Liquid extraction machine and method for cleaning floor surfaces

An extraction machine (101) for cleaning a floor surface, such as carpeting, has a cleaning solution dispenser capable of dispensing a cleaning solution onto the surface being cleaned and a diluting solution dispenser capable of dispensing a diluting solution onto the floor surface. The diluting solution is substantially different from the chemical cleaning solution. A recovery system is included for extracting a dirty solution from the floor surface. The cleaning solution dispenser, diluting solution dispenser and recovery system are arranged on the extraction machine (101) relative to each other such that as the extraction machine is moved over a segment of the floor surface in a forward direction of travel of the machine, the cleaning solution dispenser passes over the segment prior to the diluting solution dispenser, dispensing cleaning solution to promote the removal of dirt from the floor surface segment. The diluting solution dispenser then passes over the segment of floor surface to promote suspension of the chemical solution and dirt in the diluting solution thereby forming the dirty solution. Finally, the recovery system passes over the segment of floor surface to extract the dirty solution from the floor surface, thereby leaving a cleaned floor surface.
Description

Background of the Invention

[0001] This invention relates generally to an extraction machine used for cleaning floor surfaces with a cleaning liquid and then extracting the liquid from the floor, and more particularly to such an extraction machine having an improved cleaning system.

[0002] In extraction machines of conventional design, a solution tank contained within the machine housing releases a cleaning solution onto the surface to be cleaned, such as a carpet. The cleaning solution is a pre-mixed solution comprised of water and a liquid or powder cleaning agent. The solution is sprayed onto the carpet through one or more spray nozzles located in front of a scrub brush of the extraction machine. The scrub brush, driven by a brush motor, works the cleaning solution into the carpet to effect cleaning of the carpet, leaving a dirty solution within the carpet.

[0003] During operation, the machine is self propelled or moved manually to pass over the dirty solution so that a vacuum shoe attached to the machine remains in contact with the carpet and collects the dirty solution. A vacuum pump driven by a vacuum motor creates a vacuum within a recovery tank which communicates with the shoe by means of a recovery line extending between the recovery tank and the shoe. Suction created by the vacuum pump extracts the dirty cleaning solution from the carpet, resulting in a cleaned carpet. The dirty solution is suctioned through the shoe and recovery line into the recovery tank carried by the machine.

[0004] It is also known to provide an additional set of spray nozzles intermediate the brush and the vacuum shoe to dispense additional cleaning solution, drawn from the same solution tank, onto the carpet to rinse the carpet prior to the dirty solution being suctioned from the floor.

[0005] One drawback associated with the conventional extraction machines described above is that a residue of cleaning chemical often remains in the carpet after cleaning. This typically results in quicker re-soiling of the carpet. Another drawback is that the pre-mixed cleaning solution in the tank must be drained from the solution tank when the extraction machine is being stored, such as when cleaning for the day is completed. This prevents settling or separation of the cleaning chemical and water in the tank. However, this also results in wasted solution where the contents of the tank are not completely used during cleaning.

Summary of the Invention

[0006] In general, an extraction machine of the present invention for cleaning a floor surface, such as carpeting, comprises a cleaning solution dispenser capable of dispensing a cleaning solution onto the surface being cleaned and a diluting solution dispenser capable of dispensing a diluting solution onto the floor surface. The diluting solution is substantially different from the chemical cleaning solution. The extraction machine further comprises a recovery system for extracting a dirty solution from the floor surface. The cleaning solution dispenser, diluting solution dispenser and recovery system are arranged on the extraction machine relative to each other such that as the extraction machine is moved over a segment of the floor surface in a forward direction of travel of the machine, the cleaning solution dispenser passes over the segment prior to the diluting solution dispenser whereby cleaning solution is dispensed onto the floor surface to promote the removal of dirt from the floor surface segment. The diluting solution dispenser passes over the segment of floor surface prior to the recovery system to promote suspension of the chemical solution and dirt in the diluting solution thereby forming the dirty solution. Finally, the recovery system passes over the segment of floor surface to extract the dirty solution from the floor surface thereby leaving a cleaned floor surface.

[0007] A method of the present invention for cleaning a floor surface, such as carpeting, generally comprises dispensing a chemical cleaning solution onto the floor surface to promote the removal of dirt from the floor surface. Then, a diluting solution is dispensed onto the floor surface. The diluting solution is substantially different from the cleaning solution whereby chemical cleaning solution and dirt removed from the floor surface become suspended in the diluting solution to form a dirty solution. Finally, the dirty solution is recovered from the floor surface to leave a cleaned surface.

[0008] Among the several objects of this invention may be noted the provision of an extraction machine with an improved cleaning system which leaves carpets cleaner than conventional extraction machines; the provision of such an extraction machine which leaves less cleaning chemical residue in the carpet after cleaning; the provision of such an extraction machine which reduces solution waste; and the provision of such an improved cleaning system which can be incorporated into existing extraction machines.

[0009] Other objects and features will become in part apparent and in part pointed out hereinafter.

Brief Description of the Drawings

[0010] Fig. 1 is a side view of a conventional extraction machine with parts removed to show details; Fig. 2 is a schematic top view of a cleaning system of the present invention shown mounted on a test fixture; and Fig. 3 is a schematic perspective of the cleaning system of Fig. 2.
[0011] Corresponding parts are designated by corresponding reference characters and numerals throughout the several views of the drawings.

Description of the Preferred Embodiment

[0012] Referring now to Fig. 1, a conventional extraction machine for cleaning floor surfaces, such as carpeting, is indicated in its entirety by the reference numeral 21. The extraction machine comprises a main housing, indicated generally at 23, mounted on wheels 35 so the machine can readily be moved by an operator. The wheels may also be driven by a motor (not shown) to self-propel the extraction machine. A handle 39 mounted at the rear of the machine 21 provides the operator with a convenient means for guiding and maneuvering the extraction machine during operation. Suitable controls (not shown) on the handle 39 are provided for activating various operating components of the machine.

[0013] The main housing 23 has a top wall 25, a bottom wall 27, a front wall 29, a rear wall 31 and side walls (not shown), portions of which define a solution tank 41. The main housing 23 also defines a cavity 33 which contains the operating components of the extraction machine 21. The bottom wall 27 of the main housing 23 is partially defined by plates 28 (one of which is shown in Fig. 1). The plates 28 are spaced apart in close relationship with each other to define interstices (not shown) between the plates. The interstices allow ambient air external to the main housing 23 to enter the cavity 33.

[0014] The solution tank 41 holds a supply of cleaning solution 43 for cleaning the floor surface. A solution pump 44 communicates with the solution tank 41 to deliver cleaning solution from the tank to a feed line 45. A brush housing 46 is attached to the underside of the main housing 23. A locator pin 52 is provided for releasably securing the brush housing 46 at a predetermined height above the floor and for adjusting the height of the brush housing depending on the depth of the carpet to be cleaned. The feed line 45 extends through the brush housing 46 to a manifold (not shown) to direct cleaning solution to one or more spray nozzles 51 spaced laterally across the bottom of the brush housing for delivering cleaning solution onto the surface to be cleaned. A second set of nozzles 54 is located beneath the front of the main housing 23 for directing additional cleaning solution onto the surface to be cleaned.

[0015] A rotary scrub brush 47 mounted for rotation within the brush housing 46 has bristles 49 which contact the surface to be cleaned. The scrub brush 47 is located close to the spray nozzles 51 to encourage interaction between the scrub brush and the cleaning solution 43. The scrub brush 47 is driven by a brush motor 53 located in a compartment 55 in the brush housing 46 to effect a scrubbing action with the cleaning solution 43 to remove dirt on or within the floor surface.

As dirt is removed from the surface, it attaches itself to the cleaning solution 43 to leave a dirty solution 57 on the surface of the floor. Additional cleaning solution is dispensed onto the surface through the second set of nozzles 54 after the brush has passed over a particular portion of the surface to further attract dirt prior to suctioning of the dirty solution from the surface.

[0016] A vacuum pump 59 is mounted within the cavity 33 directly below a solution recovery tank 61 seated in an opening 63 in the top wall 25 of the housing 23. The vacuum pump 59 and an associated suction fan (not shown) are driven by a vacuum motor 65, such as an electric drive motor, mounted beneath the pump. The vacuum pump 59 has an intake (not shown) which communicates with the inside of a hollow air cap 69 sealingly attached to or integrally formed with the bottom wall of the recovery tank. A suction pipe 73 extends up from this cap 69 to a location adjacent the top of the recovery tank 61. The arrangement is such that operation of the vacuum pump 59 and associated suction fan draws air from the recovery tank to create a vacuum in the tank. The vacuum pump 59 has an exhaust 75 through which air from the suction fan is exhausted. A liquid level sensor 77 is provided for sensing the level of dirty solution 57 within the recovery tank 61. This sensor 77 is operable to shut off the extraction machine 21 before the solution level reaches the upper end of the suction pipe 73.

[0017] A vacuum shoe 79 is attached to the underside of the main housing 23 and extends between the housing and the floor surface so that the shoe and wheels 35 combine to support the extraction machine 21 in an upright position. The shoe 79 has a centrally located opening (not shown) extending upwardly throughout. This opening is connected by means of a flexible recovery line or hose 81 to a rigid fill tube 83 extending up into the recovery tank 61, the upper end of the tube being at a level higher than that of the aforementioned level sensor 77. As the shoe 79 passes over the surface being cleaned the vacuum in the recovery tank 61 is sufficient to extract the dirty solution 57 from the floor surface through the opening in the shoe and up through the hose 81 and the fill tube 83 for delivery to the recovery tank 61. A drain line 85 with a closure 87 is provided for draining dirty solution 57 from the recovery tank 61 as needed.

[0018] Now referring to Figs. 2 and 3, a cleaning system of the present invention for replacing the cleaning system of the conventional extraction machine 21 described above is generally indicated at 101. For purposes of illustrating and describing the new cleaning system 101, the various components of the cleaning system are shown separated from the extraction machine 21 and instead mounted on a test fixture T used for testing operation of the cleaning system. The cleaning system is described herein in accordance with a forward direction of travel of the extraction machine as indicated by the direction line in Fig. 2. As an example,
the forward direction of travel of the extraction machine 21 of Fig. 1 in order to clean a carpet would be movement toward the rear of the machine.

[0019] The cleaning system 101 is similar to that of the conventional extraction machine 21 described above in that it includes a solution tank 141, pump 144, feed line 145, brush housing 146, brush (not shown but similar to brush 47 of Fig. 1) and vacuum shoe 179. However, the solution tank 141 of the present invention is filled only with water instead of a pre-mixed cleaning solution so that the pump 144 directs water under pressure from the solution tank through the fluid line 145. The water in the solution tank 141 broadly serves as a diluting solution for use in forming a cleaning solution within the cleaning system 101 during operation of the extraction machine as will be described later. A pressure gauge is disposed in the feed line 145 for measuring the fluid pressure of water pumped through the feed line. The fluid pressure in the feed line 145 is preferably at least about 45 psi (310.26 kPa). However, the fluid pressure in the feed line 145 may vary without departing from the scope of this invention. It is also understood that the pressure gauge 107 may be omitted from the cleaning system 101.

[0020] As shown in Fig. 3, the feed line 145 leading from the solution tank 141 has a T-connector 121 for directing water pumped through the feed line into a pair of delivery lines 123, 125. One delivery line 123 extends forward from the T-connector and is connected to a forward manifold 103 positioned above the brush housing 146 slightly forward of the brush 47. Spray nozzles 105 are connected to the manifold 103 and extend through the brush housing 146 in spaced relationship above the floor surface for dispensing cleaning solution from the manifold onto the carpet forward of the brush before the brush is moved over that segment of the carpet. In the preferred embodiment, there are two forward nozzles 105, although the number of nozzles may vary depending on the volume of cleaning solution to be dispensed onto the floor surface during operation of the extraction machine. It is also understood that the spray nozzles 105 may be disposed outside of the brush housing 146, or both inside and outside of the brush housing, without departing from the scope of this invention, as long as the nozzles are positioned forward of the brush such that fluid is dispensed onto an area of the carpet prior to the brush being moved over that area of the carpet. The delivery line 123, manifold 103 and nozzles 105 together define a cleaning solution dispenser for dispensing cleaning solution onto the floor surface being cleaned.

[0021] The other delivery line 125 extends rearward from the T-connector 121 and is connected to a rear manifold 113 positioned slightly forward of the vacuum shoe 179 for delivering water from the feed line 145 to the rear manifold. Spray nozzles 115 are connected to the rear manifold 113 in spaced relationship above the floor surface for dispensing water (e.g., diluting solution) onto a segment of the carpet slightly forward of the vacuum shoe 179 before the vacuum shoe is moved over that segment of the carpet to suction dirty solution from the carpet. In the preferred embodiment, there are four rear nozzles 115, although the number of rear nozzles may vary depending on the volume of water to be dispensed from these nozzles. The delivery line 125, rear manifold 113 and nozzles 115 together broadly define a diluting solution dispenser for dispensing dilution solution (e.g., water) onto the floor surface being cleaned. It is understood that a third set of spray nozzles (not shown) and second vacuum shoe (not shown) may be added to the extraction machine rearward of the spray nozzles 115 and vacuum shoe 179 without departing from the scope of this invention.

[0022] A chemical container 131 is sized for carriage onboard the extraction machine and contains a chemical cleaning agent for cleaning the carpet. The cleaning agent may be soap or other cleaning composition and is preferably in a concentrated liquid form to minimize the size of the container carried by the extraction machine. The container 131 may be disposed within the main housing (e.g., the main housing 23 of the conventional extraction machine shown in Fig. 1) or carried by the machine external of the main housing by a suitable container holder (not shown) mounted on the extraction machine. A chemical delivery line 133 leads from the container 131 and is connected to the delivery line 123 extending forward from the T-connector 121 generally intermediate the T-connector and the forward manifold 103 by a conventional venturi injector 135 disposed in the forward extending delivery line. The venturi injector 135 permits fluid pressure in the forward extending delivery line 123 to draw the cleaning agent from the chemical container 131 through the chemical delivery line 133 and into the forward extending delivery line for admixture with the water in the delivery line. A cleaning solution is thus formed within the forward extending delivery line 123 for dispensing onto the carpet via the forward manifold 103 and spray nozzles 105.

[0023] The venturi injector 135 preferably includes a metering tip (not shown) in communication with the chemical delivery line to meter the flow rate of the chemical cleaning agent from the chemical container into the venturi injector. The metering tip is preferably releasably connected to the venturi injector 135 to permit metering tips having different sized metering orifices to be used depending on the desired flow rate of chemical cleaning agent. It is understood, however, that the venturi injector may include means other than a metering tip to control the flow rate of cleaning agent from the cleaning container, such as a metering screw or other suitable metering device, without departing from the scope of this invention. It is also contemplated that the means for metering the flow rate of chemical cleaning agent from the chemical container may be disposed external of the main housing of the extraction machine to permit adjustment of the flow rate by the operator dur-
An extraction machine (101) for cleaning a floor surface, such as carpeting, the extraction machine (101) being movable relative to the floor surface in a desired direction of travel to clean the floor surface, said extraction machine (101) comprising,

a cleaning solution dispenser (103, 105, 123, 131, 133, 135) capable of dispensing a cleaning solution onto the surface being cleaned;
a diluting solution dispenser (113, 115, 125) capable of dispensing a diluting solution onto the surface, the diluting solution being substantially different from the chemical cleaning solution; and
a recovery system (179) for extracting a dirty solution from the floor surface;
the cleaning solution dispenser (103, 105, 123, 131, 133, 135), diluting solution dispenser (113, 115, 125) and recovery system (179) being arranged on the extraction machine (101) relative to each other such that as the extraction machine (101) is moved over a segment of the floor surface in the direction of travel of the machine (101), the cleaning solution dispenser (103, 105, 123, 131, 133, 135) passes over the segment prior to the diluting solution dispenser (113, 115, 125) whereby cleaning solution is dispensed onto the floor surface to promote the removal of dirt from the floor surface segment, the diluting solution dispenser (113, 115, 125) passing over the segment of floor surface prior to the recovery system (179) to promote suspension of the chemical solution and dirt in the diluting solution thereby forming the dirty solution, and the recovery system (179) subsequently passing over the segment of floor surface to extract the dirty solution from the floor surface thereby leaving a cleaned floor surface.

2. An extraction machine (101) according to claim 1, wherein the cleaning solution comprises a mixture of chemical cleaning agent and diluting solution, the cleaning agent and diluting solution being mixed in the extraction machine (101) during operation of the machine (101).

3. An extraction machine (101) according to claim 2, wherein the cleaning solution is formed by mixing the cleaning agent and diluting solution in the cleaning solution dispenser (103, 105, 123, 131, 133, 135) prior to the cleaning solution being dispensed onto the floor surface.

4. An extraction machine (101) according to any one of claims 1 to 3, wherein the cleaning solution dispenser (103, 105, 123, 131, 133, 135) comprises a delivery line (123) in fluid communication with a source of diluting solution (141) for directing diluting solution through the cleaning solution dispenser (103, 105, 123, 131, 133), the delivery line (123) further being in fluid communication with a source of chemical cleaning agent (131) for receiving cleaning agent into the cleaning solution dispenser (103, 105, 123, 131, 133) for admixture with the diluting solution in the delivery line (123) to form a cleaning solution in the delivery line (123) for dispensing onto the floor surface.

5. An extraction machine (101) according to claim 4, wherein the delivery line (123) is a first delivery line, the diluting solution dispenser (113, 115, 125) comprising a second delivery line (125) in fluid communication with a source of diluting solution (141) for directing diluting solution through the diluting solution dispenser (113, 115, 125) for dispensing onto the floor surface.

6. An extraction machine (101) according to claim 5, wherein the first delivery line (123) and the second (125) delivery line are in fluid communication with a common source of diluting solution (141).

7. An extraction machine (101) according to claim 5, wherein the first delivery line (123) has a venturi injector (135) disposed therein to permit passage of the diluting solution, the venturi injector (135) being in fluid communication with the source of chemical cleaning agent (131) for drawing cleaning agent into the first delivery line (123) for admixture with diluting solution flowing through the venturi injector (135) to form the cleaning solution in the first delivery line (123).

8. An extraction machine (101) according to any one of claims 5 to 7, wherein the cleaning solution dispenser (103, 105, 123, 131, 133) further comprises at least one nozzle (105) in fluid communication with the first delivery line (123) for jetting the cleaning solution onto the floor surface, the diluting solution dispenser (113, 115, 125) further comprising at least one nozzle (115) in fluid communication with the second delivery line (125) for jetting diluting solution onto the floor surface.

9. An extraction machine (101) according to claim 7 or claim 8, wherein the first delivery line (123) further has a one-way check valve (137) disposed therein upstream of the venturi injector (135) to inhibit chemical cleaning agent from the source of chemical cleaning agent (131) against flowing upstream of the check valve (137).

10. An extraction machine (101) according to claim 9, further comprising a feed line (145) in fluid communication with the source of diluting solution (141), a pump (144) for pumping diluting solution from the source of diluting solution (141) through the feed line (145), and a connector (121) for connecting the first (123) and second (125) delivery lines to the feed fluid line (145) such that diluting solution pumped through the feed line (145) is directed through the first (123) and second (125) delivery lines, the check valve (137) being disposed intermediate the venturi injector (135) and the connector (121) to inhibit chemical cleaning agent flowing into the first delivery line (123) against flowing into the second delivery line (125).

11. An extraction machine (101) according to any one
of claims 1 to 10, further comprising an agitator arranged on the machine (101) to pass over the segment of floor surface subsequent to the cleaning solution dispenser (103, 105, 123, 131, 133, 135) and prior to the diluting solution dispenser (113, 115, 125), the agitator being adapted for working the cleaning solution into the floor surface to promote dirt removal from the floor surface prior to dispensing of the diluting solution onto the floor surface.

12. An extraction machine (101) according to any one of claims 1 to 11, further comprising a frame (T), the chemical cleaning solution dispenser (103, 105, 123, 131, 133, 135), the diluting solution dispenser (113, 115, 125) and the recovery system (179) being carried on the frame (T), the extraction machine (101) further comprising a solution tank (141) carried on the frame (T) for containing said diluting solution, a chemical cleaning agent container (131) carried on the frame (T) for containing a chemical cleaning agent, and a recovery tank supported on the frame (T) in fluid communication with the recovery system (179) for containing dirty solution extracted from the floor surface by the recovery system (179).

13. An extraction machine (101) according to any one of claims 1 to 12, wherein the diluting solution is water.

14. A method of cleaning a floor surface, such as carpeting, comprising the steps, in order, of:

- dispensing a chemical cleaning solution onto the floor surface to promote the removal of dirt from the floor surface;
- dispensing a diluting solution onto the floor surface, the diluting solution being substantially different from the cleaning solution whereby chemical cleaning solution and dirt removed from the floor surface become suspended in the diluting solution to form a dirty solution; and
- recovering the dirty solution from the floor surface to leave a cleaned surface.

15. A method according to claim 14, further comprising the step of agitating the chemical cleaning solution dispensed onto the floor surface prior to dispensing the diluting solution onto the floor surface to work the cleaning solution into the floor surface to promote removal of dirt from the floor surface prior to dispensing of the diluting solution onto the floor surface.

16. A method according to claim 14 or claim 15, wherein the steps of dispensing cleaning solution onto the floor surface, dispensing diluting solution onto the floor surface and recovering dirty solution from the floor surface are carried out by moving a frame along the floor surface in a desired direction of travel, the frame carrying means for dispensing the chemical cleaning solution, means for dispensing a diluting solution and means for recovering the dirty solution from the floor surface.

17. A method according to claim 16, wherein said means for dispensing chemical cleaning solution onto the floor surface comprises a cleaning solution dispenser carried by the frame, the cleaning solution comprising a mixture of chemical cleaning agent and diluting solution, the method further comprising the step of mixing the cleaning agent and the diluting solution in the cleaning solution dispenser to form the cleaning solution prior to the step of dispensing the cleaning solution onto the floor surface.