HARD AND SOFT FLOOR SURFACE CLEANER

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ABSTRACT
A floor cleaner configured to perform both hard and soft floor cleaning operations includes a mobile body, a motorized cleaning head, a cleaning liquid dispenser, a vacuum, a first vacuum extractor tool and a vacuum squeegee connected to the mobile body. The mobile body is configured to travel over a surface. The motorized cleaning head is connected to the mobile body and includes a cleaning tool. The cleaning liquid dispenser is configured to apply a cleaning liquid to the surface or the cleaning tool. The first vacuum extractor tool is configured for vacuum communication with the vacuum through a first vacuum path.
HARD AND SOFT FLOOR SURFACE CLEANER
CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application is based on and claims the benefit of U.S. provisional patent application Ser. No. 60/669,054, filed Apr. 7, 2005, the content of which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention generally relates to a floor cleaning machine and, more particularly, to a floor cleaning machine that is configurable to perform both hard and soft floor cleaning operations.

BACKGROUND OF THE INVENTION

[0003] Mobile floor cleaners, such as those produced by Tennant Company of Minneapolis, Minnesota, are generally designated as either a soft floor cleaner configured to perform a cleaning operation on a soft floor (e.g., carpet, rugs, etc.), or a hard floor cleaner configured to perform a cleaning operation on a hard floor surface (e.g., tile, linoleum, cement, etc.).

[0004] Soft floor cleaning operations include soil transfer and deep extraction cleaning operations. U.S. Pat. No. 6,735,812, which is assigned to Tennant Company, describes a dual mode cleaner that is configurable to perform both soil transfer and deep cleaning extraction operations on a carpeted surface.

[0005] Soil transfer cleaning operations utilize special cylindrical rollers to which a cleaning solution is applied with pumps and spray heads. When the rollers are rotated against a surface, soil is transferred to the rollers and the soil cleaning liquid is subsequently suctioned from the rollers with vacuum extractor tools. This technology can be used to clean various fabric surfaces. The roller design, rotational speed, pressure, vacuum parameters and cleaning liquid flows can be altered in the same machine to optimize cleaning for the particular carpet or fabric. The cleaning liquid can be minimized to reduce drying time while still providing effective interim cleaning of carpet, thereby allowing a space to be ready for use in less than one hour.

[0006] Deep cleaning extraction cleaning operations are typically performed less frequently than the soil transfer cleaning operation. The deep cleaning extraction operation generally performs a more thorough cleaning of a carpeted surface. During such a cleaning operation, a relatively large amount of cleaning solution is sprayed directly onto the carpeted or soft floor surface. The carpet is scrubbed with brushes designed for the surface and soiled liquid is extracted from the carpet with one or more vacuum extractor tools located behind the brushes. Carpets cleaned with the deep cleaning extraction operation require considerably longer drying times before use than carpets cleaned with the soil transfer method.

[0007] Hard floor surface cleaning operations are performed by hard floor surface cleaners that generally employ scrubbing brushes and a vacuumized fluid recovery system positioned behind the scrubbing brushes. A cleaning liquid is typically sprayed directly to the floor and/or on the brushes and the hard floor surface is scrubbed with the brushes. The vacuumized fluid recovery system typically includes a vacuum squeegee that collects the soiled cleaning liquid and delivers the soiled cleaning liquid to a recovery tank. The vacuum squeegee removes substantially all of the liquid waste left by the scrubbing brushes from the hard floor surface, leaving the surface ready for use almost immediately.

[0008] Cleaning operations on spaces having a mixture of soft floor surfaces and hard floor surfaces have generally required separate soft and hard floor cleaning machines. Such a requirement is costly in terms of the time required to complete the multi-surface cleaning operations and the maintenance and storage of multiple machines.

SUMMARY OF THE INVENTION

[0009] The present invention generally relates to a floor cleaner configured to perform both hard and soft floor cleaning operations. The cleaner generally includes a mobile body, a motorized cleaning head, a cleaning liquid dispenser, a vacuum, a first vacuum extractor tool and a vacuum squeegee connected to the mobile body. The mobile body is configured to travel over a surface. The motorized cleaning head is connected to the mobile body and includes a cleaning tool. The cleaning liquid dispenser is configured to apply a cleaning liquid to the surface or the cleaning tool. The first vacuum extractor tool is configured for vacuum communication with the vacuum through a first vacuum path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a perspective view of a floor cleaner 100 in accordance with embodiments of the invention.

[0011] FIG. 2 is a side view of a floor cleaner 100 in accordance with embodiments of the invention.

[0012] FIG. 3 is a block diagram of a floor cleaner in accordance with embodiments of the invention.

[0013] FIG. 4 is a simplified block diagram of embodiments of the cleaner in soil transfer mode of operation with the mobile body and other components removed.

[0014] FIG. 5 is a simplified block diagram of embodiments of the cleaner in deep extraction cleaning mode of operation with the mobile body and other components removed.

[0015] FIG. 6 is a simplified block diagram of embodiments of the cleaner in hard floor scrubbing mode of operation with the mobile body and other components removed.

[0016] FIG. 7 is a simplified block diagram of embodiments of the cleaner in hard floor scrubbing mode of operation with the mobile body and other components removed.

[0017] FIG. 8 is a block diagram of a cleaning liquid dispenser in accordance with embodiments of the invention.

[0018] FIG. 9 is a block diagram of a soft and hard floor cleaning liquid dispensers in accordance with embodiments of the invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0019] The present invention relates to a floor cleaner 100 that is configurable for performing both hard floor cleaning
operations and soft floor cleaning operations. FIGS. 1-3 respectively show a perspective view of the floor cleaner, a side view of the cleaner and a block diagram of the floor cleaner, in accordance with embodiments of the invention.

[0020] As will be discussed below in greater detail, embodiments of the cleaner 100 include a soil transfer cleaning mode in which the cleaner 100 is configured to perform a soil transfer cleaning operation on a floor surface 102 (i.e., a soft floor surface) and/or an deep extraction mode, in which the cleaner 100 is configured to perform a deep extraction cleaning operation on the surface 102. Additionally, one embodiment of the cleaner 100 includes a hard floor scrubbing mode, in which the cleaner 100 is configured to scrub the floor surface 102 (i.e., a hard floor surface 102) and remove liquid waste and debris with a fluid recovery system.

[0021] The floor cleaner 100 shown in FIGS. 1 and 2 is configured for use by an operator that walks behind the cleaner 100. A control panel 104 provides various settings for controlling the operation of the cleaner 100. Alternatively, the cleaner 100 may be designed as a ride-on cleaner, or towed behind cleaner. The cleaner 100 may be powered through an on-board power source, such as batteries or an internal combustion engine, or powered through an electrical cord.

[0022] Embodiments of the floor cleaner 100 generally include a mobile body 106, a motorized cleaning head 108, a cleaning liquid dispenser 110, one or more vacuums 112, at least one vacuum extractor tool 114 and a vacuum squeegee 116.

[0023] One embodiment of the mobile body 106 comprises framework for supporting the various components of the cleaner 100. The mobile body 106 supported on drive wheels 118 and caster wheels 120 for travel over the surface 102. In one embodiment, the drive wheels are driven by a motor 122. A housing 124 encloses many of the components of the cleaner 100 that are supported on the mobile body 106. Some of the components (e.g., batteries, tanks, etc.) can be accessed by opening a cover 126.

[0024] The motorized cleaning head 108 is connected to the mobile body 106. In one embodiment the motorized head is positioned at a forward location of the cleaner 100, as shown in FIGS. 1 and 2. However, the cleaning head 108 can also be positioned at other locations relative to the mobile body 106, such as central and rearward locations of the cleaner 100.

[0025] The cleaning head 108 includes a cleaning tool 128 and one or more motors 130 for driving rotation of the cleaning tool 128 about an axis that is either parallel or perpendicular to the surface 102. The rotating cleaning tool 128 engages the surface 102 to perform a hard or soft floor cleaning operation, as indicated by arrow 131 in FIG. 3.

[0026] In accordance with one embodiment of the cleaner 100 includes a cleaning head lift 132 configured to lower the cleaning head 108 for floor cleaning operations and raise the cleaning head 108 when not in use, such as during transport of the cleaner 100. One embodiment of the head lift 132, shown in FIG. 2, includes a motorized screw drive 133 coupled to the head through a suitable linkage 135, which pivots the head 108 about a connection 137 to raise or lower the head 108 as desired.

[0027] One embodiment of the cleaning head 108 is configured for use with multiple types of cleaning tools 128 in order to accommodate different cleaning operations while using the same motors 130, for example. Thus, the cleaning head 108 can be equipped with a soft floor cleaning tool 128 to allow the cleaner to perform a soft floor cleaning operation. The soft floor cleaning tool 128 can then be replaced with a hard floor cleaning tool 128 to allow the cleaner 100 to perform a hard floor cleaning operation. Alternatively, the cleaner 100 is configurable with separate soft and hard floor cleaning heads 108 respectively including soft and hard floor cleaning tools 128.

[0028] As mentioned above, embodiments of the cleaner 100 include several different modes of operation including a soft transfer soft floor cleaning mode, a deep extraction soft floor cleaning mode, and at least two hard floor scrubbing modes. FIG. 4 is a block diagram of embodiments of the cleaner 100 in soil transfer mode of operation with the mobile body 106 and other components removed to simplify the illustration. In this embodiment, the cleaning tool 128 includes one or more soil transfer rolls 134, shown in FIGS. 1, 2 and 4, that are driven by one or more motors 130 to respectively rotate the rolls 134 about their horizontal axes in the directions indicated by arrows 136 and 138, shown in FIG. 4, during soil transfer cleaning operations on the soft floor surface 102.

[0029] FIG. 5 is a simplified block diagram of embodiments of the cleaner 100 in a deep extraction soft floor cleaning mode of operation with the mobile body 106 and other components removed. In this embodiment, the cleaning tool 128 includes one or more deep extraction brushes 140 that are dedicated for use in a deep extraction soft floor cleaning operation. Exemplary deep extraction brushes 140 are shown in FIG. 5, which and are respectively driven by one or more motors 130 for rotation about their horizontal axes in the directions indicated by arrows 142 and 144 during deep extraction cleaning operations on the soft floor surface 102.

[0030] FIG. 6 is a simplified block diagram of embodiments of the cleaner 100 in hard floor scrubbing mode of operation with the mobile body 106 and other components removed. In accordance with this embodiment, the cleaning tool 128 includes one ore more hard floor scrub brushes 146 dedicated to performing a hard floor cleaning operation. An exemplary hard floor scrub brush 146 is shown in FIG. 6, that is configured to rotate about a vertical axis 148 as indicated by arrow 150, during a scrubbing operation on hard floor surface 102. In one embodiment, at least one other scrub brush is positioned adjacent the depicted scrub brush 146 to expand the width of the scrubbing swath covered by the cleaning head 108.

[0031] FIG. 7 is a simplified block diagram of embodiments of the cleaner 100 in a second hard floor scrubbing mode of operation, in which the cleaning tool 128 includes “hybrid” rolls 152 configured to perform soil transfer soft floor cleaning operations and hard floor scrubbing operations respectively on soft and hard floor surfaces 102. In one embodiment, the hybrid rolls 152 are driven by one or more motors 130 for rotation about their horizontal axes in the directions indicated by arrows 154 and 156, during the cleaning operations.

[0032] The one or more vacuums 112 each generally include a motor 158 and vacuum fan 160 (FIG. 2). The
vacuum fan(s) 112 is used in combination with the at least one vacuum extractor tool 114 to remove liquid and solid waste 162 (i.e., soiled cleaning liquid) from the cleaning tool 128 of the cleaning head 108 and/or the surface 102, as respectively indicated by arrows 164 and 166. One vacuum 112 also operates with the vacuum squeegee 116 to remove waste 162 from the surface 102, as indicated by arrow 168. The waste 162 is then deposited in one or more waste recovery tanks 170 or other location, as will be described in greater detail below.

[0033] In accordance with one embodiment, the vacuum 112 is selectively placed in vacuum communication with the vacuum squeegee 116 and the vacuum extractor tool 114 using a vacuum path selector 172. Vacuum communication is intended to mean that a vacuum path is opened between the component (i.e., squeegee or extractor tool) and the low pressure vacuum generated by the vacuum 112. Once established, the vacuum communication allows for liquid and/or solid waste 162 to be sucked up through an opening of the vacuum squeegee 116 and/or the extractor tool 114 and deposited in the waste recovery tank 170, as indicated in FIG. 3. Embodiments of the vacuum path selector 172 include one or more valves (e.g., multi-way valve, Y-valves) and other conventional vacuum path controlling components. The vacuum paths 173, such as vacuum path 174, coupled to the vacuum squeegee 116 or vacuum path 176 coupled to the extractor tool 114, are formed by vacuum conduit or tubing. In accordance with one embodiment, multiple components or paths can be placed in vacuum communication with the vacuum 112 using the vacuum path selector 172.

[0034] In accordance with another embodiment, the cleaner 100 includes separate vacuums 112 for the vacuum squeegee 116 and the extractor tool. With such a configuration, the vacuum path selector may be discarded or disconnected from the vacuum path of the vacuum squeegee 116.

[0035] In another embodiment, vacuum ports corresponding to the various vacuum paths 173 are made accessible by the operator of the cleaner 100. The coupling of one of the vacuum ports to the vacuum port that is in vacuum communication with the vacuum 112 can be made by manually connecting a tubing section to the appropriate ports.

[0036] The vacuum extractor tool 114 can take on various conventional forms depending on its purpose. The extractor tool generally extends widthwise across the surface 178 of the cleaning tool 128 or the surface 112, from which waste 162 is to be extracted. Multiple extractor tools 114 can be used to cover large widths. It is understood by those skilled in the art that extractor tools 114 are used for removing liquid and solid debris from soft surfaces 102, such as soft floor surfaces and soft soil transfer roll surfaces, and they do not include a squeegee that would render them operable on hard floor surfaces.

[0037] One embodiment of the extractor tool 114 is in the form of a roll extractor tool 180, two of which are shown in FIGS. 1 and 4. Each of the roll extractor tools 180 removes liquid and solid waste 162 from one of the soil transfer rolls 134. The extracted waste travels through vacuum path 182, having branches 184 and 186 and is deposited in the waste recovery tank, as illustrated in FIGS. 1, 3 and 4.

[0038] Another embodiment of the extractor tool 114 is in the form of a surface extractor tool 188 that is configured to remove liquid and solid waste 162 from the surface 102. The extracted waste 162 travels through vacuum path 190 and is deposited in the waste recovery tank 170, as illustrated in FIG. 5.

[0039] In accordance with one embodiment, the cleaner 100 includes an extractor tool lift 192 that allows the surface extractor tool 188 to be raised above the surface 102 (as shown in FIGS. 1, 6, and 7) when not in use and lowered into an operating position (shown in FIGS. 1 and 5) for use in a deep extraction cleaning operation, in which the surface extractor tool 188 engages the surface 102. One exemplary extractor tool lift 192, shown in FIG. 2, includes a main support 194 connected to either the cleaning head 108 or the mobile body 106. The surface extractor tool lift 192 also includes guide members 196 attached to the surface extractor tool 188 that slide within slots in a side plate 198 of the main support 194. A second side set of guide members and side plate are provided on the opposing side of the extractor tool lift and surface extractor tool. A spring 200, compressed between a top surface of the surface extractor tool 188 and the bottom surface of a cross plate 202 of the main support 194, biases the surface extractor tool 188 in the lowered or operating position. The surface extractor tool 188 can be held in the raised position manually using a locking mechanism 204 (e.g., a pin) or a suitable actuator mechanism. Alternatively, the extractor tool lift 192 can include a motor to raise and lower the surface extractor tool 188.

[0040] The vacuum squeegee 116 is a component of a fluid recovery device that is conventionally used only in dedicated hard floor surface cleaners. The vacuum squeegee 116 generally comprises a squeegee 210 connected to frame 212. The squeegee 210 extends across the width of the cleaner 100 or the cleaning swath of the cleaning head 108. A vacuum port 214 is positioned to receive waste collected by the squeegee 210, such as, for example, adjacent the surface 102 at the widthwise center of the squeegee 210. During operation, the squeegee 210 engages the surface 102 and collects soiled cleaning liquid waste 162 as the cleaner 100 moves along the surface 102 in a forward direction, as indicated by arrow 216 in FIG. 6. One embodiment of the squeegee 116 includes a concave shape that directs the collected soiled cleaning liquid waste 162 toward the vacuum port 214. When vacuum communication is established between the vacuum port 214 and the vacuum 112, the waste 162 is sucked through the vacuum port 214 and the connected vacuum path 174 and deposited into the recovery tank 170, as illustrated in FIGS. 3 and 6.

[0041] A squeegee lift 217, shown in FIG. 2 and schematically in FIG. 3, is used to move the vacuum squeegee 116 from a raised position off the surface 102 (shown in FIGS. 2, 4, and 5) to a lowered operating position (shown in FIGS. 6 and 7), in which the squeegee engages the surface 102. One exemplary embodiment of the squeegee lift 217 includes a cable 218 having one end connected to the frame 212 and another end connected to an actuating lever 220. The frame 212 is coupled to the mobile body 106 through a suitable pivotal connection (not shown). The operator of the cleaner 100 can raise and lower the vacuum squeegee 116 as desired using the actuating lever 220 which causes the frame 212 and the attached squeegee 210 to move about the pivotal connection to the raised or operating positions. A castor wheel 222 can be coupled to the frame 212 to limit the height at which the squeegee 210 can be lowered.
[0042] The cleaning liquid dispenser 110 is configured to apply a cleaning liquid 230 to one of the surface 102 and the cleaning tool 128 and respectively indicated by arrows 230A and 230B of FIG. 3. FIG. 8 is a block diagram of the cleaning liquid dispenser 110 in accordance with embodiments of the invention.

[0043] One embodiment of the cleaning liquid dispenser 110 includes a supply of the cleaning liquid 230 and a pump 232 for driving a flow of the cleaning liquid 230 (arrows) cleaning liquid through tubing to be discharged at a desired location. The cleaning liquid 230 can comprise water or a combination of water and a cleaning agent. In one embodiment, separate supplies of water 234 and cleaning agent 236 are provided. The water 234 can be stored in a tank supported on the mobile body 106, while the cleaning agent is provided in a separate container, such as a fixed tank or removable container or cartridge. A mixing member 238 combines a flow of water 240 with a flow of the cleaning agent 242 at a desired dosage to form the flow of cleaning liquid 230.

[0044] The dosing of the flow of cleaning agent 242 into the flow of water 240 can be accomplished using a venturi injector or through use of a dosing pump 244. In accordance with one embodiment, the flow of cleaning agent 242 is less than 10.0 cubic centimeters per minute.

[0045] In order to accommodate different cleaning liquids and different cleaning liquid flow rates that may be desired for soft and hard floor cleaning operations, one embodiment of the cleaning liquid dispenser 110 includes separate soft and hard floor cleaning liquid dispenser 250 and 252, respectively. The cleaning liquid dispensers 250 and 252 generally have the form of the embodiments of the cleaning liquid dispenser 110 described above, but can share components, such as pumps and the water supply, for example. In one embodiment, the soft floor cleaning liquid dispenser 250 utilizes a different cleaning agent and/or provides a lower volumetric flow rate of cleaning liquid 230S than the flow of the cleaning liquid 230H of the hard floor cleaning liquid dispenser 252. The lower volumetric flow rate is essential in soft floor cleaning operations in order to prevent long drying times for the soft floor surface 102 and to prevent the development of mold. Additionally, hard floor surface 102 cleaning operations generally desire a complete wetting of the hard floor surface 102 in order to remove embedded or debris that has dried on the surface 102. If necessary, a valve 254 can be used to switch between the flow of soft floor cleaning liquid 230S and the flow of hard floor cleaning liquid 230H.

[0046] Another embodiment of the cleaning liquid dispenser 110 includes one or more nozzles, or other fluid distributor, for discharging the flow of cleaning liquid 230 to the desired location. In one embodiment, the cleaning liquid dispenser 110 includes one or more nozzles 260 or tubing for directing the flow of cleaning liquid 230 onto the cleaning tool 128, such as the soil transfer rolls 134 (FIG. 4) or the hard floor scrub brush (FIG. 6). In accordance with another embodiment, the cleaning liquid dispenser 110 includes one or more nozzles 262 for directing the cleaning liquid 230 onto the surface 102, preferably in front of the cleaning tool 128. In yet another embodiment, the cleaning liquid dispenser 110 includes one or more nozzles 264 for directing the cleaning liquid 230 onto both the surface 102 and the cleaning tool 128, as shown in FIGS. 4 and 5. One or more valves 266 can control the flow of cleaning liquid 230 to the desired nozzle or location.

[0047] In accordance with yet another embodiment of the invention, the cleaning liquid dispenser 110 is configured to dispense the flow of cleaning liquid 230 to the desired surface 102 as a foam. In general, soft floor cleaning operations utilize a dry foam to avoid overly wetting the soft floor surface 102 and long drying times, whereas hard floor surface cleaning operations may utilize a relatively wet foam that is suitable for completely wetting the hard floor surface 102. In accordance with one embodiment, at least one of the nozzles 260, 262 or 264 is an aeration nozzle that converts the flow of cleaning liquid 230 into a foam, which is then discharged to either the surface 102 in front of the cleaning tool 128, on the cleaning tool 128, or both. Alternatively, an aeration device located upstream of the nozzles can be used to convert the cleaning liquid into a foam.

[0048] Another aspect of the present invention is directed to methods of cleaning hard and soft floor surfaces 102 using embodiments of the cleaner 100 described above. As mentioned above, FIG. 4 illustrates embodiments of a soil transfer soft floor cleaning mode operation for the cleaner 100. Initially, the soil transfer rolls 134 are installed in the cleaning head 108 and lowered to the operating position by the head lift 132, the vacuum squeegee 116 is moved to the raised position using the squeegee lift 217, and the surface extractor tool 114 is moved to the raised position using the tool lift 192, as shown in FIG. 4. Additionally, vacuum communication is established between the vacuum 112 and the roll extractor tools 180 through the paths 182, 184 and 186. Next, the soil transfer rolls 134 are wetted with cleaning liquid 230 discharged through nozzle 260, then extracted by operation of roll extractor tools 180 to remove soil cleaning liquid 162 from the rolls 134. Nozzle 264 can also be activated if desired to spray the surface 102 and/or the leading roll 134. The rolls are rotated by operation of the motor(s) 130 and wipe the surface 102, which transfers soil from the surface 102 onto soil transfer rolls 134. The rotation of the rolls 134 in the directions indicated by arrows 136 and 138 results in different portions of the soil transfer rolls 134 being wetted with the cleaning liquid 230, extracted by roll extractors 180, or wiped against the surface 102.

[0049] The roll extractors 180 engage the surfaces 178 of the rolls 134 and are placed in vacuum communication with the vacuum 112, which removes some of the just deposited cleaning liquid 230 and soil previously transferred from the surface 102. As a result, the wetness of the rolls 134 is reduced from the initially sprayed condition by the extraction of some of the cleaning liquid 230 by the roll extractors 180.

[0050] As the rolls 134 are revolved, they engage the soft floor (e.g., carpet fibers) 102 and cause soil to be transferred from the carpet fibers to the rolls 134. After engaging and wiping the surface 102, the rolls 134 are further rotated and sprayed again with cleaning liquid 230 by nozzle 260. Subsequently, the surfaces 178 of the rolls 134 are vacuum extracted to remove the soiled cleaning liquid 162 from the rolls 134, which is conveyed into the recovery tank 170.

[0051] FIG. 5 illustrates embodiments of a deep extraction cleaning mode of operation, in which the cleaner 100 functions similarly to known carpet extractors. If necessary,
the soil transfer rolls 134 are replaced with the extractor brushes 140, the cleaning head 108 and the surface extractor 188 are moved to their operating positions, and the vacuum squeegee 116 is moved to the raised position, as shown in FIG. 5. Additionally, vacuum communication is established between the vacuum 112 and the surface extractor tool 188 through the vacuum path 190. The cleaner 100 operates while moving in the forward direction indicated by arrow 216. The cleaning liquid dispenser 110 discharges cleaning liquid 230 to the surface 102 through nozzle(s) 264 or uses nozzle(s) 262 to direct cleaning liquid 230 onto both the surface 102 and the leading extractor brush 140. The extractor brushes 140 are driven via the motor(s) 130 to engage the floor surface 102 and transfer soil into a soiled cleaning solution 162. The extractor brushes 140 may include bristles to facilitate soil transfer. In one embodiment, the direction of rotation of the extractor brushes 140 is indicated by arrows 142 and 144. As the cleaner 100 progresses across the floor surface 102, the surface extractor 188 engages the wetted portion of the surface 102 to remove the soiled cleaning liquid 162 from the surface 102. The soiled cleaning liquid 162 is moved through the vacuum path 190 and into the waste recovery tank 170 by operation of the vacuum 112.

[0052] The deep extraction soft floor cleaning operation utilizes a larger volume of cleaning liquid 230 per unit area than the soil transfer cleaning operation performed by the cleaner 100. As a result, the surface 102 requires a longer drying time following a deep extraction cleaning operation than that required following a soil transfer cleaning operation. However, the drying times for both the deep extraction cleaning operation and the soil transfer cleaning operation can be reduced by utilizing the cleaning liquid in an aerated or foam state.

[0053] FIG. 6 illustrates embodiments of the hard floor scrubbing mode of operation for the cleaner 100. Initially, the hard floor scrub brush 146 is installed in the reconfigurable cleaning head 108, or a hard floor cleaning head 108 having the scrub brush 146 is attached to the mobile body 106. Also, the cleaning head 108 and the vacuum squeegee 116 are moved to their operating positions and the surface extractor tool 188 is moved to the raised position, as shown in FIG. 6. Vacuum communication is also established between the vacuum 112 and the vacuum port 214 of the vacuum squeegee 116 through the vacuum path 174. Next the cleaning liquid dispenser 110 wets the surface 102 with cleaning liquid 230 by discharging the cleaning liquid 230 through the nozzle 262 and/or wets the surface 102 and the scrub brush 146 by discharging cleaning liquid 230 through tubing 260 that is internal to the scrub brush 146. The motor 130 rotates the scrub brush 146 as it engages the wetted surface 102 and forms soiled cleaning liquid 162. As the cleaner 100 moves in the forward direction 216 the soiled cleaning liquid 162 is collected by the squeegee 210 and directed toward the vacuum port 214. The soiled cleaning liquid 162 is then sucked through the vacuum port 214, through the vacuum path 174 and discharged into the waste recovery tank 170.

[0054] When the cleaning tool 128 comprises hybrid rolls 152 configured for both soil transfer soft floor cleaning operations and hard floor cleaning operations, the cleaner 100 operates in substantially the same manner as described above with respect to the soil transfer cleaning mode of operation. The benefit of the hybrid rolls 152 is that they can be used to perform a hard floor cleaning operation. The conversion to the hard floor cleaning mode involves lowering the vacuum squeegee 116 to the operating position, establishing vacuum communication between the vacuum squeegee 116 and the vacuum 112 through the path 174 and discharging cleaning liquid 230 onto the surface 102, as shown in FIG. 7. The surface 102 is scrubbed by the rotating rolls 152. The soiled cleaning liquid left behind by the rolls is collected by the vacuum squeegee 116 and transferred to the waste recovery tank 170 through the path 174.

[0055] Additional embodiments of this hybrid hard floor cleaning mode include applying cleaning liquid 230 to the hybrid rolls 152 through, for example, nozzle(s) 260 or 262, and establishing vacuum communication between the vacuum 112 and the roll extractor tools 180 through the paths 182, 184 and 186. As a result, one embodiment includes extracting the soiled cleaning liquid 162 from the rolls 152 and transferring the soiled cleaning liquid 162 to the waste recovery tank 170 through the path 182.

[0056] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. What is claimed is:

1. A floor cleaner comprising:
   a mobile body configured to travel over a surface;
   a motorized cleaning head connected to the mobile body and comprising a cleaning tool;
   a cleaning liquid dispenser configured to apply a cleaning liquid to one of the surface and the cleaning tool;
   a vacuum supported on the mobile body;
   a first vacuum extractor tool configured for vacuum communication with the vacuum through a first vacuum path; and
   a vacuum squeegee connected to the mobile body.
2. The cleaner of claim 1, wherein the vacuum squeegee is configured for vacuum communication with the vacuum through a second vacuum path.
3. The cleaner of claim 1, wherein the cleaning tool comprises a hybrid floor surface cleaning tool.
4. The cleaner of claim 1, wherein the cleaning tool comprises a hybrid floor scrub brush.
5. The cleaner of claim 1, wherein the cleaning tool comprises a hybrid floor surface cleaning tool.
6. The cleaner of claim 5, wherein the cleaning tool comprises one of a soil transfer roller and a soft floor extraction brush.
7. The cleaner of claim 1, wherein the first vacuum extractor tool is configured to remove liquid from a surface of the cleaning tool.
8. The cleaner of claim 1, wherein the first vacuum extractor tool is configured to engage the surface.
9. The cleaner of claim 8, further comprising an extractor tool lift coupled to the first vacuum extractor tool, the lift mechanism configured to move the first vacuum extractor tool relative to the mobile body between a raised position, in which the first vacuum extractor tool is displaced from the surface, and an operating position, in which the first vacuum extractor tool engages the surface.
10. The cleaner of claim 2, further comprising a second vacuum extractor tool configured for vacuum communication with the vacuum.

11. The cleaner of claim 10, wherein the first and second vacuum extractor tools are each configured to engage the cleaning tool.

12. The cleaner of claim 10, wherein:
   the first vacuum extractor tool is configured to engage the cleaning tool and the second vacuum extractor tool is configured to engage the surface; and
   the second vacuum extractor tool is configured for vacuum communication with the vacuum through a third vacuum path.

13. The cleaner of claim 12, further comprising a vacuum path selector means for controlling vacuum communication between the vacuum and the first vacuum path, the second vacuum path and the third vacuum path.

14. The cleaner of claim 2, further comprising a vacuum path selector means for selectively opening and closing vacuum communication between the vacuum and the first and second vacuum paths.

15. A floor cleaner comprising:
   a mobile body configured to travel over a surface;
   a motorized cleaning head connected to the mobile body and comprising a cleaning tool;
   a cleaning liquid dispenser configured to apply a cleaning liquid to one of the surface and the cleaning tool;
   a vacuum supported on the mobile body;
   a first vacuum path configured for vacuum communication with the vacuum;
   a second vacuum path configured for vacuum communication with the vacuum;
   a first vacuum extractor tool configured for vacuum communication with the vacuum through the first vacuum path; and
   a vacuum squeegee connected to the mobile body and configured for vacuum communication with the vacuum through the second vacuum path.

16. The cleaner of claim 15, further comprising a vacuum path selector means for selectively opening and closing vacuum communication between the vacuum and the first and second vacuum paths.

17. The cleaner of claim 15, wherein the first vacuum extractor tool is configured to remove liquid from a surface of the cleaning tool.

18. The cleaner of claim 15, wherein the first vacuum extractor tool is configured to engage the surface.

19. The cleaner of claim 18, further comprising an extractor tool lift coupled to the first vacuum extractor tool, the lift mechanism configured to move the first vacuum extractor tool relative to the mobile body between a raised position, in which the first vacuum extractor tool is displaced from the surface, and an operating position, in which the first vacuum extractor tool engages the surface.

20. The cleaner of claim 15, wherein the cleaning tool is selected from the group consisting of a soft floor cleaning tool and a hard floor cleaning tool.

21. A floor cleaner comprising:
   a mobile body configured to travel over a surface;
   a motorized cleaning head connected to the mobile body and comprising a cleaning tool;
   a cleaning liquid dispenser configured to apply a cleaning liquid to one of the surface and the cleaning tool;
   a vacuum supported on the mobile body;
   a first vacuum path configured for vacuum communication with the vacuum;
   a second vacuum path configured for vacuum communication with the vacuum;
   a third vacuum path configured for vacuum communication with the vacuum;
   a first vacuum extractor tool configured for vacuum communication with the vacuum through the first vacuum path;
   a second vacuum extractor tool configured for vacuum communication with the vacuum through the second vacuum path; and
   a vacuum squeegee connected to the mobile body and configured for vacuum communication with the vacuum through the third vacuum path.

22. The cleaner of claim 21, wherein the first and second vacuum extractor tools are each configured to remove liquid from a surface of the cleaning tool.

23. The cleaner of claim 21, wherein the first vacuum extractor tool is configured to remove liquid from a surface of the cleaning tool and the second vacuum extractor tool is configured to engage the surface.

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