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(54) **FLOOR CLEANING MACHINE WITH A WATER SOFTENING DEVICE**

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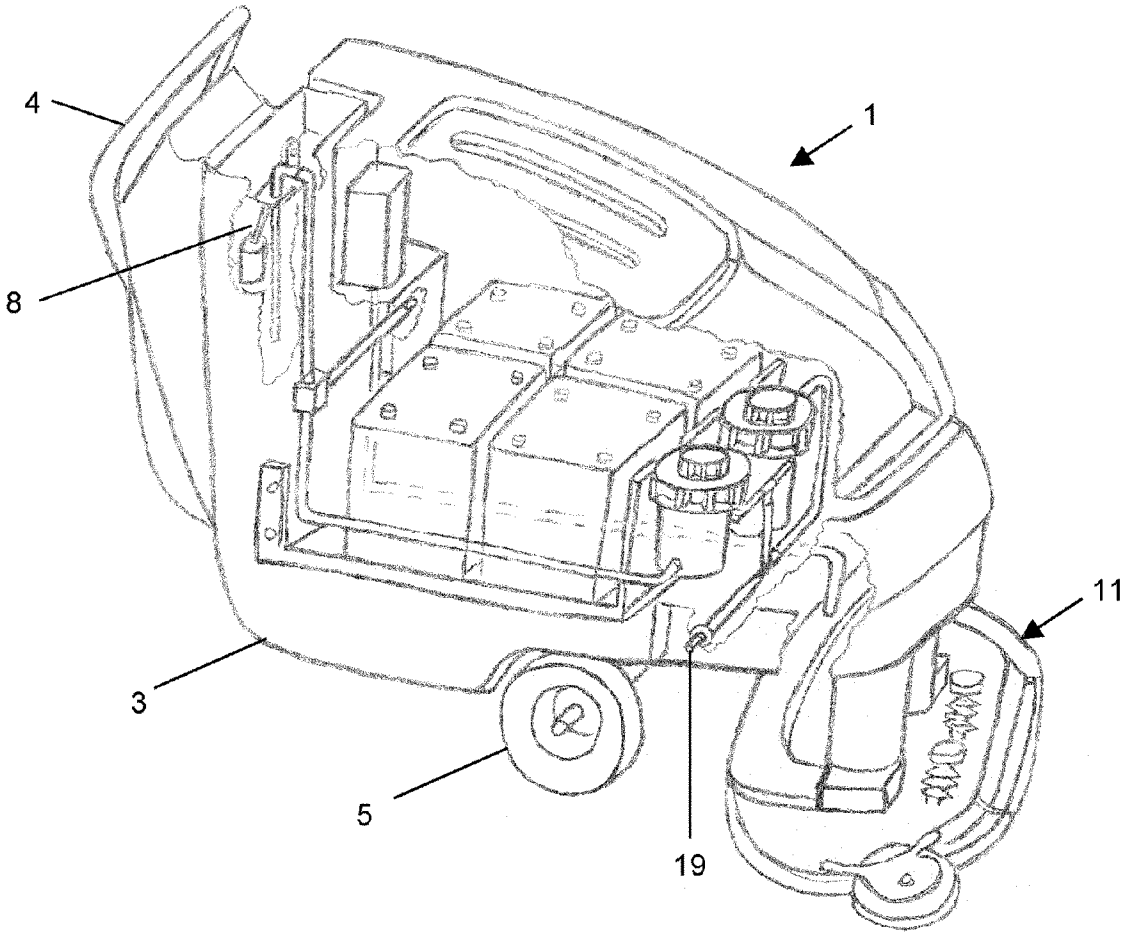
(57) **ABSTRACT**

Shown and described is a floor cleaning machine with a housing on which a carriage is provided for moving the machine over a floor surface to be cleaned, a fresh-water tank, which is accommodated in the housing, and a cleaning unit, which is attached to the housing and is designed to come into contact with the floor surface to be cleaned, the cleaning unit being connected to the fresh-water tank, and a method for operating a floor cleaning machine. The object of providing a floor cleaning machine and a method for operating it that make it possible at least for the clearing agent requirement to be reduced is achieved in terms of the device by providing an ion-exchanger unit, by the ion-exchanger unit being connected to the fresh-water tank and by the ion-exchanger unit being flowed through by fresh water from an inlet to an outlet.



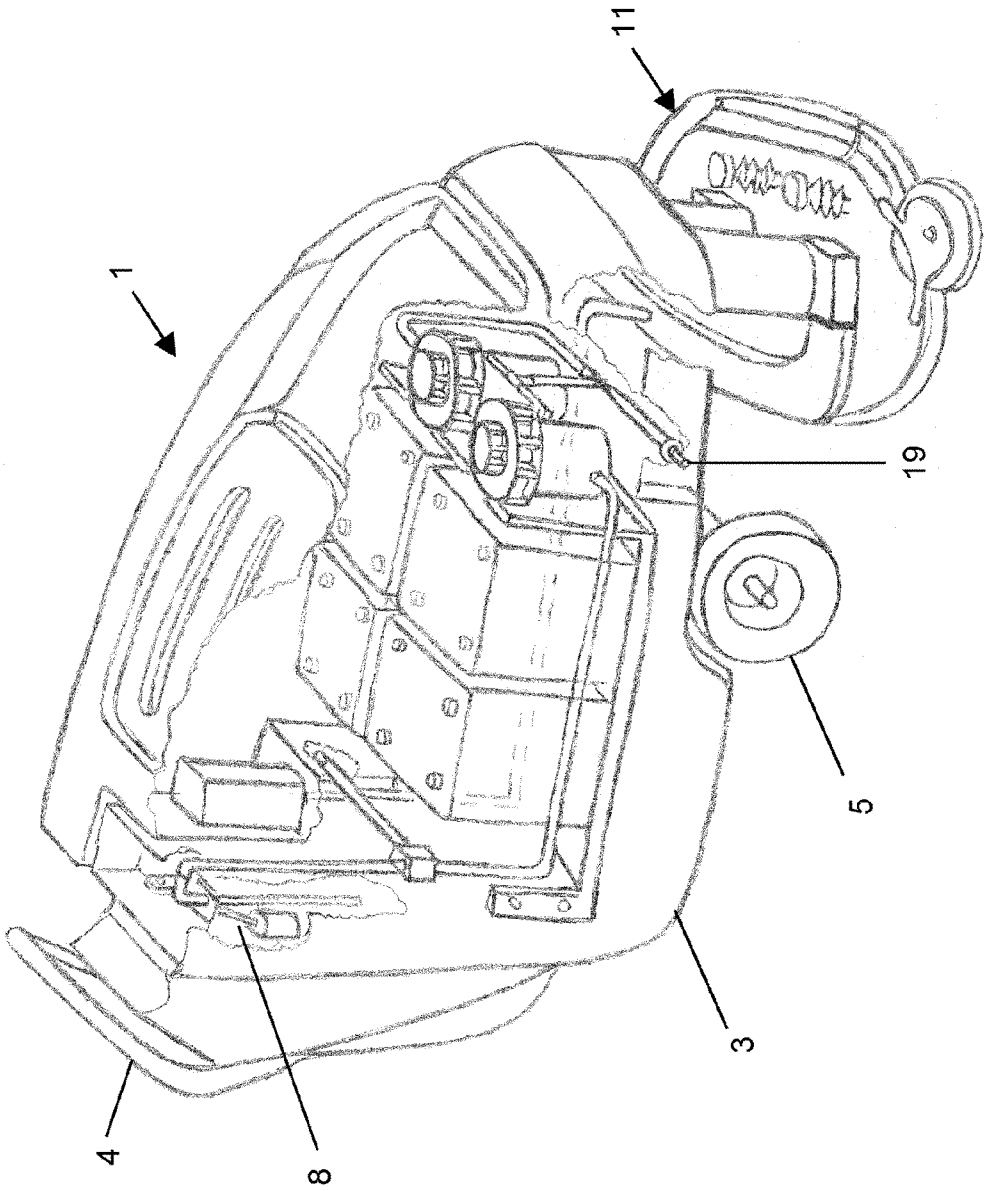


Fig. 1

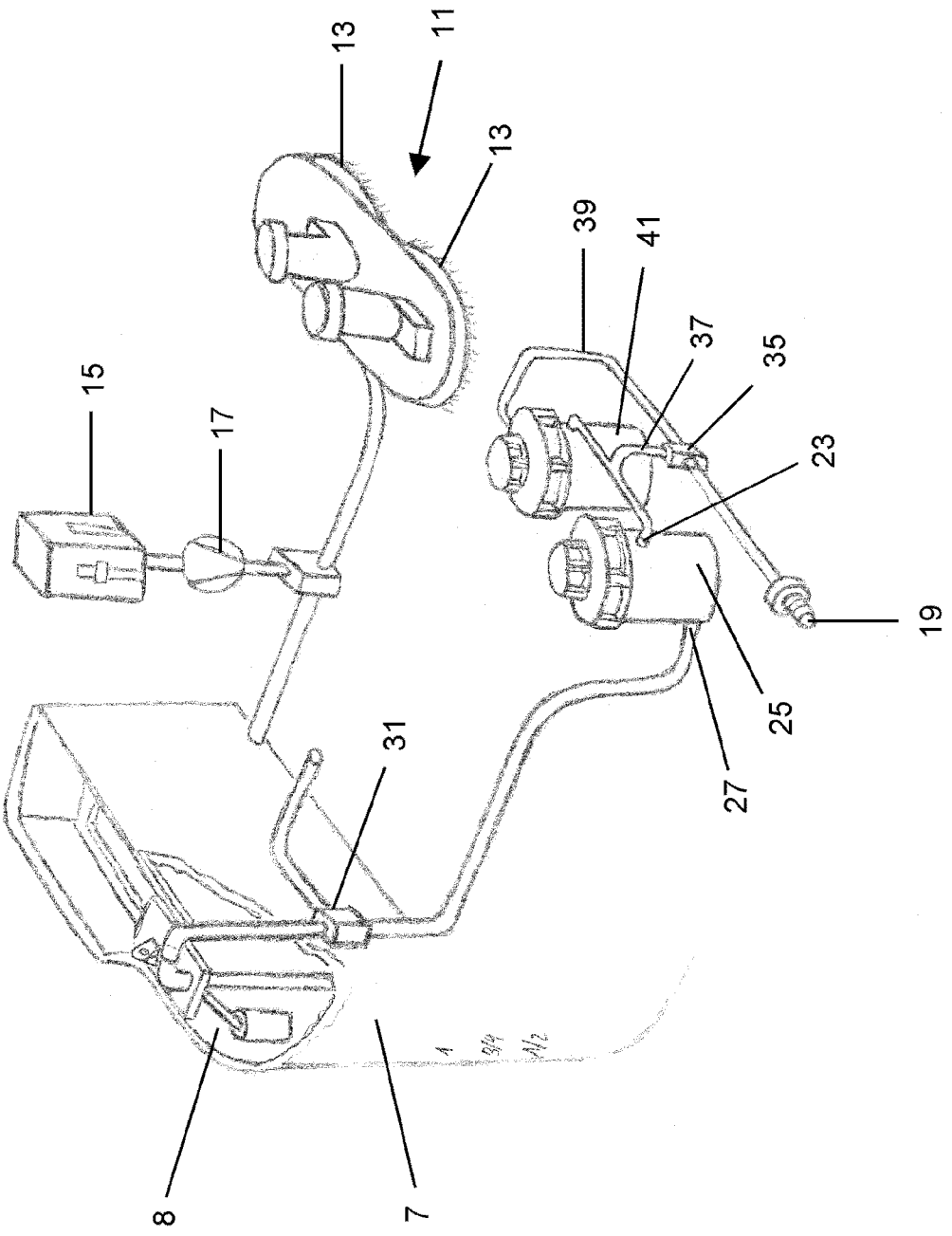


Fig. 2

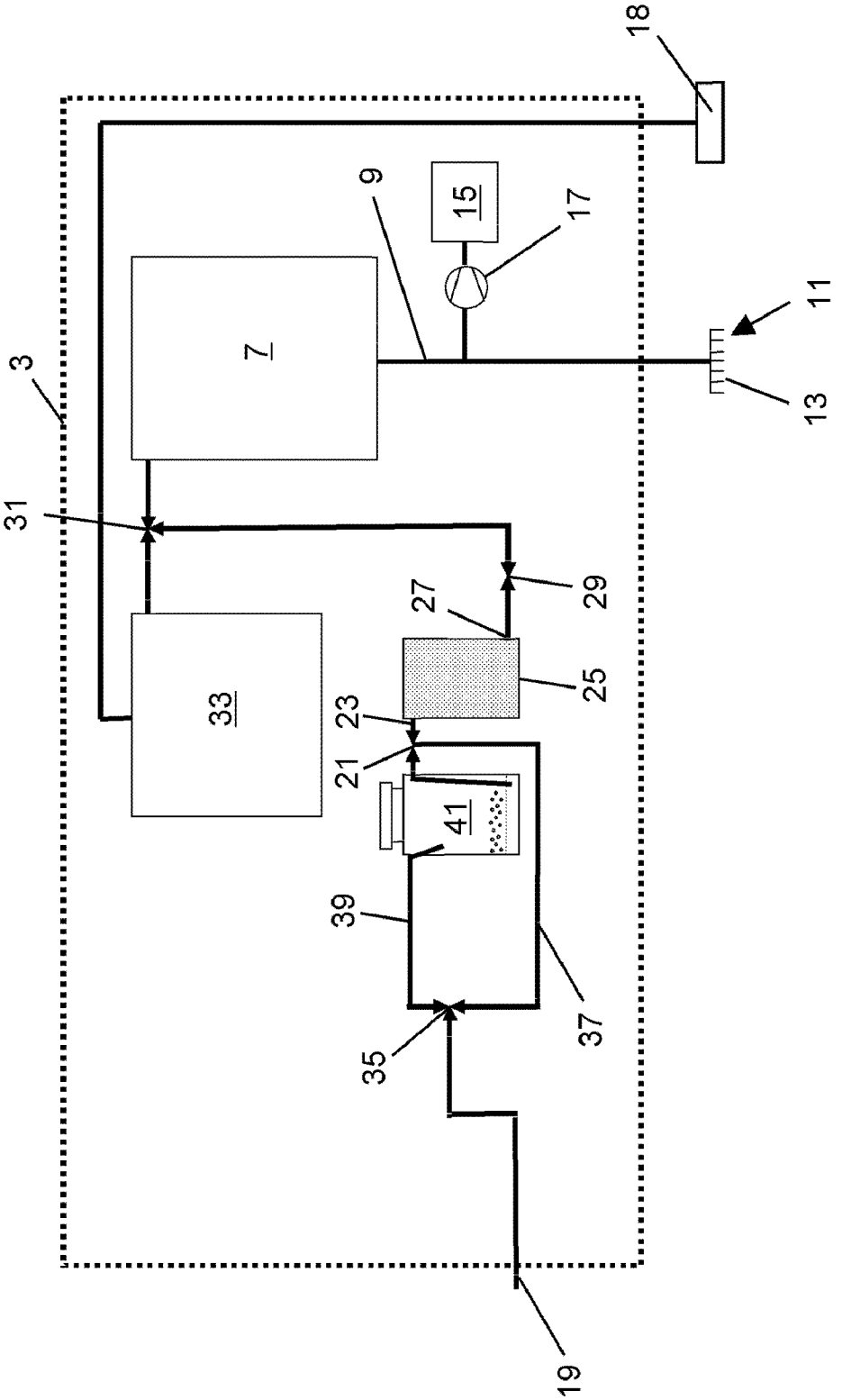


Fig. 3

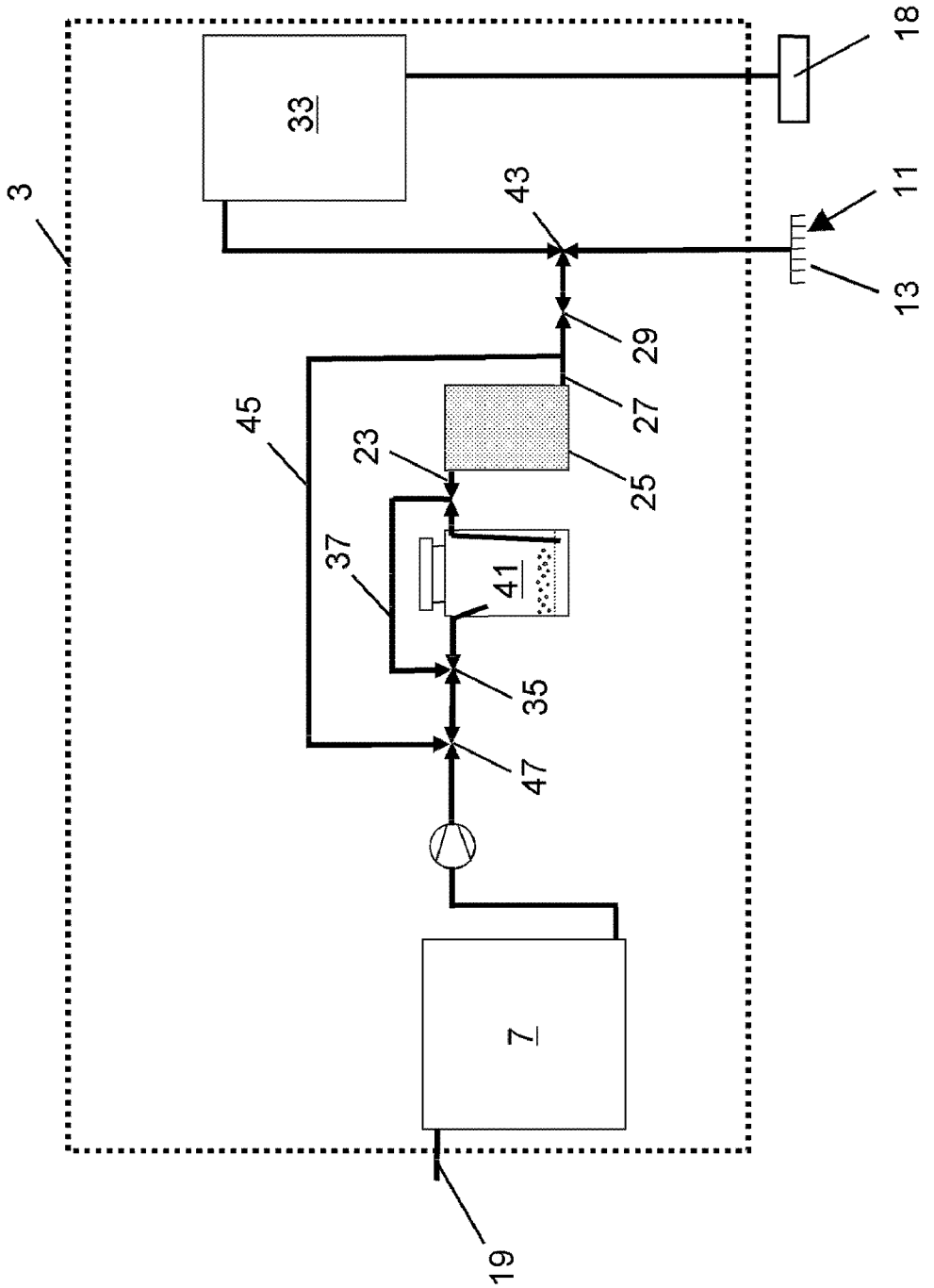


Fig. 4

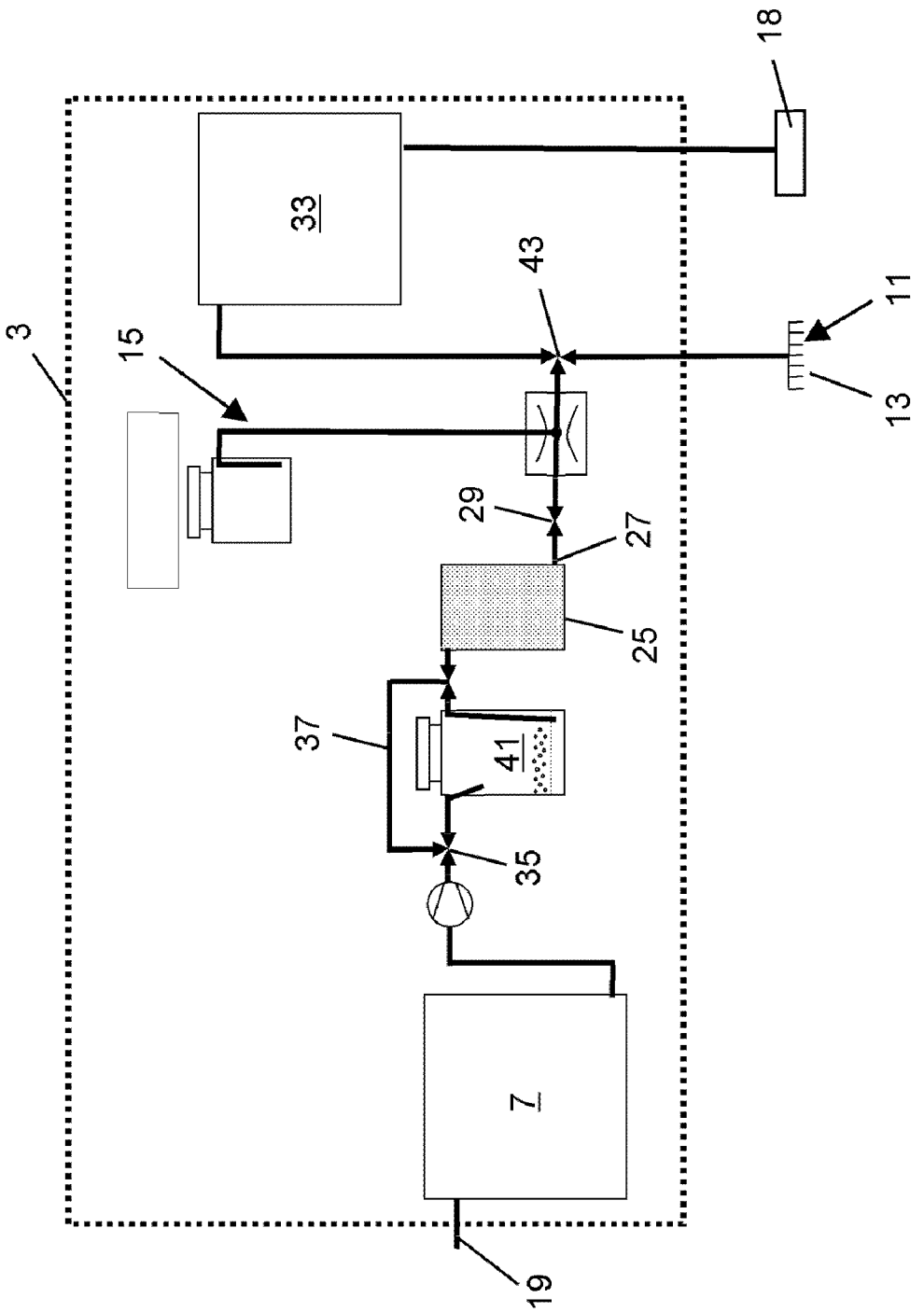


Fig. 5

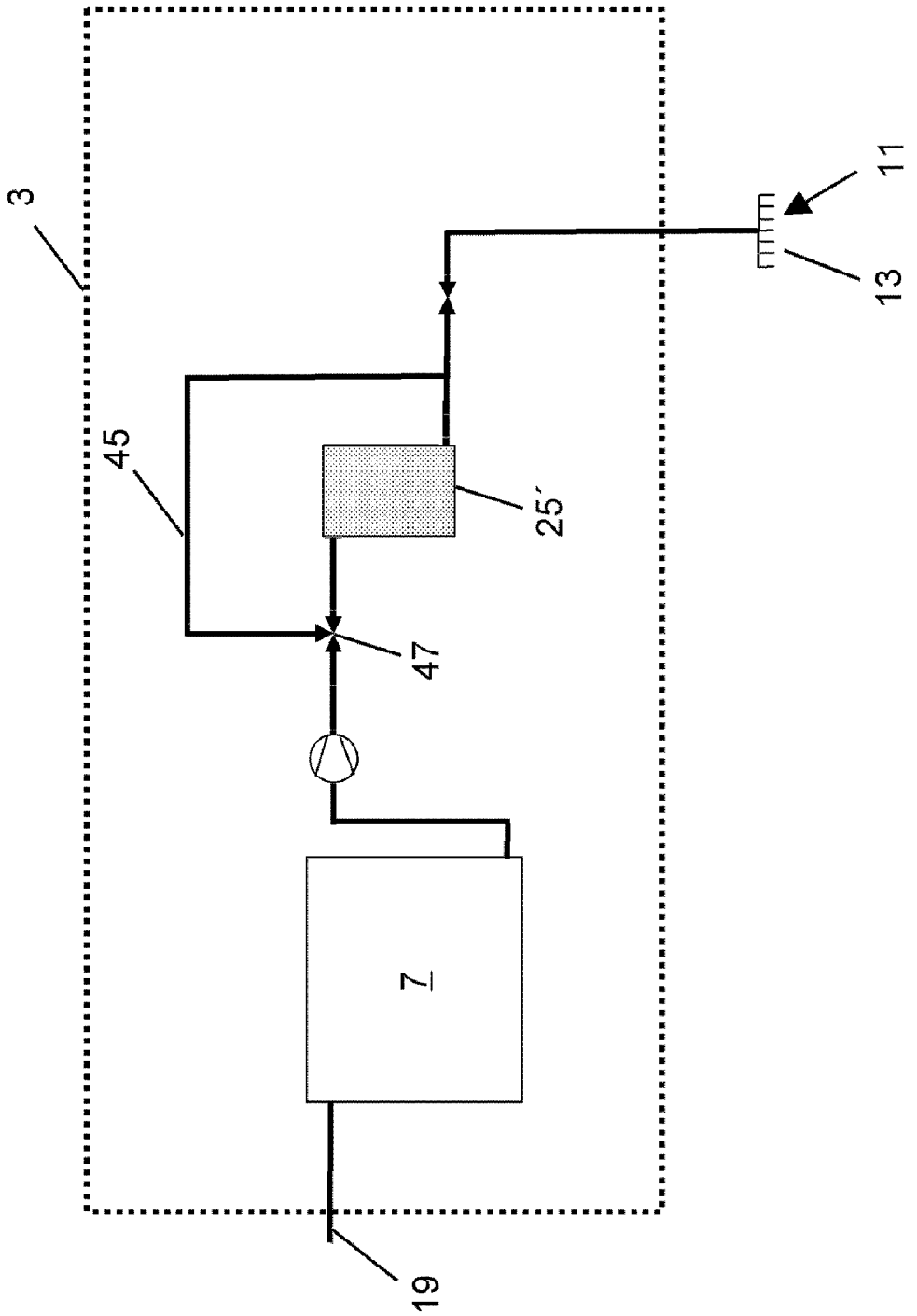


Fig. 6

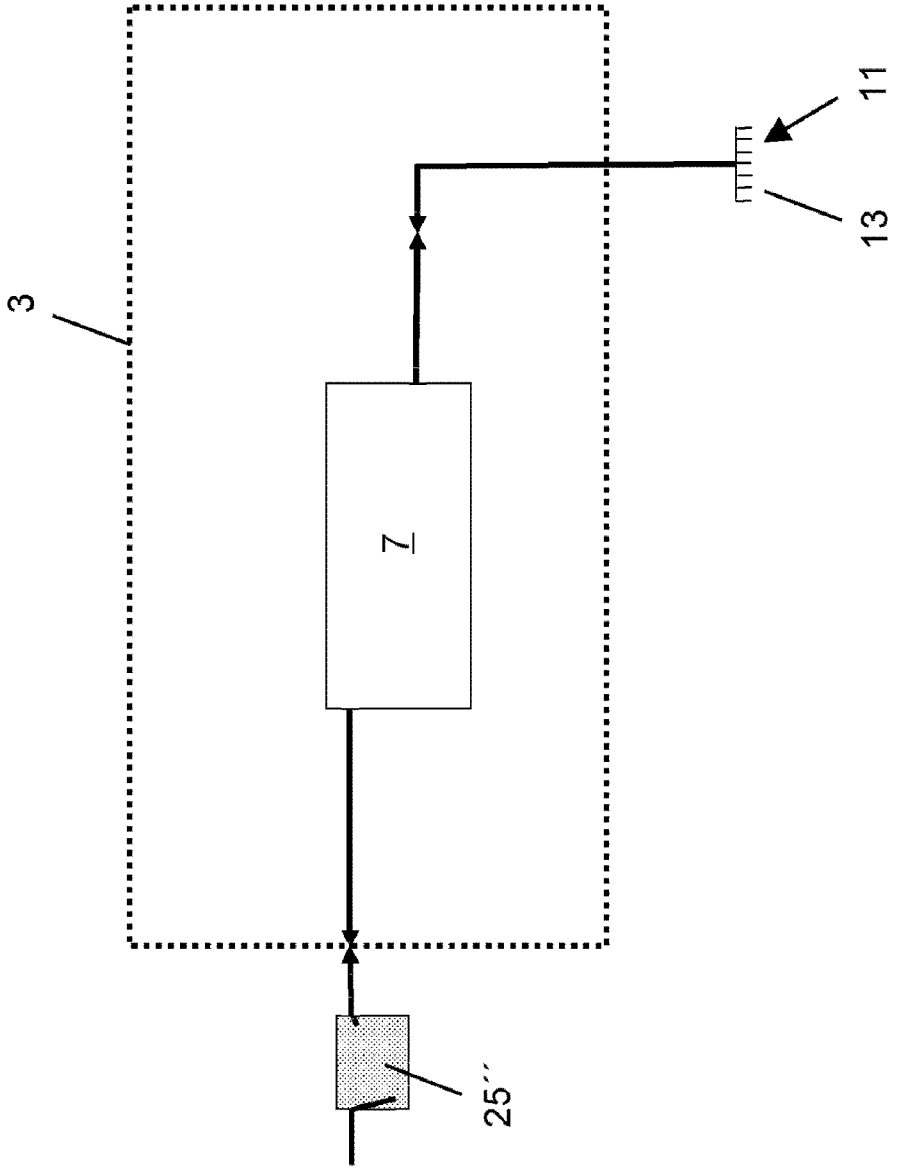


Fig. 7

FLOOR CLEANING MACHINE WITH A WATER SOFTENING DEVICE

[0001] The present invention relates to a floor cleaning machine with a housing, on which a carriage is provided for moving the machine over a floor surface to be cleaned, a fresh-water tank, which is accommodated in the housing, and a cleaning unit, which is attached to the housing and is designed to come into contact with the floor surface to be cleaned, the cleaning unit being connected to the fresh-water tank, and relates to a method for operating a floor cleaning machine.

[0002] Such a floor cleaning machine is known, for example, from EP 0 387 446 A1. During the operation of this machine, water is supplied from a fresh-water tank to a cleaning unit, which has rotating brushes, so that a floor surface can be cleaned by the brushes acting together with the water supplied, to which a cleaning agent has also been added. Although an adequate cleaning effect is achieved with such machines, there is the problem that a comparatively high consumption of cleaning agent takes place.

[0003] This is firstly disadvantageous with regard to aspects of environmental protection, and secondly leads to not inconsiderable operating costs. A further problem that arises when a large amount of cleaning agent is used on a floor surface is that of the residues of cleaning agent that are left there. These quickly cause dirt to reattach itself, so there is an increased incidence of what is known as re-soiling. Residues of lime or other minerals contained in tap water can also be left behind on the floor and lead to a build-up of layers or to rapid re-soiling.

[0004] Against the background of the prior art, the present invention is therefore based on the object of providing a floor cleaning machine and a method for operating it that make it possible at least for the cleaning agent requirement to be reduced.

[0005] This object is achieved in terms of the device by providing an ion-exchanger unit, by the ion-exchanger unit being connected to the fresh-water tank and by the ion-exchanger unit being flowed through by fresh water from an inlet to an outlet.

[0006] For the purposes of the present invention, an "ion-exchanger unit" is understood as meaning a device which is designed inter alia for exchanging positive, limescale-forming ions contained in the water, such as Ca^+ and Mg^+, for other ions, such as for instance Na^+ ions, so that the limescale-causing minerals Ca und Mg are extracted and the water is thereby softened. After passing through the ion-exchanger unit and the exchange thereby involved, the water no longer contains the limescale-causing minerals $CaSO_4$, $MgCl_2$, $Ca(HCO_3)_2$ but other salts, which may take the form of Na_2SQ_4, $2NaCl_2$ und $2NaHCO_3$. This means that, with this method, the overall hardness of the water is reduced.

[0007] In the ion-exchanger unit, the untreated fresh water may also be passed through a combination of cation exchangers and anion exchangers with commercially available cation exchanger resins and anion exchanger resins being used for this. The cations contained in the fresh water (for example Ca, Mg, Na, K) are thereby exchanged by the cation exchanger for H^+ ions, while the anions (for example Cl^-, NO_3^-, SO_4^-, HCO_3^-) are exchanged by the anion exchanger for OH^- ions. Subsequently, the H^+ ions and the OH^- ions react with one another and form water (H^2O). With this alternative it is also the case that, inter alia, the limescale-causing minerals Ca and Mg are extracted from the water and the water is thereby softened. Here, both the overall hardness and the electrical conductivity of the water are reduced.

[0008] The fact that the treated water that is supplied to the cleaning unit and used for floor cleaning no longer contains scarcely any limescale-causing minerals, and is therefore softened, allows the requirement for cleaning agent to be significantly reduced, so that a considerably reduced concentration of cleaning agent in the water is adequate to ensure a satisfactory cleaning result. This effect may go so far that it is possible to dispense completely with the adding of cleaning agent to the water for the cleaning unit.

[0009] Since water with less cleaning agent can then be used, the amount of cleaning agent left behind on the floor surface to be cleaned is then also reduced, which in turn has the effect that the adhesive attachment with which new dirt is held on the floor surface is also reduced. Consequently, the susceptibility of the floor surface to become newly soiled is also reduced, so that re-soiling does not occur as readily. Cleaning agents combine with lime contained in the water to form so-called "lime soap". This can only be removed with increased cleaning effort, and it is also a reason for the tendency of the floor to quickly become newly soiled. This problem is significantly reduced with the floor cleaning machine according to the invention. Since no residues can be left behind on the floor, the sureness of footing (prevention of slipping) is also increased.

[0010] In a preferred embodiment, the inlet of the ion-exchanger unit is connected to a regeneration unit, and there is a bypass line, through which fresh water can flow to the inlet of the ion-exchanger unit without flowing through the regeneration unit.

[0011] With a regeneration unit as provided by the present invention, it is possible for example to restore the capability of the ion-exchanger unit to exchange Ca^+ and Mg^+ ions for Na^+ ions or other ions, once this capability has been lost or at least reduced as a result of the unit being used for a lengthy period of time. For this purpose, the regeneration unit may be filled with sodium chloride, and this sodium chloride is flushed into the ion-exchanger unit as a solution or as brine and remains there for a certain period of time. During this period of time, the material of the ion-exchanger unit gives off once again the Ca^{30} and Mg^+ ions it has taken up and instead takes up Na^+ ions. Once this re-exchange has taken place to an adequate extent, the ion-exchanger unit is flushed, in order that the solution, which now contains Ca^+ and Mg^+ ions, is removed from the ion-exchanger unit.

[0012] The bypass line makes it possible on the one hand for the fresh water, which in normal operation is untreated and does not contain any additions of cleaning agent, to pass directly to the ion-exchanger unit, in order to be appropriately treated there. On the other hand, however, when the bypass line is closed, fresh water can be pumped into the regeneration unit, in order in turn to achieve the effect that brine, for example, is forced into the ion-exchanger unit.

[0013] Altogether, the arrangement comprising the regeneration unit and the bypass line makes it possible that the capability of the ion-exchanger unit can be restored without parts on the floor cleaning machine having to be exchanged. Just one interruption to normal operation is required, during which, for example, brine in the ion-exchanger unit reacts. The regeneration is preferably automatically controlled electronically.

[0014] In an embodiment of a floor cleaning machine according to the present invention there is a fresh-water connection, which is connected to the inlet of the ion-exchanger unit, the outlet of the ion-exchanger unit is connected to the fresh-water tank, and the cleaning unit is in turn connected to the fresh-water tank, and is consequently arranged downstream of the latter. In this case, the treatment of the fresh water by the ion-exchanger unit can take place during the filling of the fresh-water tank, the fresh water subsequently being passed from the fresh-water tank directly to the cleaning unit during cleaning operation.

[0015] Furthermore, a waste-water tank may be provided in the housing of the floor cleaning machine, the outlet of the ion-exchanger unit being connected to the waste-water tank and a valve being provided, so as to release either the connection between the outlet and the fresh-water tank or the connection between the outlet and the waste-water tank.

[0016] The valve makes it possible that, during filling, water which has flowed through the ion-exchanger unit passes into the fresh-water tank. If, however, the regeneration unit is being used to regenerate the ion-exchanger unit, after that, during the flushing of the ion-exchanger unit, the flushing liquid can be passed directly into the waste-water tank. This arrangement consequently makes simple operation of the regeneration unit possible.

[0017] Finally, a cleaning agent metering device may be provided in the connection between the fresh-water tank and the cleaning unit for adding cleaning agent to the fresh water. This makes it possible, where necessary, also to add cleaning agent to the softened water.

[0018] In the case of an alternative embodiment of a floor cleaning machine according to the invention, the fresh-water tank is connected to the inlet of the ion-exchanger unit, and the outlet of the ion-exchanger unit is connected to the cleaning unit. In the case of this embodiment, during cleaning operation water constantly flows out of the fresh-water tank through the ion-exchanger unit and then to the cleaning unit, so that the ion-exchanger unit is not only in operation during the filling of the fresh-water tank, as was the case with the previous example. Therefore, this arrangement has the advantage that the throughflow per unit of time for the ion-exchanger unit is less than in the case of the previous embodiment, in which the softening takes place during the filling of the fresh-water tank.

[0019] Furthermore, here, too, a waste-water tank may be provided in the housing, the outlet of the ion-exchanger unit being connected to the waste-water tank. Furthermore, a valve is provided, so as to release either the connection between the outlet and the cleaning unit or the connection between the outlet and the waste-water tank. Consequently, in the case of this embodiment too, on the one hand water can be passed through the ion exchanger to the cleaning unit or on the other hand, after regeneration, the flushing liquid can be passed directly to the waste-water tank, with the respective flow path depending on the position of the valve.

[0020] In a preferred embodiment, a bridging line is provided, connecting the fresh-water tank directly to the cleaning unit, so that fresh water can flow to the cleaning unit without passing through the ion-exchanger unit. This makes it possible that, when a cleaning agent which would damage the ion-exchanger unit is added to the fresh water in the fresh-water tank, the fresh water can flow directly to the cleaning unit. This makes the floor cleaning machine more versatile in the way in which it can be used.

[0021] Alternatively or in addition, however, a cleaning agent metering device may also be provided between the outlet of the ion-exchanger unit and the cleaning unit.

[0022] Finally, the above object is also achieved by a method for operating a floor cleaning machine, the cleaning unit being supplied with fresh water which has flowed through an ion-exchanger unit. This likewise achieves the effect that the water supplied to the cleaning unit no longer contains any limescale-causing minerals, and is therefore softened. This has the advantages already explained in connection with the floor cleaning machine according to the invention. Alternatively, the fresh water may flow through the ion-exchanger unit before or after the filling of the fresh-water tank. In this case, it is also possible that the ion-exchanger unit is not provided in the floor cleaning machine itself but takes the form of a separate unit through which the fresh water flows during the filling of the fresh-water tank.

[0023] The present invention is described below merely on the basis of preferred exemplary embodiments, which are represented in the accompanying drawing, in which

[0024] FIG. **1** is a partially broken-away representation of a floor cleaning machine according to the invention,

[0025] FIG. **2** is a perspective representation of the water supply system of the floor cleaning machine from FIG. **1**,

[0026] FIG. **3** is a schematic representation of the water supply system of the floor cleaning machine from FIG. **1**,

[0027] FIG. **4** is a schematic representation of a first alternative water supply system for a floor cleaning machine according to the invention,

[0028] FIG. **5** is a schematic representation of a second alternative water supply system for a floor cleaning machine according to the invention,

[0029] FIG. **6** is a schematic representation of a third alternative water supply system for a floor cleaning machine according to the invention and

[0030] FIG. **7** is a schematic representation of a system according to the invention comprising a floor cleaning machine with a separate ion-exchanger unit.

[0031] In FIGS. **1** to **3**, a first exemplary embodiment of a floor cleaning machine **1** according to the invention is represented. FIG. **3** thereby shows a schematic representation of the water supply system of the floor cleaning machine **1**.

[0032] The floor cleaning machine **1** has a housing **3**, on which a carriage with wheels **5** is provided. As a result, it is possible to move the floor cleaning machine **1** over a floor surface to be cleaned, the floor cleaning machine **1** being guided by means of a handle **4** attached to the housing **3**.

[0033] Accommodated in the housing **3** is a fresh-water tank **7**, which has a float valve **8** and is connected by way of a line **9** to a cleaning unit **11** attached to the housing **3**. The cleaning unit **11** has in a way known per se rotating brushes **13**, which, with the cleaning unit **11** lowered in the direction of the floor surface to be cleaned, come into contact with the latter. In the case of this preferred exemplary embodiment, connected to the line **9** is a cleaning agent metering device **15**, by way of which a cleaning agent can be mixed into the water flowing from the fresh-water tank **7** to the cleaning unit **11** by means of a cleaning agent pump **17**. Finally, attached in the usual way to the housing **3** is a suction foot **18**, with which water applied to the floor surface can be sucked up by way of the cleaning unit **11**.

[0034] As shown in particular by FIG. **2**, a fresh-water connection **19** is provided, allowing the fresh-water tank **7** to be filled with water. For this purpose, the fresh-water connec-

tion **19** is connected by way of a valve **21** to the inlet **23** of an ion-exchanger unit **25**, the outlet **27** of which is in turn connected by way of a valve **29** to a valve **31**. The valve **31** is connected on the one hand to the fresh-water tank **7** and on the other hand to a waste-water tank **33**, so that the valve **31** is arranged in such a way that it releases either the connection between the outlet **27** and the fresh-water tank **7** or the connection between the outlet **27** and the waste-water tank **33**.

[0035] The ion-exchanger unit **25** serves the purpose of softening the water flowing through or exchanging limescale-forming ions contained therein, such as Ca^+ or Mg^+, for other ions.

[0036] This may take place by these ions being exchanged for Na+ ions.

[0037] Provided upstream of the ion-exchanger unit **25**, between the fresh-water connection **19** and the valve **21**, is a further valve **35**, from which a bypass line **37** leads to the valve **21** upstream of the inlet **23** of the ion-exchanger unit **25** and a further line **39** leads to the inlet of the regeneration unit **41**. Finally, the outlet of the regeneration unit **41** is connected to the valve **21**.

[0038] The regeneration unit **41** makes it possible to restore the full capability of the ion-exchanger unit **25** when the latter no longer adequately exchanges Ca^+ or Mg^+ ions for Na^+ ions, for example, as a result of being used for a relatively long time. For this purpose, in the preferred exemplary embodiment represented here, the regeneration unit **41** is filled with regenerating salt, which corresponds to a slowly dissolving sodium chloride (NaCl) with only a low degree of purity. In the regeneration unit **41** there is also salt dissolved in water, which is referred to as brine. If the valves **35** and **21** are appropriately switched, sodium chloride solution can flow out of the regeneration unit **41** into the ion-exchanger unit **25**. Subsequently, the Ca^+ or Mg^+ ions taken up during operation by the material of the ion-exchanger unit **25** are exchanged "back" again for Na^+ ions. In a final regeneration step, the solution, which then contains Ca^+ or Mg^+ ions, is then flushed out of the ion-exchanger unit **25** and, through a corresponding position of the valve **21**, into the waste-water tank **33**.

[0039] While the ion-exchanger unit **25** has been described in connection with this exemplary embodiment as being based on the exchange of Ca^+ or Mg^+ ions for Na^+ ions, the present invention is not, however, restricted to such exchanger units. In the same way, exchanger units in which an exchange of the positively charged cations, inter alia Ca^+ or Mg^+ ions, for H^+ ions takes place may be used. In addition, an exchange of the negatively charged anions for OH^- ions also takes place. In the latter example, however, the ion-exchanger unit **25** cannot regenerate again in the comparatively simple way described, so that then there is no need for the regeneration unit **41**.

[0040] The exemplary embodiment of a floor cleaning machine **1** that is represented in FIGS. **1** to **3** can operate in the following way.

[0041] Firstly, the floor cleaning machine **1** is connected by means of the fresh-water connection **19** to a water supply, and the valves **35** and **21** are switched in such a way that the water flows from the fresh-water connection **19** through the bypass line **37** to the inlet **23** of the ion-exchanger unit **25**. The water passes through the ion-exchanger unit **25**, and is thereby softened by the exchange of the limescale-forming Ca^+ or Mg^+ ions for Na^+ ions. The valve **31** is switched in such a way that the softened water can flow into the fresh-water tank **7**. The filling operation is stopped when the float valve **8** closes as the intended upper filling level is reached.

[0042] After the filling of the fresh-water tank **7**, the floor cleaning machine **1** can be used for cleaning a floor surface, fresh water being passed from the fresh-water tank **7** by way of the line **9** to the cleaning unit **11**. In this case, if necessary, a cleaning agent can be added to the fresh water by way of the cleaning agent metering unit **15**. However, on account of the previous softening or the exchange of the limescale-causing minerals, the requirement for cleaning agent is greatly reduced, and in many cases it is possible to dispense completely with the addition of cleaning agent.

[0043] During the cleaning operation, the water applied by means of the cleaning unit **11** is sucked up again by way of the suction foot **18** and delivered into the waste-water tank **33**.

[0044] After a certain amount of throughflow, which is dependent on the hardness of the tap water supplied, it may be necessary to regenerate the material of the ion-exchanger unit **25**, since its capability of exchanging Ca^+ or Mg^+ ions subsides. For this purpose, the floor cleaning machine **1** is connected by way of the fresh-water connection **19** to a water supply, and the valves **35** and **21** are switched in such a way that water flows into the regeneration unit **41** and, by way of the outlet of the regeneration unit **41**, forces N^+-containing brine into the ion-exchanger unit **25**. Subsequently, the brine must remain in the ion-exchanger unit **25** for a certain period of time, namely the regeneration time, during which the Ca^+ or Mg^+ ions are exchanged back for Na^+ ions.

[0045] Subsequently, the valves **35** and **21** are switched in such a way that water can flow from the fresh-water connection **19** by way of the bypass line **37** directly into the ion-exchanger unit **25** for flushing. Furthermore, the valve **31** is switched in such a way that the flushing water flows on into the waste-water tank **33**. After completion of the flushing operation, the floor cleaning machine can then be filled again, in the way already described, and operated.

[0046] FIG. **4** schematically shows the construction of the water supply system of a second exemplary embodiment of a floor cleaning machine according to the invention with a housing **3**. In the case of this exemplary embodiment, the fresh-water connection **19** is connected directly to the fresh-water tank **7**.

[0047] Between the fresh-water tank **7** and the cleaning unit **11**, the already described regeneration unit **41** and ion-exchanger unit **25** are provided, the fresh-water tank **7** being connected by way of the bypass line **37** directly to the inlet **23** of the ion-exchanger unit **25**. Finally, the outlet **27** of the ion-exchanger unit **25** is connected by way of the valve **43** to the cleaning unit **11**. The valve **43** is also connected to the waste-water tank **33**, so that the valve **43** is provided, so as to release either the connection between the outlet **27** and the cleaning unit **11** or the connection between the outlet **27** and the waste-water tank **33**.

[0048] Furthermore, this exemplary embodiment also has a bridging line **45**, which connects the fresh-water tank **7** directly to the valve **43**, and consequently the cleaning unit **41**, so that fresh water can flow to the cleaning unit **11** without passing through the ion-exchanger unit **25**.

[0049] In the case of this embodiment, during cleaning operation water constantly flows out of the fresh-water tank **7** through the bypass line **37** and the ion-exchanger unit **25** and then by way of the appropriately switched valve **43** to the cleaning unit **11**, so that the ion-exchanger unit **25** is not only in operation during the filling of the fresh-water tank **7**, as was the case with the previous example. Therefore, this arrangement has the advantage that the throughflow per unit of time through the ion-exchanger unit **25** is less here. Nevertheless, here, too, there is the advantage that the water supplied to the cleaning unit **11** is softened, and consequently leads to a better cleaning result.

[0050] Furthermore, the bridging line **45** makes it possible that, when a cleaning agent which would damage the ion-exchanger unit **25** is added to the fresh water in the fresh-water tank **7**, the fresh water can flow directly to the cleaning unit **11**. In this case, although the water supplied to the cleaning unit **11** is not softened, the floor cleaning machine **1** is more versatile in the way in which it can be used.

[0051] If, in the case of this exemplary embodiment, the ion-exchanger unit **25** has to be regenerated, the valves **47** and **35** are switched in such a way that fresh water flows out of the fresh-water tank **7** into the regeneration unit **41** and forces brine out of it into the ion-exchanger unit **25**. Once the already described exchange process between Ca^+ und Mg^+ on the one hand and Na^+ on the other hand has taken place, the ion-exchanger unit **25** is flushed by way of the bypass line **37**, the flushing water being passed by way of the appropriately switched valve **43** into the waste-water tank **33**.

[0052] The exemplary embodiment represented in FIG. **5** differs from that represented in FIG. **4** in that no bridging line **45** is provided here, but a cleaning agent metering device **15**, by way of which a cleaning agent can be added, if required, to the water which has already passed through the ion-exchanger unit **25**. Otherwise, the operation of this exemplary embodiment does not differ from the previous one. However, it should be pointed out at this stage that the exemplary embodiments according to FIGS. **4** and **5** can also be combined with one another, so that both a bridging line **45** and a cleaning agent metering device **15** are provided.

[0053] The exemplary embodiment represented in FIG. **6** differs from that described in conjunction with FIG. **4** in that no regeneration unit is provided here, but the ion-exchanger unit **25'** must be exchanged when its ion exchanging capability has decreased too much, and therefore the unit is depleted. Furthermore, here, too, during operation the water is passed from the fresh-water tank **7** through the ion-exchanger unit **25** to the cleaning unit **11**, and is thereby softened, and it is also the case with this exemplary embodiment that a bridging line **45** is provided, making it possible to bypass the ion-exchanger unit **25** if a cleaning agent has been added to the water in the fresh-water tank **7**.

[0054] Finally, FIG. **7** shows an exemplary embodiment in which the ion-exchanger unit **25"** is not arranged within the housing **3** of the floor cleaning machine **1**, but is provided as an external device. Here, the ion-exchanger unit **25"** is flowed through when the fresh-water tank **7** in the floor cleaning machine is being filled, so that the mode of operation corresponds substantially to that described in conjunction with the exemplary embodiment according to FIGS. **1** to **3**.

[0055] In the case of the previously described exemplary embodiments of a floor cleaning machine according to the invention, the cleaning unit is respectively supplied with fresh water which has previously flowed through an ion-exchanger unit. As a result, the supplied water that is used for the floor cleaning no longer contains scarcely any limescale-causing minerals, and is therefore softened. Therefore, the requirement for cleaning agent can be significantly reduced, so that a considerably reduced concentration of cleaning agent in the water is adequate to ensure a satisfactory cleaning result. This effect may go so far that it is possible to dispense completely with the adding of cleaning agent to the water.

1-12. (canceled)

13. A floor cleaning machine comprising:

a wheeled carriage for moving the machine over a floor surface to be cleaned;

a housing mounted to said carriage;

a fresh-water tank in the housing;

a cleaning unit mounted to the housing for contacting a floor, said cleaning unit being connected to and receiving water from said fresh-water tank; and

an ion-exchanger carried by said carriage and connected to said fresh-water tank, said ion-exchanger passing fresh water from an inlet to said fresh-water tank for use in cleaning said floor surface.

14. The floor cleaning machine according to claim **1**, further including a regeneration unit wherein said inlet of said ion-exchanger unit may be selectively connected to said regeneration unit and further including a bypass line through which water can flow directly to said inlet of said ion-exchanger unit without flowing through said regeneration unit.

15. The floor cleaning machine of claim **2** further comprising a fresh water connection which is connected to the inlet of the ion-exchanger unit, the outlet of said ion-exchanger unit connected to the fresh-water tank and said cleaning unit is connected to the fresh-water tank.

16. The floor cleaning machine of claim **3** further comprising a waste-water tank within said housing wherein said ion-exchanger unit may be connected to the waste-water tank and further including a valve for coupling the output of said ion-exchanger unit to the inlet of said fresh water tank or to said waste water tank.

17. The floor cleaning machine of claim **3** further including a cleaning agent metering device connected into a line between the fresh-water tank and the cleaning unit for metering cleaning agent to the fresh water fed to the cleaning unit.

18. The floor cleaning machine according to claim **1** characterized in that said fresh-water tank is connected to an inlet of the ion-exchanger unit and the outlet of the fresh water tank exchanger unit is connected to the cleaning unit for delivering de-ionized water.

19. The floor cleaning machine according to claim **6** further comprising a waste-water tank in the housing, the outlet of the ion-exchanger unit being connected to the waste-water tank, and further including a valve for coupling either the connection between said outlet of said ion-exchanger unit and said fresh water tank, or the connection between said outlet of said ion-exchanger and the waste-water tank.

20. The floor cleaning machine of claim **6** further comprising a bridging line connecting the fresh-water tank directly to the cleaning unit, whereby fresh water may flow directly to said cleaning unit without passing through said ion-exchanger unit.

21. The floor cleaning machine of claim **1** further comprising a cleaning agent metering device for metering cleaning agent into a line extending from the outlet of the fresh water tank and the cleaning unit.

22. A method of operating a floor cleaning machine including a housing, a carriage, and a cleaning unit, comprising:

flowing the fresh water through a first valve to de-ionizing unit and thence de-ionizing unit to a fresh water storage tank;

passing the de-ionized water from the fresh water storage tank and mixing the de-ionized water with a cleaning solution;

then, passing the mixed de-ionized water and cleaning solution to the cleaning unit and thence to the floor to be cleaned while brushing the floor with the cleaning unit.

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