure (i.e., suction vacuum pressure).

[0038] The negative pressure acting on the dust separator 7 acts on the suction port 28 sequentially through the connection port 12, the connecting tube 19, the dust collecting hose 21, the hand operation tube 22, the extension tube 25, and the cleaner head 26. The electric vacuum cleaner 1 sucks in the dust on the surface to be cleaned together with the air by the negative pressure acting on the suction port 28 so as to clean the surface to be cleaned. The dust separator 7 separates and accumulates dust from the dust-containing air having been sucked into the electric vacuum cleaner 1, and sends the dust-separated clean air to the electric blower 8. The electric blower 8 exhausts the air sucked in from the dust separator 7 to the outside of the cleaner body 2.

[0039] Next, the cleaner head 26 will be described in detail.

[0040] Fig. 2 is a perspective view illustrating the cleaner head according to the embodiment of the present invention from the right front side.

[0041] As shown in Fig. 2, the cleaner head 26 according to the present embodiment includes: a substantially rectangular parallelepiped cleaner-head body 32; and a connecting tube 33 provided at the rear of the cleaner-head body 32.

[0042] In the following, directional terms including front, rear, right, left, upper, and lower are described based on the viewpoint of the user of the electric vacuum cleaner 1. The direction of the solid arrow X in Fig. 2 indicates the front or the forward direction of the cleaner head 26, and the opposite direction is the rear or the backward direction. Additionally, the direction of the solid arrow Y in Fig. 2 indicates the leftward of the cleaner head 26, and the opposite direction indicates the rightward. Further, the direction of the solid arrow Z in Fig. 2 indicates the upward of the cleaner head 26, and the opposite direction indicates the downward.

[0043] The cleaner-head body 32 has a longer width dimension (i.e., right-left dimension) than its depth dimension (i.e., front-rear dimension). In other words, the cleaner-head body 32 has a short side in the front-rear direction and a long side in the right-left direction. The cleaner-head body 32 includes: a box-shaped lower cas-

ing 41 that is opened upward; and an upper casing 42 that covers the lower casing 41. The upper casing 42 includes: an upper front casing 43 disposed on the front side; and an upper rear casing 44 disposed on the rear side.

[0044] At the rear of the cleaner-head body 32, the connecting tube 33 is disposed at the approximately central portion in the width direction of the cleaner-head body 32. The connecting tube 33 includes: a rotatable connecting tube portion 46 that rotatably provided with the cleaner-head body 32; and a swingable connecting tube portion 47 that swingably provided with the rotatable connecting tube portion 46.

[0045] The rotatable connecting tube portion 46 rotates around an axis along the front-rear direction of the cleaner head 26 (i.e., rotates around the X-axis or around an axis parallel to the X-axis)

[0046] The swingable connecting tube portion 47 swings around an axis orthogonal to the rotating axis (i.e., the X-axis or the axis parallel to the X-axis) of the rotatable connecting tube portion 46. The free end of the swingable connecting tube portion 47 is a joint that can be attached to and detached from the free end of the extension tube 25.

[0047] Fig. 3 is a longitudinal cross-sectional view of the cleaner head according to the embodiment of the present invention.

[0048] Fig. 4 is a perspective view illustrating the cleaner head according to the embodiment of the present invention from the left front side.

[0049] Fig. 5 is a front view of the cleaner head according to the embodiment of the present invention.

[0050] In Fig. 4 and Fig. 5, the upper casing 42, the brushbar 29, and a belt (not shown) of a power transmission mechanism 51 are omitted.

[0051] As shown in Fig. 3 and Fig. 4, the cleaner head 26 according to the present embodiment includes: the cleaner-head body 32, the brushbar 29 rotatably supported by the cleaner-head body 32; the electric motor 31 accommodated in the cleaner-head body 32; a cleaner-head controller 53, and a brush-hair dust-remover 55.

[0052] The lower casing 41 and the upper rear casing 44 of the cleaner-head body 32 partition most of the machine chamber 61, in which the electric motor 31 is accommodated, and the control chamber 62, in which the cleaner-head controller 53 is accommodated. The lower casing 41, the upper front casing 43, and the upper rear casing 44 partition a suction chamber 63 in which the brushbar 29 is accommodated. In other words, the lower casing 41 partitions the lower half of the suction chamber 63 in which the brushbar 29 is accommodated, the lower half of the machine chamber 61 in which the electric motor 31 is accommodated, and the lower half of the control chamber 62 in which the cleaner-head controller 53 is accommodated. The upper rear casing 44 partitions most of the upper half of the machine chamber 61 and the upper half of the control chamber 62, and closes the upper portion of most of the machine chamber 61 and the upper portion of the control chamber 62. The upper front casing 43 and the upper rear casing 44 partition the upper half of the suction chamber 63 and close the upper portion of the suction chamber 63. The upper front casing 43 corresponds to the outer wall of the suction chamber 63. The upper rear casing 44 separates the upper half of the suction chamber 63 from the upper half of the machine chamber 61, and separates the upper half of the suction chamber 63 from the upper half of the control chamber 62. The upper rear casing 44 has a part of an inner wall face 71 of the suction chamber 63.

[0053] The suction chamber 63 is partitioned in the front half of the cleaner-head body 32. The suction chamber 63 extends in the width direction of the cleaner-head body 32. The suction chamber 63 communicates with the suction port 28 that is disposed on the bottom face of the cleaner-head body 32. In other words, the suction chamber 63 is opened toward the lower side of the cleaner-head body 32 through the suction port 28.

[0054] The machine chamber 61 extends from the left half of the rear half to the left side of the cleaner-head body 32. In other words, the machine chamber 61 surrounds the rear left half and the left side of the suction chamber 63. A portion of the machine chamber 61 located on the left side of the suction chamber 63 is partitioned using the upper front casing 43 and the lower casing 41.

[0055] The control chamber 62 is disposed in the right half of the rear half of the cleaner-head body 32.

[0056] The brushbar 29 is disposed in the suction chamber 63. The rotation centerline of the brushbar 29 is directed in the width direction of the cleaner-head body 32. The brushbar 29 includes a bar-shaped base 64 and brush hairs 65 extending in the normal direction of the brushbar 29. The base 64 corresponds to the axis of the brushbar 29. The brush hairs 65 include a plurality of brushes extending in the longitudinal direction of the brushbar 29 and are arranged radially in the circumferential direction of the brushbar 29. Each of the brush hairs 65 extends radially from the base 64 in the normal direction of the base 64. Further, the brush hairs 65 are arranged in a spiral shape in the longitudinal direction of the base 64.

[0057] The electric motor 31 is disposed in a portion of the machine chamber 61 located on the rear portion of the suction chamber 63. The electric motor 31 includes an output shaft (not shown) that protrudes toward the inner face of the left side-wall of the cleaner-head body 32. The rotation centerline of the output shaft is substantially parallel to the rotation centerline of the brushbar 29. The electric motor 31 rotates the brushbar 29 in the direction of assisting the forward movement of the cleaner head 26 (solid arrow r in Fig. 3).

[0058] The cleaner-head controller 53 operates the electric motor 31 using the power to be supplied from the cleaner body 2 through the connecting tube 19, the dust collecting hose 21, the hand operation tube 22, and the extension tube 25.

[0059] The cleaner head 26 includes: a relay tube 66

that fluidly connects the suction chamber 63 and the connecting tube 33 (more specifically, the rotatable connecting tube portion 46); a motor support (not shown) that floatingly supports the electric motor 31 on the cleaner-head body 32; a drive gear (not shown) fixed to the output shaft (not shown) of the electric motor 31; a driven gear (not shown) provided on the brushbar 29; and an endless belt (not shown) that is wound around the drive gear and the driven gear and transmits the driving force from the electric motor 31 to the brushbar 29. The drive gear, the driven gear, and the belt are included in the power transmission mechanism 51.

[0060] The relay tube 66 is a discharge port that is spatially connected with the suction port 28 through the suction chamber 63. The relay tube 66 is disposed at the rear center of the suction chamber 63, i.e., between the machine chamber 61 and the control chamber 62. The relay tube 66 separates the machine chamber 61 from the control chamber 62.

[0061] The brush-hair dust-remover 55 protrudes from the inner wall face 71 of the suction chamber 63 so as to contact the brush hairs 65 of the brushbar 29, and restricts the air to be sucked into the relay tube 66. The brush-hair dust-remover 55 is provided integrally with the upper rear casing 44. The brush-hair dust-remover 55 contacts substantially the entire width of the brushbar 29.

[0062] The brush-hair dust-remover 55 has an arc-shaped contact surface 72 (Fig. 6) that follows the external form of the brushbar 29. The contact surface 72 according to the present embodiment becomes narrower from the right and left sides of the suction chamber 63 toward the relay tube 66 such that its contact distance becomes shorter at a position closer to the relay tube 66 in the width direction of the brushbar 29. Note that the contact surface 72 may have a uniform contact distance in the width direction of the brushbar 29. Further, the contact surface 72 may have an uneven portion 73 (two-dot chain line in Fig. 6).

[0063] As shown in Fig. 3, when the cleaner head 26 is disposed on the surface to be cleaned (i.e., cleaning target surface) and the brushbar 29 is in contact with the cleaning target surface f, the suction chamber 63 is divided into a first space 75 that is spatially connected with the relay tube 66 and the second space 76 that is isolated from the relay tube 66. The first space 75 is partitioned using the cleaning target surface f, the brushbar 29, the inner wall of the suction chamber 63, and the brush-hair dust-remover 55. The second space 76 is, on the one hand, partitioned using the cleaning target surface f, the brushbar 29, the inner wall of the suction chamber 63, and the brush-hair dust-remover 55. On the other hand, the second space 76 is separated from the relay tube 66 using the contact portion a between the brushbar 29 and the cleaning target surface f and the contact portion b between the brushbar 29 and the brush-hair dust-remover 55.

[0064] That is, the cleaner head 26 restricts the air to be sucked into the relay tube 66 from the side of the second space 76 using the contact portion b between the brushbar 29 and the brush-hair dust-remover 55 in addition to the contact portion a between the brushbar 29 and the cleaning target surface f.

[0065] The brush-hair dust-remover 55 covers and blocks a portion of the relay tube 66 far from the suction port 28. The brush-hair dust-remover 55 reliably separates the first space 75 and the second space 76 of the suction chamber 63 by covering and blocking the above-described portion of the relay tube 66 far from the suction port 28. The brush-hair dust-remover 55 substantially covers and hides the upper half of the relay tube 66 in front view.

[0066] The brushbar 29 has a sufficient amount of brush hairs 65 for increasing the flow rate of the air to be sucked into the relay tube 66 through the gaps between the brush hairs 65 contacting the brush-hair dust-remover 55. That is, the brush hairs 65 may be provided continuously (densely) or discontinuously (diffusely) in both the circumferential direction and the width direction (i.e., longitudinal direction) of the brushbar 29. It is sufficient if the amount of the brush hairs 65 is large enough to reduce the airflow in the entire width of the brush-hair dust-remover 55 by bringing the brush hairs 65 into contact with the brush-hair dust-remover 55. That is, the plurality of brush hairs 65 may be substantially integrated around the brushbar 29, may be spirally wound around the brushbar 29, or may extend linearly in the width direction of the brushbar 29.

[0067] The brush hairs 65 may have a coating of polytetrafluoroethylene (i.e., PTFE or so-called Teflon (registered trademark)) such that the attached dust can be readily removed. The brush hairs 65 includes: long brush hairs 78 that have long legs and sequentially contact the brush-hair dust-remover 55 in association with rotation of the brushbar 29; and non-contact short brush hairs 79 that have short hair legs and are spaced apart from the brush-hair dust-remover 55.

[0068] The long brush hairs 78 strongly wipe a hard surface to be cleaned such as flooring, and removes fine dust adhering to the surface. From the viewpoint of the load of rotating the brushbar 29, the length of the leg of long brush hairs 78 is preferably as short as possible within the range where long brush hairs 78 contact the brush-hair dust-remover 55.

[0069] The short brush hairs 79 wipe the dust out of the cleaning target surface, where the surface is soft like a carpet and the dust tends to get in between the carpet hairs. From the viewpoint of restricting the air flowing between the first space 75 and the second space 76 as much as possible, the length of the leg of short brush hairs 79 is preferably as long as possible within the range where the each short brush hair 79 does not contact the brush-hair dust-remover 55.

[0070] Fig. 6 is a longitudinal cross-sectional view of the cleaner head according to the embodiment of the present invention, taken along the line VI-VI in Fig. 5.

[0071] As shown in Fig. 6 in addition to Fig. 4 and Fig.

5, the cleaner-head body 32 includes a plurality of motor cooling-air vents 81 that spatially connect the machine chamber 61 with the suction chamber 63.

[0072] The motor cooling-air vents 81 spatially connect the first space 75 of the suction chamber 63 with the machine chamber 61. The motor cooling-air vents 81 exhaust the air, which is in the machine chamber 61 and has cooled the electric motor 31, from the periphery of the electric motor 31 to the suction chamber 63. The motor cooling-air vents 81 are slit-shaped openings extending up and down the cleaner head 26. The motor cooling-air vents 81 are arranged in the width direction of the suction chamber 63 along the electric motor 31.

[0073] It is sufficient that the motor cooling-air vents 81 are provided in at least one of the lower casing 41 and the upper rear casing 44. In the present embodiment, the motor cooling-air vents 81 are provided in both the lower casing 41 and the upper rear casing 44.

[0074] Note that the brush-hair dust-remover 55 may be provided with a hole 82 (two-dot chain line in Fig. 5 and Fig. 6). A plurality of holes 82 may be provided in the width direction of the cleaner-head body 32. The holes 82 spatially connect the first space 75 with the second space 76 of the suction chamber 63. The cleaner head 26 can adjust the amount of air leakage at the contact portion between the brushbar 29 and the brush-hair dust-remover 55 by the number and size of the holes 82 (i.e., by the total opening area of the holes 82). The amount of air leakage at the contact portion between the brushbar 29 and the brush-hair dust-remover 55 adjusts the flow rate of the airflow carrying the dust, which is scraped from the brush hairs 65 by the brush-hair dust-remover 55, to the relay tube 66.

[0075] The cleaner head 26 drives the electric motor 31 to rotate the brushbar 29. The brushbar 29 in the rotating motion causes the brush-hair dust-remover 55 to sequentially contact the brush hairs 65, in particular, the long brush hairs 78. The brush-hair dust-remover 55 beats the fine dust, which is adhered to the long brush hairs 78 after being wiped from the surface to be cleaned, out of the long brush hairs 78. In this case, the first space 75 and the second space 76 of the suction chamber 63 are separated by the long brush hairs 78 in contact with the brush-hair dust-remover 55, which increases the flow rate of the air to be sucked from the second space 76 into the first space 75 consequently. This airflow strongly causes the dust beaten out of the long brush hairs 78 to flow into the relay tube 66.

[0076] Since the brushbar 29 rotates in the direction that assists the forward movement of the cleaner head 26 (solid arrow r in Fig. 3), the dust adhered to the long brush hairs 78 is beaten off exclusively into the first space 75 when the long brush hairs 78 contact the brush-hair dust-remover 55. The dust beaten off into the first space 75 is caused to strongly flow into the relay tube 66.

[0077] Note that the brushbar 29 may rotate in the direction that assists the backward movement of the cleaner head 26 (i.e., in the direction opposite to the solid arrow r in Fig. 3). In this case, when the long brush hairs 78 contact the brush-hair dust-remover 55, the dust adhered to the long brush hairs 78 is beaten off exclusively into the second space 76. The dust beaten off into the second space 76 is caused to strongly flow into the relay tube 66 through the gaps between the brush hairs 65 in contact with the brush-hair dust-remover 55 or through the gaps resulted from the brush hairs 65 moving away from the brush-hair dust-remover 55.

[0078] As described above, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the brush-hair dust-remover 55 that contacts the brush hairs 65 and restricts the air to be sucked into the relay tube 66. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 beat off the dust adhered to the brush hairs 65 (i.e., the dust that got into the brush hairs 65) and quickly move away the dust, which has been beaten out of the brush hairs 65, by the airflow having a higher flow rate than the surroundings. In other words, the cleaner head 26 and the electric vacuum cleaner 1 reliably prevent the dust beaten out of the brush hairs 65 from reattaching to the brush hairs 65.

[0079] In addition, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include a sufficient amount of brush hairs 65 for increasing the flow rate of the air to be sucked into the relay tube 66. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 reliably generate strong airflow for quickly moving the dust, which has been beaten out of the brush hairs 65, away from the brush hairs 65.

[0080] Further, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the brush-hair dust-remover 55 having an arc-shaped contact surface 72 that follows the external form of the brushbar 29. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 restrict the air to be sucked into the relay tube 66, and more reliably generate the strong airflow for quickly moving the dust, which has been beaten out of the brush hairs 65, away from the brush hairs 65.

[0081] Moreover, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the contact surface 72 provided with the uneven portion 73. The uneven portion 73 repels the brush hairs 65 plural times while the brush hairs 65 pass through the contact surface 72, and more reliably beats off the dust adhered to the brush hairs 65 (i.e., dust having entered the brush hairs 65).

[0082] Furthermore, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the brush-hair dust-remover 55 that covers and blocks the portion of the relay tube 66, which portion is far from the suction port 28. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 concentrate the air flowing from the suction port 28 into the relay tube 66 such that this air directly flows from the cleaning target surface f into the relay tube 66 through the first space 75, and thereby reduce the airflow flowing into the relay

tube 66 by bypassing the second space 76 so as to enhance its suction force.

[0083] Additionally, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the brush hairs 65 having a polytetrafluoroethylene coating. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 readily beat off dust when the brush hairs 65 are brought into contact with the brush-hair dust-remover 55.

[0084] Further, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include: the long brush hairs 78 that sequentially contact the brush-hair dust-remover 55 in association with rotation of the brushbar 29; and the short brush hairs 79 that is spaced apart from the brush-hair dust-remover 55. Consequently, as compared with the case where the brush hairs 65 are always in contact with the brush-hair dust-remover 55, the cleaner head 26 and the electric vacuum cleaner 1 can suppress the load of the electric motor 31 that rotationally drives the brushbar 29.

[0085] Moreover, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the brush-hair dust-remover 55 provided with the holes 82. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 can adjust the degree of speed-up of the airflow, which is accelerated around the brush-hair dust-remover 55, by the opening area of the holes 82 and by the gaps between the brush hairs 65.

[0086] Furthermore, the cleaner head 26 and the electric vacuum cleaner 1 according to the present embodiment include the motor cooling-air vents 81 that spatially connect the machine chamber 61 with the suction chamber 63. Consequently, the cleaner head 26 and the electric vacuum cleaner 1 cool the electric motor 31, and introduce outside air into the first space 75 from other than the suction port 28 so as to cause the dust beaten out of the brush hairs 65 to flow into the relay tube 66.

[0087] Therefore, according to the cleaner head 26 and the electric vacuum cleaner 1 of the present embodiment, the dust having entered between the brush hairs 65 of the brushbar 29 can be quickly removed by the rotation of the brushbar 29.

[0088] Note that the electric vacuum cleaner 1 according to the present embodiment is not limited to the canister type but may be an upright type, a stick type, or a handy type.

[0089] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Reference Signs List

[0090]

1	electric vacuum cleaner
2	cleaner body
3	tubular part
5	housing
6	wheel
7	dust separator
8	electric blower
9	cleaner controller
11	power cord
12	connection port
14	attachment plug
19	connecting tube
21	dust collecting hose
22	hand operation tube
23	grip
24	input unit
24a	stop switch
24b	start switch
25	extension tube
26	cleaner head
28	suction port
29	brushbar
31	electric motor
32	cleaner-head body
33	connecting tube
41	lower casing
42	upper casing
43	upper front casing
44	upper rear casing
46	rotatable connecting tube portion
47	swingable connecting tube portion
51	power transmission mechanism
53	cleaner-head controller
55	brush-hair dust-remover
61	machine chamber
62	control chamber
63	suction chamber
64	base
65	brush hair
66	relay tube
71	inner wall face
72	contact surface
73	uneven portion
75	first space
76	second space
78	long brush hair
79	short brush hair
81	motor cooling-air vent
82	hole

Claims

1. A cleaner head comprising:

a cleaner-head body that includes a suction port disposed at a bottom face of the cleaner-head body, a suction chamber spatially connected with the suction port, and a discharge port spatially connected with the suction port through the suction chamber;
a brushbar that is disposed in the suction chamber, is rotatably supported by the cleaner-head body, and is provided with plurality of brush hairs extending in a normal direction of the brushbar;
an electric motor accommodated in the cleaner-head body;
a power transmission mechanism that transmits driving force from the electric motor to the brushbar; and
a brush-hair dust-remover that protrudes from an inner wall face of the suction chamber to be in contact with part of the plurality of brush hairs and restricts air to be sucked into the discharge port.

2. The cleaner head according to claim 1, wherein: amount of the plurality of brush hairs is to such an extent that flow rate of air to be sucked into the discharge port is increased.

3. The cleaner head according to claim 1 or claim 2, wherein the brush-hair dust-remover has an arc-shaped contact surface that follows an external form of the brushbar.

4. The cleaner head according to claim 3, wherein the contact surface is an uneven surface.

5. The cleaner head according to any one of claim 1 to claim 4, wherein the brush-hair dust-remover covers and blocks a portion of the discharge port that is far from the suction port.

6. The cleaner head according to any one of claim 1 to claim 5, wherein the plurality of brush hairs have a coating of polytetrafluoroethylene.

7. The cleaner head according to any one of claim 1 to claim 6, wherein: the plurality of brush hairs include long brush hairs that have long legs and sequentially contacts the brush-hair dust-remover in association with rotation of the brushbar, and short brush hairs that have short legs and is spaced apart from the brush-hair dust-remover.

8. The cleaner head according to any one of claim 1 to claim 7, wherein the brush-hair dust-remover is provided with a hole.

9. The cleaner head according to any one of claim 1 to claim 8, wherein the cleaner-head body includes: a machine chamber that accommodates the electric motor; and a motor cooling-air vent that spatially connects the machine chamber with the suction chamber.

10. An electric vacuum cleaner comprising:

a cleaner body;
an electric blower accommodated in the cleaner body and configured to generate negative pressure; and
the cleaner head according to any one of claim 1 to claim 9 to be fluidly connected to the electric blower.

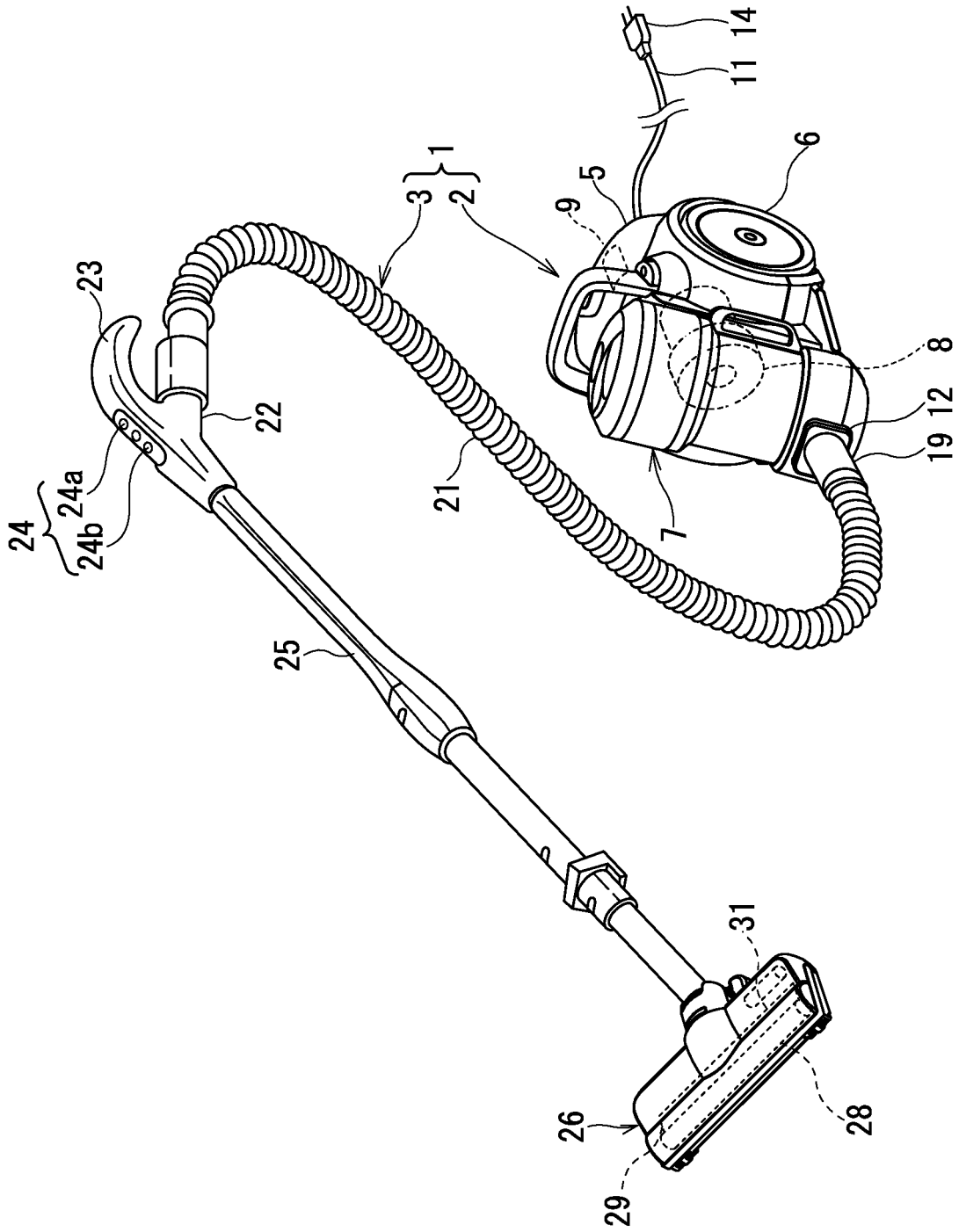

FIG. 1

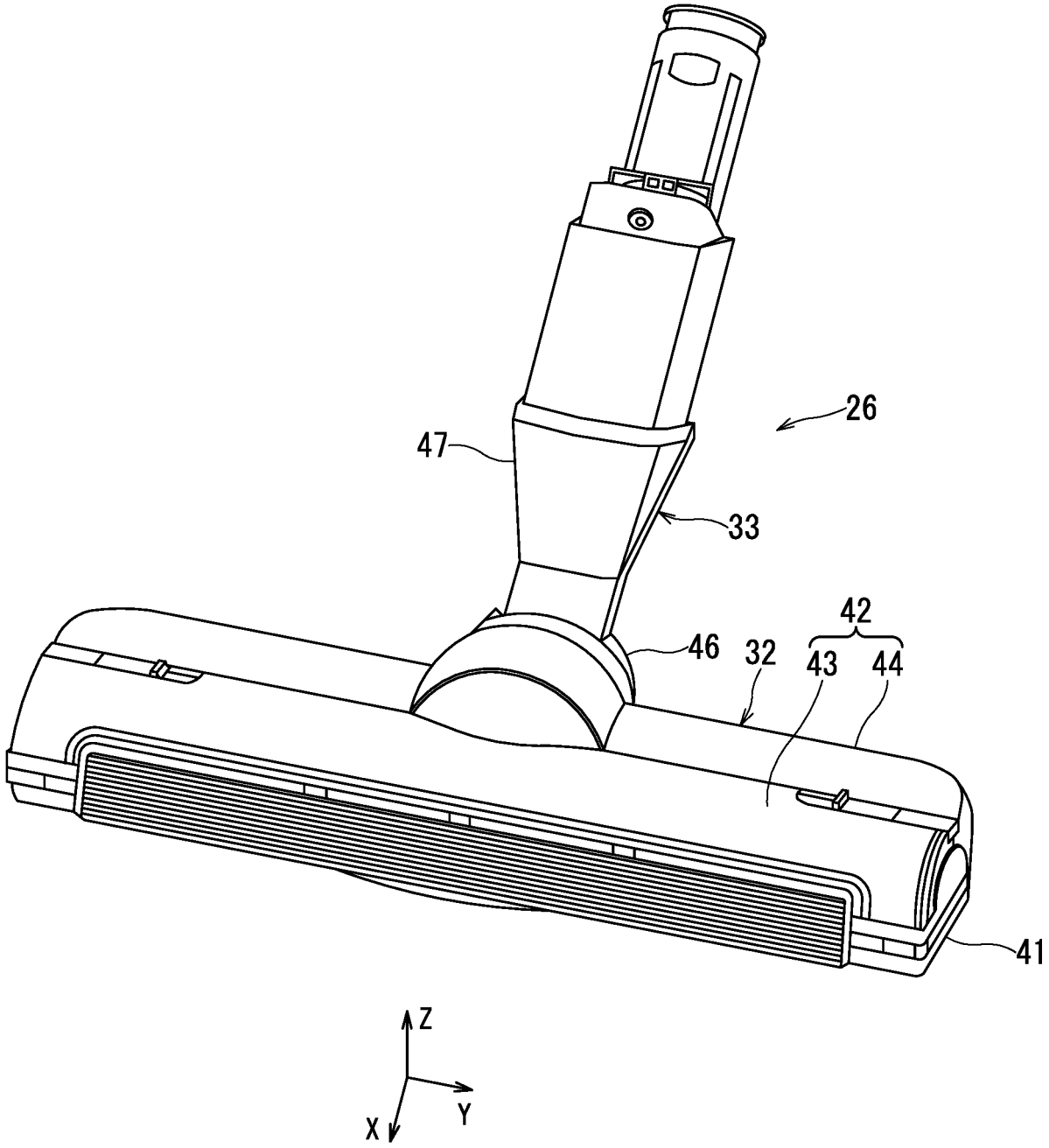

FIG. 2

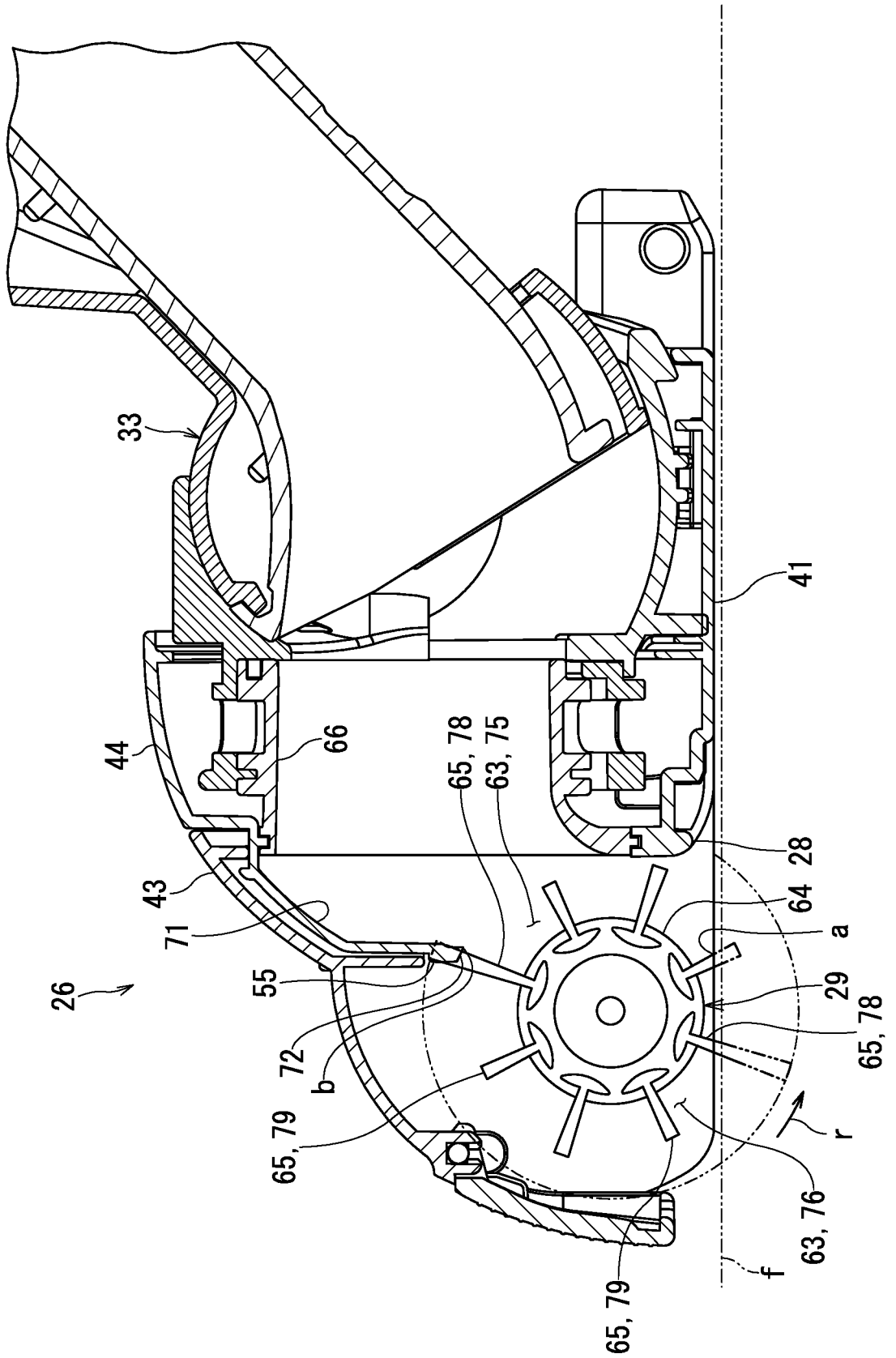
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FIG. 3

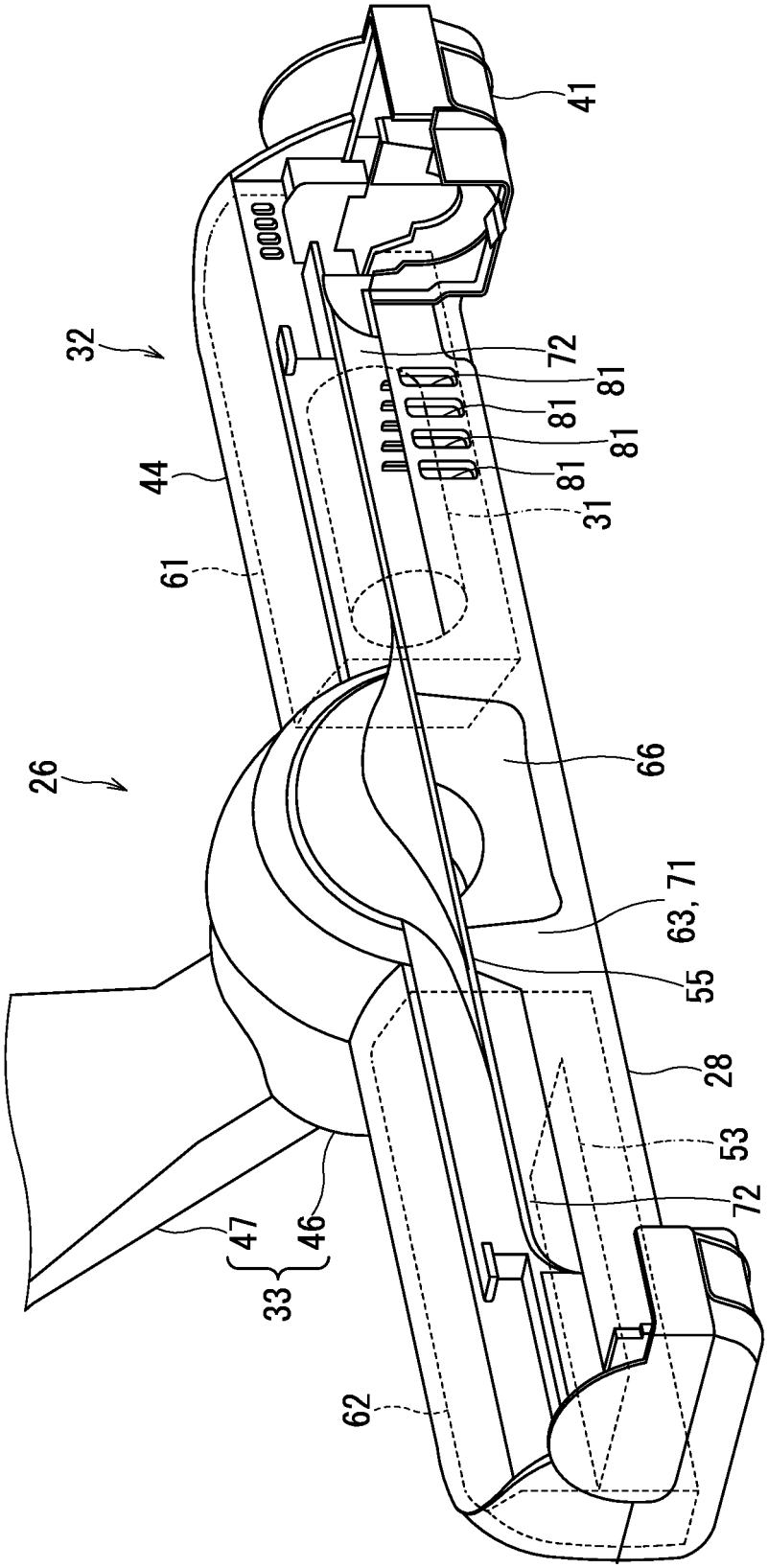

FIG. 4

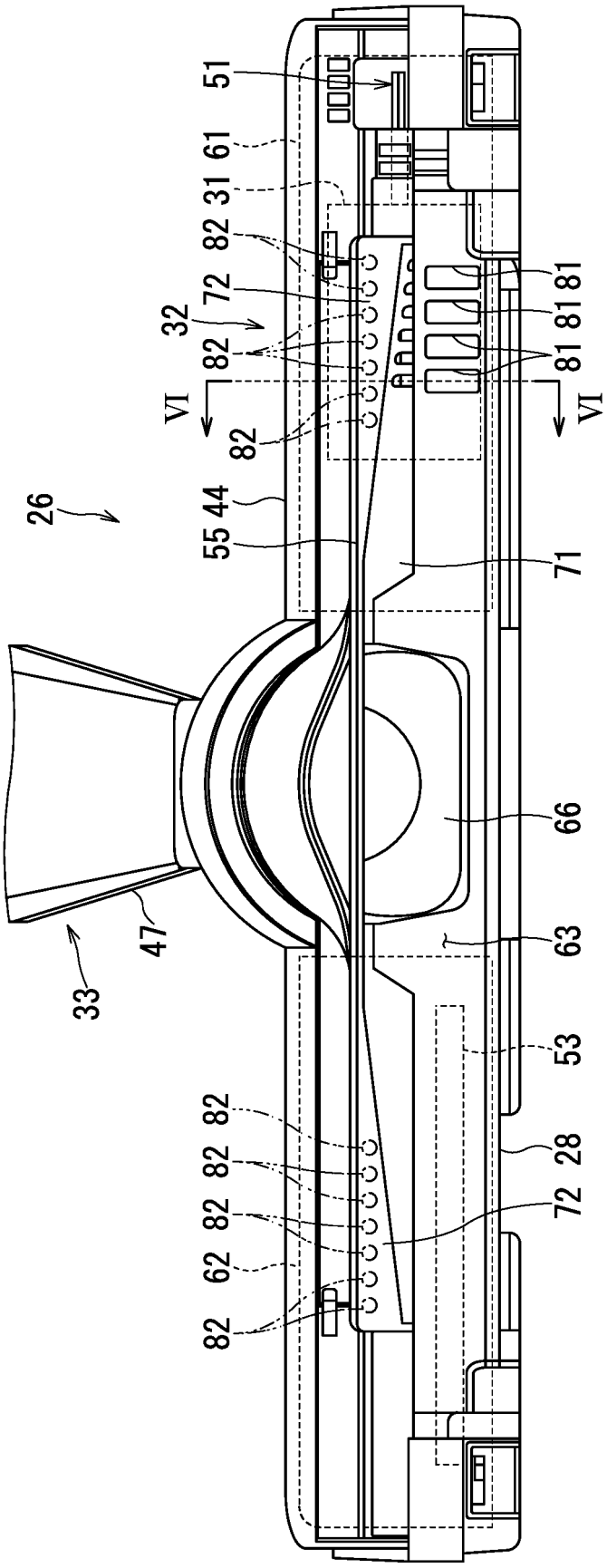
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FIG. 5

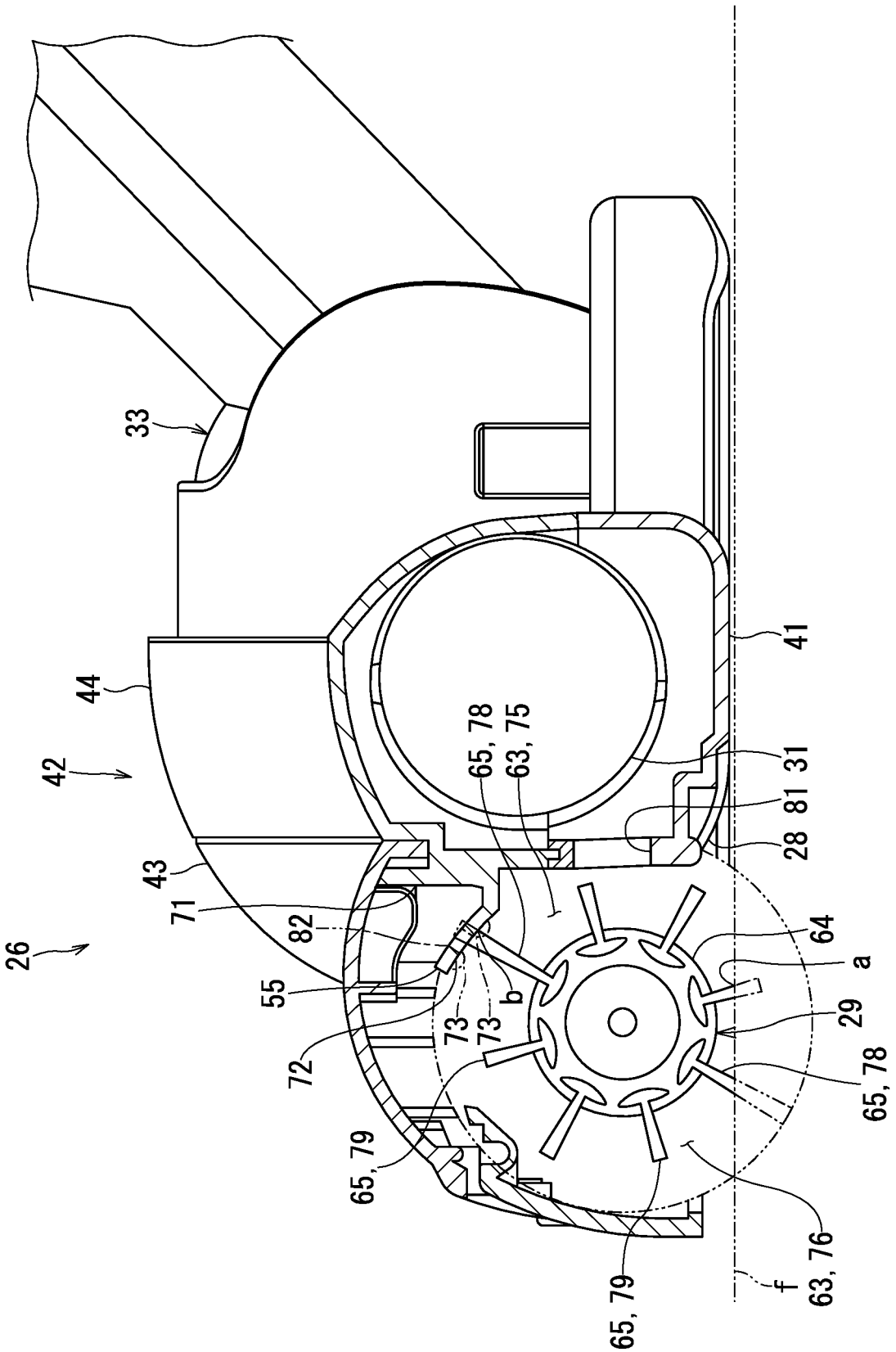
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FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/028603

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. A47L9/04(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)
Int.Cl. A47L9/04

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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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 2011-115542 A (MITSUBISHI ELECTRIC CORP.) 16 June 2011, paragraphs [0001], [0011], [0014], [0019], fig. 1-5 & US 2013/0042429 A1, paragraphs [0001], [0025]-[0026], [0034] & WO 2011/125580 A1 & TW 201201761 A & CN 102843946 A & NZ 601903 A & HK 1175082 A1	1, 6, 10 2-5, 7-9
Y A	JP 2017-394 A (SHARP CORP.) 05 January 2017, paragraphs [0001], [0020], [0051], fig. 10 & WO 2016/199456 A1 & CN 107613825 A	1, 6, 10 2-5, 7-9

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

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Date of the actual completion of the international search 24 August 2018 (24.08.2018)	Date of mailing of the international search report 04 September 2018 (04.09.2018)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/028603

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 2007-000465 A (TWINBIRD CORPORATION) 11 January 2007, paragraph [0023] & US 2006/0288521 A1, paragraph [0035] & EP 1736088 A2	1, 6, 10 2-5, 7-9
Y A	WO 2015/137241 A1 (KONICA MINOLTA, INC.) 17 September 2015, paragraphs [0041]-[0042] (Family: none)	6, 10 2-5, 7-9
Y A	JP 2005-230732 A (TSUCHIYA TSCO CO., LTD.) 02 September 2005, paragraph [0022] (Family: none)	6, 10 2-5, 7-9
A	WO 2014/140935 A2 (AKTIEBOLAGET, ELECTROLUX) 18 September 2014, paragraph [0028] & US 2009/0229075 A1, paragraphs [0030]-[0032], fig. 3A-3B & EP 2991533 A2 & KR 10-2016-0003656 A & CN 105338870 A	1-10
A	US 2016/0113458 A1 (CONET INDUSTRIES, INC.) 28 April 2016, paragraphs [0040]-[0104], fig. 1-10 & KR 10-1509737 B1	1-10

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