In a dust transporting pipe 6, a microphone 20 is installed in a predetermined position. An output signal of the microphone 20, that is, a voltage signal of amplitude according to sound volume of the inside of the dust transporting pipe 6 picked is inputted to a controller 10. Initial amplitude according to sound volume of the inside of the dust transporting pipe 6 in the case of sucking dust in a state in which there is no dust inside a dust chamber 5 at all and the amount of change in amplitude indicating what amount amplitude changes from the initial amplitude in the case that the dust chamber 5 becomes full of dust are previously stored in the controller 10.
**FIG. 1**

- Controller
- Cleaning Controller
- Propelling Controller
- Floor Surface

- 1
- 10
- 11
- 12
- 20

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**FIG. 2**

1. **START**
2. **AMPLITUDE DIRECTION** S1
3. **DIFFERENCE CALCULATION** S2
4. **DIFFERENCE VALUE > AMOUNT OF CHANGE IN AMPLITUDE?** S3
5. **YES**
   - **CLEANING STOP CONTROL** S4
   - **TRAVEL STOP CONTROL** S5
6. **END**
FIG. 5

START

TRAVEL AND CLEANING ACTION S11

DUST IS CLOGGING DETECTED? S12

YES

DECELERATION IS DETECTED? S13

YES

STOP TRAVEL ACTION S14

STOP CLEANING ACTION S15

WAIT FOR PREDETERMINED TIME S16

RESUME CLEANING ACTION S17

NO

DUST IS CLOGGING DETECTED? S18

YES

GIVE WARNING OF DUST CLOGGING S19

STOP TRAVEL ACTION S21

STOP CLEANING ACTION S22

GIVE WARNING OF DUST CLOGGING S23

RESUME TRAVEL ACTION S31

STOP
SELF-PROPELLING CLEANER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to a self-propelling cleaner for cleaning while automatically moving within a preset region.

[0003] 2. Description of the Related Art

[0004] A self-propelling cleaner includes a propelling unit for propelling a main body and a cleaning unit for doing cleaning, and does cleaning while automatically moving within a preset region. When dust accommodated in a dust chamber is in a full state, dust cannot be sucked surely and the primary purpose of the cleaner for doing cleaning cannot be achieved. As a result of this, a method for detecting the full of dust of the dust chamber has been devised conventionally.

[0005] For example, a method for detecting the full of dust of a dust chamber of a self-propelling cleaner includes a method in which a frequency of sound of the inside of a pipe for leading dust to a dust chamber is measured and when this frequency reaches a predetermined value, it is detected that the dust accommodated in the dust chamber is in a full state (see JP-A-7-039498).

[0006] FIG. 6 is a configuration diagram showing a schematic configuration of a conventional self-propelling cleaner.

[0007] As shown in FIG. 6, the conventional self-propelling cleaner includes drive wheels 2 and a driven wheel 3 in a main body 1, and also includes a nozzle 4 having a brush 40 for raising dust on a floor surface in contact with the floor surface, a dust chamber 5 for receiving the dust raised by the nozzle 4, a dust transporting pipe 6 for leading the dust from the nozzle 4 to the dust chamber 5 and a discharge fan 13 provided in a flooral wall of the dust chamber 5. The conventional self-propelling cleaner includes a propelling controller 11 for propelling the main body 1 in a predetermined path of the inside of a preset cleaning range by controlling a driving motor 14 for driving the drive wheels 2, a cleaning controller 12 for performing control over cleaning of action control etc. of the brush 40, and a controller 10 for controlling an operation of the whole apparatus.

[0008] Such a self-propelling cleaner moves within the preset path while controlling rotation of the drive wheels 2 through the driving motor 14 by the propelling controller 11. Concurrently with this, the self-propelling cleaner drives the discharge fan 13 while rotating the brush 40 by the cleaning controller 12, and sucks dust on a floor surface from the nozzle 4 to receive the dust in the dust chamber 5 through the dust transport passage 6 (for example, see JP-A-2002-360480).

SUMMARY OF THE INVENTION

[0009] However, in the self-propelling cleaner described in JP-A-7-039498, sound of the inside of the pipe is picked by a microphone and a frequency of this sound is detected through a filter and F-V conversion is made by an F-V converter and further a voltage obtained by the F-V conversion is compared with a preset reference voltage by a comparator and thereby the full of dust accommodated in the dust chamber is detected. That is, in the self-propelling cleaner described in JP-A-7-039498, a frequency of a signal of sound obtained by the microphone is first detected. Next, a voltage signal of amplitude according to the detected frequency is generated. Then, the amplitude of this voltage signal is compared with preset amplitude and when the amplitude of the voltage signal is larger than the preset amplitude, it is decided that dust accommodated in the dust chamber is full. In the self-propelling cleaner described in JP-A-7-039498 thus, the frequency of the sound picked by the microphone must be detected once and a configuration of dust full detection unit becomes complicated.

[0010] In the self-propelling cleaner disclosed in JP-A-2002-360480, connection between the dust chamber 5 and the nozzle 4 with predetermined shape is made by the dust transporting pipe 6 with a cross-sectional area smaller than that of these nozzle 4 and dust chamber 5, and dust taken in the nozzle 4 by the brush 40 is led into the dust chamber 5 through the dust transporting pipe 6 by a drawing pressure of the discharge fan 13. As a result of this, the dust transporting pipe 6 may be clogged with dust such as a piece of paper with a predetermined size or larger. In this case, in the conventional self-propelling cleaner, dust clogging is detected by dust clogging detection means made of a pressure sensor or an air volume sensor, etc. and a user is notified of the dust clogging.

[0011] On the other hand, a floor surface which the self-propelling cleaner cleans is not even always and a carpet or a mat may be placed locally on the floor surface. Then, the conventional self-propelling cleaner detects that it is clogged with dust even when the carpet or the mat is drawn partially. As a result of this, a user could not easily recognize whether the dust transporting pipe was actually clogged with the dust or the carpet or the mat was merely drawn.

[0012] One of objects of the invention is to provide a self-propelling cleaner for simplifying dust full detection unit.

[0013] Another object of the invention is to provide a self-propelling cleaner capable of discriminating between a state of clogging a dust transporting pipe with dust and a state of drawing a carpet or a mat to exactly detect the states.

[0014] According to a first aspect of the invention, there is provided a self-propelling cleaner including: a main body; a cleaning unit that accommodates dust taken from a cleaning nozzle through a dust transporting pipe within a dust chamber; a propelling unit that automatically moves and turns arounds the main body within a preset region; a controller for controlling the propelling unit and the cleaning unit; a microphone mounted in the dust transporting pipe; a dust full detection unit that detects a full state of dust in the dust chamber based on a sound volume picked by the microphone and a preset reference sound volume; a switching unit for switching cleaning modes; and a display that indicates the full state when the dust full detection unit detects the full state, wherein the propelling unit stops moving the main body when the dust full detection unit detects the full state, wherein the propelling unit moves the main body in different manner from that at a time of normal cleaning when the dust full detection unit detects the full state, wherein the dust full detection unit switches the reference sound volume according to the cleaning mode switched by the switching unit.

[0015] According to a second aspect of the invention, there is provided a self-propelling cleaner including: a main
body; a cleaning unit that accommodates dust taken from a cleaning nozzle through a dust transporting pipe within a dust chamber; a propelling unit that automatically moves and turnarounds the main body within a preset region; a controller for controlling the propelling unit and the cleaning unit; a microphone mounted in the dust transporting pipe; and a dust full detection unit that detects a full state of dust in the dust chamber based on a sound volume picked by the microphone and a preset reference sound volume.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The above objects and advantages of the present invention will become more apparent by describing preferred exemplary embodiments thereof in detail with reference to the accompanying drawings, wherein:

[0017] FIG. 1 is a block diagram showing a schematic configuration of a self-propelling cleaner according to a first embodiment;

[0018] FIG. 2 is a flowchart of dust full detection, travel control and cleaning control of the self-propelling cleaner according to the first embodiment;

[0019] FIG. 3 is a block diagram showing a schematic configuration of a self-propelling cleaner according to a second embodiment;

[0020] FIG. 4 is a configuration diagram showing a schematic configuration of a self-propelling cleaner according to a third embodiment;

[0021] FIG. 5 is a flowchart of dust clogging detection, drawing state detection, travel control and cleaning control of the self-propelling cleaner according to the third embodiment; and

[0022] FIG. 6 is a configuration diagram showing a schematic configuration of a conventional self-propelling cleaner.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Referring now to the accompanying drawings, a description will be given in detail of preferred embodiments of the invention.

[0024] FIG. 1 is a configuration diagram showing a schematic configuration of a self-propelling cleaner according to a first embodiment.

[0025] The self-propelling cleaner includes propelling unit for moving a main body 1 along a preset track within a cleaning region, and cleaning unit for removing dust from a floor surface within the cleaning region and receiving the dust.

[0026] The right and left of a backward lower portion of the main body 1 are provided with drive wheels 2 and a driving motor 14 which is connected to each of the drive wheels 2 and rotates the drive wheels 2, and a forward lower portion of the main body 1 is provided with a driven wheel 3. Also, the driving motor 14 is electrically connected to a propelling controller 11 for controlling travel of the main body 1. These propelling controller 11, drive wheels 2, driving motor 14 and driven wheel 3 correspond to “propelling unit” of the invention.

[0027] Also, the main body 1 is provided with a nozzle 4 which is provided in a forward lower portion and removes dust from a floor surface, a box-shaped dust chamber 5 for receiving the dust and a dust transporting pipe 6 for making connection between the nozzle 4 and the dust chamber 5 and leading the dust to the dust chamber 5, and a brush 40 is arranged in the inside of the nozzle 4. Also, a discharge fan 13 is installed in a sidewall of the side opposed to the dust transporting pipe 6 of the dust chamber 5. Then, the main body 1 is provided with a cleaning controller 12 for controlling a cleaning action and the cleaning controller 12 is electrically connected to the discharge fan 13 and the brush 40. These nozzle 4, brush 40, dust chamber 5, discharge fan 13, dust transporting pipe 6 and cleaning controller 12 correspond to “cleaning unit” of the invention. Also, a microphone 20 for picking sound of the inside of the dust transporting pipe 6 is installed in a predetermiened position of the dust transporting pipe 6. Incidentally, the microphone 20 may be provided inside the dust transporting pipe 6 or in the vicinity of the outside of the dust transporting pipe 6, and could be installed in a position in which sound of the inside of the dust transporting pipe 6 can be picked stably.

[0028] Also, the main body 1 is provided with a controller 10 for controlling an operation of the whole self-propelling cleaner, and the controller 10 performs control of propelling the main body 1 along a preset path through the propelling controller 11. Then, while such travel control is performed, the controller 10 performs control of a cleaning action through the cleaning controller 12. Also, the controller 10 is electrically connected to the microphone 20 and detects a voltage signal outputted from the microphone 20. Since amplitude of an electrical signal from the microphone 20 is proportional to sound volume of the inside of the dust transporting pipe 6 picked by the microphone 20, the controller 10 can observe a state (for example, clogging) of the inside of the dust transporting pipe 6 or the nozzle 4 by the amplitude of this electrical signal.

[0029] Next, an operation of such a self-propelling cleaner will be described.

[0030] When a cleaning start command is inputted from a user or preset cleaning start time is detected, the cleaning controller 12 rotates the brush 40 and raises dust on a floor surface and takes the dust into the nozzle 4. Concurrently with this, the cleaning controller 12 actuates the discharge fan 13 and discharges air of the inside of the dust chamber 5 to the outside. As a result of this, the dust taken into the nozzle 4 is led to the dust chamber 5 through the dust transporting pipe 6 and is sequentially deposited and received inside the dust chamber 5.

[0031] The propelling controller 11 controls the driving motor 14 and rotates the drive wheels 2 and starts movement from a cleaning start position. In this case, a movement path (track) of the main body 1 is previously stored in memory (not shown). For example, when it is assumed that the interior of a room with rectangular shape is a cleaning region, the main body 1 moves along a long side direction (forward path) and turns in a short side direction in the case of reaching the boundary and moves along the short side direction by a predetermined distance. Next, the main body 1 turns in the long side direction and moves along the long side direction in a direction opposite to the forward path. Then, the main body 1 turns in the short side direction and
moves by a predetermined distance. Hereinafter, this operation is repeated and this track is generally called a zigzag travel track. In the propelling controller 11, information about a speed, a position, and a direction of the main body 1 obtained from information from the acceleration sensor 21 is inputted from the controller 10, and the driving motor 14 is controlled so as to move along the track, and the driving motor 14 rotates the drive wheels 2 in a predetermined direction according to this control. Here, plural sensors (not shown) are mounted in the main body 1 and these sensors or the like detect a peripheral situation of the main body 1. This detection result is inputted to the propelling controller 11, and the propelling controller 11 prevents collision with a wall or an obstacle of the periphery by driving the driving motor 14 based on this detection result.

[0032] While cleaning is done as well as travel within a predetermined region thus, the microphone 20 picks sound of the inside of the dust transporting pipe 6 and outputs a voltage signal of amplitude according to this sound volume.

[0033] Initial amplitude according to sound volume of the inside of the dust transporting pipe 6 in the case of sucking dust in a state in which dust is not deposited inside the dust chamber 5 at all and the amount of change in amplitude indicating what amount amplitude changes with respect to the initial amplitude in the case of sucking dust in a state in which the dust chamber 5 becomes full of dust are previously stored in the controller 10. Then, based on a flow shown in FIG. 2, the controller 10 detects a dust full state of the inside of the dust chamber 5 and performs control as to whether cleaning and travel operations are continuously performed or stopped. The controller 10 functions as “dust full detection unit” of the invention by adopting this configuration. Then, in this case, sound volume according to the initial amplitude and the amount of change in amplitude corresponds to “reference sound volume” of the invention.

[0034] FIG. 2 is a flowchart showing a flow of performing detection of a dust full state and travel and cleaning control.

[0035] The controller 10 detects amplitude of a voltage signal outputted from the microphone 20 in a predetermined cycle (S1). Next, the controller 10 calculates a difference value between this detected amplitude and the initial amplitude stored previously (S2). Then, the controller 10 compares this difference value with the amount of change in amplitude stored previously (S3) and when the difference value is smaller than or equal to the amount of change in amplitude, the propelling controller 11 and the cleaning controller 12 are controlled so as to continuously perform a cleaning action and a movement action. Then, the controller 10 repeats this operation in a predetermined cycle until cleaning within a predetermined region is ended or the difference value becomes larger than the amount of change in amplitude.

[0036] When the difference value becomes larger than the amount of change in amplitude, the controller 10 decides that the dust chamber 5 is full of dust, and control of stopping a dust suction action is performed with respect to the cleaning controller 12 (S4) and also, control of stopping movement of the main body 1 is performed with respect to the propelling controller 11 (S5).

[0037] When stop control of a dust suction action is received, the cleaning controller 12 stops rotation of the brush 30 and also stops an operation of the discharge fan 31. On the other hand, when movement stop control is received, the propelling controller 11 stops driving of the driving motor 14.

[0038] Thus, in the self-propelling cleaner of the present embodiment, a change in sound volume of the inside of the dust transporting pipe at the time of dust suction according to a receiving state of dust accommodated in the dust chamber is utilized and this sound volume can be used in a threshold value of dust full detection. As a result of this, a self-propelling cleaner for surely detecting a dust full state while using a simple structure without using a complicated configuration as shown in a conventional example can be achieved.

[0039] Also, by stopping travel and cleaning when a dust full state is detected, a self-propelling cleaner for preventing an unnecessary action in which a cleaning action is continued with ability to suck dust little had can be achieved.

[0040] Incidentally, in the present embodiment, a dust full state has been detected using amplitude according to sound volume of the inside of the dust transporting pipe in a state in which there is no dust inside the dust chamber and the amount of change in amplitude indicating what amount amplitude changes in the case of shifting to a dust full state. However, in the case of previously grasping whether sound volume becomes larger or smaller as dust is deposited inside the dust chamber, a dust full state may be detected by previously storing amplitude based on sound volume in a dust full state as reference amplitude and deciding whether to become larger or smaller than this reference amplitude. In this case, the amount of amplitude stored previously is one and a dust full state can be detected by only comparing this amplitude with amplitude of a voltage signal outputted from a microphone, so that a dust full state can be detected by a simpler flow.

[0041] Also, in the embodiment described above, movement of the main body has been stopped in the case of detecting the dust full state, but an action different from a normal travel action may be performed in the case of shifting the dust full state. For example, after stopping a cleaning action, operations such as continuous rotations in its position or reciprocating motion within a predetermined range at a predetermined angle with respect to a normal travel path may be performed. By adopting such a configuration, a user can recognize a dust full state soon by seeing behavior of the main body of the self-propelling cleaner. As a result of this, a self-propelling cleaner for notifying a user of a dust full state more clearly while the dust full state is detected surely by a simple structure can be achieved.

[0042] Also, in the embodiment described above, the amplitude and the amount of change in amplitude used as reference have been used by one kind, respectively, but a plurality of amplitudes and the amounts of change in amplitude used as reference may be stored and used according to kinds of a floor surface within a cleaning region. For example, amplitude and the amount of change in amplitude in the case that a floor surface is flooring, amplitude and the amount of change in amplitude in the case that a floor surface is a carpet, and amplitude and the amount of change in amplitude in the case that a floor surface is a tatami mat are respectively stored. Then, a switching switch for switching cleaning modes according to specifications of the floor
surface is provided in a main body. Incidentally, this switch may be a manual switch provided in a surface of the main body or an automatic switch which is constructed of a sensor etc. and automatically detects the floor surface. As a result of this, the amplitude and the amount of change in amplitude used as reference vary based on the cleaning modes switched according to specifications of the floor surface, so that a dust full state can be detected surely regardless of the specifications of the floor surface.

[0043] Next, a self-propelling cleaner according to a second embodiment will be described with reference to FIG. 3.

[0044] FIG. 3 is a block diagram showing a schematic configuration of a self-propelling cleaner according to the second embodiment.

[0045] The self-propelling cleaner shown in FIG. 3 includes a display part 15 in the upper side of a main body 1, and other configurations are equal to those of the self-propelling cleaner shown in FIG. 1.

[0046] The display part 15 includes, for example, plural LED lamps, and notifies the outside of an operation state etc. of the main body 1 by changing luminous colors and luminous patterns. Luminous control of the display part 15 is performed by a controller 10, and the controller 10 outputs each control command to a propelling controller 11 and a cleaning controller 12 and also, the display part 15 performs luminous control of performing display indicating the dust full state. For example, control in which a green LED is illuminated at the time of normal cleaning and travel and a red LED is illuminated at the time of shifting to the dust full state is performed.

[0047] In such a self-propelling cleaner, as described above, when sound volume picked by a microphone 20 changes larger than a predetermined change amount with respect to preset initial sound volume (amplitude), the controller 10 detects a dust full state of the inside of a dust chamber 5 and controls the propelling controller 11 and the cleaning controller 12 and also, the display part 15 performs control of performing display indicating the dust full state. For example, control in which a green LED is illuminated at the time of normal cleaning and travel and a red LED is illuminated at the time of shifting to the dust full state is performed.

[0048] By adopting such a configuration, the outside can be notified of the dust full state by a luminous state from the display part with a change in an operation of the main body, so that a user can more surely recognize that dust is in a full state and the dust accommodated in the dust chamber must be dumped.

[0049] FIG. 4 is a configuration diagram showing a schematic configuration of a self-propelling cleaner according to a third embodiment. Parts the same as those in the first and the second embodiments are denoted by the same reference numerals as those in the first and the second embodiment, so that detailed description of the parts will be omitted here.

[0050] In the self-propelling cleaner according to the third embodiment, an acceleration sensor 21 corresponding to “speed detection unit” of the invention is fixed and installed in the main body 1, and the acceleration sensor 21 always observes acceleration of the main body 1 and outputs the acceleration to the controller 10. Thus, the controller 10 can always calculate a speed, a moving distance and a direction of the main body 1 by always observing the acceleration of the main body 1 by the acceleration sensor 21.

[0051] Initial amplitude according to sound volume of the inside of the dust transporting pipe 6 in the case of sucking dust in a state in which dust is not deposited inside the dust chamber 5 at all and the amount of change in amplitude indicating what amount amplitude changes with respect to the initial amplitude in the case of sucking dust in a state in which the nozzle 4 or the dust transporting pipe 6 is clogged with dust are previously stored in the controller 10. Then, the controller 10 computes a difference value between amplitude of sound picked by the microphone 20 and the initial amplitude stored, and detects whether or not dust clogging occurs by comparing this difference value with the amount of change in amplitude. Incidentally, sound volume according to the initial amplitude and the amount of change in amplitude corresponds to “reference sound volume” of the invention.

[0052] Also, information from the acceleration sensor 21 is input to the controller 10, so that the controller 10 detects dust clogging or drawing of a carpet etc. on a floor surface and performs control as to whether cleaning and travel operations are continuously performed or stopped based on this information from the acceleration sensor 21 and a dust clogging detection result (sound volume change detection result) as shown by a flow shown in FIG. 5.

[0053] FIG. 5 is a flowchart showing a flow of performing detection of a dust clogging state, detection of a drawing state, and propelling and cleaning control.

[0054] When a cleaning start command is inputted or preset cleaning start time is detected, the controller 10 performs control of cleaning a floor surface while propelling the main body 1 along a preset path as described above through the propelling controller 11 and the cleaning controller 12 (s11).

[0055] In this case, the controller 10 detects amplitude of a voltage signal outputted from the microphone 20 in a predetermined cycle and when a difference value between the detected amplitude and preset initial amplitude is smaller than the amount of change in amplitude, it is determined that cleaning is normally done, and travel and cleaning action control is continuously performed (from s12 to s11).

[0056] On the other hand, when the difference value is larger than the amount of change in amplitude, the controller 10 determines that the nozzle 4 or the dust transporting pipe 6 is clogged with an object (s12).

[0057] Then, the controller 10 checks whether or not the main body 1 has moved at negative acceleration, that is, has decelerated based on information inputted from the acceleration sensor 21 (s13).

[0058] When the main body 1 has not decelerated herein, it is decided that a carpet etc. spread on the floor surface is not drawn and the nozzle 4 or the dust transporting pipe 6 is clogged with dust such as a piece of paper, and travel stop control is performed with respect to the propelling controller 11 and also cleaning stop control is performed with respect to the cleaning controller 12 (from s13 to s21 and to s22). When the travel stop control is received, the propelling controller 11 stops driving of the driving motor 14. Also, when stop control of a dust suction action is received, the cleaning controller 12 stops rotation of the brush 40 and also stops an operation of the discharge fan 13. Then, a warning indicating that dust clogging occurs is given to the outside
through a display part 15 or a sound generation part 16 (corresponding to “notification unit” of the invention) (S23).

As this warning, for example, the display part 15 which illuminates green at the time of normal travel cleaning is illuminated red or a warning sound is generated from the sound generation part 16. By giving such a warning, a user can recognize that the dust clogging occurs and the self-propelling cleaner stops.

[0059] On the other hand, when the main body 1 has accelerated, it is determined that the nozzle 4 or the dust transporting pipe 6 is not clogged with dust merely and the nozzle 4 draws a carpet etc. spread on the floor surface and a travel speed has decreased, and travel stop control is performed with respect to the propelling controller 11 and also cleaning stop control is performed with respect to the cleaning controller 12 (from s13 to s14 and to s15). When the travel stop control is received, the propelling controller 11 stops driving of the driving motor 14. Also, when stop control of a dust suction action is received, the cleaning controller 12 stops rotation of the brush 40 and also stops an operation of the discharge fan 13. Since the rotation of the brush 40 stops and the discharge fan 13 does not operate, force of drawing the carpet is eliminated. As a result of this, when the carpet returns from the nozzle 4 to the floor surface, a drawing path of dust, that is, the nozzle 4 and the dust transporting pipe 6 lead again.

[0060] The controller 10 performs the travel stop control and the cleaning stop control and after a lapse of predetermined time, only cleaning action control is resumed (from s16 to s17) and a voltage signal outputted from the microphone 20 is observed. When the carpet returns to the floor surface as described above herein, a change in sound volume is not detected, so that the controller 10 decides that there is no dust inside the nozzle 4 and the dust transporting pipe 6 and there is also no drawing of the carpet etc., and travel action control is resumed. As a result of this, the self-propelling cleaner does cleaning while propelling again (from s18 to s31 and to s11). Incidentally, at the time of resuming the cleaning action described above, by resuming the cleaning action in a state of reducing a drawing pressure lower than that at the time of normal cleaning, the carpet can be prevented from being drawn into the nozzle 4 again. Then, according to timing at which the main body 1 starts propelling, the drawing pressure is returned to a normal drawing pressure and cleaning is resumed.

[0061] On the other hand, when the carpet does not return to the floor surface and remains being drawn into the nozzle 4, the controller 10 gives a warning indicating that drawing abnormality occurs through the display part 15 or the sound generation part 16 (from s18 to s19). As this warning, for example, the display part 15 which illuminates green at the time of normal travel cleaning is illuminated green in a blinking state or a warning sound is generated from the sound generation part 16. By giving such a warning, a user can recognize that the drawing of the carpet etc. occurs and the self-propelling cleaner stops. By varying the warning of drawing abnormality and the warning of dust clogging in this manner, the user can recognize the drawing abnormality and the dust clogging without a mistake.

[0062] Also, meaningless operations in which travel is continuously performed in a state of drawing a carpet etc. or cleaning is continuously done in a state of being clogged with dust can be prevented by stopping travel and cleaning when the drawing abnormality or the dust clogging occurs.

[0063] Also, when abnormality is not detected again in the case that cleaning and travel are once stopped and the cleaning is resumed at the time of the drawing abnormality, the travel is resumed and thereby, return from the cleaning abnormality can be performed to resume the cleaning without involvement by a user.

[0064] Incidentally, in the present embodiment, a state of clogging of the nozzle or the dust transporting pipe has been detected using amplitude according to sound volume of the inside of the dust transporting pipe in a state in which there is no dust (object) inside the nozzle or the dust transporting pipe and the amount of change in amplitude indicating what amount amplitude changes in the case of shifting to a state of clogging the nozzle or the dust transporting pipe. However, in the case of previously grasping whether sound volume becomes larger or smaller as the nozzle or the dust transporting pipe is clogged with dust, a state of clogging of the nozzle or the dust transporting pipe can be detected by previously storing amplitude based on sound volume in a state of clogging the nozzle or the dust transporting pipe as reference amplitude and deciding whether to become larger or smaller than this reference amplitude. In this case, the amount of amplitude stored previously is one and a dust clogging state can be detected by only comparing this amplitude with amplitude of a voltage signal outputted from a microphone, so that a state of clogging of the nozzle or the dust transporting pipe can be detected by a simpler flow.

[0065] Also, in the embodiment described above, movement of the main body has been stopped in the case of detecting the dust clogging state and the drawing, but an action different from a normal travel action may be performed in the case of detecting the drawing. For example, after stopping a cleaning action, operations such as continuous rotations in its position or reciprocating motion in a predetermined direction may be performed. By performing such operations, a user can recognize a drawing state soon by seeing behavior of the main body of the self-propelling cleaner. Further, the drawn carpet can be separated depending on a travel action.

[0066] As described above with reference to the embodiments, according to one aspect of the invention, there is provided a self-propelling cleaner including: a main body; a cleaning unit that accommodates dust taken from a cleaning nozzle through a dust transporting pipe within a dust chamber; a propelling unit that automatically moves and turns around the main body within a preset region; a controller for controlling the propelling unit and the cleaning unit; a microphone mounted in the dust transporting pipe; and a dust full detection unit that detects a full state of dust in the dust chamber based on a sound volume picked by the microphone and a preset reference sound volume.

[0067] In this configuration, a change in sound volume of the inside of a dust transporting pipe according to a receiving state of dust accommodated in a dust chamber is utilized. That is, a microphone picks sound of the inside of the dust transporting pipe, and a voltage signal of amplitude according to this sound volume is outputted. Dust full detection unit compares the amplitude of this voltage signal with preset amplitude and when a difference between these amplitudes is larger than a predetermined value, it is decided that dust accommodated in the dust chamber is in a full state.
In the self-propelling cleaner, when the dust full detection unit detects the full of dust accommodated in the dust chamber, the propelling unit is controlled to stop the main body.

In this configuration, when the dust full detection unit decides the full of dust by sound volume, the propelling unit stops movement of the main body and it waits until dust accommodated in the dust chamber is dumped.

In the self-propelling cleaner, when the dust full detection unit detects the full of dust accommodated in the dust chamber, the propelling unit is controlled to perform travel different from that at the time of normal cleaning.

In this configuration, when the dust full detection unit decides that dust accommodated in the dust chamber is in a full state by sound volume, the propelling unit makes the main body perform a travel action different from that at the time of normal cleaning.

In the self-propelling cleaner, switching unit for switching cleaning modes is provided in a main body and the dust full detection unit is made to switch the reference sound volume according to the cleaning modes.

In this configuration, the reference sound volume by which the full of dust accommodated in the dust chamber is detected is switched according to specifications of floor surfaces such as flooring, a carpet or a tatami mat.

In the self-propelling cleaner, display is provided in a main body and the display is made to perform display indicating the full of dust when the dust full detection unit detects a dust full state.

In this configuration, a user is notified of the full of dust by the display along with a stop of the main body or a travel action different from a normal cleaning action.

According to the self-propelling cleaner, a change in sound volume of the inside of a dust transporting pipe at the time of clogging the dust transporting pipe or a nozzle with dust is utilized. Then, when a self-propelling cleaner draws a carpet or a mat, etc., controller detects that sound volume picked by a microphone changes and decides that the dust transporting pipe or the nozzle is clogged with an object. Also, speed detection unit provided in a main body always observes a predetermined measured value according to travel of the main body. Then, when the self-propelling cleaner draws the carpet or the mat, etc., a travel speed of the main body decreases due to the carpet or the mat, etc., so that the speed detection unit observes the decrease in speed of the main body. On the other hand, when the nozzle or the dust transporting pipe is clogged with dust such as a piece of paper, the controller decides that it is clogged with the object, but a speed of the main body does not decrease, so that a decrease in speed is not observed in the speed detection unit. As a result of this, when the controller detects that the sound volume picked by the microphone changes by a predetermined value or more and simultaneously the speed detection unit observes the decrease in speed of the main body, the self-propelling cleaner decides that the carpet or the mat is drawn, and gives a warning.

In the self-propelling cleaner, when the controller detects that sound volume picked by the microphone changes by a predetermined value or more as compared with preset reference sound volume and also the speed detection unit detects a decrease in speed of the main body, the cleaning unit is made to stop cleaning and also the propelling unit is made to stop travel of the main body.

In this configuration, the self-propelling cleaner stops cleaning or travel and waits until processing of elimination of a drawing state is performed when a carpet or a mat is drawn as described above.

In the self-propelling cleaner, after a lapse of predetermined time since the cleaning unit was made to stop cleaning and also the propelling unit was made to stop travel of the main body, the cleaning unit is made to start cleaning again and in the case of detecting that the sound volume picked by the microphone is less than or equal to the predetermined value as compared with the preset reference sound volume, the propelling unit is made to resume travel of the main body.

In this configuration, even when a carpet or a mat is drawn as described above, force of drawing the carpet or the mat is eliminated by temporarily stopping a cleaning action. Because of this, the carpet or the mat once drawn in the inside of a nozzle returns to the outside of the nozzle. When the carpet or the mat returns to the outside of the nozzle and there is no dust inside the nozzle or the dust transporting pipe, controller does not detect a change in sound volume of a predetermined value or more at a point in time of resuming cleaning. As a result of this, it is decided that the nozzle or the dust transporting pipe is not clogged with dust, and propelling unit resumes travel of a main body and cleaning of a self-propelling cleaner is resumed.

According to the embodiments, a dust full state can be decided by only comparing reference amplitude with sound volume of the inside of a dust transporting pipe, that is, amplitude of a voltage signal outputted from a microphone, so that a self-propelling cleaner with a simple structure capable of detecting the dust full state can be achieved.

According to the embodiments, propelling (travel) of a main body stops at a point in time of detecting the full of dust, so that a self-propelling cleaner for inhibiting unnecessary travel such as travel in a state in which cleaning cannot be done can be achieved.

According to the embodiments, a user can surely recognize a dust full state by performing a travel action different from a normal action at a point in time of detecting the full of dust. As a result of this, a self-propelling cleaner capable of detecting a dust full state to surely notify the user of the dust full state while using a simple structure can be achieved.

According to the embodiments, different reference sound volume is set according to specifications of floor surfaces, so that a self-propelling cleaner for exactly detecting a dust full state according to a floor surface during cleaning can be achieved.

According to the embodiments, the outside is notified of a dust full state by display along with a change in the travel operation so that a self-propelling cleaner capable of detecting a dust full state to more surely notify a user of the dust full state while using a simple structure can be achieved.

According to the embodiments, a state of drawing a carpet etc. can exactly be discriminated from a state of
being clogged with dust such as a piece of paper and the outside can be notified. As a result of this, a user can exactly recognize whether to be in the state of drawing a carpet etc. or the state of being clogged with dust, and can instantaneously perform handling according to the respective states.

According to the embodiments, cleaning and travel of a main body are stopped at a point in time of detecting drawing a carpet etc., so that a self-propelling cleaner in which meaningless operations in which cleaning is continued in a state of drawing the carpet is inhibited from being performed can be achieved.

According to the embodiments, a self-propelling cleaner in which in the case of drawing a carpet etc., the carpet etc. can be removed from a nozzle to automatically resume cleaning and travel can be achieved. As a result of this, it is unnecessary for a user to perform return processing with respect to the drawing of the carpet etc. and only when a nozzle or a dust transporting pipe is clogged with dust such as a piece of paper, processing could be performed.

Although the present invention has been shown and described with reference to a specific preferred embodiment, various changes and modifications will be apparent to those skilled in the art from the teachings herein. Such changes and modifications as are obvious are deemed to come within the spirit, scope and contemplation of the invention as defined in the appended claims.

What is claimed is:
1. A self-propelling cleaner comprising:
   a main body;
   a cleaning unit that accommodates dust taken from a cleaning nozzle through a dust transporting pipe within a dust chamber;
   a propelling unit that automatically moves and turns- arounds the main body within a preset region;
   a controller for controlling the propelling unit and the cleaning unit;
   a microphone mounted in the dust transporting pipe;
   a dust full detection unit that detects a full state of dust in the dust chamber based on a sound volume picked by the microphone and a preset reference sound volume;
   a switching unit for switching cleaning modes; and
   a display that indicates the full state when the dust full detection unit detects the full state,
   wherein the propelling unit stops moving the main body when the dust full detection unit detects the full state,
   wherein the propelling unit moves the main body in a different manner from that at a time of normal cleaning when the dust full detection unit detects the full state,
   wherein the dust full detection unit switches the reference sound volume according to the cleaning mode switched by the switching unit.
2. A self-propelling cleaner comprising:
   a main body;
   a cleaning unit that accommodates dust taken from a cleaning nozzle through a dust transporting pipe within a dust chamber;
   a propelling unit that automatically moves and turns- arounds the main body within a preset region;
   a controller for controlling the propelling unit and the cleaning unit;
   a microphone mounted in the dust transporting pipe; and
   a dust full detection unit that detects a full state of dust in the dust chamber based on a sound volume picked by the microphone and a preset reference sound volume.
3. The self-propelling cleaner as claimed in claim 2, wherein the controller controls the propelling unit to stop moving the main body when the dust full detection unit detects the full state.
4. The self-propelling cleaner as claimed in claim 2, wherein the controller controls the propelling unit to move the main body in a different manner from that at a time of normal cleaning when the dust full detection unit detects the full state.
5. The self-propelling cleaner as claimed in claim 2, further comprising a switching unit for switching cleaning modes,
   wherein the dust full detection unit switches the reference sound volume according to the cleaning mode switched by the switching unit.
6. The self-propelling cleaner as claimed in claim 2, further comprising a display that indicates the full state when the dust full detection unit detects the full state.
7. The self-propelling cleaner as claimed in claim 2, further comprising:
   a speed detection unit that detects speed of the main body; and
   a notification unit that notifies a warning to a user,
   wherein when the controller detects that sound volume picked by the microphone changes by a predetermined value or more as compared with preset reference sound volume and the speed detection unit detects a decrease in speed of the main body, the controller controls the notification unit to notify the warning to the user.
8. The self-propelling cleaner as claimed in claim 7, wherein when the controller detects that sound volume picked by the microphone changes by a predetermined value or more as compared with preset reference sound volume and the speed detection unit detects a decrease in speed of the main body, the controller controls the cleaning unit to stop cleaning.
9. The self-propelling cleaner as claimed in claim 8, wherein when the controller controls the cleaning unit to resume cleaning after a lapse of a predetermined time since the cleaning unit and the propelling unit is stopped, and
   wherein when the sound volume picked by the microphone is less than or equal to the predetermined value as compared with the preset reference sound volume, the controller controls the propelling unit to resume propelling the main body.