Description

SUCTION TOOL

Technical Field

[0001] The present invention relates to a suction tool attached to a suction-type cleaning device.

Background Art

[0002] Various suction tools attached to a suction-type cleaning device have been developed (see Patent Literature 1). A suction tool of Patent Literature 1 includes a case configured to define an internal space and a channel for air flowing from the internal space into the cleaning device, the internal space extending upward from a suction opening which is opened downward. The suction tool further includes a rotary cleaning body rotatably held in the internal space of the case. At a position facing the suction opening, the rotary cleaning body extends from a side of the case in the width direction of the suction tool. The rotary cleaning body tapers toward a position that is substantially the center in the extension direction of the rotary cleaning body.

[0003] When the case moves forward, the rotary cleaning body in the case rotates about an axis extending in the width direction of the case under a condition in contact with the floor surface. As a result of the rotation of the rotary cleaning body, dust on the floor surface is scraped off by the rotary cleaning body. At this time, however, long dust such as hair may wind around the rotary cleaning body. According to Patent Literature 1, since the rotary cleaning body tapers toward the position that is the approximate center in the extension direction of the rotary cleaning body, the long dust winds spirally around the rotary cleaning body. This prevents the long dust from winding around the rotary cleaning body at one portion of the rotary cleaning body in the extension direction of the rotary cleaning body. Accordingly, the dust winding spirally around the rotary cleaning body is sucked into the cleaning device by the suction force of the cleaning device.

[0004] The technique of Patent Literature 1 makes it possible to cause long dust to spirally wind around the rotary cleaning body. However, long dust does not always wind spirally around the rotary cleaning body. For example, in some cases, long dust may wind around the rotary cleaning body such that a part of the dust intersects another part of the dust. In this case, the dust is not sucked into the cleaning device. In other words, the dust may keep a condition of winding around the rotary cleaning body. At this position where dust winds around, the rotary cleaning body is less likely to come into contact with the floor surface, so that a cleaning function of the rotary cleaning body may be worsened. In order to regain the cleaning function of the rotary cleaning body, it may be necessary to remove dust which fails to be sucked into the cleaning device and keeping a condition of winding around the rotary cleaning body. In this case, a user has to cut the dust winding around the rotary cleaning body, using a cutting tool such as scissors or a cutter.

Citation List

Patent Literature

[0005] Patent Literature 1: JP 2011 -188951 A

Summary of Invention

[0006] An object of the present invention is to provide a suction tool configured to allow easy removal of long dust winding around a rotary cleaning body.

[0007] A suction tool according to one aspect of the present invention is configured to be attached to a suction-type cleaning device. The suction tool includes: a case configured to define an internal space between a pair of side walls disposed respectively at positions spaced away from each other in a left-to-right direction and a channel for air flowing from the internal space into the cleaning device on a rear wall, the internal space being configured to extend upward from a suction opening which is opened downward and allows dust to be sucked from the suction opening; a rotary cleaning body configured to extend laterally in the internal space and come in contact with a floor surface through the suction opening, the rotary cleaning body being configured to taper toward a distal end of the rotary cleaning body, and another rotary cleaning body including a proximal end connected to the other of the pair of side walls and being configured to extend laterally in the internal space and come in contact with the floor surface through the suction opening, the other rotary cleaning body being configured to taper toward a distal end of the other rotary cleaning body. The rotary cleaning body and the other rotary cleaning body are supported in a cantilever style by the case so that a space is formed between the distal ends of the rotary cleaning body and the other rotary cleaning body, the space being configured to allow dust winding around the rotary cleaning body and the other rotary cleaning body to be removed through the space.

[0008] The aforementioned suction tool allows easy removal of long dust winding around the rotary cleaning body.

[0009] The object, features, and advantages of the present invention will be made clear through the following detailed description and the accompanying drawings.

Brief Description of Drawings

[0010] FIG. 1 is a schematic side view of a cleaning device to which a suction tool according to the first embodiment is attached.

FIG. 2 is a schematic perspective view of the suction tool.

FIG. 3 is a schematic perspective view of the suction tool.

FIG. 4 is a schematic front view of the suction tool.

FIG. 5 is a schematic front view of a rotary cleaning body of the suction tool.

FIG. 6 is a schematic diagram of a scraping portion of the suction tool.

FIG. 7 is a schematic diagram of the rotary cleaning body.

FIG. 8 is a schematic front view of the rotary cleaning body.

FIG. 9 is a graph showing a relationship between a diameter of a core rod and a projection amount of the scraping portion.

FIG. 10 is a schematic perspective view of a suction tool of the second embodiment.

FIG. 11 is a schematic perspective view of the suction tool.

Description of Embodiments

[0011] <First Embodiment>

FIG. 1 is a schematic side view of a cleaning device 101 to which a suction tool 100 is attached. The cleaning device 101 is described with reference to FIG. 1.

[0012] FIG. 1 shows a vacuum cleaner as the cleaning device 101. The cleaning device 101 includes a main body 102 and a hose 103 extended from the main body 102, the main body 102 being configured to house a suction fan (not shown) and a motor (not shown) configured to drive the suction fan. The cleaning device 101 further includes an operation portion 104 situated at the midpoint of the hose 103. The suction tool 100 is connected to the distal end of the hose 103. The operation portion 104 is electrically connected to the main body 102 and the suction tool 100 by a cable extended along the hose 103. The operation portion 104 is configured to generate an instruction signal for actuating or stopping drive portions of the main body 102 and the suction tool 100 when the operation portion 104 receives a user's operation.

[0013] Schematic perspective views of the suction tool 100 are shown respectively as FIGS. 2 and 3. FIG. 2 mainly shows a lower part of the suction tool 100. FIG. 3 mainly shows an upper part of the suction tool 100. A schematic front view of the suction tool 100 is shown as FIG. 4. The suction tool 100 is described with reference to FIGS. 1 to 4.

[0014] The suction tool 100 includes a case 120 configured to define a suction opening 111 through which dust on a floor surface F is sucked, a connection portion 130 configured to connect the case 120 to the distal end of the hose 103, and two rotary cleaning bodies 141,142 configured to scrape dust off. The suction tool 100 further includes rollers 151 to 154 for assisting the suction tool 100 in moving in the front-to-rear direction. The suction opening 111 is a rectangular area that opens downward to face the floor surface F, the rectangular area being long in the left-to-right direction.

[0015] The case 120 has a hollow box structure that is long in the left-to-right direction, the structure being configured to define an internal space 112 extending upward from the suction opening 111. The internal space 112 is used as a space that allows air and dust to flow in, the rotary cleaning bodies 141,142 being placed in the internal space 112.

[0016] The case 120 includes a front wall 121, a rear portion 122, side portions 123,124, an upper wall 125, and a holding arm 126. The front wall 121, the rear portion 122, the side portions 123,124, and the upper wall 125 are a portion that defines the suction opening 111 and the internal space 112. The holding arm 126 is a portion that holds the rollers 153,154.

[0017] The front wall 121 is a portion standing in front of the internal space 112 and long in the left-to-right direction. On the lower edge of the front wall 121, three recesses 113 are recessed upward. These recesses 113 are formed at positions by which the lower edge of the front wall 121 is substantially divided equally in the longitudinal direction of the front wall 121.

[0018] The side portions 123,124 are situated at an interval in the width direction of the suction tool 100, so that the suction opening 111 and the internal space 112 are formed between these side portions 123,124. Each of the side portions 123,124 has a hollow structure. In the side portions 123,124, there are drive mechanisms for driving the rotary cleaning bodies 141,142 (e.g., motors

and drive belts), respectively. Driving sources for the drive mechanisms are electrically connected to the operation portion 104, respectively, so that the driving sources are actuated or stopped by an operation on the operation portion 104. The drive mechanisms have rotating shafts which project from the inner surfaces (i.e., the surfaces facing the internal space 112) of the side portions 123,124, and these rotating shafts are connected respectively to the rotary cleaning bodies 141,142.

[0019] On the rear end of the lower surface of each of the side portions 123,124, a recess 114 is formed. In the recess 114 of the side portion 123, the roller 151 is placed. In the recess 114 of the side portion 124, the roller 152 is placed. The side portions 123,124 hold the rollers 151,152 rotatably such that the rollers 151,152 partially project downward from the lower surfaces of the side portions 123,124.

[0020] The rear portion 122 is a portion situated behind the internal space 112 and long in the left-to-right direction. The lower surface of the rear portion 122 is substantially flush with the lower surfaces of the side portions 123,124. The inner surface (i.e., the surface facing the internal space 112) of the rear portion 122 is of a V shape projecting frontward in a bottom view. A distance between the inner surface of the rear portion 122 and the inner surface (i.e., the surface facing the internal space 112) of the front wall 121 is the shortest at a substantially center position of the internal space 112 in the left-to-right direction. A distance between the inner surfaces of the rear portion 122 and the front wall 121 gradually increases as it becomes closer to the side portions 123,124.

[0021] In the rear portion 122, a channel 116 extending in the front-to-rear direction is formed. A substantially rectangular opening end 115 of the channel 116 appears on the inner surface of the rear portion 122 and is opened frontward. The opening end 115 is formed substantially at the center of the inner surface of the rear portion 122 in the left-to-right direction. The channel 116 extends rearward from the opening end 115 and is connected to the connection portion 130. The channel 116 is used as a flow path through which air and dust flow from the internal space 112 into the cleaning device 101.

[0022] Inside the rear portion 122, there are two internal spaces isolated by the channel 116, the two internal spaces being formed on the right and left sides of the channel 116. These internal spaces are used to place the drive mechanisms for driving the rotary cleaning bodies 141,142.

[0023] The upper wall 125 is situated over the internal space 112, and forms the upper surface of the case 120. The upper surface of the case 120 is curved upward.

[0024] The connection portion 130 includes a holding portion 131 projecting rearward from the back surface of the rear portion 122 (i.e., the surface opposite to the inner surface of the rear portion 122) at a position that is substantially the center of the suction tool 100 in the left-to-right direction, and a connection tube 132 held by the holding portion 131 and configured to be pivoted vertically. The holding portion 131 has a tubular structure of which upper part is cut out. The distal end of the connection tube 132 is inserted into the holding portion 131 and held by the holding portion 131, the connection tube 132 being allowed to pivot vertically. The rear end of the connection tube 132 is

connectable to the distal end of the hose 103. An internal space in the connection tube 132 communicates with the channel 116 formed in the rear portion 122.

[0025] The holding arm 126 is a substantially U-shaped portion that extends from the back surface of the rear portion 122 to surround a lower part of the holding portion 131. The lower surface of the holding arm 126 is substantially flush with the lower surfaces of the side portions 123,124 and the rear portion 122. On a rear end portion of the lower surface of the holding arm 126, there is a recess 117 which is recessed upward, the rollers 153,154 being placed in the recess 117. A part of the rollers 153,154 placed in the recess 117 projects downward from the lower surface of the holding arm 126, and are rotatably held by the holding arm 126.

[0026] The rotary cleaning body 141 has a core rod 161 extending laterally (rightward) from the inner surface of the side portion 123, and a plurality of scraping portions 162 arranged on the outer peripheral surface of the core rod 161 so that the scraping portions 162 scrape dust off the floor surface F. The core rod 161 is slightly shorter than a half of the length of the internal space 112 in the left-to-right direction. The proximal end of the core rod 161 is situated near the inner surface of the side portion 123 (the proximal end of the core rod 161 is situated on the right side of the side portion 123) and is connected to the rotating shaft of the drive mechanism placed in the side portion 123. The proximal end of the rotary cleaning body 141 is, therefore, supported by the rotating shaft of the drive mechanism and the side portion 123.

[0027] The core rod 161 has an elongated and truncated cone shape tapering from the proximal end toward the distal end. The axis (i.e., the axis of rotation) of the core rod 161 is inclined frontward from the proximal end of the core rod 161 so that a generating line of the core rod 161 (truncated cone), which is defined at the position closest to the front wall 121 (i.e., the front one of a pair of intersecting lines of the outer peripheral surface of the core rod 161 with a horizontal plane encompassing the axis of the core rod 161), becomes substantially in parallel with the inner surface of the front wall 121. Since the inner surface of the rear portion 122 is bent to have a V shape in a bottom view as described above, a generating line of the core rod 161, which is defined at the position closest to the rear portion 122 (i.e., the rear one of the aforementioned intersecting lines), becomes substantially in parallel with the inner surface of the rear portion 122. In addition, the axis of the core rod 161 is inclined downward from the proximal end of the core rod 161 so that a generating line of the core rod 161, which is defined at the lowermost side (i.e., the lower one of a pair of intersecting lines of the outer peripheral surface of the core rod 161 with a vertical plane encompassing the axis of the rotary cleaning body 141 or 142), becomes substantially in parallel with the lower surfaces of the side portions 123,124 and the rear portion 122.

[0028] Each of the scraping portions 162 is a strip portion extending over a section from the proximal end to the distal end of the core rod 161. The scraping portion 162 is made of an elastically deformable material. For example, the scraping portion 162 may be formed using a number of brush bristles, or using a strip-shaped elastomer or elastic resin, or using a strip-shaped cloth material.

[0029] Over the section from the proximal end to the rear end of the core rod 161, the scraping portion 162 projects from the outer peripheral surface of the core rod 161 in a substantially uniform projection amount. The projection amount of the scraping portion 162 is set to a value so that the scraping portion 162 projects from the suction opening 111 to come in contact with the floor surface F.

[0030] The scraping portion 162 is not in parallel with the axis of the core rod 161. In short, the scraping portion 162 is extended spirally to three-dimensionally intersect the axis of the core rod 161. This means that the positions of the proximal and distal ends of the scraping portion 162 are different from each other in the circumferential direction of the core rod 161.

[0031] The rotary cleaning body 142 is bilaterally symmetrical to the rotary cleaning body 141. In other words, the distal end of the rotary cleaning body 142 faces the distal end of the rotary cleaning body 141. The rotary cleaning body 142 extends laterally from its distal end toward the side portion 124. The proximal end of the core rod 161 of the rotary cleaning body 142 is situated near the side portion 124, and is connected to the rotating shaft of the drive mechanism placed in the side portion 124. The proximal end of the rotary cleaning body 142 is, therefore, supported by the rotating shaft of the drive mechanism and the side portion 124.

[0032] Since each of the rotary cleaning bodies 141,142 is slightly shorter than the half of the length of the internal space 112 in the left-to-right direction, a space 118 is formed between the distal ends of the rotary cleaning bodies 141,142. In short, in the extension direction of the rotary cleaning bodies 141,142, the space 118 is formed adjacent to the distal ends of the rotary cleaning bodies 141,142. The rotary cleaning bodies 141,142 are bilaterally symmetrical in shape with respect to the space 118. The space 118 is used to remove long dust (e.g., hair) winding around the rotary cleaning bodies 141,142.

[0033] The space 118 is formed substantially at the center of the internal space 112 in the left-to-right direction, and is situated near the opening end 115 of the channel 116 (in front of the opening end 115). In other words, the space 118 is aligned with the opening end 115 in the opening direction of the opening end 115.

[0034] The operation of the suction tool 100 is hereinafter described.

[0035] A user operates the operation portion 104 to actuate the main body 102 and the drive mechanisms of the suction tool 100, and moves the suction tool 100 back and forth. As a result of the actuation of the main body 102, air in the internal space 112 is sucked and flows in the main body 102 through the channel 116, the connection portion 130 and the hose 103. Dust on the floor surface F is sucked together with the air into the main body 102. The rotary cleaning bodies 141,142 are rotated by the drive mechanisms in the suction tool 100. As a result, the scraping portions 162 in contact with the floor surface F scrapes dust off the floor surface F. Accordingly, dust is effectively removed from the floor surface F.

[0036] As a result of the rotation of the rotary cleaning bodies 141, 142, long dust may wind around the rotary cleaning bodies 141, 142. When a part of the long dust overlaps other parts of the long

dust, the long dust is likely to keep a condition of winding around the rotary cleaning bodies 141, 142. In this case, it becomes difficult to remove the long dust from the rotary cleaning bodies 141, 142 only by the suction force of the cleaning device 101.

[0037] When the long dust winds around the rotary cleaning bodies 141, 142 such that a part of the long dust overlaps other parts of the long dust, cross-sections of the long dust align along a line substantially perpendicular to the axis of the rotary cleaning bodies 141, 142, as shown in FIG. 5 (a schematic front view of the rotary cleaning body 141 or 142). In this case, the winding force of the dust acts on the rotary cleaning bodies 141, 142 in a direction substantially perpendicular to the axis of the rotary cleaning bodies 141, 142.

[0038] As described above, since the core rod 161 has a truncated cone shape whereas the projection amount of the scraping portion 162 is substantially uniform, the rotary cleaning body 141 or 142 as a whole has substantially a truncated cone shape that tapers from its proximal end toward its distal end as shown in FIG. 5. In this case, one component of the winding force is directed toward the distal end of the rotary cleaning body 141 or 142. Due to this force component, the dust winding around the rotary cleaning body 141 or 142 may move toward the distal end of the rotary cleaning body 141 or 142.

[0039] The space 118 is formed between the distal ends of the rotary cleaning bodies 141,142. Accordingly, the dust having moved to the distal ends of the rotary cleaning bodies 141, 142 and reached the space 118 is eventually removed from the rotary cleaning bodies 141, 142 through the space 118.

[0040] Since the space 118 is formed near the opening end 115 of the channel 116, the suction force of the cleaning device 101 acts relatively strongly on the space 118 (and on the distal ends of the rotary cleaning bodies 141, 142). Since the space 118 is aligned with the opening end 115 in the opening direction of the opening end 115, the long dust removed through the space 118 is directly sucked into the channel 116.

[0041] The suction tool 100 scrapes off dust on the floor surface F, using the rotary cleaning bodies 141,142 arranged in the left-to-right direction. Therefore, although the length of each of the rotary cleaning bodies 141,142 is less than the half of the length of the internal space 112 in the left-to-right direction, the suction tool 100 is still capable of scraping off dust on the floor surface F over a wide area.

[0042] Since the length of each of the rotary cleaning bodies 141,142 is less than the half of the length of the internal space 112 in the left-to-right direction, the suction tool 100 has a structure more robust than a cantilever support structure in which a single rotary cleaning body is provided to extend over the entire length of the internal space 112 in the left-to-right direction. In short, in such a robust structure, when a force that pushes up the distal end of the rotary cleaning body 141 or 142 acts on the rotary cleaning body 141 or 142, a load applied to the proximal end (i.e., connection portions connected to the drive mechanisms) of the rotary cleaning body 141 or 142 is relatively small.

[0043] Since the rotary cleaning bodies 141,142 have a bilaterally symmetrical structure, the left and right parts of the suction tool 100 may be substantially equal in cleaning abilities with each other.

[0044] Since the axis of the rotary cleaning body 141 or 142 is inclined downward from the proximal end of the rotary cleaning bodies 141, 142, the lowermost generating line of the rotary cleaning body 141 or 142 becomes substantially in parallel with the lower surfaces of the rear portion 122 and the side portions 123,124. Therefore, the rotary cleaning bodies 141, 142 may come in contact with the floor surface F with a substantially uniform force over the section from the proximal end to the distal end of the rotary cleaning body 141 or 142.

[0045] Since the axis of the rotary cleaning body 141 or 142 is inclined frontward from the proximal end of the rotary cleaning body 141 or 142, the generating line of the rotary cleaning body 141 or 142 at the position closest to the front wall 121 becomes substantially in parallel with the inner surface of the front wall 121. Since a gap between the rotary cleaning body 141 or 142 and the inner surface of the front wall 121 becomes substantially uniform over the section from the proximal end to the distal end of the rotary cleaning body 141 or 142, the suction force is less likely to change in strength due to a change in the gap size.

[0046] The inner surface of the rear portion 122 is bent into a V shape in conformity to the inclination of the rotary cleaning bodies 141,142. Therefore, a gap between the rotary cleaning body 141 or 142 and the inner surface of the rear portion 122 also becomes substantially uniform over the section from the proximal end to the distal end of the rotary cleaning body 141 or 142. Accordingly, the suction force is less likely to change in strength due to a change in the gap size.

[0047] When the scraping portion 162 does not three-dimensionally intersect the axis of the rotary cleaning body 141 or 142, dust is likely to fall in a state described with reference to FIG. 5 of winding around the rotary cleaning body 141 or 142. For example, when the core rod 161 provided with no scraping portion 162 rotates on dust extending in a direction perpendicular to the axis of the core rod 161, the dust winds around the core rod 161 at one part of the core rod 161 in its longitudinal direction. When the scraping portion 162 is set to three-dimensionally intersect the axis of the rotary cleaning body 141 or 142 (see FIG. 6 showing a schematic view of the scraping portion 162), the scraping portion 162 applies a force diagonally to the dust on a contact part at which the scraping portion 162 comes in contact with the dust. As a result, the contact part at which the scraping portion 162 comes in contact with the dust gradually moves in the longitudinal direction of the rotary cleaning body 141 or 142. As a result of the movement of the contact part, the dust does not wind around the rotary cleaning body 141 or 142 at one part in the longitudinal direction of the rotary cleaning body 141 or 142 but is likely to wind spirally around the outer peripheral surface of the rotary cleaning body 141 or 142. In this case, the dust winding around the rotary cleaning body 141 or 142 is removed from the rotary cleaning body 141 or 142 by the suction force of cleaning device 101.

[0048] In the aforementioned embodiment, each of the rotary cleaning bodies 141,142 has the

plurality of scraping portions 162. Alternatively, each of the rotary cleaning bodies 141,142 may have one scraping portion 162. It is preferable in this case that the scraping portion 162 spirally goes around the outer peripheral surface of the core rod 161 (see FIG. 7 showing a schematic view of the rotary cleaning body 141 or 142). In this case, since the scraping portion 162 extends not in parallel with the axis of the core rod 161, it becomes possible to gradually move the contact position of the scraping portion 162 with the long dust in the longitudinal direction of the core rod 161.

[0049] In the aforementioned embodiment, the space 118 is formed between the rotary cleaning bodies 141,142. In other words, the rotary cleaning bodies 141,142 are not coupled to each other. Alternatively, as shown in FIG. 8 (a schematic front view of the rotary cleaning bodies 141,142), the suction tool 100 may further include a coupling member 143 configured to couple the distal ends of the rotary cleaning bodies 141,142 to each other. The coupling member 143 is detachable from the distal ends of the rotary cleaning bodies 141,142. For example, the coupling member 143 may be a universal joint.

[0050] Dust gathering at the coupling member 143 during use of the suction tool 100 is removed together with the coupling member 143 when the coupling member 143 is detached from the distal ends of the rotary cleaning bodies 141,142. When the coupling member 143 is detached from the distal ends of the rotary cleaning bodies 141,142, the space 118 appears adjacent to the distal ends of the rotary cleaning bodies 141,142. Dust near the distal ends of the rotary cleaning bodies 141,142 may be removed through the space 118.

[0051] Since the distal ends of the rotary cleaning bodies 141,142 are coupled together by the coupling member 143, a coupled structure composed of the rotary cleaning bodies 141,142 coupled together is supported on their both ends by the case 120. Accordingly, the coupled structure composed of the rotary cleaning bodies 141,142 shown in FIG. 8 is more robust than the structure in which each of the rotary cleaning bodies 141,142 is supported separately by the case 120 in a cantilever style (see FIG. 2).

[0052] In the aforementioned embodiment, the core rod 161 has a tapered shape tapering from the proximal end toward the distal end. Alternatively, as shown in the graph of FIG. 9 (the graph showing a relationship between a diameter of the core rod 161 and a projection amount of the scraping portion 162), the diameter of the core rod 161 may be substantially constant over the section from the proximal end to the distal end of the core rod 161. In this case, the scraping portion 162 is formed such that the projection amount of the scraping portion 162 decreases from the proximal end toward the distal end of the core rod 161.

[0053] Since the distal end of the core rod 161 is distant from the side portion 123 or 124, the distal end of the core rod 161 is more likely to move upward than the proximal end of the core rod 161. Since the projection amount of the scraping portion 162 at the distal end of the core rod 161 is relatively small, the scraping portion 162 is less likely to elastically deform at the distal end of the core rod 161. Although the upward movement of the distal end of the core rod 161 may weaken contact of the scraping portion 162 with the floor surface F, since the scraping portion 162 is less

likely to elastically deform at the distal end of the core rod 161, it may be possible to strengthen the contact of the scraping portion 162 with the floor surface F. Accordingly, these effects offset each other. Since the projection amount of the scraping portion 162 at the proximal end of the core rod 161 is relatively large, the scraping portion 162 is likely to elastically deform at the proximal end of the core rod 161. The proximal end of the core rod 161 is less likely to move upward. Although the scraping portion 162 is likely to elastically deform and weaken contact of the scraping portion 162 with the floor surface F, since the core rod 161 is less likely to move upward and strengthen the contact of the scraping portion 162 with the floor surface F, these effects thus offset each other.

[0054] <Second Embodiment>

The suction tool 100 of the first embodiment has two rotary cleaning bodies 141,142. Alternatively, the suction tool 100 may have one rotary cleaning body 141 (see FIG. 10 showing a schematic perspective view of the suction tool 100). The suction tool 100 of the second embodiment including one rotary cleaning body 141 is described with reference to FIGS. 1 and 10.

[0055] The proximal end of the rotary cleaning body 141 is situated near the inner surface of the side portion 123. The rotary cleaning body 141 extends laterally (rightward), and its distal end is situated near the side portion 124. In other words, the distal end of the rotary cleaning body 141 faces the inner surface of the side portion 124. Between the distal end of the rotary cleaning body 141 and the side portion 124, the space 118 is formed. In the space 118, the coupling member 143 is situated, the coupling member 143 being configured to couple the distal end of the rotary cleaning body 141 to the side portion 124.

[0056] The axis of the rotary cleaning body 141 is inclined downward from the proximal end such that the lowermost generating line of the core rod 161 become substantially in parallel with the floor surface F. The axis of the rotary cleaning body 141 is inclined frontward from the proximal end such that the generating line of the core rod 161 at the position closest to the front wall 121 become substantially in parallel with the inner surface of the front wall 121.

[0057] The front wall 121 and the side portion 123 of the second embodiment are substantially the same as the front wall 121 and the side portion 123 of the first embodiment. However, the side portion 124 and the rear portion 122 of the second embodiment are different from the side portion 124 and the rear portion 122 of the first embodiment.

[0058] In the second embodiment, since it is not necessary to house the drive mechanism configured to drive the rotary cleaning body 142, the side portion 124 is thinner than the side portion 124 of the first embodiment. The side portion 124 includes a main wall 127 having a through-hole formed at a position facing the distal end of the rotary cleaning body 141, and a plug piece 128 configured to close the through-hole of the main wall 127 and be connected to one end of the coupling member 143. The plug piece 128 may be detachable from the main wall 127 and the coupling member 143.

[0059] A recess 119 is formed on the lower surface of the rear portion 122, the roller 151 being placed in the recess 119. The recess 119 is formed substantially at the center of the lower surface of

the rear portion 122 in the left-to-right direction. The roller 151 is placed in the recess 119 whereas the suction tool 100 of the second embodiment does not have the rollers 152 to 154 described in the context of the first embodiment. The suction tool 100 of the second embodiment, therefore, does not have portions for attaching these rollers 152 to 154 (i.e., the recess 114 and the holding arm 126). The internal space of the rear portion 122 on the left side of the recess 119 is used to house the drive mechanism to drive the rotary cleaning body 141.

[0060] The rear portion 122 is different in formation position of the channel 116 from the rear portion 122 of the first embodiment. In short, on the rear portion 122 of the second embodiment, the channel 116 is formed not substantially at the center of the rear portion 122 but at a position closer to the side portion 124 than the center in the left-to-right direction. The opening end 115 of the channel 116, therefore, appears near the space 118 between the rotary cleaning body 141 and the side portion 124.

[0061] The inner surface of the rear portion 122 is inclined frontward from the side portion 123 toward the side portion 124 such that a gap between the rotary cleaning body 141 and the inner surface of the rear portion 122 is substantially uniform in the left-to-right direction.

[0062] The connection portion 130 is provided on the rear surface of the rear portion 122 in correspondence to the formation position of the channel 116. In short, the connection portion 130 extends rearward from the back surface of the rear portion 122 at a position closer to the side portion 124 than the center of the back surface of the rear portion 122 in the left-to-right direction.

[0063] Since the suction tool 100 of the second embodiment includes the rotary cleaning body 141 tapering from the proximal end toward the distal end like the suction tool 100 of the first embodiment, it is possible to move long dust winding around the rotary cleaning body 141 to the space 118. Although dust may accumulate on the coupling member 143 provided in the space 118, a user may remove such dust from the suction tool 100 by removing the plug piece 128 and the coupling member 143 in order.

[0064] The proximal end of the rotary cleaning body 141 is supported by the rotating shaft of the drive mechanism and the side portion 123. The distal end of the rotary cleaning body 141 is supported by the side portion 124 via the coupling member 143. In other words, the rotary cleaning body 141 is supported on its both ends by the side portions 123,124. The suction tool 100 of the second embodiment, therefore, has a structure more robust than the structure of the suction tool 100 having the rotary cleaning body 141 supported in the cantilever style.

[0065] Unlike the suction tool 100 of the first embodiment, the suction tool 100 of the second embodiment does not include the rotary cleaning body 142. The suction tool 100 of the second embodiment, therefore, does not need the drive mechanism to drive the rotary cleaning body 142. As a result, the suction tool 100 of the second embodiment is constructed by using components fewer than components for the suction tool 100 of the first embodiment.

[0066] If the rotary cleaning body 141 and the drive mechanism have robust structures, the rotary cleaning body 141 may be supported in the cantilever style (see FIG. 11 showing a schematic

perspective view of suction tool 100)). In such a case, the suction tool 100 does not need to have the coupling member 143. In addition, no through-hole has to be formed on the side portion 124, and no plug piece 128 for closing the through-hole is required. The suction tool 100 thus has a simple structure.

[0067] In the aforementioned embodiment, a vacuum cleaner is shown as an example of the cleaning device 101, which requires the user to move the suction tool 100 by himself or herself. However, the suction tool 100 may be incorporated in a robot vacuum cleaner configured to move autonomously.

[0068] The aforementioned embodiments mainly include the following configurations.

[0069] A suction tool according to one aspect of the aforementioned embodiments is configured to be attached to a suction-type cleaning device. The suction tool includes: a case configured to define an internal space between a pair of side walls disposed respectively at positions spaced away from each other in a left-to-right direction and a channel for air flowing from the internal space into the cleaning device on a rear wall, the internal space being configured to extend upward from a suction opening which is opened downward and allows dust to be sucked from the suction opening; a rotary cleaning body including a proximal end connected to one of the pair of side walls and being configured to extend laterally in the internal space and come in contact with a floor surface through the suction opening, the rotary cleaning body being configured to taper toward a distal end of the rotary cleaning body, and another rotary cleaning body including a proximal end connected to the other of the pair of side walls and being configured to extend laterally in the internal space and come in contact with the floor surface through the suction opening, the other rotary cleaning body being configured to taper toward a distal end of the other rotary cleaning body. The rotary cleaning body and the other rotary cleaning body are supported in a cantilever style by the case so that a space is formed between the distal ends of the rotary cleaning body and the other rotary cleaning body, the space being configured to allow dust winding around the rotary cleaning body and the other rotary cleaning body to be removed through the space.

[0070] According to the aforementioned configuration, the pair of rotary cleaning bodies extends laterally so as to rotate under a condition in contact with the floor surface, so that dust on the floor surface is scraped off by the pair of rotary cleaning bodies over an extension range of the rotary cleaning body along with movement of the suction tool. At this time, long dust on the floor surface may wind around these rotary cleaning bodies. Since these rotary cleaning bodies taper toward the distal end, the dust winding around these rotary cleaning bodies moves toward the distal ends of the rotary cleaning bodies. Since the space is formed between the distal ends of the rotary cleaning bodies, the dust reaching the distal ends of the rotary cleaning bodies may be removed through the space.

[0071] In the aforementioned configuration, the space may be formed near an opening end of the channel which is opened toward the internal space.

[0072] According to the aforementioned configuration, since the space for removing the dust is

formed near the opening end of the channel, a suction force from the cleaning device relatively acts strongly on the space for removing the dust and on the distal end of the rotary cleaning body. As a result, the dust having reached the space for removing the dust and the distal end of the rotary cleaning body is easily sucked into the cleaning device.

[0073] In the aforementioned configuration, the space may be aligned with the opening end in the opening direction of the opening end.

[0074] According to the aforementioned configuration, since the space for removing the dust is aligned with the opening end of the channel in the opening direction of the opening end, the dust having reached the space for removing the dust and the distal end of the rotary cleaning body is easily sucked into the cleaning device.

[0075] In the aforementioned configuration, the pair of rotary cleaning bodies may be symmetrical in shape with each other with respect to the space.

[0076] According to the aforementioned configuration, since the pair of rotary cleaning bodies are symmetrical in shape with each other with respect to the space, the rotary cleaning bodies show cleaning abilities substantially equal to each other.

[0077] In the aforementioned configuration, an axis of the rotary cleaning body may be inclined downward from the proximal end of the rotary cleaning body.[0078] According to the aforementioned configuration, since the axis of the rotary cleaning body is inclined downward from the proximal end of the rotary cleaning body, the distal end of the rotary cleaning body may project downward out of the suction opening. Therefore, although the rotary cleaning body tapers toward its distal end, the distal end portion of the rotary cleaning body may be brought into contact with the floor surface.

[0079] In the aforementioned configuration, the case may include a front wall situated in front of the internal space. The axis of the rotary cleaning body may be inclined frontward from the proximal end of the rotary cleaning body. The space is situated in front of the opening end of the channel which is opened toward the internal space.

[0080] According to the aforementioned configuration, since the case has the front wall situated in front of the internal space, a suction force of the cleaning device hardly acts on a space in front of the case but concentrates in the suction opening. Since the axis of the rotary cleaning body is inclined forward, the distal end portion of the rotary cleaning body can be brought closer to the front wall although the rotary cleaning body tapers toward its distal end. As a result, a gap between the distal end portion of the rotary cleaning body and the front wall does not become excessively large, which suppresses a drop in the suction force around the distal end portion of the rotary cleaning body.

[0081] In the aforementioned configuration, the rotary cleaning body may include a core rod extending laterally, and a scraping portion provided on an outer peripheral surface of the core rod and configured to scrape off dust on the floor surface. The scraping portion may extend spirally on the outer peripheral surface of the core rod or extends diagonally to three-dimensionally intersect an

axis of the core rod.

[0082] According to the aforementioned configuration, since the scraping portion extends spirally on the outer peripheral surface of the core rod or extends diagonally to three-dimensionally intersect the axis of the core rod, the scraping portion applies a force to dust on the floor surface in the extension direction of the core rod. When long dust comes in contact with the scraping portion, the contact position of the dust in contact with the scraping portion tends to move in the extension direction of the core rod. As a result, the long dust tends to wind around the core rod such that a part of the long dust does not overlap other parts of the long dust.

[0083] In the aforementioned configuration, the projection amount of the scraping portion may be uniform.

[0084] According to the aforementioned configuration, since the projection amount of the scraping portion is uniform, deformability of the scraping portion in the projection direction may be substantially constant. In this case, a force acting between the scraping portion and the floor surface (i.e., a force for scraping off dust on the floor surface) may also become substantially constant.

[0085] In the aforementioned configuration, the projection amount of the scraping portion from the outer peripheral surface of the core rod may be reduced toward the distal end of the rotary cleaning body.

[0086] According to the aforementioned configuration, since the distal end of the rotary cleaning body is distant from the side portion of the case, the distal end of the rotary cleaning body is more likely to displace than the proximal end of the rotary cleaning body. In this case, a force acting on the floor surface near the distal end of the rotary cleaning body (i.e., the force for scraping off dust on the floor surface) tends to weaken. However, since the projection amount of the scraping portion from the outer peripheral surface of the core rod is reduced toward the distal end of the rotary cleaning body, a part of scraping portion that is closer to the distal end of the rotary cleaning body is less deformable in the projection direction of the scraping portion. This allows the scraping portion closer to the distal end of the rotary cleaning body to apply a strong force (scraping force) to dust on the floor surface. Since the proximal end of the rotary cleaning body is relatively less likely to displace, the scraping portion near the proximal end of the rotary cleaning body may also apply a strong force (scraping force) to dust on the floor surface.

[0087] In the aforementioned configuration, the scraping portion may be made of an elastically deformable material.

[0088] According to the aforementioned configuration, the scraping portion deforms elastically and flexibly when hitting the floor surface, and returns to its original form when leaving the floor surface. This action scrapes dust off the floor surface effectively.

Industrial Applicability

[0089] Principles disclosed in the present embodiments are applied preferably to devices used for cleaning work.

Claims

1. A suction tool attached to a suction-type cleaning device, the suction tool comprising:

a case configured to define an internal space between a pair of side walls disposed respectively at positions spaced away from each other in a left-to-right direction and a channel for air flowing from the internal space into the cleaning device on a rear wall, the internal space being configured to extend upward from a suction opening which is opened downward and allows dust to be sucked from the suction opening;

a rotary cleaning body including a proximal end connected to one of the pair of side walls and being configured to extend laterally in the internal space and come in contact with a floor surface through the suction opening, the rotary cleaning body being configured to taper toward a distal end of the rotary cleaning body, and

another rotary cleaning body including a proximal end connected to the other of the pair of side walls and being configured to extend laterally in the internal space and come in contact with the floor surface through the suction opening, the other rotary cleaning body being configured to taper toward a distal end of the other rotary cleaning body,

wherein the rotary cleaning body and the other rotary cleaning body are supported in a cantilever style by the case so that a space is formed between the distal ends of the rotary cleaning body and the other rotary cleaning body, the space being configured to allow dust winding around the rotary cleaning body and the other rotary cleaning body to be removed through the space.

2. The suction tool according to claim 1,

wherein the space is formed near an opening end of the channel which is opened toward the internal space.

3. The suction tool according to claim 2,

wherein the space is aligned with the opening end in an opening direction of the opening end.

5. The suction tool according to any one of claims 1 to 3,

wherein a pair of the rotary cleaning bodies are symmetrical in shape with each other with respect to the space.

5. The suction tool according to any one of claims 1 to 4,

wherein an axis of the rotary cleaning body is inclined downward from the side portion configured to support the proximal end of the rotary cleaning body.

6. The suction tool according to any one of claims 1 to 4,

wherein the case includes a front wall situated in front of the internal space, and

wherein the axis of the rotary cleaning body is inclined frontward from the side portion configured to support the proximal end of the rotary cleaning body, and

wherein the space is situated in front of the opening end of the channel which is opened toward the internal space.

7. The suction tool according to any one of claims 1 to 6,

wherein the rotary cleaning body includes a core rod extending laterally, and a scraping portion provided on an outer peripheral surface of the core rod and configured to scrape off dust on the floor surface, and

wherein the scraping portion extends spirally on the outer peripheral surface of the core rod or extends diagonally to three-dimensionally intersect an axis of the core rod.

8. The suction tool according to claim 7,

wherein a projection amount of the scraping portion is uniform.

9. The suction tool according to claim 7,

wherein a projection amount of the scraping portion from the outer peripheral surface of the core rod is reduced toward the distal end of the rotary cleaning body.

10. The suction tool according to any one of claims 7 to 9,

wherein the scraping portion is made of an elastically deformable material.