TITLE OF INVENTION: DEBRIS AGITATION MECHANISM FOR A VACUUM CLEANING ASSEMBLY

FIELD

[0001] The present invention relates to a debris agitation mechanism for a vacuum cleaning assembly. While the debris agitation mechanism according to the present disclosure will be described with respect to its use in robotic vacuum cleaners, it is to be appreciated that the debris agitation mechanism is not limited to this application, and can be used with other types of vacuum cleaning machines.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] Debris agitation mechanisms are commonly used to agitate debris on the ground to thereby increase the vacuuming efficiency of a vacuum cleaning machine. In the case of a robotic vacuum cleaner, these debris agitation mechanisms must be incredibly efficient due to the power limitations normally associated with such robotic vacuum cleaning machines. The limited power supply will result in a vacuum assembly having a relatively low suction power when compared with, for example, mains powered vacuum cleaning machines and debris agitation mechanisms typically used with such vacuum cleaning machines may not have the necessary efficiency to operate within a robotic vacuum cleaner having a lower suction power.

[0004] With lower suction power available in robotic vacuum cleaners, the debris agitation mechanism still needs to be able to pick up debris in one pass. This is however difficult or not possible to achieve with the conventional design used in such robotic vacuum cleaners where the suction is provided at the back of the vacuum cleaning assembly accommodating the debris agitation mechanism with respect to the direction of operation of the robotic vacuum cleaner. This is because the suction

is the last line of defense when picking up debris on the floor, and if the vacuum does not pick up the debris in that pass, then there is no extra chance for the debris to be picked up by the robotic vacuum cleaner.

[0005] Also, in conventional designs with suction at the back of the vacuum cleaning assembly, this generally requires some sort of rubber or interface between the floor and the vacuum cleaning assembly, similar to the rubber piece at the end of some dustpans, that allows for the debris to be swept into the suction area of the vacuum cleaning assembly. This means that rubber piece is facing forwards and downwards, and this makes rubber piece easily susceptible to breaking at that interface when facing small low height obstacles like nails protruding, for example about 3mm from the ground, where the obstacle detection algorithm would typically be unable to detect that nail.

[0006] Conventional debris agitation mechanisms are also not typically able to be taken out from a robotic vacuum cleaner. This makes cleaning and maintenance of these mechanisms significantly difficult and cumbersome.

[0007] An object of the invention is to ameliorate one or more of the above-mentioned difficulties.

SUMMARY

[0008] According to an aspect of the present disclosure, there is provided a debris agitation mechanism for a vacuum cleaning assembly having a housing with a front end and a rear end relative to a normal direction of operation of the vacuum cleaning assembly, and a suction opening provided at the front end thereof;

The debris agitation mechanism comprising a rotatable bristle brush locatable adjacent the front end of the housing; and

a rotatable cloth brush locatable adjacent the rear end of the housing;

wherein the bristle brush and cloth brush are rotatable in the same direction to thereby direct debris respectively entrained by the bristle brush and cloth brush

towards the front end of the housing.

[0009] In some embodiments, the cloth brush is a microfibre brush.

[0010] In some embodiments, the bristle brush and cloth brush are driven for rotation by a drive mechanism comprising a belt drive, gear, chain drive or direct drive assembly.

[0011] In some embodiments, the bristle brush is releasably mounted within the vacuum cleaning assembly.

[0012] In some embodiments, the cloth brush is releasably mounted within the vacuum cleaning assembly.

[0013] In some embodiments, the vacuum cleaning assembly further comprises a flap located at the front end of the housing for guiding debris to the suction opening.

[0014] In some embodiments, the vacuum cleaning assembly comprises a coupling member including an electrical contact device and a coupling device for coupling with a vacuum cleaning machine.

[0015] In some embodiments, the electrical contact device is a pogo pin device.

[0016] In some embodiments, the coupling device is a magnet mounted on the coupling member.

[0017] According to another aspect of the present disclosure, there is provided a vacuum cleaning assembly for a vacuum cleaning machine comprising a debris agitation mechanism as described above.

[0018] In some embodiments, the vacuum cleaning machine comprises a coupling mechanism for coupling with the coupling member of the vacuum cleaning apparatus.

[0019] In some embodiments, the coupling mechanism comprises a channel within which can be inserted the coupling member.

[0020] In some embodiments, the coupling mechanism comprises a circuit board

for contacting the electrical contact device on the coupling member.

[0021] In some embodiments, further comprising a magnetic locking arrangement comprising at least one magnet and/or ferromagnetic material mounted on the coupling mechanism and at least one corresponding magnet and/or ferromagnetic material mounted on the coupling member.

[0022] According to a further aspect of the present disclosure, there is provided a robotic vacuum cleaner comprising a vacuum cleaning assembly as described above.

[0023] Other aspects and features will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In the figures, which illustrate, by way of example only, embodiments of the present invention,

[0025] [Figure 1] is a side view of a vacuum cleaning assembly according to the present disclosure;

[0026] [Figure 2] is a cross-sectional side view of the vacuum cleaning assembly as shown in [figure 1];

[0027] [Figure 3] is a partial perspective view of a robotic vacuum cleaner and a vacuum cleaning assembly according to the present disclosure in an extended position from the vacuum cleaning machine;

[0028] [Figure 4] is a partial perspective view of a robotic vacuum cleaner and a vacuum cleaning assembly according to the present disclosure in a fully installed position within the vacuum cleaning machine;

[0029] [Figure 5] is a perspective view of a coupling mechanism, shown in a partial phantom view, of the robotic vacuum cleaner of [figure 3 and 4] and the vacuum cleaning assembly according to the present disclosure prior to coupling

therebetween;

[0030] [Figure 6] is a perspective view of a coupling mechanism of the robotic vacuum cleaner of [figure 3 and 4] and the vacuum cleaning assembly according to the present disclosure when fully coupled therebetween;

[0031] [Figures 7 and 8] are respectively an exploded perspective view and exploded side view of the vacuum cleaning assembly according to the present disclosure; and

[0032] [Figure 9] is an exploded bottom view of the vacuum cleaning assembly according to the present disclosure without the bristle brush and roller brush being present.

[0033] Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

DETAILED DESCRIPTION

[0034] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0035] Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0036] Example embodiments of the present invention will now be described with reference to the accompanying drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present invention. Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout the

description. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one or ordinary skill in the art to which this invention belongs. Where possible, the same reference numerals are used throughout the figures for clarity and consistency.

[0037] Referring initially to [figs 1 and 2], there is respectively shown a side view and cross-sectional side view of a vacuum cleaning assembly 1, also referred to as the ‘floor tool’, according to the present disclosure. The vacuum cleaning assembly 1 comprises a housing 3 having a front end 3a and rear end 3b relative to a normal direction of operation of the vacuum cleaning assembly 1 which will be towards the left in the orientation of the vacuum cleaning assembly 1 as shown in [figs. 1 and 2]. The housing further comprises a suction opening 9 at the front end of the housing 3, and a vacuum opening 8 located at the bottom of the housing 3.

[0038] Accommodated within the housing 3 is a debris agitation mechanism 2 according to the present disclosure comprising a rotatably mounted bristle brush 5 located adjacent the housing front end 3a, and a rotatably mounted cloth brush 7 located adjacent the housing rear end 3b. The cloth brush 7 may be for example be covered by a microfibre cloth. An electric motor 11 rotatably drives the bristle brush 5 and cloth brush 7 via a drive belt assembly 15 as shown in [fig. 1]. Both the bristle brush 5 and cloth brush 7 are therefore driven in the same rotational direction which would be clockwise in the orientation of the vacuum cleaning assembly 1 as shown in [figs. 1 and 2]. The debris is therefore thrown forward by both the bristle brush 5 and the cloth brush 7 towards the housing front end 3a where the suction opening 9 is provided. A flexible flap 14 is also provided at the housing front end 3a at a front portion of the vacuum opening 8. The flexible flap 14 acts to guide any debris thrown by the bristle brush 5 and cloth brush 7 towards the suction opening 9. The flexible flap 14 may be flexible enough to allow for dirt or other debris on the floor surface to go under the flap 14 rather than being pushed forward by the flap 14. The flap 14 is also inclined rearwardly and is therefore less susceptible to damage from low height obstacles than the rubber interface piece used in conventional designs. The cloth brush 7 may also act to provide a seal with the floor surface thereby keeping the vacuum suction pressure stronger at the housing front end 3a. Furthermore, the cloth brush 7 can also act to push debris that was not initially swept up by the rotating

bristle brush 5 towards the housing front end 3a thereby improving the amount of debris sucked up by the vacuum cleaning assembly 1. The cloth brush 7 can also provide a rolling surface to help to ensure that any low height obstacle encountered on the floor surface will be less likely to damage the vacuum cleaning assembly 1. It is also envisaged that the bristle brush 5 and cloth brush 7 be releasably mounted within the vacuum cleaning assembly 1 such that they are readily removable from the housing 3. As well as facilitating the replacement or servicing of the vacuum cleaning assembly 1, this also allows for brushes of different diameters, bristle type or materials, or cloth material to be installed within the vacuum cleaning assembly.

[0039] [Figs. 3 and 4] respectively show a partial view of a robotic vacuum cleaner 10 within which can be accommodated the vacuum cleaning assembly 1 according to the present disclosure. [Fig. 3] shows the vacuum cleaning assembly 1 prior to insertion into the robotic vacuum cleaner 10, while [fig. 4] shows the vacuum cleaning assembly 1 fully accommodated with the robotic vacuum cleaner 10. The vacuum cleaning assembly 1 can be slid into the robotic vacuum cleaner 10 into the fully accommodated position shown in [fig. 4].

[0040] [Figs. 5] is a perspective view of the vacuum cleaning assembly 1 and a coupling mechanism 12, shown in partial phantom view, that couples the vacuum cleaning assembly 1 with the robotic vacuum cleaner 10. The vacuum cleaning assembly 1 is provided with a coupling member 16 which can be slidably accommodated within a channel 12a provided within coupling mechanism 12. The coupling member 16 is provided with an electrical contact device 18 which may for example be in the form of a ‘pogo pin’ device. That pogo pin device 18 will contact a circuit board 20 provided within the channel 12a when the coupling member 16 is fully inserted within the coupling mechanism 12. This then allows electrical power to be delivered to the electric motor 11. A magnet 22 can also be provided on the coupling member 16, with a corresponding magnet 24 being provided within the channel 12a. The two magnets 22,24 are magnetically attracted to each other such that when the coupling member 16 is fully inserted within the coupling mechanism 12, the two magnets 22,24 form a magnetic lock arrangement for holding in position the coupling member 16 within the coupling mechanism 12. This therefore allows for the vacuum cleaning assembly 1 to be releasably engaged by the coupling

mechanism 12 to thereby facilitate the coupling to and removal of the vacuum cleaning assembly 1 from the robotic vacuum cleaner 10. The vacuum cleaning assembly 1, once fully coupled to the coupling mechanism 12 will be in the position as shown in [fig. 6].

[0041] [Figs. 7 to 9] show different perspective views of the vacuum cleaning assembly 1 and coupling mechanism 12. These figures show various features including the bristle brush 5, cloth brush 7, electric motor 11 and belt drive assembly 15, coupling member 16 including the magnet 22 and pogo pin device 18, coupling mechanism 12, vacuum cleaning assembly housing 3 and flap 14.

[0042] It should be appreciated by the person skilled in the art that the above invention is not limited to the embodiment described. It is to be appreciated that modifications and improvements may be made without departing from the scope of the present invention. For example, the brushes 5,7 of the described embodiment are shown driven by a belt drive assembly 15. It is however also envisaged that alternative drive mechanisms used to drive the brushes 5,7 including a gear, chain drive or direct drive assembly. Furthermore, the magnetic locking arrangement used to lock the coupling member 16 to the coupling mechanism 12 of the described embodiment has magnets 22,24 respectively provided on the coupling member 16 and coupling mechanism 12. It is however also envisaged that the magnetic locking arrangement comprises one or more magnets and/or ferromagnetic material on one side, and one or more magnets and/or ferromagnetic material provided on the other side.

[0043] It should be further appreciated by the person skilled in the art that one or more of the above modifications or improvements, not being mutually exclusive, may be further combined to form yet further embodiments of the present invention.

CLAIMS

[Claim 1] A debris agitation mechanism for a vacuum cleaning assembly having a housing with a front end and a rear end relative to a normal direction of operation of the vacuum cleaning assembly, and a suction opening provided at the front end thereof;

the debris agitation mechanism comprising a rotatable bristle brush locatable adjacent the front end of the housing; and

a rotatable cloth brush locatable adjacent the rear end of the housing;

wherein the bristle brush and cloth brush are rotatable in the same direction to thereby direct debris respectively entrained by the bristle brush and cloth brush towards the front end of the housing.

[Claim 2] A debris agitation mechanism according to claim 1, wherein the cloth brush is a microfibre brush.

[Claim 3] A debris agitation mechanism according to claim 1 or 2, wherein the bristle brush and cloth brush are driven for rotation by a drive mechanism comprising a belt drive, gear, chain drive or direct drive assembly.

[Claim 4] A debris agitation mechanism according to any one of the preceding claims, wherein the bristle brush is releasably mounted within the vacuum cleaning assembly.

[Claim 5] A debris agitation mechanism according to any one of the preceding claims, wherein the cloth brush is releasably mounted within the vacuum cleaning assembly.

[Claim 6] A debris agitation mechanism according to any one of the preceding claims, wherein the vacuum cleaning assembly further comprises a flap located at the front end of the housing for guiding debris to the suction opening.

[Claim 7] A debris agitation mechanism according to any one of the preceding claims, wherein the vacuum cleaning assembly comprises a coupling member including an electrical contact device and a coupling device for coupling with a vacuum cleaning

machine.

[Claim 8] A debris agitation mechanism according claim 7, wherein the electrical contact device is a pogo pin device.

[Claim 9] A debris agitation mechanism according claim 7 or 8, wherein the coupling device is a magnet mounted on the coupling member.

[Claim 10] A vacuum cleaning assembly for a vacuum cleaning machine comprising a debris agitation mechanism according to claim 7.

[Claim 11] A vacuum cleaning assembly according to claim 10, wherein the vacuum cleaning machine comprises a coupling mechanism for coupling with the coupling member of the vacuum cleaning apparatus.

[Claim 12] A vacuum cleaning assembly according to claim 11, wherein the coupling mechanism comprises a channel within which can be inserted the coupling member.

[Claim 13] A vacuum cleaning assembly according to claim 11 or 12, wherein the coupling mechanism comprises a circuit board for contacting the electrical contact device on the coupling member.

[Claim 14] A vacuum cleaning assembly according to any one of claims 11 to 13, further comprising a magnetic locking arrangement comprising at least one magnet and/or ferromagnetic material mounted on the coupling mechanism and at least one corresponding magnet and/or ferromagnetic material mounted on the coupling member.

[Claim 15] A robotic vacuum cleaner comprising a vacuum cleaning assembly according to any one of claims 10 to 14.