TITLE OF INVENTION: MAGNETIC QUICK RELEASE INTERFACE FOR A CLEANING MACHINE

FIELD

[0001] The present invention relates to a magnetic quick release interface for a cleaning machine. While the present invention will be described with reference to its use in industrial and commercial floor cleaning machines including autonomous floor cleaning robots, it is to be appreciated that the invention is not limited to this application, and that other applications are also envisaged.

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] Commercially available autonomous floor cleaning robots typically dispense water with optional chemical additives onto the floor. This water, with or without the optional chemical additives, can for example be supplied to a rotary scrubbing pad or a cylindrical brush tool that can agitate and lift debris off of the floor. This leaves behind a water suspension of water, chemical, and debris on the floor, which must be carried away by the robot using other mechanisms such as by a squeegee assembly.

[0004] Therefore, the autonomous floor cleaning robots designed by the Applicant are typically provided with a concave squeegee assembly comprising a rear trailing squeegee, and a leading squeegee blade having slots for the suspension to pass therethrough. The suspension then passes into a vacuum cavity provided between the leading and trailing squeegee blades. An inlet of a vacuum source communicates with the cavity to thereby create low pressure within the cavity that sucks the suspension off the floor into the vacuum inlet. The trailing squeegee blade, that is in full edge contact with the floor, simultaneously scrapes along the suspension with

the vacuum cavity to ensure that most or all of that suspension is collected by the floor-cleaning robot.

[0005] Such squeegee assemblies must be regularly serviced and maintained because the leading and trailing squeegee blades experience friction with the floor during operation of the squeegee assembly. This friction cannot be reduced or eliminated, because reducing contact pressure would reduce the suspension removal efficacy. That ffriction can therefore lead to wear of the leading and trailing squeegee blades which can degrade the squeegee surfaces in contact with the floor. This can result in a reduction in the efficacy of suspension removal, leading to more suspension being left on the floor. Furthermore, in the process of suspension removal, debris inevitably remains on the squeegee blades, and or within the vacuum cavity. Accumulation of debris reduces cleaning efficacy as the airflow to the vacuum inlet could be impacted. This can result in accelerated debris build up, and more suspension being left on the floor.

[0006] It is therefore necessary to conduct regular maintenance of the squeegee assembly. This requires the user of the floor cleaning robot to regularly access and clean the squeegee assembly. This can however be difficult to do as it is typically difficult to disassemble the floor cleaning robot or requires multiple steps to get access to the squeegee assembly.

[0007] While the use of fastening arrangements such as a manually actuated knob supported on a threaded post extending from the floor tool has been considered, this arrangement can also be difficult to access and align correctly and can take time to release and reengage due to the need to manually tighten and loosen the knob.

[0008] Another step associated with the maintenance process on an autonomous floor-cleaning robot, is the need for an additional step that requires the user to properly inform the robot when a tool is swapped. This can however lead to errors arising in the operation of the floor cleaning robot. For example, if the user swaps the squeegee assembly with a dry mop pad, this can create errors that would impact the robot’s efficacy or cause unwanted effects. If the robot is not informed of this swap and is unaware that there is no squeegee assembly that would remove water from

the floor, then the robot will continue to supply water on the basis that the squeegee assembly is still present. This can then result in excess water being dispensed from the robot everywhere, causing hazards to users and a potential loss of business via liquidated damages and or loss of reputation.

[0009] An object of the invention is to ameliorate one or more of the above-mentioned difficulties.

SUMMARY

[0010] According to an aspect of the present disclosure, there is provided a magnetic quick release interface for a cleaning machine comprising:

a connection interface supportable on the cleaning machine;

a floor tool interface supportable on a floor tool;

a magnetic assembly for connecting the floor tool interface to the connection interface, the magnetic assembly including at least one magnetic element and at least one ferromagnetic component respectively supported by the floor tool interface and the connection interface; and

an alignment arrangement for ensuring correct alignment of the floor tool on the cleaning machine.

[0011] In some embodiments; the at least one magnetic element is supported on the connection interface.

[0012] In some embodiments, the at least one magnetic element is a permanent magnet.

[0013] In some embodiments, the at least one magnetic element is a cylindrical magnet having magnetic poles at opposing ends of the magnet.

[0014] In some embodiments; the at least one ferromagnetic component is a ferromagnetic plate secured to the floor tool.

[0015] In some embodiments; the alignment arrangement comprises at least one lug extending generally laterally from the floor tool interface and/or the connection interface, and at least one cooperating cavity for accommodating the at least one lug therein when the floor tool is correctly aligned with the connection interface.

[0016] In some embodiments, the at least one lug is located on and extend generally laterally from the connection interface, and the at least one cooperating cavity is provided on the floor too interface.

[0017] In some embodiments, the alignment arrangement comprises a plurality of asymmetrically located said lugs.

[0018] In some embodiments, the floor tool is a squeegee assembly, and the alignment member is a suction hose connection nozzle extending from the floor tool, the suction hose connection nozzle being located within a cooperating generally ‘U’ shaped slot provided on the connection interface when the floor tool is correctly aligned.

[0019] In some embodiments, the floor tool and connection interface further comprises at least one alignment mark for providing a visual indication of correct alignment.

[0020] In some embodiments; the floor tool further comprises a contactless identifier for identifying the floor tool.

[0021] In some embodiments; the identifier is an NFC or RFID device.

[0022] In some embodiments; the identifier is a colour strip or barcode visual marking.

[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] [Figures 1a and 1b] are perspective views of a magnetic quick release interface according to the present disclosure showing a floor tool in the form of a squeegee assembly floor tool in a connected and release positions respectively;

[0026] [Figure 2] is a plan view of the squeegee assembly floor tool shown in [figures 1a and 1b];

[0027] [Figure 3] is a perspective view of the squeegee assembly floor tool shown in [figures 1a and 1b];

[0028] [Figure 4] is an underside view of a connection interface of the floor tool quick release interface of [figs. 1a and 1b]; and

[0029] [Figure 5] is a perspective view of an alternative floor tool in the form of a dry mop.

[0030] 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

[0031] 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”.

[0032] 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.

[0033] 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.

[0034] Throughout the specification, the term ‘cleaning machine’ refers to domestic, industrial and commercial cleaning machines including autonomous cleaning robots.

[0035] Throughout the specification, the term ‘floor tool’ refers to devices that can be installed on a cleaning machine including an autonomous floor-cleaning robot, and can include but is not limited to the following devices:

- squeegee assembly for collecting water accumulated on a floor surface and for directing the collected water towards a suction outlet to carry away the water;

- dry mop pad tool for wiping the floor in a trail behind the cleaning robot;

- sensor assembly for mounting a sensor package for monitoring cleaning efficacy, and/or floor surface flatness, during a cleaning audit;

- floor UVC disinfection module for shining UVC light along traversed path to disinfect an area from biological contaminants;

- dry vacuum assembly for making use of the existing vacuum provided by the cleaning robot to act as a robotic vacuum cleaner. The squeegee blades of the cleaning robot can be replaced with bristles instead to work in association with the dry vacuum assembly;

- wet mop pad tool for releasing liquid on to floor, to be mopped by the trailing mop pad, for chemical/liquid-based cleaning activities;

- tow linkage for towing a small payload behind the robot such as a bin, food

trolley, cleaning carts etc; and

- use and throw (single use) disinfectant wipes for specific environments (e.g. hospitals)

[0036] [Figs. 1a and b] respectively show a magnetic quick release interface 1 for a cleaning machine, with [fig. 1a] showing a floor tool 3, in the form of a squeegee assembly, connected to a connection interface 5 of the cleaning machine such as a cleaning robot (not shown), and [fig. 1b] showing the floor tool 3 separated from the connection interface 5. The connection interface 5 is connectable to a floor tool interface 9 that is part of the floor tool 3. The connection interface 5 is connected to the cleaning machine by a linkage assembly 11 connected to a support bracket 15 provided on the cleaning machine. This enables the floor tool 3 when connected to the connection interface 5 to be displaced upwardly and downwardly via a separate actuation mechanism acting (not shown) on the linkage assembly 11. The connection interface 5 is in the form of a plate having a planar underside 6 and a 'U' shaped slot 17, the purpose of which will be subsequently described.

[0037] The magnetic quick release interface 1 includes a magnetic arrangement 7 respectively provided on the connection interface 5 and the floor tool interface 9. That magnetic arrangement 7 can include one or more magnetic elements (not shown) that may be installed on or within the connection interface 5. The magnetic elements may be coated with a rubber or other protective layer to prevent the magnetic elements from being exposed to water that can lead to corrosion of the magnetic elements. The magnetic arrangement 7 further includes a ferromagnetic component 21 that may be in the form of a ferromagnetic plate secured to the floor tool 3 and providing part of the floor tool interface 9. It is also envisaged that the magnetic elements be installed on both the connection interface 5 and the floor tool interface 9 or only on the floor tool interface 9. It is also envisaged that the ferromagnetic component 21 may be installed on both the floor tool interface 9 and the connection interface 5 or only on the connection interface 5. The force between the magnetic element(s) and the ferromagnetic component 21 may be strong enough

that it can hold up the floor tool 3 during movement of the cleaning robot, but not too strong that user would have difficulty removing it with one hand.

[0038] The magnetic elements may be selected based on the connection requirements for the floor tool interface 9 and the connection interface 5. For example, the magnetic arrangement may be provided by a pair of magnet assemblies, each assembly having a ring of smaller magnets arranged radially, and attached to the connection interface 5 by a central fastener. Alternatively, this magnetic arrangement could be replaced by a pair of single magnets with a fastener, or a magnetic strip spanning the length of the floor tool 3. The ferromagnetic component 21 of the floor tool interface 9 can be attracted to the magnetic elements provided on or within the connection interface 5. This floor tool interface 9 could however be replaced with a greater number of magnetic assemblies as previously described. This arrangement could increase the resultant magnetic force between thew connection and floor tool interfaces 5,9. The magnets may also be arranged asymmetrically on the interface(s) 5,9 to force a single orientation of attachment of the interfaces 5,9. Magnetic elements may only exert a vertical force on the ferromagnetic component. It is however also envisaged that cylindrical magnets be used as magnetic elements, with the north and south poles split axially letting the magnets exert a horizontal self-aligning force since each pair of interacting magnets will align themselves concentric to each other.

[0039] The magnetic quick release interface 1 may also be provided with an alignment arrangement 20 for ensuring correct alignment of the floor tool interface 9 with the connection interface 5. The alignment arrangement 20 includes one or more lugs 23 located on an extending laterally from the planar underside 6 of the connection interface 5 as shown in [fig. 4]. There may for example be provided two or more asymmetrically positioned lugs 23 located on the connection interface 5. Each lug 23 may have a rounded tip and may be generally frustoconical in shape. This facilitates the engagement of these lugs to cooperating cavities 25 provided on the floor tool interface 9 thereby providing a degree of self-alignment of the interfaces 5,9. The cavities 25 may be provided with conical edges to assist in this self-alignment. The asymmetric positioning of the lugs 23 also ensures that the floor tool interface 9 can only engage the control interface 5 when the floor tool is in the correct

position. The abovenoted alignment arrangement also ensures floor tool 3 cannot slide backwards when floor tool 3 is in contact with the floor and the cleaning robot is moving. The lugs 23 may consist of a male metal dowel extending from the connection interface 5. Alternatively, the lugs 23 may be provided by a screw thread or other protrusion from the connection interface 20.It is also envisaged that the connection interface 5 and floor tool interface 9 be providing with matching asymmetric concave and convex curved engagement surfaces to achieved the necessary alignment therebetween.

[0040] The floor tool 3, when in the form of a squeegee assembly as shown in [figs. 2 and 3] includes a squeegee main mount 27 and a squeegee cartridge 29 to which are secured a pair of squeegee blade 31 used to form a seal along the floor for allowing the suction of water and other matter therefrom. A suction hose attachment nozzle 33 extends upwardly from the floor tool 3 when in its installed position. The suction hose attachment nozzle 33 will engage the 'U' shaped slot 17 of the connection interface 5 to thereby act as a further aligning feature to assist in the proper alignment of the floor tool 3.

[0041] The floor tool 3 may have visual alignment guides 35 which ned to be aligned by the user to a corresponding visual alignment guide 34 provided on the connection interface 5. This aids the user in correctly aligning the floor tool interface 9 to the connection interface 5 such that the alignment features let the floor tool 3 be pulled up by the magnetic elements of the connection interface 5.

[0042] The floor tool interface 9 can be provided on other floor tools. [Fig. 5] shows a dust mop assembly 3A consisting of a dust mop mounting plate 35 and a dust mop pad 37. The dust mop assembly 3A is also provided with a floor tool interface 9 to enable connection to the connection interface 5 of a cleaning machine. This allows the user to easily switch between different floor tools provided with the same floor tool interface 9.

[0043] Each of the floor tools 3,3A may also be provided with a tool type identifier 30 which may be located on an upper surface of the floor tool 3,3A. That identifier 30 may provide for contactless identification by the cleaning machine using technical features such as NFC and RFID, or visual features such as colour strips, or barcodes.

This allows the cleaning machine to detect the presence and type of floor tool connected to the connection interface 5.

[0044] The magnetic quick release interface according to the present disclosure provides the following advantages to the user of the cleaning robot having this interface. There is less down time of the cleaning robot during floor tool assembly and servicing, as the entire floor tool assembly can be swapped with a ready to use one thereby Increasing the cleaning productivity of the cleaning robot. There is also less down time in between floor tool changes, for example between a squeegee assembly and a mop pad. No workshop tools like screwdrivers, are required to remove the floor tool for servicing. No stocking or management of items such as screws and knobs through the loss of that item is required when removing the floor tool for servicing. As no screws are required for the magnetic quick release interface, problems resulting from damaged screws such as cross-threading, or over tightening, or loss of the screws is avoided. Furthermore, no judgment of tightness of screws/knobs is required, which could lead to unintended detachment of the floor tool due to under tightness, or inconvenient detachment of tool assembly due to over tightness. The magnetic quick release interface according to the present disclosure may also provide for one handed operation, as vertical magnetic force may be easy to overcome, when detaching and reattaching the floor tool. The magnetic force automatically attaches the floor tool interface to the connection interface without additional actions/tools beyond sliding the floor tool into position with visual guidance. There may also be no risk of wrong tool type initialized, by means of forgetting to change the tool type on the robot interface if the identifier according to the present disclosure is used.

[0045] The manufacturer and retailer of cleaning robots using the magnetic quick release interface according to the present disclosure may also be provided with the following advantages. The maintainability of these cleaning robots may be facilitated by the offsite replacement of parts susceptible to wear, such as the squeegee blades. The standardisation of the magnetic quick release interface allows for new floor tools to be developed and be backward compatible. The use of magnetic attraction only requires that the floor tool interface be provided with a ferromagnetic component having standardised alignment features to ensure compatibility, and without requiring

additional machining that a screw thread would require, thereby reducing manufacturing cost and time. There may also be more uptime, and less unintended efficacy issues, because the cleaning robot and the tool type identifier on the tools take the responsibility of initializing the cleaning equipment, away from the user.

[0046] 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.

[0047] 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 magnetic quick release interface for a cleaning machine comprising:

a connection interface supportable on the cleaning machine;

a floor tool interface supportable on a floor tool;

a magnetic assembly for connecting the floor tool interface to the connection interface, the magnetic assembly including at least one magnetic element and at least one ferromagnetic component respectively supported by the floor tool interface and the connection interface; and

an alignment arrangement for ensuring correct alignment of the floor tool on the cleaning machine.

[Claim 2] A magnetic quick release interface for a cleaning machine according to claim 1, wherein the at least one magnetic element is supported on the connection interface.

[Claim 3] A magnetic quick release interface for a cleaning machine according to claim 2, wherein the at least one magnetic element is a permanent magnet.

[Claim 4] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the at least one magnetic element is a cylindrical magnet having magnetic poles at opposing ends of the magnet.

[Claim 5] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the at least one ferromagnetic component is a ferromagnetic plate secured to the floor tool.

[Claim 6] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the alignment arrangement comprises at least one lug extending generally laterally from the floor tool interface and/or the connection interface, and at least one cooperating cavity for accommodating the at least one lug therein when the floor tool is correctly aligned with the connection interface.

[Claim 7] A magnetic quick release interface for a cleaning machine according to claim 6, wherein the at least one lug is located on and extend generally laterally from the connection interface, and the at least one cooperating cavity is provided on the floor too interface.

[Claim 8] A magnetic quick release interface for a cleaning machine according to claim 7, wherein the alignment arrangement comprises a plurality of asymmetrically located said lugs.

[Claim 9] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the floor tool is a squeegee assembly, and the alignment member is a suction hose connection nozzle extending from the floor tool, the suction hose connection nozzle being located within a cooperating generally ‘U’ shaped slot provided on the connection interface when the floor tool is correctly aligned.

[Claim 10] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the floor tool and connection interface further comprises at least one alignment mark for providing a visual indication of correct alignment.

[Claim 11] A magnetic quick release interface for a cleaning machine according to any one of the preceding claims, wherein the floor tool further comprises a contactless identifier for identifying the floor tool.

[Claim 12] A magnetic quick release interface for a cleaning machine according to claim 11, wherein the identifier is an NFC or RFID device.

[Claim 13] A magnetic quick release interface for a cleaning machine according to claim 11, wherein the identifier is a colour strip or barcode visual marking.