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Robotic floor cleaning with sterile, disposable cartridges

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(71) Applicant(s)

Optimus Services, LLC

(72) Inventor(s)

Mangiardi, John R.

(74) Agent/Attorney

Phillips Ormonde Fitzpatrick, 367 Collins Street, Melbourne, VIC, 3000

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(71) Applicant *(for all designated States except US)*: **OPTIMUS SERVICES, LLC** [US/US]; 50 East 72nd Street, New York, NY 10021 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MANGIARDI, John, R.** [US/US]; 54 Doubling Road, Greenwich, CT 06830 (US).

(74) Agent: **RZUCIDLO, Eugene, C.**; Hunton & Williams/New York, Intellectual Property Dept., 1900 K Street, N.W., Suite 1200, Washington, DC 20006-1109 (US).

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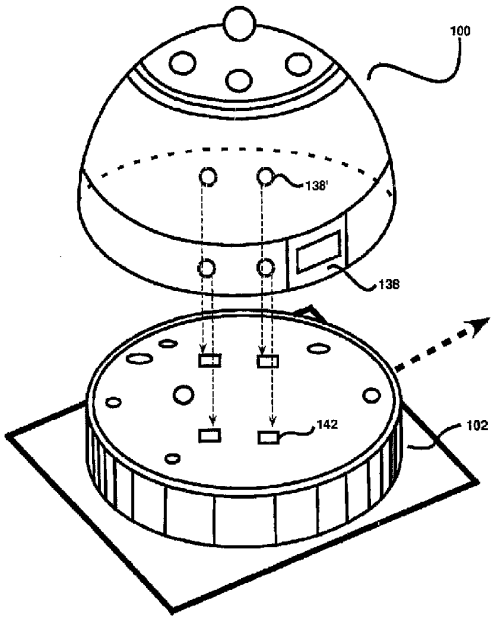
(54) Title: ROBOTIC FLOOR CLEANING WITH STERILE, DISPOSABLE CARTRIDGES



(57) Abstract: An automated (robotic) floor cleaner (100) is adapted to allow sterile cleaning of sensitive environments, such as hospital room. In particular, the floor-cleaner chassis (124) is redesigned to be mounted on a deck (102) containing cleaning devices that contact the floor. The cleaning devices mounted on the deck (102) include vacuum head (132), brushes (120), cleaning fluid sprays (128), and conceivably sanitizing devices such as UV germicidal light, are provided pre-sterilized. As such, the adapted floor-cleaner chassis (124) allows the deck (102) to be mounted to the bottom of the chassis (124), the floor-cleaner (100) is then used to clean a floor, after which, the deck (102) is removed from the chassis (124) and disposed. The robotic-floor cleaner (100) and sterilization system cleans floor between or even during cases. Further, the robotic floor cleaner (100) reduces the "turnover time" required between cases, as it operates simultaneously while the staff prepares the room for the next case.

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ROBOTIC FLOOR CLEANING WITH STERILE, DISPOSABLE CARTRIDGES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of provisional patent application U.S. Ser. No. 60/701,106, filed July 20, 2005 by the present inventor. The contents of U.S. Ser No. 60/701,106 are expressly incorporated herein by reference thereto.

The following references are hereby explicitly incorporated by reference thereto:

- U.S. Pat. No. 6,605,156 B1
- U.S. Pat. No. 6,883,201
- Applications filed along with present application by current inventor on this date entitled:
    - IN-CEILING FOCUS LOCATED SURGICAL LIGHTING
    - HOSPITAL OPERATING ROOM RE-DESIGN
    - AMBIENT LIGHTING IN HOSPITAL SURGICAL ENVIRONMENTS
    - USE OF ULTRAVIOLET GERMICIDAL IRRADIATION IN HEALTH CARE ENVIRONMENTS
    - IN-WALL WASTE RECEPTACLES FOR HOSPITAL AND LABORATORY ENVIRONMENTS
    - MULTIFUNCTIONAL FLOOR PODS
    - RE-DESIGN OF OPERATING ROOM TABLES

BACKGROUND OF THE INVENTION -- FIELD OF INVENTION

The present invention relates to a disposable, sterile cartridge for use with a robotic floor-cleaning device and a method of using said disposable, sterile cartridge and said robotic floor-cleaning device in a hospital or laboratory environment.

BACKGROUND OF THE INVENTION

Autonomous robot cleaning devices are known in the art. For example, U.S. Pat. Nos. 5,940,927 and 5,781,960 disclose an Autonomous Surface Cleaning Apparatus and a Nozzle Arrangement for a Self-Guiding Vacuum Cleaner. Also, U.S. Pat. Nos. 6,605,156 and

6,883,201 disclose improved, automated cleaning devices with self-contained power supplies. Particularly, these devices provide optimized cleaning efficiency under reduced power requirements. Nonetheless, these devices are not adapted to provide cleaning of surfaces using sterile, disposable cleaning assemblies. In other words, after said cleaning devices clean a dirty floor, the incorporated brushes and surfaces in contact with said floor become contaminated. As such, their use in environments where the transfer of pathogens cannot be allowed to occur, such as a hospital operating room, is obviated. Therefore, an invention that allows a robotic floor-cleaning device to repeatedly clean a sensitive environment while maintaining sanitary and sterile conditions would be of benefit.

SUMMARY AND OBJECTS OF THE INVENTION

An automated (robotic) floor-cleaner, such as the commercial available Scooba® or Floor Genie™, is adapted to allow sterile cleaning of sensitive environments, such as a hospital operating room. In particular, the floor-cleaner chassis is redesigned to be mounted on a deck containing cleaning devices that contact the floor. The cleaning devices mounted on the deck, which can comprise such cleaning devices as vacuum heads, brushes, cleaning fluid sprays, and conceivably sanitizing devices such as a UV germicidal light, are provided pre-sterilized. As such, the adapted floor-cleaner chassis allows the deck to be mounted to the bottom of the chassis; the floor-cleaner is then used to clean a floor, after which, the deck is removed from the chassis and disposed. The robotic-floor cleaner and sterilization system cleans floors between or even during cases. The system's disposable, sterile cleaning-cassettes ensure a sterile environment. Further, the robotic floor cleaner reduces the "turnover time" required between cases, as it operates simultaneously while the staff prepares the room for the next case.

The present invention comprises a housing infrastructure including

- a chassis,
- a power subsystem for providing the energy to power the autonomous floor-cleaning robot,
- a motive subsystem operative to propel and operate the autonomous floor-cleaning robot for cleaning operations,
- a control module, such as an on-board computer, operative to control the autonomous floor-cleaning robot to effect cleaning operations, and

- a cleaning subsystem that includes
    - a sterile, disposable deck which latches into and mounts in pivotal combination with the chassis,
    - a brush assembly mounted in deck and powered by the motive subsystem to sweep up particulates during cleaning operations,
    - a vacuum assembly disposed in combination with the deck and powered by the motive subsystem to ingest particulates during cleaning operations, and
    - a spray assembly disposed in combination with the deck and powered by the motive subsystem to disperse fluids, such as cleaning fluid, during cleaning operations.

Therefore, one object of the present invention is to provide a sterile cleaning device that is operable without human intervention to clean designated areas.

It is another object of the present invention to provide an automated floor-cleaning device adapted to receive a sterile, disposable cartridge attachable to the lower chassis of said floor-cleaning device.

It is yet another object of the present invention to provide a sterile, disposable cartridge for use with automated floor-cleaning devices.

At least one of the above objects is met in whole or in part by the present invention. Additional objects are apparent by the following description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can best be understood in connection with the accompanying drawings. It is noted that the invention is not limited to the precise embodiments shown in drawings, in which:

- Fig. 1 is a side elevation view in partial cutaway of a robotic floor cleaner in accordance with the invention;
- Fig. 2 is a top plan view of the disposable portion of the robotic floor cleaner depicted in Fig. 1.
- Fig. 3 is a perspective view of the top chassis being inserted onto the deck.

BRIEF DESCRIPTION OF REFERENCE NUMERALS

100 Robotic Floor Cleaner with Cartridge; 102 Sterile, Disposable Cartridge; 104 Light; 106 On/Off Switch; 108 Rechargeable Battery; 110 Cover; 112 Waste Receptacle; 114 Vacuum; 116 Motor/Impeller; 118 Bumper; 120 Brush; 120' Brush; 122 Reusable Chassis; 124 Independent Motors; 126 Cleaning Fluid Reservoir; 128 Spray Nozzle; 130 Floor; 132 Vacuum Inlet; 134 Wheel; 136 Castor; 138 Side Handles with Latch Bar Control; 138' Counter-Latch; 141 Motor; 142 Latching Slots; 144 Brush Motor Drive Socket; 146 Drive Motor Shaft Socket; 148 Vacuum Connections; 150 Water/Cleaning Fluid Connection

DETAILED DESCRIPTION OF THE INVENTION

Figures 1 and 2 shows a modified robotic floor cleaner, such as a modified Floor Genie™, iRobot® Scooba, or iRobot® Roomba. The floor cleaner incorporates sterile disposable elements. Figure 1 shows Robotic Floor Cleaner with Cartridge **100** with cover **110** shown in a cutaway view to reveal its interior, and to show the placement of some of the major components. Reference numeral **122** is the chassis of the reusable portion of Robotic Floor Cleaner with Cartridge **100**. Portion **102** below is a disposable unit that is re-supplied in a sterile pack, with connections to reusable chassis portion **122**. An optional bumper **118** may be provided around Robotic Floor Cleaner with Cartridge **100**. Disposable portion **102** of Robotic Floor Cleaner with Cartridge **100** has wet scrubbing brushes **120'** at the front and brushes **120** at the rear. These are connected to, and driven by, motor **141** within the non-disposable, reusable portion **122**. Cleaning fluid in reservoir **126** is sprayed through nozzles **128**, which have back-flow preventers to prevent reverse contamination of fluid supply reservoir **126**. Vacuum cleaner **114** is also provided with motor/impeller **116** and receptacle **112** has vacuum inlets **132** at front and back of disposable portion **102**.

The entire Robotic Floor Cleaner with Cartridge **100** is powered by rechargeable battery pack **108** and is controlled by computer **152**. Flashing light **104** indicates operation and ON/OFF switch **106** is preferably provided at a top of reusable portion **122**. The drive configuration is similar to that of a zero turning radius riding lawnmower. Here, the two fixed drive wheels **134** are driven by two independent motors **124** near the front. Two passive swiveling casters **136** are near the rear. Side handles **138** with latch bar control coupling and de-coupling from disposable platform **102** that carries both drive wheels **134**, brushes **120** and **120'** as well as casters **136**.

Figure 2 is a top plan view of disposable platform **102** of Robotic Floor Cleaner with Cartridge **100** showing alignment and latching slots **142** that engage with the top reusable portion **122**. Vacuum connections **148** and water/cleaning fluid connections **150** are illustrated as well as drive motor shaft sockets **146** and brush motor drive socket **144**. Although autonomous and very maneuverable, the accuracy and/or simplicity of the guidance system can be enhanced with waypoint emitters, embedded in the floor surface, that are detectable by computer **152** via appropriate sensors.

Figure 3 shows a perspective view. As can be seen by the figure, any one embodiment of the invention can have various shapes. In this example, the deck and upper portion of the device is rounded. The large dotted arrow indicates a direction of movement for the cleaning device. The top reusable portion **122** is being inserted into latches **142** guided into place by side handles and latch bar control **138**. The handles **138** can also function to disengage counter-latch **138'** from latches **142**, thereby allowing removal of the deck and top reusable portion.

In the foregoing description, certain terms and visual depictions are used to illustrate the preferred embodiment. However, no unnecessary limitations are to be construed by the terms used or illustrations depicted, beyond what is shown in the prior art, since the terms and illustrations are exemplary only, and are not meant to limit the scope of the present invention. It is further known that other modifications may be made to the present invention, without departing the scope of the invention, as noted in the appended claims.

I claim:

1. A robotic floor cleaner for locations needing sterile conditions, comprising:

a chassis,

a power subsystem for providing the energy to power said floor-cleaning robot,

a motive subsystem operative to propel and operate said floor-cleaning robot for cleaning operations,

a control module, such as an on-board computer, operative to control said floor-cleaning robot to effect cleaning operations, and

a cleaning subsystem, adapted for cleaning in locations needing sterile conditions, that includes:

a sterile, disposable deck which latches into and mounts in pivotal combination with said chassis, said deck further adapted to be interchangeable with like decks of similar construction;

a brush assembly mounted in said deck and powered by said motive subsystem to sweep up particulates during cleaning operations;

a vacuum assembly disposed in combination with said deck and powered by said motive subsystem to ingest particulates during cleaning operations; and

a spray assembly disposed in combination with said deck and powered by said motive subsystem to disperse fluids, such as cleaning fluid, during cleaning operations.

2. The automated robotic floor cleaner of claim 1 in which said deck is provided pre-sterilized in sterile packaging.

3. A cleaning cartridge comprising

a sterile, disposable deck adapted to latch into and mount in pivotal combination with a chassis on a robotic floor cleaner, said deck further adapted to be interchangeable with like decks of similar construction;

a brush assembly mounted in said deck and powered by a motive subsystem on said robotic floor cleaner to sweep up particulates during cleaning operations;

a vacuum assembly disposed in combination with said deck and powered by said motive subsystem to ingest particulates during cleaning operations; and

a spray assembly disposed in combination with said deck and powered by said motive subsystem to disperse fluids, such as cleaning fluid, during cleaning operations.

4. The automated robotic floor cleaner of claim 3 in which said deck is provided pre-sterilized in sterile packaging.

5. A method of cleaning a floor, comprising:

providing the automated robotic floor cleaner of claim 1;

providing a room with a floor;

if said deck on said chassis is non-sterile then

disengaging said deck from said chassis and disposing of said chassis, and

reengaging a new, sterile deck onto said chassis;

placing said automated robotic floor cleaner in said room;

activating said automated robotic floor cleaner and allowing said automated robotic floor cleaner to clean said room;

deactivating said automated robotic floor cleaner;

disengaging said deck from said chassis;

reengaging a new, sterile deck onto said chassis.

6. The method of claim 5 in which said new, sterile deck is provided pre-sterilized in sterile packaging.

7. A method for sterilizing components of an automatic floor-cleaning device which have contacted a floor, comprising:

providing the automated robotic floor cleaner of claim 1;

disengaging said deck from said chassis; and

reengaging a new, sterile deck onto said chassis.

8. The method of claim 7 in which said new, sterile deck is provided pre-sterilized in sterile packaging.

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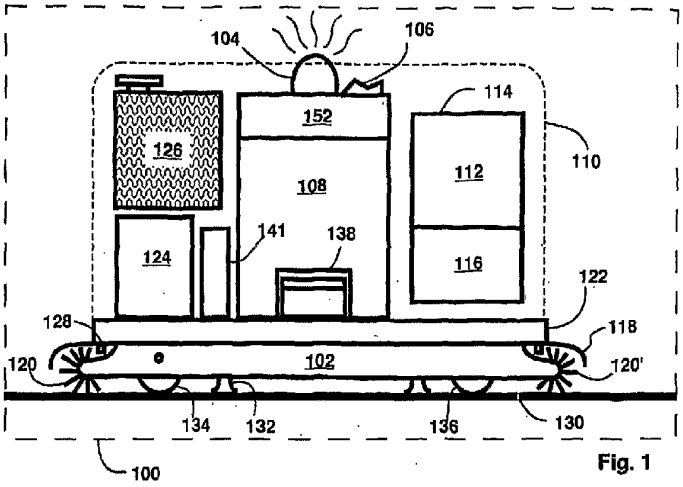
104
106
114
152
126
110
112
108
124
141
138
116
122
128
118
120
102
120'
134
132
136
130
100

Fig. 1

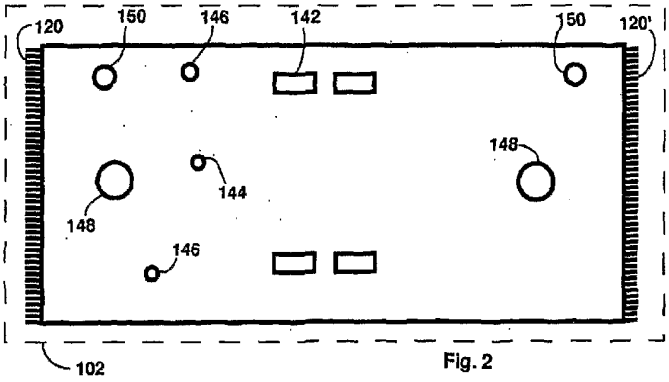
120
150
146
142
150
120'
148
144
148
146
102

Fig. 2

2/2

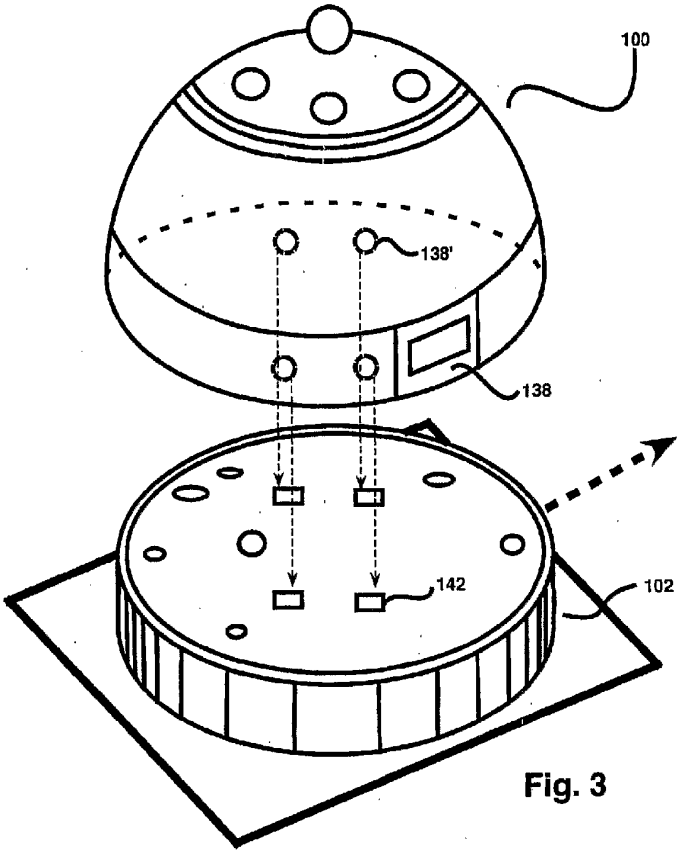

Fig. 3