TITLE OF INVENTION: SIDE BRUSH SUPPORT MECHANISM FOR AN AUTONOMOUS CLEANING ROBOT

FIELD

[0001] The present invention generally relates to autonomous cleaning robots, and in particular to a side brush support mechanism for such robots.

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] Autonomous cleaning robots typically have at least one, and preferably two opposing side brushes that rotate to push dust and other debris located at and adjacent the side edges of the cleaning robot towards the centre line of the robot where the dust/debris can be picked up and carried away by the vacuum cleaning system of the cleaning robot.

[0004] In currently used side brush control systems, the cleaning robot detects whether there are any low height obstacles on the floor being cleaned, and then has a lifting mechanism that raises the side brushes to thereby prevent damage to the side brushes due to contact with the low height obstacle. However, the side brushes when located in the down/lowered position are not free to move upwards. Therefore, there is a chance that any low height obstacles which are not detected by the system may contact and damage the side brushes.

[0005] Furthermore, it can be difficult for the user of the cleaning robot to manually lift the side brushes when mounted on the robot frame as there is no grip for the user to hold on to push the side brushes back up into the robot. There is also a high chance of breakage of the side brushes and the side brush support mechanism in the current side brush system.

[0006] An object of the invention is to ameliorate one or more of the above-mentioned difficulties.

SUMMARY

[0007] According to an aspect of the present disclosure, there is provided a side brush support mechanism for supporting a side brush of an autonomous cleaning robot, comprising:

a mount frame;

a rotatably driven drive shaft extending from the mount frame;

a cam member supported on the drive shaft and rotatably driven thereon,

an actuation arm rotatably supported at one end thereof on the drive shaft, the side brush being supportable at an opposing end of the actuation arm; and

an engagement member extending from the cam member accommodated within an arcuate slot provided at said one end of the actuation arm;

wherein the cam member is rotatable between an elevated position where the engagement member is positioned at an upper portion of the arcuate slot, the actuation arm further comprising a lug member for engaging a stop member located on the mount when the cam member is in the elevated position to thereby restrict movement of the actuation arm; and

wherein the cam member is rotatable to a down position where the lug member is disengaged with the stop member to thereby allow a degree of rotational movement of the actuation arm.

[0008] In some embodiments, the cam member comprises a cam surface for engaging a limit switch supported on the mount frame to thereby prevent further rotation of the cam member.

[0009] In some embodiments, the side brush is rotatably driven by a side brush motor supported on a side brush motor mounting member.

[0010] In some embodiments, the side brush is releasably interconnected to the side brush motor by a releasable connector.

[0011] In some embodiments, the opposing end of the actuation arm is connectable to the side brush motor mounting member.

[0012] In some embodiments, the drive shaft is driven by a rotary motor assembly supported on the mount frame.

[0013] In some embodiments, the rotary motor assembly comprises a rotary motor supported on the mount, and a drive assembly interconnecting the rotary motor with the drive shaft.

[0014] In some embodiments, the engagement member comprises a shoulder bolt extending from a side face of the cam member.

[0015] In some embodiments, the side brush is elevated at least 10 mm from a floor surface supporting the cleaning robot when the side brush support mechanism is in the elevated position.

[0016] In some embodiments, the side brush is elevated between 20 to 30 mm from a floor surface supporting the cleaning robot when the side brush support mechanism is in the elevated position.

[0017] According to another aspect of the present disclosure, there is provided a side brush assembly for an autonomous cleaning robot comprising:

a side brush support mechanism comprising a mount frame, a rotatably driven drive shaft extending from the mount frame, a cam member supported on the drive shaft and rotatably driven thereon; an actuation arm rotatably supported at one end thereof on the drive shaft, the side brush being supportable at an opposing end of the actuation arm; and an engagement member extending from the cam member accommodated within an arcuate slot provided at said one end of the actuation arm; and

a side brush supported by the side brush support mechanism;

wherein the cam member is rotatable between an elevated position where the

engagement member is positioned at an upper portion of the arcuate slot, the actuation arm further comprising a lug member for engaging a stop member located on the mount frame when the cam member is in the elevated position to thereby restrict movement of the actuation arm; and

wherein the cam member is rotatable to a down position where the lug member is disengaged with the stop member to thereby allow a degree of rotational movement of the actuation arm.

[0018] 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

[0019] In the figures, which illustrate, by way of example only, embodiments of the present invention,

[0020] [Figure 1] is a perspective view of a side brush support mechanism for an autonomous cleaning robot according to the present disclosure;

[0021] [Figure 2] is a side view of the side brush support mechanism of [figure 1];

[0022] [Figure 3] is a cross-sectional view taken along section C-C of the side brush support mechanism as shown in [figure. 2];

[0023] [Figure 4] is a bottom view of the side brush support mechanism as shown in [figure 1]; and

[0024] [Figure 5] is a cross-sectional view taken along section A-A of the side brush support mechanism as shown in [figure 4].

[0025] 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

[0026] 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”.

[0027] 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.

[0028] 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.

[0029] , The side brush support mechanism according to the present disclosure preferably has one or more of the features as follows:

[0030] a) The user must be able to pull out the side brush without the side brush support mechanism moving down. In other words, the side brush support mechanism should not be back drivable.

[0031] b) When side brush is down, it is free to move up so that any low height obstacles not seen by the sensors will not damage the side brush or side brush support mechanism.

[0032] c) When in the lifted/up position of the side brush support mechanism, the lowest part of the side brush must clear the floor. In an example configuration, the side brush may clear the floor by at least 10mm, mainly to go over humps on the floor, and preferably provide a 20 - 30mm clearance from the floor. These values can

however vary depending on the use case.

[0033] d) It is preferable to have the same manufactured parts for the side brush support mechanism on each side of the cleaning robot. This will help to reduce the unique part counts that incur costs to produce, and creates additional inventory to stock and manage. Therefore, any asymmetry between the parts on opposing sides should ideally be minimised where possible.

[0034] Referring to [figs. 1 to 5], there is shown an example embodiment of the side brush support mechanism 1 for an autonomous cleaning robot according to the present disclosure. It is noted that the autonomous cleaning robot is typically provided with two side brushes on opposing sides of the robot, and that [figs. 1 to 5] only show the side brush mechanism 1 for one side only. The side brush support mechanism 1 supports a side brush 3 driven by a side brush motor 2 mounted on a side brush motor mounting member 10. The side brush motor 2, which may preferably be a DC motor, rotatably drives a side brush 3 during cleaning operations of the cleaning robot. The side brush 3 may be connected to the side brush motor 3 by a releasable connector, for example in the form of a snap fit mechanism that enables a user to readily pull out the side brush 3, and push back the side brush 3 thereon.

[0035] The side brush support mechanism 1 comprises a mount frame 5 which is adapted to be secured to a body of the autonomous cleaning robot to support the side brush support mechanism 1 thereon. A rotary motor 7 is supported on the mount frame 5, the motor 7 rotatably driving a drive shaft 12 extending outwardly from the mount frame 5 through a drive assembly 8 (see [fig. 3]). The drive assembly 8 may be in the form of a rotary worm gear having a system of gears for driving the shaft 15. Such a drive assembly 8 cannot be back driven. A cam member 11 is supported on and rotatably driven by the drive shaft 12. An actuation arm 9 is also pivotably supported at one end thereof on a stub shaft 14 extending from the cam member 11, the opposing end of the actuation arm 9 being connected to the side brush motor mounting member 10. A lug member 19 extends from one end of the actuation arm 9 for engaging a stop member 21 extending from the mount frame 5. The cam member 11 comprises a cam surface 12 for engaging a sensor 17, for example in the form of a limit switch supported on the mount frame 5. It is also envisaged that

other forms of sensors 17 be used for this application. Alternatively, a current sensor could be used to detect that the motor 7 has stalled when in the UP position. Extending from a side of the cam member 11 is an engagement member 13, which may be in the form of a shoulder bolt. That engagement member 13 is accommodated within an arcuate slot 23 provided within said one end of the actuation arm 9.

[0036] [Figs. 1 to 5] show the side brush support mechanism 1 in an elevated/up position where the cam member 11 has been rotated such that the cam surface 12 engages and actuates the limit switch 19 thereby preventing further rotation of the cam member 11. In this position of the cam member 11, the engagement member 13 engages an upper portion of the arcuate slot 23 thereby rotating the actuation arm 9 to an elevated position, while the lug member 19 engages the stop member 21. This arrangement thereby holds the actuation arm 9 in a relatively stationary position restricting further movement of the actuation arm 9. In this elevated position, the side brush 3 is also held in a stationary and elevated position which then facilities the user only requiring a single hand for removal and coupling of a side brush 3 with the side brush motor 2. The side brush 3 is interconnected to the drive shaft of the side brush motor 2 with a releasable connector 25 for this purpose.

[0037] In the down position of the side brush support mechanism 1, the cam member 11 is rotated in an opposite direction such that the cam surface 12 is disengaged with the limit switch 17, and the lug member 19 of the actuation arm 9 is disengaged with the stop member 21. The engagement member 13 is then able to travel relatively freely along the arcuate slot 23. This then allows a degree of play in the rotational movement of the actuation arm 9. This enables the side brush assembly 2 to move upwardly when the side brush 3 engages a low height obstacle during cleaning operations of the cleaning robot as the actuation arm 9 can now rotate upwardly in the down position of the side brush support mechanism 1. The side brush can be raised such that the clearance of the side brush 3 from the floor can preferably be at least 10mm, to go over humps on the floor being cleaned. This then minimises the possibility of damage to the side brush 3, and side brush motor 2 if the low height obstacle is not detected by the cleaning robot prior to coming into contact with the side brush 3. In the elevate position of the side brush support

mechanism 1, the side brush 3 can preferably be lifted between 20 – 30 mm from the supporting floor surface.

[0038] 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.

[0039] 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 side brush support mechanism for supporting a side brush of an autonomous cleaning robot, comprising:

a mount frame;

a rotatably driven drive shaft extending from the mount frame;

a cam member supported on the drive shaft and rotatably driven thereon;

an actuation arm rotatably supported at one end thereof on the drive shaft, the side brush being supportable at an opposing end of the actuation arm; and

an engagement member extending from the cam member accommodated within an arcuate slot provided at said one end of the actuation arm;

wherein the cam member is rotatable between an elevated position where the engagement member is positioned at an upper portion of the arcuate slot, the actuation arm further comprising a lug member for engaging a stop member located on the mount frame when the cam member is in the elevated position to thereby restrict movement of the actuation arm; and

wherein the cam member is rotatable to a down position where the lug member is disengaged with the stop member to thereby allow a degree of rotational movement of the actuation arm.

[Claim 2] A side brush support mechanism according to claim 1, wherein the cam member comprises a cam surface for engaging a limit switch supported on the mount frame to thereby prevent further rotation of the cam member.

[Claim 3] A side brush support mechanism according to claim 1, wherein the side brush is rotatably driven by a side brush motor supported on a side brush motor mounting member.

[Claim 4] A side brush support mechanism according to claim 3, wherein the side brush is releasably interconnected to the side brush motor by a releasable connector.

[Claim 5] A side brush support mechanism according to claim 3 or 4, wherein the opposing end of the actuation arm is connectable to the side brush motor mounting member.

[Claim 6] A side brush support mechanism according to claim 1, wherein the drive shaft is driven by a rotary motor assembly supported on the mount frame.

[Claim 7] A side brush support mechanism according to claim 1, wherein the rotary motor assembly comprises a rotary motor supported on the mount, and a drive assembly interconnecting the rotary motor with the drive shaft.

[Claim 8] A side brush support mechanism according to claim 1, wherein the engagement member comprises a shoulder bolt extending from a side face of the cam member.

[Claim 9] A side brush support mechanism according to claim 1, wherein the side brush is elevated at least 10mm from a floor surface supporting the cleaning robot when the side brush support mechanism is in the elevated position.

[Claim 10] A side brush support mechanism according to claim 1, wherein the side brush is elevated between 20 to 30 mm from a floor surface supporting the cleaning robot when the side brush support mechanism is in the elevated position.

[Claim 11] A side brush assembly for an autonomous cleaning robot comprising:

a side brush support mechanism comprising a mount frame, a rotatably driven drive shaft extending from the mount frame, a cam member supported on the drive shaft and rotatably driven thereon; an actuation arm rotatably supported at one end thereof on the drive shaft, the side brush being supportable at an opposing end of the actuation arm; and an engagement member extending from the cam member accommodated within an arcuate slot provided at said one end of the actuation arm; and

a side brush supported by the side brush support mechanism;

wherein the cam member is rotatable between an elevated position where the engagement member is positioned at an upper portion of the arcuate slot, the

actuation arm further comprising a lug member for engaging a stop member located on the mount frame when the cam member is in the elevated position to thereby restrict movement of the actuation arm; and

wherein the cam member is rotatable to a down position where the lug member is disengaged with the stop member to thereby allow a degree of rotational movement of the actuation arm.

[Claim 12] A side brush assembly according to claim 11, wherein the cam member comprises a cam surface for engaging a limit switch supported on the mount frame to thereby prevent further rotation of the cam member.

[Claim 13] A side brush assembly according to claim 11, wherein the side brush is rotatably driven by a side brush motor supported on a side brush motor mounting member.

[Claim 14] A side brush assembly according to claim 13, wherein the side brush is releasably interconnected to the side brush motor by a releasable connector

[Claim 15] A side brush assembly according to claim 13 or 14, wherein the opposing end of the actuation arm is connectable to the side brush motor mounting member.

[Claim 16] A side brush assembly according to claim 11, wherein the drive shaft is driven by a rotary motor assembly supported on the mount frame.

[Claim 17] A side brush assembly according to claim 11, wherein the rotary motor assembly comprises a rotary motor supported on the mount, and a drive assembly interconnecting the rotary motor with the drive shaft.

[Claim 18] A side brush assembly according to claim 11, wherein the engagement member comprises a shoulder bolt extending from a side face of the cam member.

[Claim 19] A side brush assembly according to claim 11, wherein the side brush is elevated at least 10mm from a floor surface supporting the cleaning robot when the side brush support mechanism is in the elevated position.

[Claim 20] A side brush assembly according to claim 11, wherein the side brush is elevated between 20 to 30 mm from a floor surface supporting the cleaning robot

when the side brush support mechanism is in the elevated position.