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(54) **METHOD FOR OPERATING A FLOOR  
CLEANING SYSTEM, AND FLOOR  
CLEANING SYSTEM FOR USE OF THE  
METHOD**

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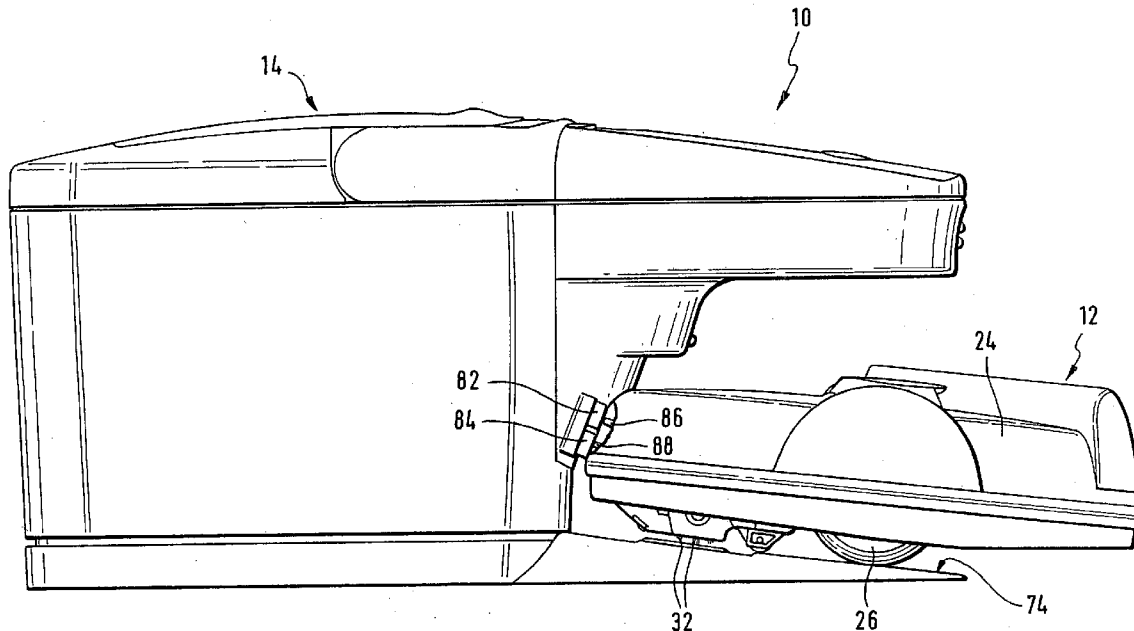
**Lipsitz & McAllister, LLC****755 MAIN STREET****MONROE, CT 06468 (US)**(57) **ABSTRACT**

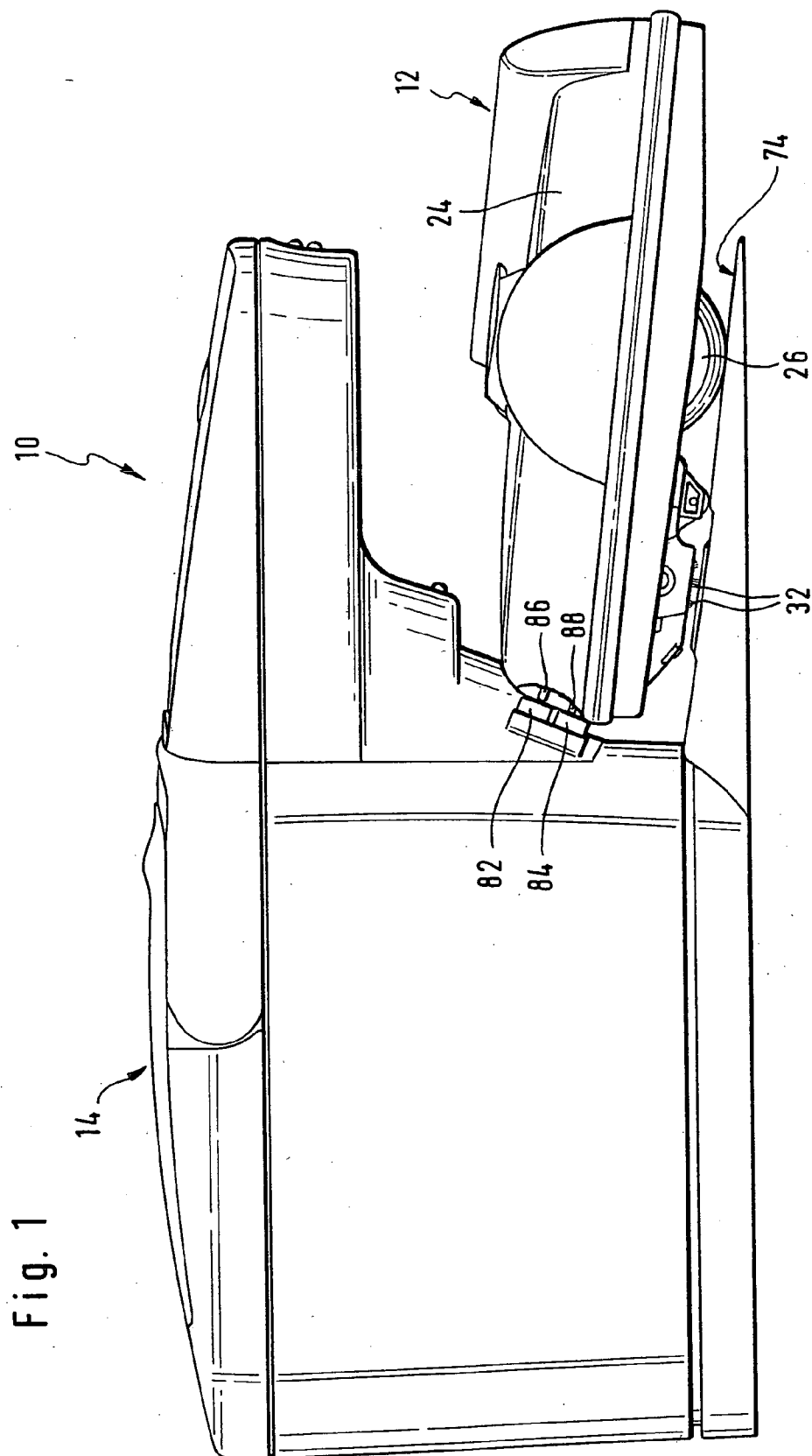
The invention relates to a method for operating a floor cleaning system having a central suction station with which there is associated a self-propelled and self-steering suction appliance, dirt being picked up from a floor surface that is to be cleaned by means of the suction appliance and being transferred into a dirt collection vessel of the suction appliance, and the suction station having a suction unit, and the dirt collection vessel being sucked out by means of the suction unit. To refine the method in such a manner that the levels of noise produced by the floor cleaning system can be reduced, it is proposed, according to the invention, that the suction unit is optionally operated with a maximum suction power or a reduced suction power. The invention also proposes a floor cleaning system for carrying out the method.

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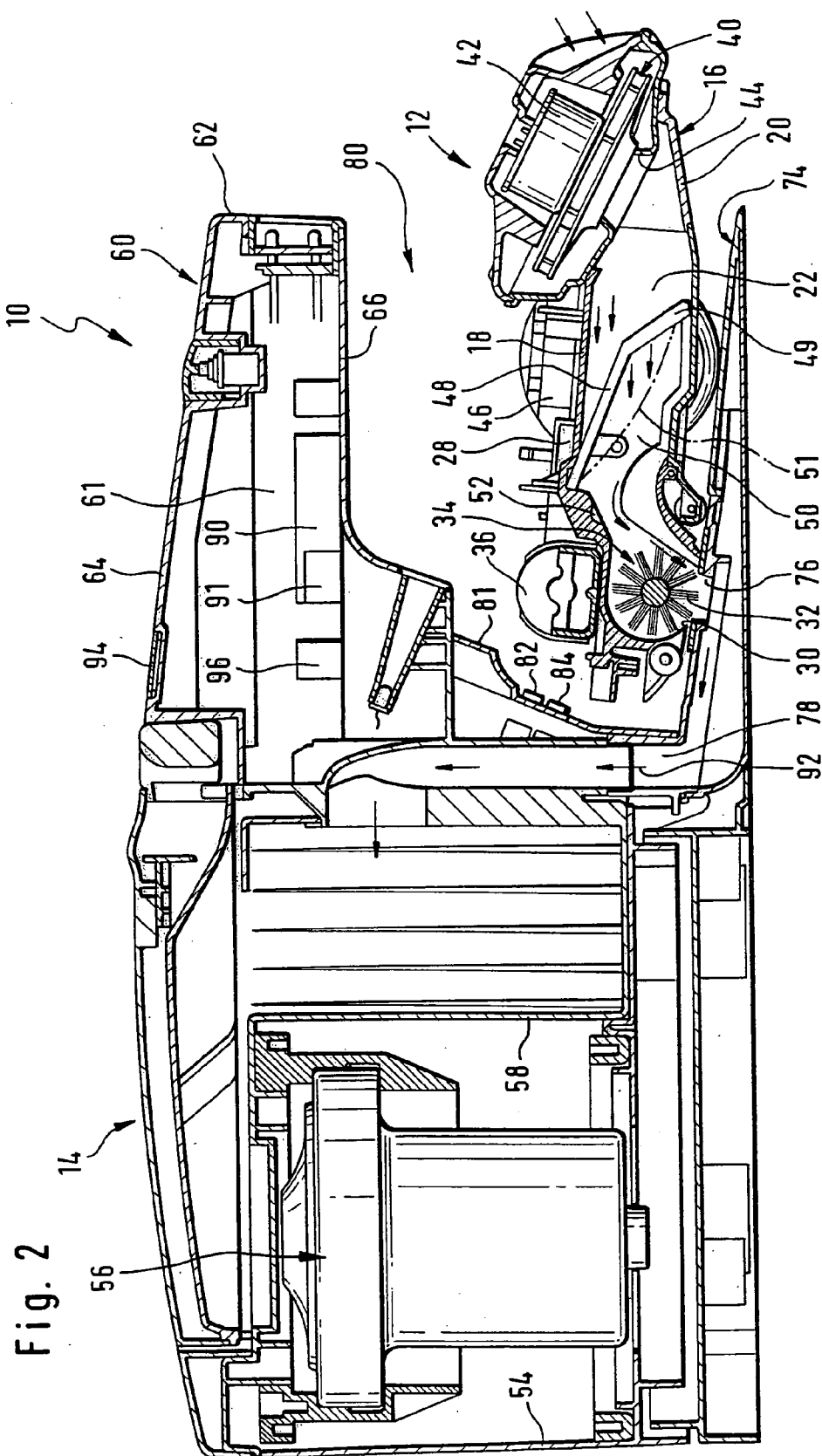
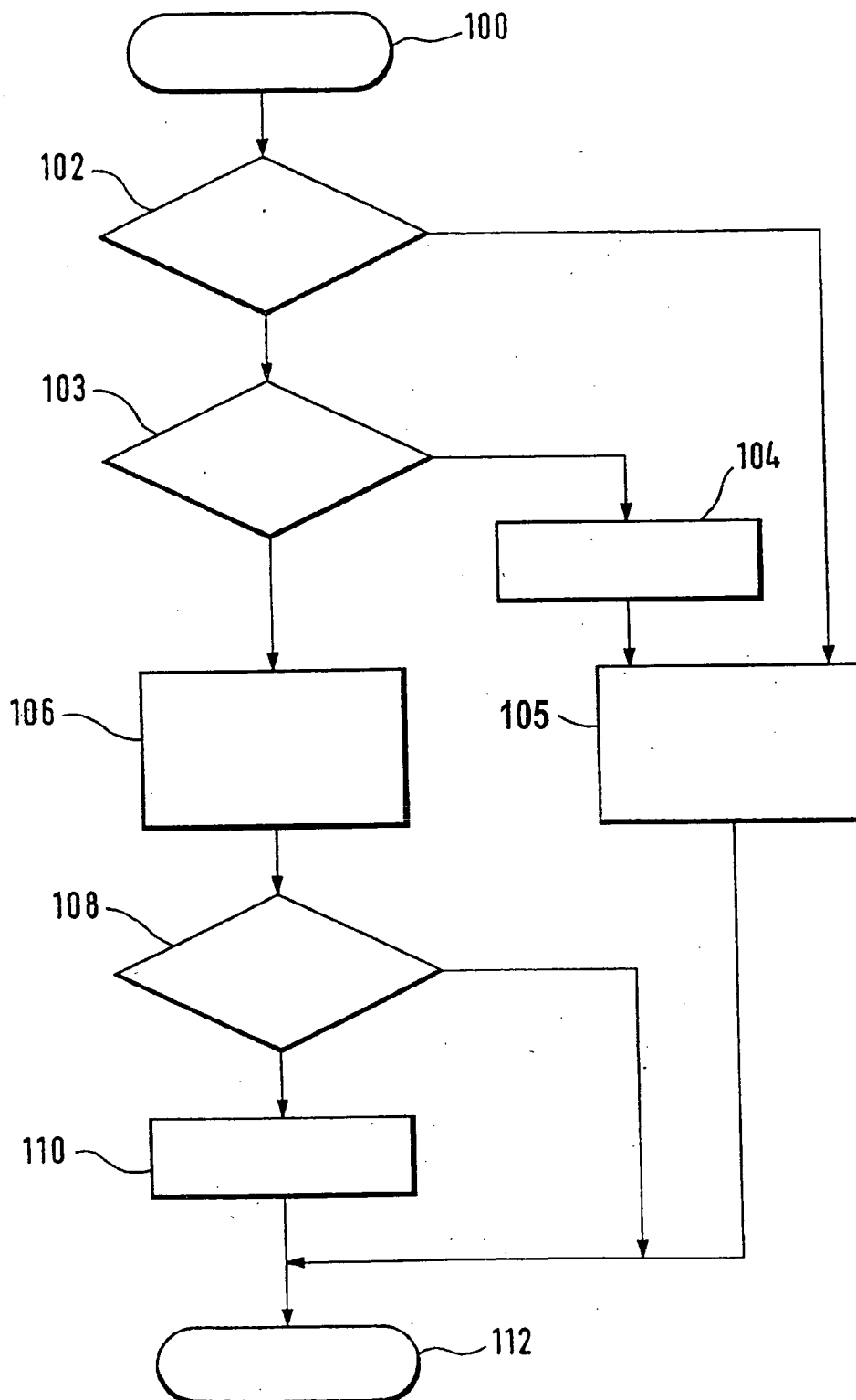


Fig. 3



## METHOD FOR OPERATING A FLOOR CLEANING SYSTEM, AND FLOOR CLEANING SYSTEM FOR USE OF THE METHOD

[0001] This application is a continuation of international application number PCT/EP 03/06222 filed on Jun. 13, 2003.

[0002] The present disclosure relates to the subject matter disclosed in international application number PCT/EP 03/06222 of Jun. 13, 2003 and German application number 102 31 384.9 of Jul. 8, 2002, which are incorporated herein by reference in their entirety and for all purposes.

### BACKGROUND OF THE INVENTION

[0003] The invention relates to a method for operating a floor cleaning system having a central suction station with which there is associated a self-propelled and self-steering suction appliance, dirt being picked up from a floor surface that is to be cleaned by means of the suction appliance and being transferred into a dirt collection vessel of the suction appliance, and the suction station having a suction unit, and the dirt collection vessel being sucked out by means of the suction unit.

[0004] Moreover, the invention relates to a floor cleaning system for use of the method.

[0005] Floor cleaning systems having a central suction installation, with which there is associated a self-propelled and self-steering suction appliance, make it possible to clean a floor surface without the need for an operator to move the suction appliance along the floor surface. The suction appliance is of self-propelled and self-steering configuration and can pick up dirt from the floor surface and transfer it into a dirt collection vessel carried along by the suction appliance. When the dirt collection vessel is full, the suction appliance automatically steers toward the central suction station, at which the dirt collection vessel is emptied. For this purpose, the suction station comprises a suction unit for sucking out the dirt collection vessel. After the dirt collection vessel has been sucked out, the suction appliance can return to its suction operation and continue to move along on the floor surface that is to be cleaned.

[0006] Sucking out the dirt collection vessel involves a certain amount of noise being produced.

[0007] It is an object of the present invention to provide a method of the type described in the introduction which can be used to reduce the noise produced by the floor cleaning system.

### SUMMARY OF THE INVENTION

[0008] In a method of the generic type, this object is achieved, according to the invention, by the suction unit being selectively operated with a maximum suction power or a reduced suction power. According to the invention, it is possible to reduce the noise produced by the floor cleaning appliance by the suction unit being operated with a reduced suction power. A reduced-power operating mode of this type is advantageous in particular when the floor cleaning system is used at night. If the floor cleaning system is used at times at which the production of noise is considered particularly disturbing, the user can opt for the operating mode with reduced suction power of the suction unit. This allows a

considerable reduction in noise, for example allows the noise to be reduced by at least 5 dB(A) compared to the amount of noise produced by the suction unit operating at maximum suction power.

[0009] The suction unit is preferably operated with a reduced suction power for a predetermined period of time and is then operated with a maximum suction power again. This ensures that the dirt collection vessel is once again subjected to the suction stream which represents the maximum suction power of the suction unit after a predetermined period of time has elapsed, so that it is fully emptied again at the latest after the predetermined period of time has elapsed, and scarcely any residual dirt remains in the dirt collection vessel. A procedure of this nature is advantageous in particular if coarse-grained dirt particles collect in the dirt collection vessel during the reduced-power operating mode of the suction unit.

[0010] For example, it may be provided that the suction unit is operated with a reduced suction power for at most approximately eight hours and is then operated with a maximum suction power again.

[0011] Preferably, the dirt collection vessel is sucked out with the maximum suction power of the suction unit at least once after the period of time which is predetermined for the operating mode with reduced suction power has elapsed. After the dirt collection vessel has been sucked out with a maximum power, it is then possible to revert to the reduced-power operating mode. It has been found that even a single sucking-out operation at maximum suction power is sufficient to completely remove even coarse-grained dirt particles from the dirt collection vessel.

[0012] The mobile suction appliance can usually be switched on and off independently of the central suction station. If the floor cleaning system is in its reduced-power operating mode and if the mobile suction appliance is switched off in this state, the situation may arise whereby the user, on switching the suction appliance on again, simultaneously also re-inputs the command for the operating mode with a reduced suction power. This means that there is a risk of the operating mode with a reduced suction power in total extending over a very long period of time and of an unacceptably large quantity of coarse-grained dirt particles collecting in the dirt collection vessel. To counteract this risk, it is advantageous if during the operation with reduced suction power, the period of time between two operations of sucking out the dirt collection vessel is measured and compared with a maximum permissible period of time, and the method is switched to the operation with maximum suction power if the maximum permissible period of time is exceeded. If the suction appliance is sucked out with a reduced suction power of the suction unit and is switched off in this state and then switched on again at a later time, with the reduced-power operation of the suction unit being selected again at the same time, it is switched to operation with maximum suction power irrespective of the operating mode selected by the user if a predetermined maximum value for the period of time between the last time the dirt collection vessel was sucked out and the current suction operation is exceeded, in order for the dirt collection vessel to be completely emptied. The operating mode with maximum suction power may in this case be limited in terms of time, and in particular it is possible to provide that in this

case the dirt collection vessel is only once sucked out at maximum suction power, and that operation then reverts to the operating mode with reduced-power suction power as selected by the user.

[0013] It is also possible to provide that a command to restart the operating mode with reduced suction power is suppressed during this operating mode. This prevents the user from extending the maximum period of time provided for the reduced-power operating mode by restarting this operating mode before the suction station has automatically switched from the reduced-power operating mode to the operating mode with maximum suction power.

[0014] The operating mode with reduced suction power may, for example, be implemented in such a way that the suction station is operated with at most 50% of the electric power of the suction station at maximum suction power. By way of example, it is possible to provide that the suction station consumes an electric power of 600 W at maximum suction power, whereas the power consumption of the suction station at reduced suction power is only 250 W.

[0015] As has already been mentioned in the introduction, the present invention also relates to a floor cleaning system for use of the method as described above. In this context, the floor cleaning system comprises a central suction station, with which there is associated a self-propelled and self-steering suction appliance, the suction appliance having a dirt collection vessel and a suction turbine for picking up dirt from a floor surface that is to be cleaned and for transferring the dirt into the dirt collection vessel, and the suction station having a suction unit for sucking out the dirt collection vessel.

[0016] To configure the floor cleaning system in such a manner that it allows operation with reduced production of noise, it is proposed, according to the invention, that the suction unit is selectively operable with a maximum suction power or a reduced suction power.

[0017] For this purpose, it is possible, for example, to provide that the suction station has an activation element, which can be actuated by the user, for example a selection switch or button element, for activating the operating mode with reduced suction power.

[0018] To prevent residual dirt from accumulating in the dirt collection vessel, it is provided, in a preferred embodiment of the floor cleaning system according to the invention, that the suction unit can be operated with a reduced suction power for a predetermined period of time and switches to an operating mode with a maximum suction power after the predetermined period of time has elapsed. This type of configuration of the floor cleaning system has the advantage that the user does not himself have to ensure that the dirt collection vessel is sucked out from time to time with the maximum suction power of the suction unit, but rather the suction unit is switched to the operating mode with maximum suction power after a predetermined period of time has elapsed, for example after approximately eight hours have elapsed, independently of a corresponding control command from the user. Should the user then wish to revert to the reduced-power operating mode of the suction unit, it is possible to provide that he has to actuate the activation element again for this purpose.

[0019] In a preferred embodiment of the floor cleaning system, it is provided that the suction station comprises an

activation element for activating the operating mode with reduced suction power, the predetermined period of time for the operating mode with reduced suction power not being extendable by multiple actuation of the activation element. This prevents actuation of the activation element during the reduced-power operating mode of the suction station from leading to an extension of this operating mode. Instead, the reduced-power operating mode can only be started during the operating mode with maximum suction power, i.e. the activation element is only active when the suction unit is at maximum suction power.

[0020] It is possible to provide that a timing element for recording the duration of the operating mode with reduced suction power is associated with the activation element, it not being possible for the timing element to be influenced by actuation of the activation element during the operation with reduced suction power. A configuration of this nature ensures that the user cannot reset the timing element, which is used to record the duration of the operating mode with reduced suction power, by actuation of the activation element in order in this way to continuously operate the suction unit at reduced suction power. Consequently, an activation signal which is provided by the activation element to a control unit of the suction station is suppressed during the operating mode with reduced suction power. Rather, in an embodiment of the floor cleaning system of this type, an activation signal of this type is only effective during the operating mode with maximum suction power of the suction unit.

[0021] In many cases, it is sufficient if the dirt collection vessel is sucked out with maximum suction power at least once after an operating mode with reduced suction power. For this purpose, in a preferred embodiment it is provided that the suction unit, following the completion of the operating mode with reduced suction power, can only be operated with reduced suction power again after the dirt collection vessel has been sucked out using maximum suction power at least once. By way of example, it is possible to provide that the suction station comprises a checking unit which can be used to check whether the dirt collection vessel has been sucked out with maximum suction power at least once after a predetermined period of time for operation with reduced suction power has elapsed. The checking device only allows reversion to the operating mode with reduced suction power when sucking-out with maximum suction power has previously been carried out.

[0022] As has already been mentioned, it is advantageous if the period of time between two operations of sucking out the dirt collection vessel is measured and compared with a maximum permissible period of time in order if appropriate to switch to operation with maximum suction power. For this purpose, it is advantageous if the suction station automatically switches to the operating mode with maximum suction power if the period of time between two operations of sucking out the dirt collection vessel exceeds a predetermined maximum value. By way of example, it is possible to provide that the suction station has a timing element which measures the period of time between two operations of sucking out the dirt collection vessel, the timing element having an associated checking device which compares the measured period of time with a predetermined maximum period of time and terminates the reduced-power operating mode of the suction unit if the maximum predetermined

period of time is exceeded. The timing element is in this case started in each case at the beginning of sucking-out of the dirt collection vessel and is read by the checking device at the start of the following operation of sucking out of the dirt collection vessel, so that the value determined can be compared with a predetermined maximum value.

[0023] In a preferred embodiment of the floor cleaning system according to the invention, the suction power of the suction unit is reducible by at least approximately 50% of the maximum suction power. This makes it possible to achieve a considerable reduction in the noise from the suction station.

[0024] The following description of a preferred embodiment of the invention, in conjunction with the drawing, is used to provide a more detailed explanation.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 shows a diagrammatic side view of a floor cleaning system according to the invention with a mobile suction appliance docked at a central suction station;

[0026] FIG. 2 shows a diagrammatic longitudinal section view of the floor cleaning system shown in FIG. 1, and

[0027] FIG. 3 shows a flow diagram illustrating the operating mode of the floor cleaning system.

#### DETAILED DESCRIPTION OF THE INVENTION

[0028] FIGS. 1 and 2 diagrammatically depict a floor cleaning system according to the invention, which is denoted overall by reference numeral 10 and comprises a self-propelled and self-steering suction appliance 12 and a central suction station 14.

[0029] The mobile suction appliance 12 comprises a housing 16 with a top wall 18 and a bottom wall 20, which between them define a suction passage 22. A cover 24, which is not shown in FIG. 2 for the sake of clarity, is fitted onto the top wall 18. The housing 16 forms a chassis of the mobile suction appliance 12. Two drive wheels 26, each with an associated electric drive motor, which is known per se and not illustrated, are mounted rotatably on the housing 16 in a manner which is known per se and is therefore not illustrated in more detail in the drawing. The drive motors are controlled by means of an electronic control unit 28, which is known per se and is therefore only diagrammatically illustrated in FIG. 2 and which is connected to the drive motors via control lines (not shown in the drawing).

[0030] In a front region, facing the suction station 14, the bottom wall 20 has a suction inlet 30 which has sweeping brushes 32 of a brush roller 34, mounted rotatably above the suction inlet 30, passing through it. The brush roller 34 is drivable in rotation by means of an electric motor 36 which is positioned above the brush roller 34 on the top wall 18 and is coupled to the brush roller 34 via transmission means which are known per se and are therefore not shown in the drawing.

[0031] In its rear region, remote from the charging station 14, the housing 16 carries a suction turbine 40 which is drivable in rotation by an electric drive motor 42 and is in flow communication with the suction passage 22 via a suction connection piece 44.

[0032] The supply of energy to the electrical consuming features of the mobile suction appliance 12 is effected by means of a rechargeable battery 46, which is carried by the top wall 18 and is illustrated in FIG. 2.

[0033] Within the suction passage 22, a dirt filter 48 is disposed obliquely with respect to the longitudinal extent of the suction passage 22, and the region of the suction passage 22 between the dirt filter 48 and the suction inlet 30 forms a dirt collection vessel 50, the filling level of which is monitored by a level sensor 52 which is electrically connected to the control unit 28.

[0034] The dirt filter 48 has a frame 49, on which a filter fabric 51 is held in a self-supporting manner, the filter fabric itself forming a curvature with respect to the frame 49 even in the load-free state. The filter fabric is in each case oriented in accordance with the flow of air prevailing in the suction passage 22. A reversal of the air flow causes the direction of the curvature of the filter fabric 51 to be reversed, and therefore results in effective filter cleaning which can be achieved in a structurally simple way.

[0035] To clean a floor surface, the suction turbine 40 generates a suction flow, with the aid of which dirt can be transferred from the floor surface that is to be cleaned, through the suction inlet 30, into the dirt collection vessel 50. The picking-up of dirt from the floor surface is boosted by the brush roller 34. The suction appliance 12 moves automatically along the floor surface that is to be cleaned until the charging state of the battery 46, which is monitored by the control unit 28, approaches a minimum value or the level sensor 52 detects that the dirt collection vessel 50 is full. If at least one of these two conditions is satisfied, the suction appliance 12 automatically steers toward the suction station 14, at which the battery 46 can be recharged and at the same time the dirt collection vessel 50 can be emptied.

[0036] The suction station 14 has a housing 54 which surrounds a suction unit 56 driven by electric motor means and a dirt receiving vessel 58, to which a reduced pressure can be applied by the suction unit 56.

[0037] An extension arm 60, which surrounds a control space 61 and at its end remote from the housing 24 has an end wall 62 connected to the housing 54 via a covering 64 and a carrier plate 66, is held laterally on the housing 54 of the suction station 14.

[0038] A ramp 74 which has a suction opening 76 is formed integrally on the housing 54, vertically below and at a distance from the carrier plate 66. The suction opening 76 is connected to the dirt receiving vessel 58 via a suction duct 78.

[0039] The region between the extension arm 60 and the ramp 74 defines a docking location 80 for the suction appliance 12 and is delimited in the direction of the housing 54 of the suction station 14 by a supporting wall 81, on which two electrical contact elements 82, 84 are mounted. The suction station comprises a charging appliance, which is known per se and is therefore not shown in the drawing and which can be connected to a mains voltage and is also connected, via supply lines (not shown in the drawing), to the electrical contact elements 82 and 84.

[0040] Two electrical contact pins 86, 88, which are diagrammatically depicted in FIG. 1 and are connected to

the rechargeable battery 46 via connecting lines (not shown in the drawing), are mounted on the outer side of the cover 24 of the suction appliance 12, such that they are associated with the electrical contact elements 82 and 84 of the suction station 14. Electrical energy can be transferred from the suction station 14 to the suction appliance 12 via the electrical contact elements 82, 84 and the associated contact pins 86 and 88, in order to recharge the battery 46.

[0041] When it is being docked at the suction station 14, the suction appliance 12 adopts a position on the ramp 74 which is such that the suction inlet 30 is aligned with the suction opening 76. Then, the suction unit 56 is activated by an electronic control unit 90, disposed in the control space 61, of the suction station 14, which detects the flow of a charging current across the contact elements 82, 84, so that the dirt collection vessel 50 can be sucked out via the suction inlet 30 and the suction duct 78, forming a suction flow symbolically indicated by the arrows 92 in FIG. 2, and dirt can be transferred into the dirt receiving vessel 58. At the same time, the battery 46 of the suction appliance 12 is recharged.

[0042] Operation of the suction unit 56 causes noise to be produced by the suction station 14. To minimize this production of noise, the user can activate an operating mode of the suction unit 56 with a reduced suction power by actuating an electrical button element 94 disposed on the covering 64 of the extension arm 60. The control unit 90, which comprises a checking device 91 and is coupled to an electronic timing element 96, checks whether the preconditions for suction with a reduced suction power are present or whether the dirt collection vessel 50 should first of all be sucked out with a maximum suction power of the suction unit 56 despite the button element 94 having been actuated. For this purpose, the control unit 90 executes the following method steps, which are explained in more detail in FIG. 3: after the docking of the suction appliance 12 to the suction station 14, illustrated by symbol 100 in FIG. 3, and the associated flow of a charging current via the contact elements 82 and 84, the checking device 91 first of all checks, in method step 102, whether the user has input the command to activate the reduced-power suction operation through actuation of the button element 94. If not, in method step 105 the dirt collection vessel 50 is sucked out with the maximum suction power of the suction unit 56. In this case, the suction unit 56 can be activated, for example, for approximately 20 to 40 seconds. This period of time is sufficient to completely empty the dirt collection vessel 50.

[0043] If the check in method step 102 shows that the user has input the command to start the reduced-power operating mode of the suction unit 56 through actuation of the button element 94, in a subsequent method step 103 the control unit 90 interrogates the timing element 96, which measures the period of time since the last docking operation of the suction appliance 12. Then, in method step 103, the checking unit 91 compares the recorded period of time with a predetermined maximum value which may, for example, be two hours. If the check carried out in method step 103 shows that a time which is longer than the maximum permissible time has elapsed since the last docking operation, the operating mode with reduced suction power is terminated in method step 104 and the dirt collection vessel 50 is sucked out in accordance with method step 105, i.e. with the maximum suction power.

[0044] If the check in method step 103 shows that a shorter period of time than the maximum predetermined period of time has elapsed since the last docking operation of the suction appliance 12, the dirt collection vessel 50 is then sucked out with a reduced suction power of the suction unit 56 in method step 106. The suction unit is in this case preferably active for 20 to 40 seconds.

[0045] In a subsequent method step 108, the checking device 91 requests a further value from the timing element 96, namely the period of time which has elapsed since the start of the reduced-power operating mode. If this check shows that the operating mode with reduced suction power has been in use for more than eight hours, the operating mode with reduced suction power is then terminated in method step 110. Alternatively, if the check shows that the maximum predetermined period of time, for example eight hours, has not yet been exceeded, the operating mode with reduced suction power is maintained.

[0046] The operation of sucking out the dirt collection vessel 50 with simultaneous recharging of the battery 46 is then at an end, and in method step 112 the suction appliance 12 can then return to its normal suction operation during which it moves along the surface which is to be cleaned.

[0047] It is clear from the above that the suction power of the suction station 14 can be reduced for a predetermined period of time of, in the present example, eight hours by actuation of the button element 94. This ensures that the floor cleaning system 10 produces only a small amount of noise for example when cleaning a floor surface at night. However, to ensure that the dirt collection vessel 50 is always sucked out at least once with maximum suction power after at most eight hours, the operating time with reduced suction power is recorded. When the maximum operating time of eight hours is reached, the suction station 14 is automatically switched to an operating mode with maximum suction power, and the operating mode with reduced suction power can only be reactivated by the button element 94 being actuated again.

[0048] As an alternative to the method step 103, in which the period of time since the last docking operation is checked, it is also possible to provide for a check to be carried out in method step 103 to establish whether the dirt collection vessel 50 has been sucked out with the maximum suction power of the suction appliance 56 at least once since the last operating mode with reduced suction power. This ensures that, after an operating mode with reduced suction power, a user cannot readily restart the operating mode with reduced suction power, but rather the dirt collection vessel 50 is first of all sucked out at least once with the full suction power, so that even coarse-grained dirt particles are reliably transferred from the dirt collection vessel 50 into the dirt receiving vessel 58.

1. Method for operating a floor cleaning system having a central suction station with which there is associated a self-propelled and self-steering suction appliance, dirt being picked up from a floor surface that is to be cleaned by means of the suction appliance and being transferred into a dirt collection vessel of the suction appliance, and the suction station having a suction unit, and the dirt collection vessel being sucked out by means of the suction unit, wherein the suction unit is selectively operated with a maximum suction power or a reduced suction power.

2. Method according to claim 1, wherein the suction unit is operated with a reduced suction power for a predetermined period of time and is then operated with a maximum suction power again.

3. Method according to claim 2, wherein the suction unit is operated with a reduced suction power for at most approximately eight hours and is then operated with a maximum suction power again.

4. Method according to claim 2, wherein the dirt collection vessel is sucked out with the maximum suction power of the suction unit at least once after the period of time which is predetermined for the operating mode with reduced suction power has elapsed.

5. Method according to claim 1, wherein during the operating mode with reduced suction power, the period of time between two operations of sucking out the dirt collection vessel is measured and compared with a maximum permissible period of time, and the method is switched to the operating mode with maximum suction power if the maximum permissible period of time is exceeded.

6. Method according to claim 1, wherein a command to restart the operating mode with reduced suction power is suppressed during this operating mode.

7. Floor cleaning system for use of the method according to claim 1, having a central suction station, with which there is associated a self-propelled and self-steering suction appliance, the suction appliance having a dirt collection vessel and a suction turbine for picking up dirt from a floor surface that is to be cleaned and for transferring the dirt into the dirt collection vessel, and the suction station having a suction unit for sucking out the dirt collection vessel, wherein the suction unit is selectively operable with a maximum suction power or a reduced suction power.

8. Floor cleaning system according to claim 7, wherein the suction unit can be operated with a reduced suction

power for a predetermined period of time and switches to an operating mode with a maximum suction power after the predetermined period of time has elapsed.

9. Floor cleaning system according to claim 8, wherein the suction station comprises an activation element for activating the operating mode with reduced suction power, the predetermined period of time for the operating mode with reduced suction power not being extendable by multiple actuation of the activation element.

10. Floor cleaning system according to claim 9, wherein a timing element for recording the duration of the operating mode with reduced suction power is associated with the activation element, it not being possible for the timing element to be influenced by actuation of the activation element during the operating mode with reduced suction power.

11. Floor cleaning system according to claim 8, wherein the suction unit, following the completion of the operating mode with reduced suction power, can only be operated with reduced suction power again after the dirt collection vessel has been sucked out using maximum suction power at least once.

12. Floor cleaning system according to claim 7, wherein the suction station automatically switches to an operating mode with maximum suction power of the suction unit if the period of time between two operations of sucking out the dirt collection vessel exceeds a predetermined maximum value.

13. Floor cleaning system according to claim 7, wherein the suction power of the suction unit is reducible by at least approximately 50% of the maximum suction power of the suction unit.

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