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Vacuum cleaner and controlling method of the same

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ABSTRACT OF THE DISCLOSURE

A vacuum cleaner that includes a dust collector forming a dust storage and a method of controlling a vacuum cleaner are provided. The vacuum cleaner includes a fixed member, a rotating member, a compressing motor, a counter, a signaler, and a controller. The fixed member is fixed to the dust storage. The rotating member compresses the dust through interaction with the fixed member. The compressing motor drives the rotating member. The counter measures a moving time of the rotating member. The signaller issues a dust empty signal. The controller operates the signaller when a measured moving time is less than a reference time. In the method, dust in the dust collector is compressed by the rotating member. A quantity of the compressed dust is determined. A signal to empty the compressed dust to an outside of the vacuum cleaner is issued when the quantity exceeds a predetermined amount.

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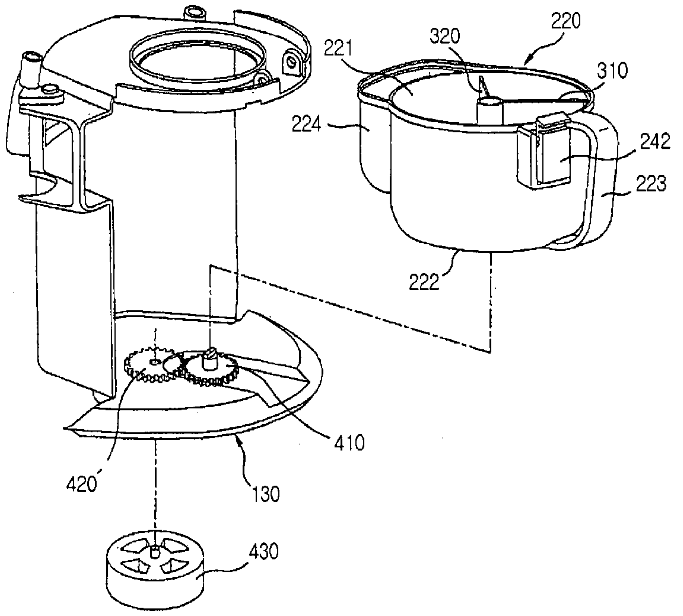
Fig.5



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The following statement is a full description of this invention, including the best method of performing it known to us:

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VACUUM CLEANER AND CONTROLLING METHOD OF THE SAME

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a vacuum cleaner and a method of controlling the vacuum cleaner, and particularly to a vacuum cleaner and a method of controlling a vacuum cleaner capable of increasing a dust collecting capacity of a dust collector, and indicating when it is time to empty the dust collector when more than a predetermined amount of dust are collected in the dust collector.

Description of the Related Art

[0002] In general, a vacuum cleaner is a device that suctions air containing dust using vacuum pressure generated by a vacuum motor mounted in a body thereof, and then filters the dust in the body.

[0003] The vacuum cleaner may be divided into a canister type in which a nozzle, an inlet, is provided separately from the body and is connected to the body by a connection pipe, and an upright type in which the nozzle and the body are integrally formed.

[0004] A dust collector mounted to a cyclone vacuum cleaner is a device that separates dust, which is rotating together with the sucked air, from the air according to the cyclone principle, collects the separated dust, and discharges the purified air to the outside of the cleaner.

[0005] In detail, the cyclone dust collector includes a collector body, an inlet through which the air is introduced to the collector body, a cyclone unit separating dust from the air sucked to the collector body, a dust storage space storing the dust separated in the cyclone unit, and an outlet through which the air purified in the cyclone unit is exhausted.

[0006] While the vacuum cleaner is in operation, the dust stored in a lower space of the collector body, that is, in the dust storage space, are continuously rotated along an inner circumferential surface of the collector body because of a rotating air current within the collector body.

[0007] When the operation of the vacuum cleaner is stopped, the dust subsides on the bottom of the collector body, and is stored at a low density.

[0008] Thus, when more than a predetermined amount of dust is collected in the related art dust collector while the vacuum cleaner is in operation, the dust ascends, rotating along an inner wall of the dust container. Then, the ascending dust invades the cyclone unit formed at an upper space of the collector body. Thus, unseparated dust is discharged through the outlet by an air current being discharged, thereby lowering the dust collecting performance.

[0009] Also, when the operation of the vacuum cleaner is stopped, the dust subsides on the bottom of the collector body and thus is stored at a low density. That is, since the dust within the collector body occupies a considerable volume for its weight, the collector body should be frequently emptied to maintain the dust collecting performance.

[0010] To improve convenience of the cleaner use, efforts are being continued to maximize the dust collection capacity and improve the dust collecting performance.

SUMMARY OF THE INVENTION

[0011] Accordingly, the present invention is directed to a vacuum cleaner and a method of controlling a vacuum cleaner that addresses one or more problems due to limitations and disadvantages of the related art.

[0012] Desirably the present invention provides a vacuum cleaner and a method of controlling a vacuum cleaner capable of increasing the dust collection capacity of a dust collector.

[0013] It is also desirable that the present invention provides a vacuum cleaner and a method of controlling a vacuum cleaner capable of automatically compressing dust provided into a dust collector.

[0014] It is also desirable that the present invention provides a method of controlling a vacuum cleaner capable of indicating a time for emptying dust when more than a predetermined amount of dust is stored in a dust collector.

[0015] Additional advantages, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0016] According to one aspect of the present invention, there is provided a vacuum cleaner including a dust collector forming a dust storage, the vacuum cleaner including:

a fixed member fixed to the dust storage;

a rotating member for performing a compressing of dust stored in the dust storage, through interaction with the fixed member;

a compressing motor for driving the rotating member;

a counter for measuring a moving time of the rotating member;

a signaller for issuing a dust empty signal of the dust storage; and

a controller for operating the signaller when a measured moving time is less than a reference time.

[0016a] According to a further aspect of the present invention, there is provided a method of controlling a vacuum cleaner including a dust collector for storing dust, the method including:

sensing a quantity of compressed dust through a pressing member during vacuuming, the compressed dust stored in the dust collector; and issuing a signal to an outside to empty the dust stored in the dust collector when the quantity of the dust exceeds a predetermined amount.

[0017] In another aspect of the present invention, there is provided a method of controlling a vacuum cleaner including a dust collector for storing dust, the method including: compressing dust stored inside the dust collector, through a pressing member rotated by a compressing motor; determining a quantity of the compressed dust; and issuing a signal to empty the compressed dust to an outside of the vacuum cleaner, when the quantity of the compressed dust is determined to exceed a predetermined amount.

[0018] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

[0018a] Comprises/comprising and grammatical variations thereof when used in this specification are to be taken to specify the presence of stated features, integers, steps or components or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0020] FIG. 1 is a perspective view illustrating a state in which a dust collector is separated from a vacuum cleaner according to an embodiment of the present invention;

[0021] FIG. 2 is a perspective view of a dust collector mounting unit and a dust collector used in the vacuum cleaner;

[0022] FIG. 3 is a cross-sectional perspective view of the

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dust collector;

[0023] FIG. 4 is an enlarged view of part A of FIG. 3;

[0024] FIG. 5 is a perspective view illustrating a coupling relation between the dust collector and a driving unit provided for compression of dust stored in the dust collector;

[0025] FIG. 6 is a perspective view of a dust separator and a dust container of the dust collector;

[0026] FIG. 7 is a bottom perspective view of the dust separator of FIG. 6;

[0027] FIG. 8 is a block diagram showing a configuration for controlling compression of dust within the dust collector;

[0028] FIG. 9 is a flowchart showing a process of compressing dust within the dust collector;

[0029] FIG. 10(a) is a waveform view of a current phase of the drive motor over the dust compression time;

[0030] FIG. 10(b) is a waveform view of a phase of power supplied to the drive motor over the dust compression time;

[0031] FIGs. 11 and 12 are plan views of the dust container, illustrating a process of compressing dust within the dust collector;

[0032] FIG. 19 is a flowchart showing a dust-emptying time indicating function of the dust collector;

[0033] FIG. 14 is a flowchart for describing an operational state of the cleaner when the dust-emptying time indicating function is performed;

[0034] FIG. 15 is a plan view showing an operational state of a first pressing plate when the dust-emptying time indicating function is performed;

[0035] FIG. 16 is a perspective view illustrating a coupling relation between a driving unit and a dust collector according to the second embodiment of the present invention;

[0036] FIG. 17 a block diagram illustrating a control unit of a vacuum cleaner according to an embodiment of the present invention;

[0037] FIG. 18 is a flowchart illustrating a dust compressing process of the dust collection unit and dust discharge alarming; and

[0038] FIG. 19 is a waveform of a pulse signal varying according to an amount of the dust collected in the dust collection unit;

[0039] FIG. 20 is a perspective view illustrating a coupling relation between a driving unit and a dust collector according to the third embodiment of the present invention;

[0040] FIG. 21 is a frontal perspective of a driven gear included in the driving unit according to the present invention;

[0041] FIG. 22 is a side view of the driven gear in FIG. 21;

[0042] FIG. 23 is a view showing the coupling of the driven gear in FIG. 21 with a micro switch;

[0043] FIG. 24 is a block diagram of a control unit of a vacuum cleaner according to the third embodiment of the present invention;

[0044] FIGs. 25 and 26 are diagrams for describing an on state of a micro switch when a first pressing member becomes close to one side of a second pressing member for compressing dust according to the present invention;

[0045] FIGs. 27 and 28 are diagrams for describing an off state of the micro switch in FIG. 25 when the first and second pressing members are positioned respectively in-line;

[0046] FIGs. 29 and 30 are diagrams for describing an on state of the micro switch in FIG. 25 when the first pressing member approaches the opposite side of the second pressing member;

[0047] FIG. 31 is a diagram for describing the overall operation of the first pressing member described in FIGs. 25 through 30; and

[0048] FIG. 32 is a flowchart of a dust compressing process and a dust emptying time of a dust collector according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0049] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0050] FIG. 1 is a perspective view showing a state in which a dust collector is separated from a vacuum cleaner according to an embodiment of the present invention.

[0051] Referring to FIG. 1, the vacuum cleaner according to an embodiment of the present invention includes a cleaner body

100 having therein a suction-force generator, and a dust collector 200 separating dust from the introduced air and storing the separated dust.

[0052] Also, the vacuum cleaner includes a suction nozzle 20 through which the air containing dust is suctioned, a handle 40 allowing a user to manipulate an operation of the vacuum cleaner, an extension pipe 30 connecting the suction nozzle 20 with the handle 40, and a connection hose 50 connecting the suction nozzle 20 with the cleaner body 100.

[0053] Since the basic constructions of the suction nozzle 20, the extension pipe 30, the handle 40, and the connection hose 50 are the same as those of the related art, the detailed description thereon will be omitted.

[0054] In detail, a body suction part 110 through which the air with dust sucked from the suction nozzle 20 is introduced is formed at a lower end portion of a front surface of the cleaner body 10.

[0055] A body discharge part 120 through which the purified air is discharged to the outside is formed at one side of the cleaner body 100.

[0056] The dust collector 200 includes a dust separator 210 separating dust from the introduced air; and a dust container 220 storing the dust separated by the dust separator 210.

[0057] Here, the dust separator 210 includes a cyclone unit 211 that separates dust from the introduced air using the cyclone principle, namely, using a difference in a centrifugal force between the air and the dust. The dust separated by the cyclone unit 211 is stored in the dust container 220.

[0058] The dust collector 200 may be configured to maximize the collection capacity of dust stored therein. To this end, the dust collector 200 may further include a structure for decreasing a volume of dust stored in the dust container 220.

[0059] Hereinafter, referring to FIGs. 2 through 5, the vacuum cleaner with a dust collector according to the present invention will now be described, which has the maximized foreign-substance collection capacity.

[0060] FIG. 2 is a perspective view of a dust collector mounting part and a dust collector applied to the vacuum cleaner, FIG. 3 is a cross-sectional perspective view of the dust collector, FIG. 4 is an enlarged view of part A of FIG. 3, and

FIG. 5 is a perspective view showing a relation between the dust collector and a driving unit provided for compression of dust stored in the dust collector.

[0061] Referring to FIGs. 2 through 5, the dust collector 200 according to an embodiment of the present invention is detachably mounted to the cleaner body 100 (depicted in FIG. 1).

[0062] The cleaner body 100 (depicted in FIG. 1) includes a dust-collector mounting part 130 for mounting of the dust collector 200.

[0063] The dust collector 200 includes a pair of pressurizing plates 310 and 320 that increase the foreign-substance collection capacity by reducing the volume of dust stored in the dust container 220.

[0064] Here, the pair of pressing plates 310 and 320 compress dust by an interaction between each other to reduce the volume of the dust. Thus, the density of the dust stored within the dust container 220 is increased, thereby increasing the maximum collection capacity of the dust container 220.

[0065] For the convenience in description, one of the pressing plates 310 and 320 is referred to as a first pressing plate 310, and the other one is referred to as a second pressing plate 320.

[0066] In the current embodiment, at least one of the pressing plates 310 and 320 is movably provided within the dust container 220 to perform compression of dust between the pressing plates 310 and 320.

[0067] That is, if the first and second pressing plates 310 and 320 are rotatably mounted within the dust container 220, the first and second pressing plates 310 and 320 rotate toward each other to reduce a distance between one surface of the first pressing plate 310 and one surface of the second pressing plate 320 facing the one surface of the first pressing plate 310. Thus, dust between the first and second pressing plates 310 and 320 are compressed.

[0068] In the current embodiment, only the first pressing plate 310 is rotatably provided in the dust container 220 while the second pressing plate 320 is fixed in the dust container 220.

[0069] In such a manner, the first pressing plate 310 serves as a rotary plate, and the second pressing plate 320 serves as a fixed plate.

[0070] The dust container 220 has therein a dust storage space 221 for storing dust. The dust storage space 221 surrounds a virtual path traveled by a free end 311 of the rotating first pressing plate 310.

[0071] In detail, the second pressing plate 320 may be provided between an inner circumferential surface of the dust storage space 221 and an axis of a rotary shaft 312 serving as the center of the rotation of the first pressing plate 310.

[0072] That is, the second pressing plate 320 is provided on a virtual plane connecting the axis of the rotary shaft 312 to the inner circumferential surface of the dust storage space 221. The second pressing plate 320 completely or partially shields the space between the inner circumferential surface of the dust storage 221 and the axis of the rotary shaft 312, so that when dust are forced toward the second pressing plate 320 by the first pressing plate 310, the second pressing plate 320 compresses the dust together with the first pressing plate 310.

[0073] To this end, the second pressing plate 320 may be constructed such that its one end 321 is integrally formed with the inner circumferential surface of the dust storage space 221, and the other end thereof is formed integrally with a stationary shaft 322 provided coaxially with the rotary shaft 312 of the first pressing plate 310.

[0074] Of course, only the one end 321 of the second pressing plate 320 may be formed integrally with the inner circumferential surface of the dust storage space 221, or only the other end may be integrally formed with the stationary shaft 322. In other words, the second pressing plate 320 is fixed to at least one of the inner circumferential surface of the dust storage space 221 and the stationary shaft 322.

[0075] The one end of the second pressing plate 320 may be formed adjacent to the inner circumferential surface of the dust storage space, without being formed integrally with the inner circumferential surface of the dust storage space 221.

[0076] Also, the other end of the second pressing plate 320 may be formed adjacent to the stationary shaft 322, without being integrally connected with the stationary shaft 322

[0077] Accordingly, leaks of dust pushed by the first pressing plate 310 through a gap formed beside the second pressing plate 320 are minimized.

[0078] Each of the first and second pressing plates 310 and 320 may be formed as a quadrangular plate. The rotary shaft 312 of the first pressing plate 310 is provided coaxially with the dust storage space 221.

[0079] The stationary shaft 322 protrudes inward from one end of the dust storage space 221, and has a cavity formed in an axial direction for the assembly of the rotary shaft 312. A predetermined portion of the rotary shaft 312 is inserted into the cavity from the upside of the stationary shaft 322.

[0080] The vacuum cleaner according to the present invention further includes a driving unit 400 that is connected to the rotary shaft 312 of the first pressing plate 310 and rotates the first pressing plate 310.

[0081] A coupling relation between the dust collector 200 and the driving unit 400 will now be described in detail with reference to FIGs. 4 and 5.

[0082] The driving unit 400 includes gears 410 and 420 rotating the first pressing plate 310, and a compressing motor 430 rotating the gears 410 and 420.

[0083] In detail, the gears 410 and 420 are a driven gear 410 coupled to the rotary shaft 312 of the first pressing plate 310, and a driving gear 420 transferring power to the driven gear 410.

[0084] The driving gear 420 is coupled to a rotary shaft of the compressing motor 430, and thus is rotated by the compressing motor 430.

[0085] Accordingly, when the compressing motor 430 is rotated, the driving gear 420 coupled to the compressing motor 430 is rotated, and then a rotary force of the compressing motor 430 is transferred to the driven gear 410 by the driving gear 420 to rotate the driven gear 410. Finally, the rotation of the driven gear 410 allows rotation of the first pressing plate 310.

[0086] Here, the compressing motor 430 is provided under the dust collector mounting part 130. The driving gear 420 is coupled to the rotary shaft of the compressing motor 430, and is provided on a bottom of the dust collector mounting part 130.

[0087] A part of an outer circumferential surface of the driving gear 420 is exposed to the outside at the bottom of the dust collector mounting part 130.

[0088] To this end, a motor receiving part at which the drive motor is installed may be formed under the bottom of the dust collector mounting part 130. An opening for exposing the part of the outer circumferential surface of the driving gear 420 may be formed at a roughly central portion of the bottom of the dust collector mounting part 130.

[0089] The rotary shaft 312 of the first pressing plate 310 is inserted in the cavity of the stationary shaft 322 from the upside of the stationary shaft 322, and the driven gear 410 is inserted in the cavity of the stationary shaft 322 from a lower end of the dust collector 220 to be coupled to the rotary shaft 312.

[0090] The rotary shaft 312 has a height-difference portion 312c supported by an upper end of the stationary shaft 322, and is divided by the height-difference portion into an upper shaft 312a coupled to the first pressing plate 310, and a lower shaft 312b coupled to the driven gear 410.

[0091] Here, a groove 312d is formed at the lower shaft 312b. A gear shaft of the driven gear 410 is inserted in the groove 312d, so that the lower shaft 312b can be coupled to the driven gear 410.

[0092] The groove 312d may have various shapes such as circular and quadrangular shapes. The gear shaft of the driven gear 410 may have a shape corresponding to the shape of the groove 312d.

[0093] Accordingly, when the driven gear 410 is coupled to the rotary shaft 312, the driven gear 410 is exposed to the outside of the dust container 220.

[0094] When the dust container 200 is mounted to the dust container mounting part 130, the driven gear 410 exposed to the outside of the dust container 220 is engaged with the driving gear 420.

[0095] The compressing motor 430 may be a motor capable of both forward rotation and backward rotation. In other words, a motor capable of bidirectional rotation may be used as the compressing motor 430.

[0096] To allow the forward and backward rotation of the compressing motor 430, a synchronous motor may be used as the compressing motor 430.

[0097] The synchronous motor is configured to be capable of forward and backward rotation by itself. When a value of a force applied to the motor becomes greater than a set value while the motor is rotating in one direction, the rotation of the motor is switched to the other direction.

[0098] The force applied to the motor is a resistance force (i.e., torque) that is generated as the first pressing plate 310 presses dust. The motor is configured to switch its rotation direction when a value of the resistance force becomes equal to a set value.

[0099] Since the synchronous motor is well known in the field of motor technologies, detailed description thereon will be omitted, except that one of technical aspects of the present invention is that the synchronous motor allows forward and backward rotation of the compressing motor 430.

[00100] Even when the first pressing plate rotates to compress dust and then reaches a limit where the first pressing plate cannot be further rotated, the first pressing plate 310 may continue to press the dust for a certain period of time.

[00101] Here, when the resistance force reaches a set value, the first pressing plate 310 is at the limit where it cannot be further rotated.

[00102] When the value of the resistance force becomes equal to the set value, power that rotates the first pressing plate 310, that is, power that is applied to the compressing motor 430, is cut off for a predetermined period of time to stop the first pressing plate 310. The stopped first pressing plate 310 maintains the compressing of the dust. When the predetermined period of time elapses, power is applied to the compressing motor 430 to move the first pressing plate 310.

[00103] Here, the power applied to the compressing motor 430 is cut off when the value of the resistance force becomes equal to the set value. Therefore, when driven again, the compressing motor 430 rotates in the opposite direction to the previous direction.

[00104] Also, when more than a predetermined amount of dust is collected within the dust container 220, the time for emptying the dust container 220 may be indicated to prevent degradation of the dust collection performance and the overload of the motor.

[00105] To this end, indication units 510 and 520 are provided at the cleaner body 100 or the handle 40. A user may be notified of the time for emptying the dust container 220 through the indication units 510 and 520 when more than a predetermined amount of dust are collected in the dust container 220 and thus an angle to which the first pressing plate 310 is rotated becomes smaller than a predetermined angle.

[00106] Each of the indication units 510 and 520 may be a light emitting diode (LED) 510 that can provide a user with visual indication of the time for emptying the dust container 220, or may be a speaker 520 that can provide a sound to the user to indicate the time for emptying the dust container 220.

[00107] Also, both the LED 510 and the speaker 520 can be used to notify the user of the time for emptying the dust container 220. In this case, the LED 510 may be mounted to the handle 40 used by the user to manipulate the operation, and the speaker 520 may be provided to any one of the cleaner body 100 and the handle 40.

[00108] FIG. 6 is a perspective view showing a dust separator and a dust container of the dust collector, and FIG. 7 is a bottom perspective view of the dust separator shown in FIG. 6.

[00109] Referring to FIGs. 6 and 7, the dust separator 210 is coupled to an upper portion of the dust container 220. In the dust separator 210, dust separated from the dust separator 210 subsides to be stored in the dust container 220.

[00110] In detail, an inlet 211a through which the air containing dust is introduced is formed at an upper portion of an outer circumferential surface of the dust separator 210 along a tangential line of the dust separator 210, and a cover 221d is detachably provided at an upper side of the dust separator 210.

[00111] An outlet 211b is formed at a central portion of the cover 211d. The purified air from which the dust has been separated in the dust separator 21, that is, by the cyclone unit 211, is discharged through the outlet 211b.

[00112] A hollow exhaust member 221c is coupled to the outlet 211b, and includes at an outer circumferential surface thereof a plurality of through holes through which the air purified in the cyclone unit 211 is discharged.

[00113] A partition plate 230 is horizontally formed under the dust separator 210, and serves to divide the dust separator 210 and the dust container 220. Also, the partition plate 230 further serves to prevent dust stored in the dust container 220 from spreading toward the dust separator 210 when the dust separator 210 is coupled to the dust container 220.

[00114] The partition plate 230 includes a dust discharge hole 231 through which dust separated in the cyclone unit 211 are discharged to the dust container 220.

[00115] The dust discharge hole 231 may be formed at the opposite side to the second pressing plate 320.

[00116] Accordingly, the amount of dust compressed at both sides of the second pressing plate 320 is maximized. Thus, the dust collection capacity is maximized, and spreading of the dust is minimized during a process of storing the dust in the dust container 220.

[00117] For the coupling between the dust separator 210 and the dust container 220, the dust separator 210 and the dust container 220 include an upper grip 212 and a lower grip 223, respectively.

[00118] A hook unit is provided at the dust collector 200 so that the dust container 220 and the dust separator 210 can be coupled together in a state where the dust container 220 has been mounted to the dust separator 210.

[00119] In detail, a hook receptacle 241 is installed at a lower end of an outer circumferential surface of the dust separator 210, and a hook 242 selectively coupled to the hook receptacle 241 is installed at an upper end of an outer circumferential surface of the dust container 220.

[00120] Provided that the cyclone unit 211 is a main cyclone unit and the dust storage space 221 is a main storage space, the dust collector 200 according to the present invention may further include at least one auxiliary cyclone unit provided to the cleaner body, and an auxiliary storage space 224 provided to the dust collector 200.

[00121] The auxiliary cyclone unit serves to secondarily separate dust from the air discharged from the main cyclone unit 211, and the auxiliary storage space 224 serves to store dust separated by the auxiliary cyclone unit.

[00122] The auxiliary storage space 224 is provided at an outer circumferential surface of the dust collector 200, with its upper end opened.

[00123] In the current embodiment, the auxiliary storage space 224 is provided at an outer circumferential surface of the dust container 220, and an auxiliary dust intake unit 213 communicating with the auxiliary storage space 224 is provided at the outer circumferential surface of the dust separator 210.

[00124] Here, auxiliary dust intake holes 231a (depicted in FIG. 3) selectively communicating with a dust discharge hole 140 of the auxiliary cyclone unit are formed at an outer wall of the auxiliary dust intake unit 213. The bottom of the auxiliary dust intake unit 213 is opened to communicate with an upper end of the auxiliary storage space 224.

[00125] Accordingly, when the main cyclone unit 211 is mounted to the cleaner body 100, the auxiliary dust intake hole 213a communicate with the dust discharge hole 140 (depicted in FIG. 1) of the auxiliary cyclone unit.

[00126] Thus, dust separated by the auxiliary cyclone unit are introduced through the auxiliary dust intake hole 213a, and are stored in the auxiliary storage space 224.

[00127] Operations of the vacuum cleaner having the aforementioned structure according to the present invention will now be described.

[00128] First, when power is supplied to the vacuum cleaner, a suction force generator generates a suction force, and the air containing dust is introduced through the suction nozzle 40 by the air suction force.

[00129] The air sucked through the suction nozzle 40 is sucked into the inlet 211a of the main cyclone unit via the body suction part 110. The air introduced through the inlet 211a of the main cyclone unit is guided along an inner wall of the main cyclone unit 211 in a tangential direction, thereby forming a spiral current. Accordingly, dust contained in the air is separated by a difference in a centrifugal force with the air, and subside.

[00130] The dust subsiding while spirally flowing along the inner wall of the main cyclone unit 211 pass through the dust discharge hole 231 of the partition plate 230, and are stored in the main storage space 221.

[00131] The air that has been primarily purified by the main cyclone unit 211 is discharged through the outlet 211b via the exhaust member 211c, and flows into the auxiliary cyclone unit.

[00132] Thus, the dust separated by the cyclone principle within the auxiliary cyclone unit is stored in the auxiliary storage space 224. The purified air within the auxiliary cyclone unit is exhausted from the auxiliary cyclone unit, is introduced to the cleaner body 100, and then is exhausted from the cleaner body 100 through the body discharge part 120.

[00133] Most of dust introduced into the vacuum cleaner are stored in the main storage space 221 during a cleaning process, and the dust within the main storage space 221 are compressed by the first and second pressing plates 310 and 320 to the minimum volume, so that a large amount of dust can be stored in the main storage space 221.

[00134] When more than a predetermined amount of dust is stored in the dust container 220 during the cleaning process, the indication units 510 and 520 are operated, so that the user may be notified of the time for emptying the dust container 220.

[00135] Then, the user separates the dust collector 200 from the cleaner body 100, and then empties the dust container 220.

[00136] A process of compressing dust collected in the dust container 220 will now be described in detail with reference to FIGs. 8 through 12.

[00137] FIG. 8 is a block diagram showing configuration for controlling compression of dust within the dust collector, and FIG. 9 is a flow chart showing a process of compressing dust within the dust collector. FIG. 10(a) is a waveform view of a current phase of the drive motor over the dust compression time, and FIG. 10(b) is a waveform view of a phase of power supplied to the drive motor over the dust compression time. FIGs. 11 and 12 are plan views of the dust container, illustrating a process of compressing dust within the dust collector.

[00138] Referring to FIG. 8, the vacuum cleaner according to an embodiment of the present invention includes a current detector 610 detecting a current value of the compressing motor 430 driving the first pressing plate 310, a motor driver 620 driving the compressing motor 430, and a controller 600 receiving the current value detected by the current detector 610 and controlling the motor driver 620 according to the detected current value.

[00139] In detail, the driver motor 430 is capable of bi-directional rotation as mentioned above, and switches its rotation direction when a value of a resistance force applied to the first pressing plate 310 becomes equal to or greater than a set value.

[00140] Here, when the value of the resistance force applied to the first pressing plate 310 becomes equal to or greater than the set value, the current value of the compressing motor 430 is momentarily increased as illustrated in FIG. 10(a), and the current detector 610 detects the current value of the compressing motor 430.

[00141] When cleaning is performed by the aforementioned structure, dust separated by the cyclone unit 211 is stored in the dust storage space 221. In such a process of storing the dust, the pair of pressing plates 310 and 320 compress the dust stored in the dust storage space 221.

[00142] In detail, when the compressing motor 430 rotates in one direction, a rotary fore of the compressing motor 430 is transferred to the driven gear 410 through the driving gear 420, thereby rotating the driven gear 410. The rotation of the driven gear 410 causes rotation of the rotary shaft 312 and the first pressing plate 310.

[00143] Since the driving gear 420 and the driven gear 410 are engaged with each other, when the compressing motor 430 rotates in one direction, the driving gear 420 is rotated in the same direction as that of the compressing motor 430, and the driven gear 410 is rotated in the other direction, the opposite direction to that of the compressing motor 430 S110.

[00144] That is, it can be seen that the direction in which the driven gear 410 and the rotary shaft 312 are rotated is opposite to the direction in which the compressing motor 430 rotates.

[00145] When the first pressing plate 310 is rotated in the other direction (counterclockwise in FIG. 17), the first pressing plate 310 pushes dust between the first pressing plate 310 and the second pressing plate 320 toward one side of the second pressing plate 320, thereby compressing the dust. The rotation of the first pressing plate 310 is continued until a value of a resistance force generated in the process of pressing the dust becomes equal to the set value.

[00146] When the value of the resistance force becomes equal to or greater than the set value S120, a current value of the compressing motor 430 is momentarily increased, and such an increase is detected by the current detector 610.

[00147] The current value detected by the current detector 610 is transmitted to the controller 600, and the controller 600 sends the motor driver 620 a signal for cutting off power applied to the compressing motor 430. Then, the driving of the compressing motor 430 is stopped, and thus the first pressing plate 310 is stopped in a state of compressing the dust S130. The first pressing plate 310 presses the dust at the stopped position for a predetermined period of time (t).

[00148] When the predetermined period of time (t) elapses, the controller 600 sends the motor driver 620 a signal for applying power to the compressing motor 430, and thus the compressing motor 430 and the first pressing plate 310 are rotated.

[00149] Here, since the first pressing plate 310 was stopped when the value of the resistance force becomes equal to the set value, the rotation direction thereof is switched, and thus the first pressing plate 310 is rotated clockwise as illustrated in FIG. 18 S140.

[00150] When the first pressing plate 310 is rotated clockwise, the first pressing plate 310 pushes dust between the first pressing plate 310 and the second pressing plate 320 toward the other side of the second pressing plate 320, thereby compressing the dust.

[00151] When a value of a resistance force applied to the first pressing plate 310 becomes equal to or greater than a set value during the rotation of the first pressing plate 310 S150, power being applied to the compressing motor 430 is cut off, and thus the first pressing plate 310 is stopped, still compressing the dust S160. The first pressing plate 310 presses the dust at the stopped position for a predetermined period of time (t).

[00152] When the predetermined period of time elapses, the compressing motor 430 is driven again and thus the first pressing plate 310 is rotated in the opposite direction (counterclockwise).

[00153] The compression is repetitively performed until an angle to which the first pressing plate 310 is rotated becomes smaller than a predetermined angle. When the operation of the cleaner is stopped by a user in this process S170, the process of compressing dust is terminated.

[00154] FIG. 19 is a flow chart showing a dust-emptying time indicating function of the dust collector, FIG. 14 is a flow chart for describing an operational state of the cleaner when the dust-emptying time indicating function is performed, and FIG. 15 is a plan view showing an operational state of a first pressing plate when the dust-emptying time indicating function is performed.

[00155] Referring to FIGs. 13 through 15, when cleaning is performed by manipulation of a user, dust are separated from the air, are stored in the dust collector 200, and are compressed by the pair of pressing plates 310 and 320 S100. Since the compression process of the dust is the same as described above, the detailed description thereon will be omitted.

[00156] Also, during the cleaning operation, a moving time (S) of the first pressing plate 310 is continuously detected S200, and the detected time value is input to the controller 500. Then, the amount of dust stored in the dust collector 200 is roughly calculated according to the time value input to the controller 600.

[00157] Here, the cleaner body 100 may further include a memory (not shown) storing the roughly calculated amount of dust according to the extent to which the first pressing plate 310 can be rotated.

[00158] In detail, referring to FIG. 10(b), the moving time (S) of the first pressing plate 310 is a period of time from the time point when power is applied to the compressing motor 430 again after power supplied to the compressing motor 430 to rotate the first pressing plate 310 in one direction is cut off for a predetermined period of time (t), to the time point when the current value of the compressing motor 430 is momentarily increased while the first pressing plate 310 is being rotated in the other direction.

[00159] Numerically, referring to FIG. 10(b), the moving time (S) is obtained by equation B=(A+t).

[00160] The moving time of the first pressing plate 310 is reduced as the amount of dust stored in the dust collector 200 is increased. During the cleaning operation, it is determined whether the moving time (S) of the first pressing plate 310 is shorter than a reference time (Sc) S300.

[00161] If the moving time (S) of the first pressing plate 310 is shorter than the reference time (Sc), it is further determined whether the number of times that the moving time (S) of the first pressing plate 310 becomes shorter than the reference time (Sc) is equal to the set number of times, for example, 10 times S400.

[00162] When it is determined that more than a predetermined amount of dust are stored in the dust collector 200, a time for emptying the dust container 220 is indicated to a user S500.

[00163] When the moving time (S) of the first pressing plate 310 is equal to or longer than the reference time (Sc), or when the number of times that the moving time (S) of the first pressing plate 310 becomes shorter than the reference time (Sc) is smaller than the set number of times, the first pressing plate 310 continuously compress the dust.

[00164] Here, the number of times the moving time (S) of the first pressing plate 310 is determined to be shorter than the reference time is set to a plurality number of times, not just once, in order to prevent the time for emptying the dust from being indicated even when the moving time (S) of the first pressing plate 310 is reduced by external factors.

[00165] In detail, the first pressing plate 310 being rotated toward one side of the second pressing plate 320 may change its rotation direction and be moved toward the other side of the second pressing plate 320, without being completely rotated to the one side of the second pressing 320 because of dust between the first pressing plate 310 and the inner circumferential surface of the dust container 220. In this case, the moving time

(S) of the first pressing plate 310 may be reduced. To prevent the time for emptying dust from being indicated in such a case, the number of times the moving time (S) of the first pressing plate 310 is determined to be shorter than the reference time (Sc) is set to a plurality of times.

[00166] When the dust-emptying time indicating function is performed, the first pressing plate 310 is moved to a location allowing the user to facilitate emptying of the dust within the dust collector S510.

[00167] In detail, the first pressing plate 310 can be stopped after rotated to a location spaced apart from the second pressing plate 320 at an angle of about 180° .

[00168] That is, the first pressing plate 310 is moved to be at the maximum distance from the second pressing plate 320, thereby facilitating the emptying of the dust.

[00169] Otherwise, the first pressing plate 310 may be stopped after moved for half of the reference time (Sc) (i.e., 1/2 of the reference time). In this case, the pressing plate 310 is spaced apart from both ends of the dust compressed at both sides of the second pressing plate 320 at the same distance.

[00170] Here, the location where the first pressing plate 310 is stopped may vary according to the amount of dust compressed at both sides of the second pressing plate 320.

[00171] In FIG. 15, the first pressing plate 310 is moved to a location where it is at an angle of about 180° from the second pressing plate 320.

[00172] The indication units 510 and 520 are operated to inform the user of a time for emptying the dust S520. As mentioned above, the LED 510 and the speaker 520 may be used as the indication units 510 and 520.

[00173] The LED 510 may be repetitively turned ON and OFF so that user can easily recognize light, and the speaker 520 may output a buzzing sound or a melody.

[00174] Here, S510 and S520 may be performed either sequentially or simultaneously.

[00175] Then, a suction motor operated by a predetermined load is continuously operated for a first set period of time S530. The predetermined load means an operational state of the suction motor before the indication units 510 and 520 work.

[00176] After the suction motor is operated for the first set

period of time, the load of the suction motor is decreased to a predetermined value, and the suction motor is operated by the decreased load for a second set period of time S530.

[00177] After the suction motor is operated by the decreased load for the second set period of time, the operation of the suction motor is finally stopped S540.

[00178] The operation of the suction motor is divided into the several processes mentioned above, in order to prevent the user from determining that the cleaner is broken when the suction motor is momentarily stopped.

[00179] When the operation of the suction motor is stopped, the operation of the indication units 510 and 520 is stopped S550.

[00180] Since a user is notified of the time for emptying the dust within the dust container 220, convenience of the user is improved. Also, the operation of the suction motor is controlled in the process of performing the dust-emptying time indicating function, so that the performance of the cleaner is prevented from being lowered by suction of an excessive amount of dust.

[00181] FIG. 16 is a perspective view illustrating a coupling relation between a driving unit and a dust collector according to the second embodiment of the present invention.

[00182] Referring to FIG. 16, the lower end of the mounting part 130 according to the second embodiment includes a compressing motor 430 and a driving gear 420 coupled to the compressing motor 430, and an on/off micro switch 440 provided to correspond to the rotation of the driving motor 420.

[00183] In detail, the driving gear 420 includes a plurality of teeth 422 formed at a predetermined interval around the perimeter thereof. Here, in the present invention, the teeth 422 on the driving gear 420 will hereinafter be called "protrusions", and the portions where the teeth 422 are not formed will hereinafter be called "recesses" 423.

[00184] A terminal that extends from an end of the micro switch 440 is disposed below the position in which the teeth 422 of the driving gear 420 are formed.

[00185] Accordingly, the terminal that extends from the micro switch 440 detects the recesses at regular intervals according to the rotation of the driving gear 420.

[00186] That is, the micro switch 440 is in an on state when a protrusion of the driving gear 420 is above its terminal, and in

an off state when a recess is above the terminal. The on-off signals of the micro switch 440 are applied to a counter 880 (to be described below) so that a predetermined pulse signal is outputted. Here, the counter 880 outputs a pulse signal that has a high level when the micro switch 440 is on and a low level when the micro switch 440 is off.

[00187] Therefore, by measuring the number of pulses (that is, the frequency of the on-off switching), the rotated state of the driving gear 420 can be measured.

[00188] That is, in the present invention, the micro switch 440 detects when the driving gear 420 cannot rotate any further due to collected dust, so that the compressing motor 430 is operated again after it is stopped for a predetermined duration.

[00189] FIG. 17 a block diagram illustrating a control unit of a vacuum cleaner according to an embodiment of the present invention, FIG. 18 is a flowchart illustrating a dust compressing process of the dust collection unit and dust discharge alarming, and FIG. 19 is a waveform of a pulse signal varying according to an amount of the dust collected in the dust collection unit.

[00190] Referring first to FIG. 17, the vacuum cleaner of the second embodiment includes a control unit 810 formed of a microcomputer, an operation signal input unit 820 (corresponding to 510 of FIG. 1) for selecting a suction power of the dust (e.g., high, middle, low power modes), a dust discharge signal display unit 830 (corresponding to 510 or 520 of FIG. 1), a suction motor driver 840 for operating the suction motor 850 that is a driving motor for sucking the dust into the dust collection unit according to the operation mode, a compression motor driver 860 for operating the compressing motor 430 used for compressing the dust collected in the dust collection unit, and a counter 880 for measuring a degree of the rotation clockwise and counterclockwise (e.g., reciprocal rotation time) of the compressing motor 430.

[00191] In operation, when the user selects one of the high, middle and low modes representing the suction power using the operation signal input unit 820, the control unit 810 controls the suction motor driver 840 so that the suction motor 850 can be operated with the suction power corresponding to the selected power mode.

[00192] Meanwhile, the control unit 810 operates the compression motor 430 simultaneously with or right after the operation of the suction motor driver 860. When the suction motor 850 operates, the dust starts being sucked into the dust collection unit through the suction nozzle 20. The dust introduced into the dust collection unit is compressed by the first compressing plate 310 rotating by the compression motor 430.

[00193] The counter 880 measures the reciprocal time (period) of the compressing motor 430 and transmits the corresponding signal to the control unit 810.

[00194] As an amount of the dust compressed in the dust collection unit increases, the reciprocal rotation time of the compression motor is reduced. When the amount of the dust reaches a predetermined level and thus the reciprocal rotation time is less than a predetermined time, the control unit 810 displays an empty request signal through the indicator 830.

[00195] Referring to FIGs. 18 and 19, the dust compression and the signal requesting an emptying of dust according the second embodiment of the present invention will be described in further detail.

[00196] First, the user operates the vacuum cleaner by selecting one of the high, middle and low modes of the operation signal input unit 820. The control unit 810 controls the suction motor driver 840 so that the suction motor 850 can be operated with the suction power corresponding to the selected power mode (S1010).

[00197] When the suction motor 850 operates, the dust starts being sucked into the dust collection unit through the suction nozzle 20. The sucked dust is collected in the dust collection unit. As described above, the dust collected in the dust collection container 220 is compressed by the pressing plates 310 and 320.

[00198] Therefore, the control unit 810 drives the compressing motor 430 to compress the dust sucked in the dust collection container (S1020).

[00199] For reference, although the compressing motor 430 is driven after the suction motor 850 is driven, the suction and compression motors 850 and 870 may be simultaneously operated.

[00200] In step S1020, when the compressing motor 430 is driven, the driving gear 420 coupled to the rotational shaft of the compressing motor 430 rotates. When the driving gear 410 rotates, the driven gear 410 starts rotating. When the driven gear 410 rotates, the rotational shaft 312 coupled to the driven gear 410 and the first pressing plate 310 rotate toward the second pressing plate 320 to compress the dust in step S1030.

[00201] When the driving gear 420 rotates as above, the terminal of the micro switch 440 is turned on and off at regular intervals according to the rotation of the driving gear 420. also, the counter 880 that receives the on/off signal of the micro switch 440 outputs a predetermined pulse signal corresponding to the received signal, and sends the pulse signal to the control unit 810.

[00202] That is, as an amount of the dust compressed by the first and second pressing plates 310 and 320 increases, the reciprocal rotation time of the driven gear 410 is reduced and thus the reciprocal rotation time of the driving gear 420 engaged with the driven gear 410 also reduced.

[00203] At this point, the reduction of the reciprocal rotation time of the driving gear 420 means that the number of on-off operations of the micro switch M is reduced. That is, the number of the pulse signals output from the counter 880 is reduced.

[00204] Here, the output of the pulse signals will be described hereinafter with reference to FIG. 19.

[00205] When the first pressing plate 310 compresses the dust while moving toward the second pressing plate 320, the driven and drive gears 410 and 420 rotate with a predetermined period and thus the micro switch M is turned on and off a predetermined period according to the rotation of the driving gear 420.

[00206] However, when the first pressing plate 310 cannot rotate toward the second pressing plate 320 as the dust are fully compressed, the driven and drive gears 410 and 420 do not rotate no longer. This means that no pulse signal is generated.

[00207] Therefore, the control unit 810 identifies that the dust are fully compressed by the rotation of the first pressing plate 310. This identification process is determined with reference to whether the pulse signal is regularly generated.

[00208] That is, the control unit 810 determines if the pulse is generated from the counter 880 in step S1040.

[00209] When the regular pulse is generated, this means that there is still a space for compressing the dust between the first and second pressing plates 310 and 320. In this case, the process is returned to the step 1030 to continue the compression process.

[00210] On the contrary, when no regular pulse is generated, i.e., when the dust is fully compressed by the first pressing plate 310, the control unit 810 stops the operation of the compressing motor 430 in step S1050.

[00211] That is, during the periodical pulses are regularly applied through the counter 880, when the regular periodical pulses is collapsed, the control unit 810 detects this fact and stops the compressing motor 430 using the compression motor driver 860. Therefore, the rotation of the first pressing plate 310 is stopped.

[00212] Next, the control unit 870 maintains the stopped state of the compressing motor 430 for a predetermined time (e.g., 3 seconds). This predetermined time is a stand by time for driving the compressing motor 430 in a reverse direction, and a time for allowing continued compression of dust while the first pressing plate 310 is immobile.

[00213] Next, the control unit 810 determines in step S1070 if the number N of the pulses from the formed compression motor stop point (time T1) to the current compression motor stop point (time T2) is less than the predetermined number. For example, when an amount of the dust is greater than a predetermined level, the reciprocal time of the first pressing plate 310 is reduced in response to the reduction of the number of the pulses output from the counter 880 during the period.

[00214] That is, whether the amount of the dust compressed in the dust collection container 220 is higher than a predetermined level is determined by measuring the reciprocal time of the first pressing plate (a difference of the number of the pulses).

[00215] In step S1070, it is determined that the number N of the pulses from the formed compression motor stop point (time T1) to the current compression motor stop point (time T2) is greater than the predetermined number, it means that there is still a space for further compressing the dust in the dust collection container. Therefore, the process is returned to the step S120. At this point, the compressing motor 430 is controlled by the control unit 810 such that it rotates in a direction opposite to that of step S1050.

[00216] In step S1070, it is determined that the number N of the pulses from the formed compression motor stop point (time T1) to the current compression motor stop point (time T2) is less than the predetermined number, the control unit 810 determines in step S1080 if the results where the number of the pulses determined in the step S1070 is measured as it is less than the predetermined number reaches to the predetermined times (e.g., 3 times). By doing this, it is possible to more accurately determine if the amount of the dust in the dust collection container 220 is higher than the predetermined amount. Furthermore, an error that may be incurred as the first pressing plate 310 cannot normally rotate in both directions due to the affection of the dust can be prevented.

[00217] In step S1080, when the results is less than the predetermined times, the process is returned to the step S1030.

[00218] On the contrary, when it is determined in step S1080 that the result reaches the predetermined times, the control unit stops the suction motor 850 that is the main driving motor in step S1090.

[00219] Next, the control unit 810 transfers an empty request signal to a dust discharge request signal display unit 830 in step 1100 so that the user can address this matter.

[00220] FIG. 19 is a waveform of a pulse signal varying according to an amount of the dust collected in the dust collection unit, where FIG. 19(a) shows a state where there is hardly any dust present in the dust container 220, FIG. 19(b) shows the dust container 220 with a certain amount of dust therein, and FIG. 19(c) shows the dust inside the dust container 220 having reached a certain level.

[00221] In FIG. 19, the pulse waveform is a signal output from the counter 880 and input to the control unit 810. The pulse signal is output from the counter 880 receiving a signal of the micro switch M that is turned on and off according to the rotation of the drive gear 420.

[00222] First, when the compressing motor 430 operates, the first pressing plate 310 will be positioned as a certain location. Therefore, for example, the control unit 810 normally operates from a point where the compressing motor 430 rotates clockwise and initially stops (here, a section a-b is 3 seconds). That is, after reaching the point (a), the control unit determines that the pulse signal input from the counter 880 is the normal pulse

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signal.

[00223] As can be noted from FIG. 19, when the amount of the dust collected in the dust collection container 220 is small, the first pressing plate 310 can rotate to the maximum clockwise and counterclockwise and thus 10 pulses will be output as shown in FIG. 19(a).

[00224] When the amount of the dust increases as the time goes, the reciprocal rotation time of the first pressing plate will be gradually reduced (i.e., the rotating angle of the first pressing plate 310 will be reduced).

[00225] As shown in FIG. 19(c), when the number of the pulse signals and the generation of these pulse signals is repeated by a predetermined times (3 times in this embodiment), the control unit receives an empty request signal.

[00226] As described above, the present invention increases dust collection efficiency by compressing the dust and displaying a dust discharge timing by converting the number of rotations of the gear rotated by the compression motor and detecting the variation in the pulse signal according to the amount of the dust.

[00227] FIG. 20 is a perspective view illustrating a coupling relation between a driving unit and a dust collector according to the third embodiment of the present invention, FIG. 21 is a frontal perspective of a driven gear included in the driving unit according to the present invention, FIG. 22 is a side view of the driven gear in FIG. 21, and FIG. 23 is a view showing the coupling of the driven gear in FIG. 21 with a micro switch.

[00228] Referring to FIGs. 20 through 23, the dust collector according to the present embodiment includes a compressing motor 430 below the mounting portion 130, a driving gear 420 coupled to the compressing motor 430, a driven gear 410 coupled to the driving gear 420, and a micro switch 450 that is turned on and off according to the rotation of the driven gear 410.

[00229] Specifically, the micro switch 450 has a terminal 460 that allows the micro switch 450 to be turned on and off that is disposed in contact with the lower side of the driven gear 410.

[00230] Also, the driven gear 410 includes a round plate shaped floor portion 412, a contact rib 413 extending upward from the lower edge of the floor portion 412 and contacting the terminal 440, and a plurality of gear teeth 416 formed along the side perimeter of the floor portion 412.

[00231] The contact rib 413 has a position check groove 415 (for checking the position of the driven gear 410) formed therein to prevent contact of the terminal 440 when at a predetermined position of the driven gear 410. Here, the terminal 440 not contacting the contact rib 413 means that when a portion of the terminal 460 is inserted into the position check groove 415, the terminal 460 does not contact the lower surface of the contact rib 413.

[00232] That is, when the dust collector 200 is installed in the mounting portion 130, the terminal 460 contacts the contact rib 413 and presses a contact point of the micro switch 430. Also, when the driven gear 410 is rotated and moves to a predetermined position, a portion of the terminal 440 is inserted in the position check groove 415, so that the terminal 440 is disengaged from the contact point 452.

[00233] Here, the micro switch 450 is turned off only when the terminal 460 is disposed at the position check groove 415, and in all other cases, the micro switch 450 is turned on when the terminal 460 is in contact with the lower surface of the contact rib 413.

[00234] Accordingly, when the driven gear 410 rotates, the micro switch 450 is always on, with the exception of when the terminal 460 is disposed at the position check groove 415.

[00235] FIG. 24 is a block diagram of a control unit of a vacuum cleaner according to the third embodiment of the present invention.

[00236] Referring to FIG. 24, the vacuum cleaner according to the third embodiment of the present invention includes a control unit 810, a signal input unit 820 for selecting a suctioning strength (i.e., high, medium, and low) of dust, a signaler 830 for issuing a signal to empty the stored dust in the dust collector 200, a driver 840 for operating a suctioning motor 850 for suctioning dust into the dust collector 200 in accordance with an operating mode (high, medium, low) from the signal input unit 820, a compressing motor driver 860 for operating the compressing motor 430 used to compress the dust inside the dust collector, a driving gear 420 that is driven by the compressing motor 430, a driven gear 410 engaged to the driving gear 420 to rotate, and at least one micro switch 450 that is turned on or off according to the rotation of the driven gear 410.

[00237] FIGs. 25 and 26 are diagrams for describing an on state of a micro switch when a first pressing member becomes close to one side of a second pressing member for compressing dust according to the present invention, FIGs. 27 and 28 are diagrams for describing an off state of the micro switch in FIG. 25 when the first and second pressing members are positioned respectively in-line, and FIGs. 29 and 30 are diagrams for describing an on state of the micro switch in FIG. 25 when the first pressing member approaches the opposite side of the second pressing member.

[00238] Referring to FIGs. 25 through 30, when a first pressing member 310 forms an angle of 180° with respect to a second pressing member 320, the terminal 460 is disposed in the position check groove 415 of the driven gear 410. In this case, the terminal 460 is disengaged from the contact point 452 so that the mask switch 450 is in an off position.

[00239] Here, the off position of the micro switch 450 will be referred to as a reference position for the sake of convenience when describing the first pressing member 310 in FIG. 28.

[00240] Also, as the first pressing member 310 rotates

counterclockwise from the reference position and compresses dust collected on the floor of the dust separator 210, the terminal 460 is engaged with the contact rib 413 of the driven gear 410 and presses the contact point 452 of the micro switch 450, so that the micro switch is turned on, as shown in FIG. 26.

[00241] Furthermore, when the first pressing member 310 that was turning counterclockwise cannot rotate further due to the accumulated dust, the first pressing member 310 rotates in a clockwise direction. Accordingly, the first pressing member 310 passes the reference position shown in FIG. 27 and rotates to the right of the second pressing plate 320 to press dust collected in the dust collector body 210.

[00242] When the first pressing member 310 that was rotating in a clockwise direction cannot rotate further because of accumulated dust, the compressing motor 430 rotates in a counterclockwise direction to repeat the procedure that has been thus described, to perform compressing of dust collected within the dust collector body 210.

[00243] FIG. 31 is a diagram for describing the overall operation of the first pressing member described in FIGs. 25

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through 30.

[00244] Referring to FIG. 31, a time TD1 that it takes for the first pressing member 270 to rotate in a clockwise direction from a reference position and return to the reference position, and a predetermined time TD2 that it takes to return to the reference position by rotating counterclockwise are shown. For the sake of descriptive convenience, the first time TD1 will be referred to as the first return time, and the second time TD2 will be referred to as the second return time. Generally, because dust is evenly distributed within the dust collector body 210, the first return time TD1 and the second return time TD2 are almost identical.

[00245] As the quantity of dust compressed by the first pressing member 310 increases, the first return time TD1 and the second return time TD2 become shorter.

[00246] In the present invention, when one of the first and second return times TD1 and TD2 reaches a predetermined reference time, it is determined that there is enough dust in the dust collector body 210, and a signal to empty the dust is issued.

[00247] FIG. 32 is a flowchart of a dust compressing process

and a dust emptying time of a dust collector according to the third embodiment of the present invention.

[00248] Referring to FIG. 32, a user selects one mode (i.e., high, medium, or low) from the suction modes displayed on an operating signal input 820 and operates the vacuum cleaner. Then, the control unit 810 activates the suction motor driver for operating suction motor 850 according to the user selected suctioning mode in step S1210.

[00249] When the suction motor operates 850, the suctioning force of the suction motor 850 suctions air including dust through the nozzle 20. The suctioned dust collects in the dust collector 200. Inside the dust collector 200, the dust is compressed by the pressing members 310 and 320.

[00250] That is, the control unit 810 operates the compressing motor 430 in step S1220 to compress the dust stored in the dust collector 200.

[00251] When the compressing motor 430 operates in step S1220, the driving gear 420 coupled to the compressing motor 430 rotates. When the driving gear 420 rotates, the driven gear 410 engaged thereto also rotates. When the driven gear 410 rotates, the first pressing member 310 coupled to the driven gear 410 automatically rotates toward the second pressing member 320 to compress the dust.

[00252] Here, the control unit 810 first determines whether the first pressing member 310 is disposed in a reference position in step S1230. The present invention uses a reference position of the first pressing member 310 as a reference to measure the first and second return times, so that when the operation is initiated, there is a need to verify that the first pressing member 310 is in a reference position.

[00253] If the first pressing member 310 is at its reference position at the start of operation, the micro switch 450 should be in an off state.

[00254] Accordingly, the control unit 810 sets an off state of the micro switch as a reference, and measures the first and second return times.

[00255] Also, with the reference position of the first pressing member 310 set at a starting point of movement, the control unit 810 measures the first and second return times according to the rotation of the first pressing member 310 in a clockwise or counterclockwise direction.

[00256] Here, as the amount of dust being compressed inside the dust collector body 210 through the first and second pressing members 310 and 320 increases, the rotating time in left and right directions of the driven gear 410 becomes shorter.

[00257] The control unit 810 measures the first and second return times TD1 and TD2 of the first pressing member 310 through the micro switch 450, and determines in step S1250 whether the first or second return times TD1 or TD2 has reached a predetermined time.

[00258] Here, the predetermined reference time is a time that a designer sets into the control unit 810, and is an indicator that signals that a predetermined amount of dust has accumulated in the dust collector body 210. The designer may conduct multiple tests to set an optimal reference time, and differs according to the capacity of each vacuum cleaner.

[00259] According to the present invention, when one of the first and second return times TD1 or TD2 reaches a reference time, it is determined that the amount of dust has reached a certain level; however, in alternate embodiments, the indicator may be based on both the first and second return times TD1 and TD2 reaching the predetermined reference time.

[00260] In the determining in step S1250, if the first or second return time TD1 or TD2 is longer than the reference time, step S1240 is restored and the previous steps are performed.

[00261] Conversely, if the first or second return times TD1 or TD2 reach the reference time, the control unit 810 turns the suction motor 850 off in step S1260 to prevent further suctioning of dust. Here, the compressing motor 870 may also be turned off.

[00262] Next, the control unit 810 sends a signal to the dust empty signal 830 in step S1270, so that a user may perceive the message.

[00263] In the above description, a canister type vacuum cleaner was used as an example. However, the present invention may also be applied to an upright type or a robot vacuum cleaner.

[00264] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their

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equivalents.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A vacuum cleaner including a dust collector forming a dust storage, the vacuum cleaner including :

a fixed member fixed to the dust storage;

a rotating member for performing a compressing of dust stored in the dust storage, through interaction with the fixed member;

a compressing motor for driving the rotating member;

a counter for measuring a moving time of the rotating member;

a signaller for issuing a dust empty signal of the dust storage; and

a controller for operating the signaller when a measured moving time is less than a reference time.

2. The vacuum cleaner according to claim 1, further including a current sensor for sensing a current applied to the compressing motor, wherein a change in a rotating direction of the rotating member is determined according to a current value sensed by the current sensor.

3. The vacuum cleaner according to claim 1, wherein the counter converts the measured moving time to a pulse signal and sends the pulse signal to the controller.

4. The vacuum cleaner according to claim 3, wherein a change in a rotating direction of the rotating member is determined according to the pulse signal.

5. The vacuum cleaner according to claim 2 or 4, wherein the moving time is a time in which the rotating member rotates in one direction.

6. The vacuum cleaner according to claim 1, further including a micro switch for sensing a reference position of the rotating member.

7. The vacuum cleaner according to claim 6, wherein the moving time is a time in which the rotating member rotates and moves from the reference position

toward the fixed member in a clockwise or counterclockwise direction and returns in a counterclockwise or clockwise direction to the reference position.

8. The vacuum cleaner according to claim 1, wherein the signaller is provided on at least one of a handle and body of the vacuum cleaner.

9. The vacuum cleaner according to claim 1, wherein the signaller is at least one of an LED (light emitting diode), a speaker, and a buzzer circuit.

10. A method of controlling a vacuum cleaner including a dust collector for storing dust, the method including:

sensing a quantity of compressed dust through a pressing member during vacuuming, the compressed dust stored in the dust collector; and

issuing a signal to an outside to empty the dust stored in the dust collector when the quantity of the dust exceeds a predetermined amount.

11. The method according to claim 10, wherein the pressing member is rotatably pivoted inside the dust collector for rotating in either direction, and the dust collector includes a fixed member fixed to an inside of the dust collector, wherein compressing of dust is performed through interaction of the pressing member and the fixed member during vacuuming.

12. The method according to claim 11, wherein a change in a rotating direction of the pressing member is determined according to a current value of a compressing motor for rotating the pressing member.

13. The method according to claim 11, wherein when a moving time of the pressing member is continuously sensed during vacuuming, a determining of when the quantity of the dust exceeds a predetermined amount is performed based on the moving time.

14. The method according to claim 13, wherein the moving time is converted to a pulse signal by a counter.

15. The method according to claim 14, wherein a rotating direction of the pressing member is determined according to the pulse signal.

16. The method according to claim 13, wherein the moving time is a time in which the pressing member moves from a first reference position to a second reference position.

17. The method according to claim 16, wherein the first reference position is a position in which the pressing member is stopped at one side of the fixed member, and the second reference position is a position in which the pressing member is stopped at the other side of the fixed member.

18. The method according to claim 16, wherein the first reference position is a position in which the pressing member and the fixed member form a straight line.

19. The method according to claim 18, wherein the first and the second reference positions are the same, and the second reference position is a position in which the pressing member moves from the first reference position toward one side of the fixed member, and returns in a reverse direction back to the first reference position.

20. The method according to claim 11, wherein in the issuing of the signal to empty the dust, the pressing member rotates and stops to form a straight line with the fixed member.

21. The method according to claim 11, wherein in the issuing of the signal to empty the dust, the pressing member stops after moving a same distance from either side of the fixed member to compressed dust.

22. The method according to claim 10, wherein in the issuing of the signal to empty the dust, a load on a suction motor is reduced incrementally and stopped.

23. The method according to claim 10, wherein in the issuing of the signal to empty the dust, an operation of a suction motor is stopped.

24. The method according to claim 10, wherein in the issuing of the signal to empty the dust, an operation of a suction motor is stopped after a predetermined time elapses from a time at which an amount of dust stored is determined to exceed a predetermined amount.

25. A method of controlling a vacuum cleaner including a dust collector for storing dust, the method including:

compressing dust stored inside the dust collector, through a pressing member rotated by a compressing motor;

determining a quantity of the compressed dust; and

issuing a signal to empty the compressed dust to an outside of the vacuum cleaner, when the quantity of the compressed dust is determined to exceed a predetermined amount.

26. The method according to claim 25, wherein the pressing member rotates in both directions in the compressing of the dust, and the compressing motor momentarily stops operating before a directional change of the pressing member.

27. The method according to claim 25, wherein the determining of the quantity of the compressed dust is performed through a measured rotating time of the compressing motor.

28. The method according to claim 27, wherein the measured rotating time of the compressing motor is converted to a pulse signal, and the quantity of the compressed dust is performed through determining a frequency of the converted pulse signal.

29. The method according to claim 25, wherein the determining of the quantity of the compressed dust is performed through a measured rotating time of the compressing member.

30. The method according to claim 25, wherein the signal to empty the compressed dust is visual data or aural data.

31. A vacuum cleaner according to claim 1, or a method according to either claim 10 or claim 25, and substantially as herein described with reference to the accompanying drawings.

LG ELECTRONICS

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Fig.1

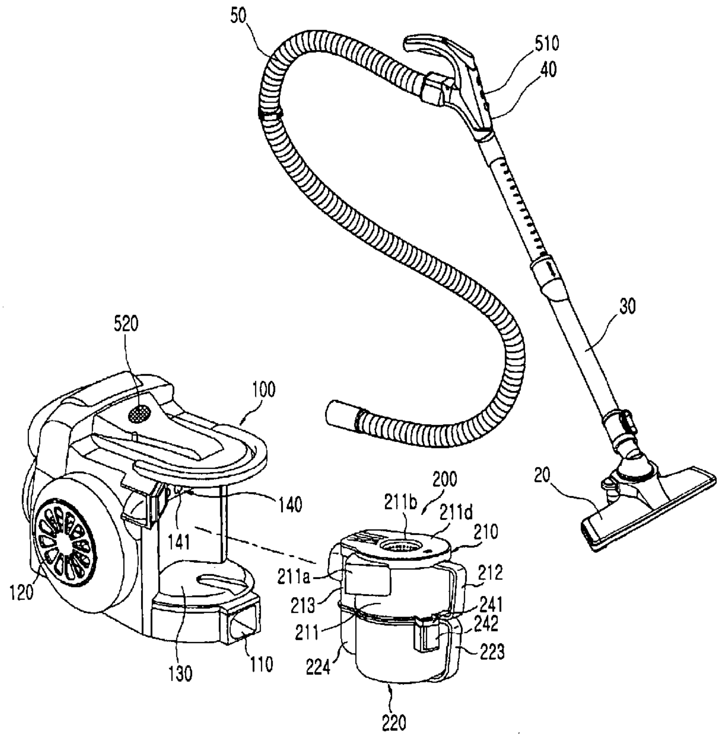

Fig.2

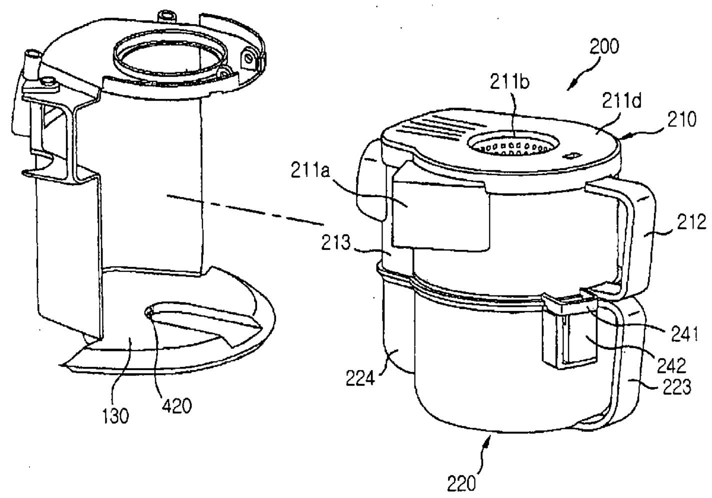

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Fig.3

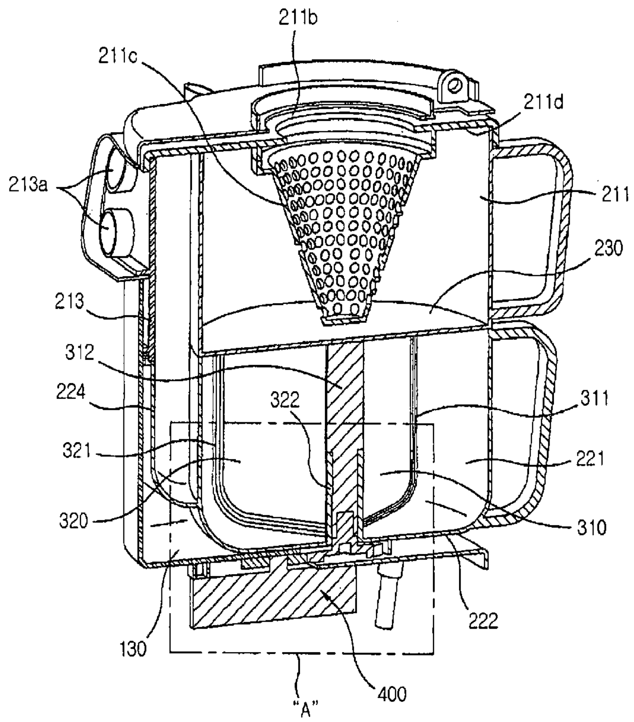

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Fig.4

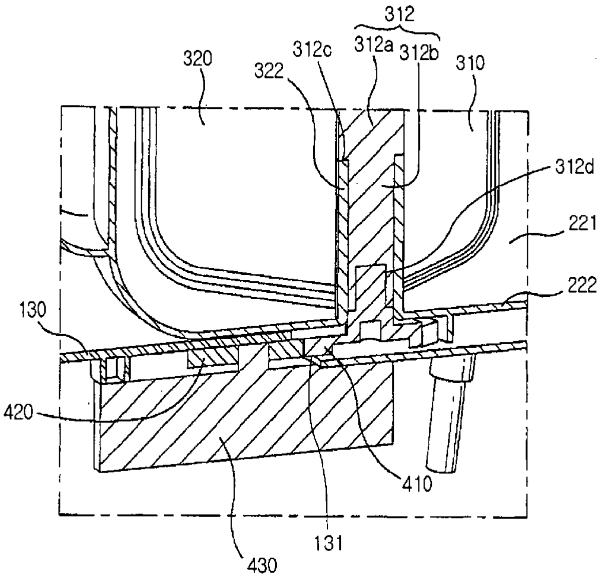

Fig.5

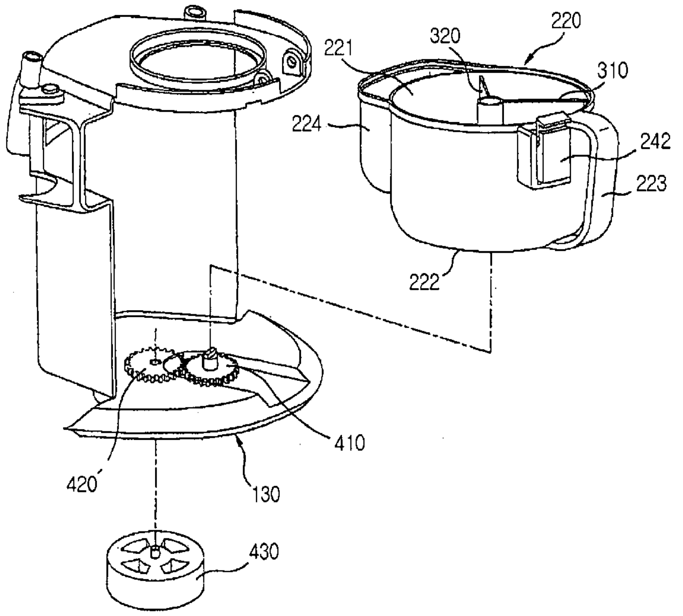

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Fig.6

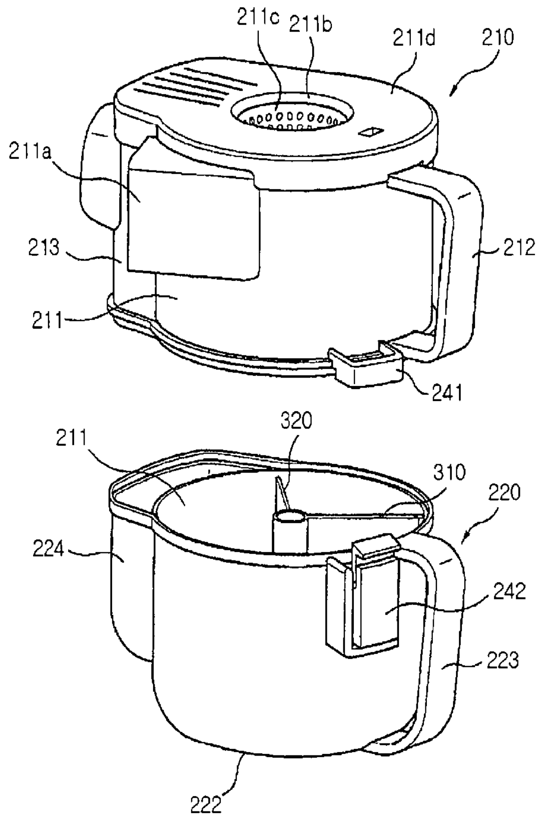

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Fig.7

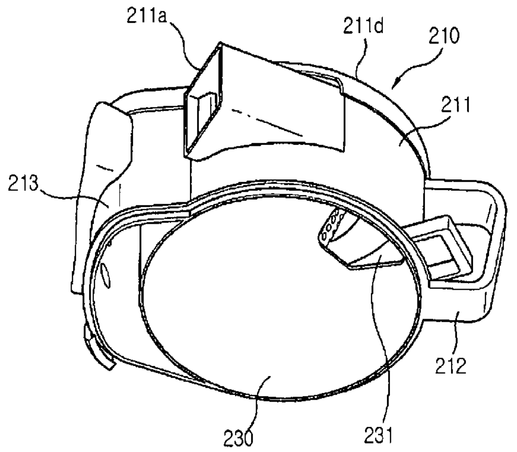

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Fig.8

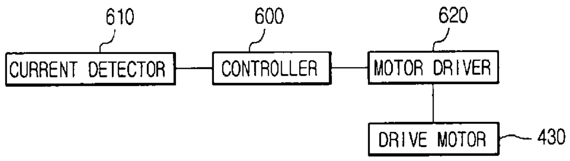

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Fig.9

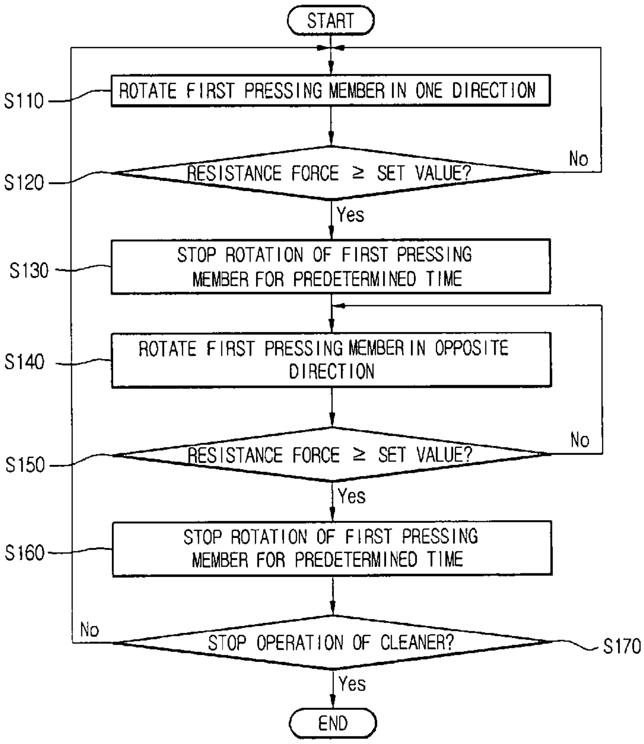
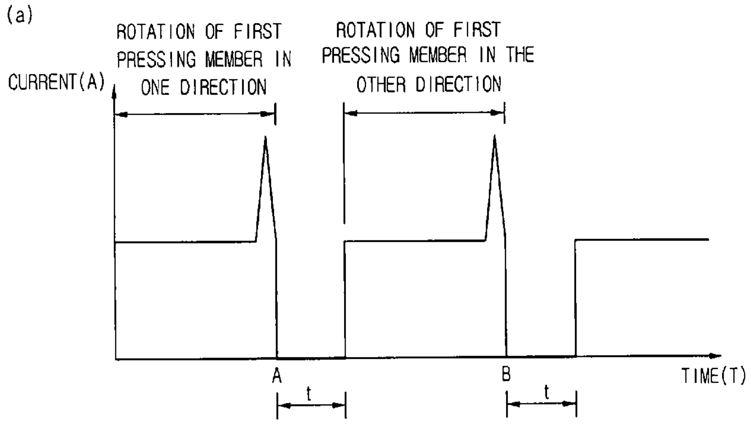


Fig.10

(a)


ROTATION OF FIRST PRESSING MEMBER IN ONE DIRECTION
ROTATION OF FIRST PRESSING MEMBER IN THE OTHER DIRECTION
CURRENT(A)
A
B
t
t
TIME(T)

(b)

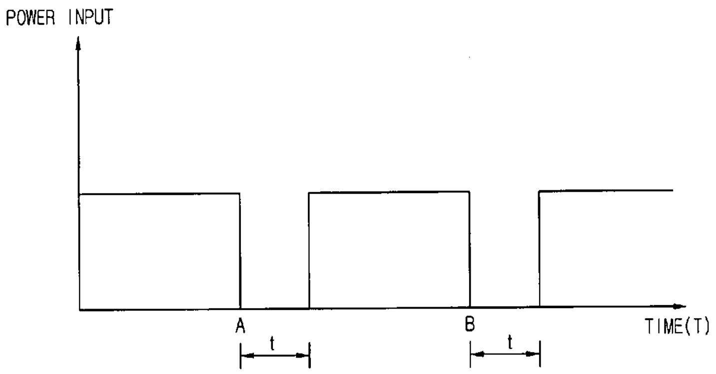

POWER INPUT
A
B
t
t
TIME(T)

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Fig.11

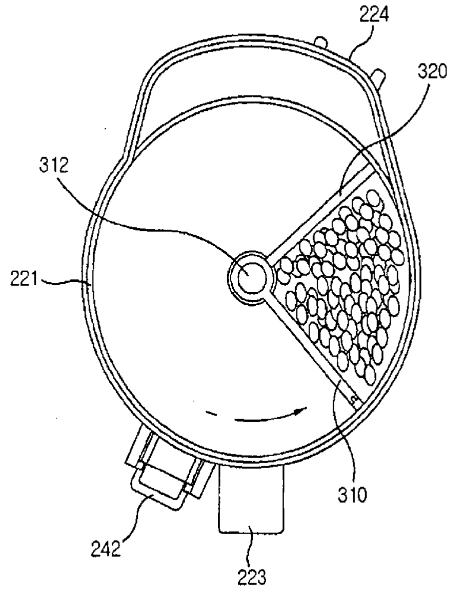

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Fig.12

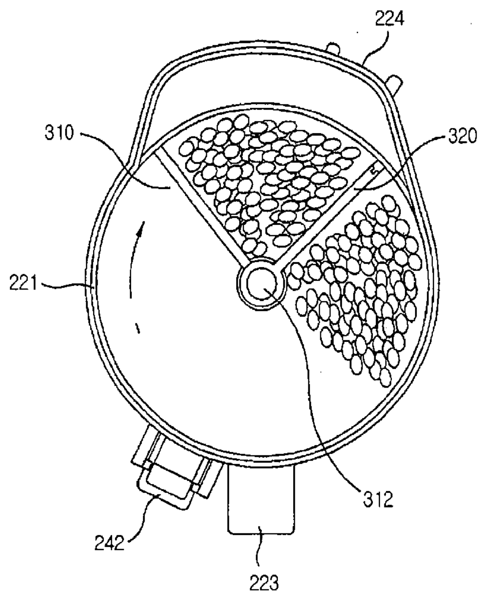

Fig.13

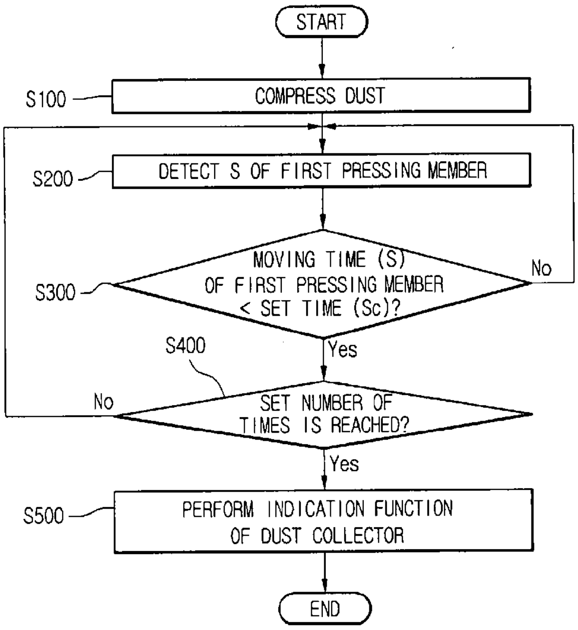
START
S100
COMPRESS DUST
S200
DETECT S OF FIRST PRESSING MEMBER
S300
MOVING TIME (S) OF FIRST PRESSING MEMBER < SET TIME (Sc)?
No
Yes
S400
SET NUMBER OF TIMES IS REACHED?
No
Yes
S500
PERFORM INDICATION FUNCTION OF DUST COLLECTOR
END

Fig.14

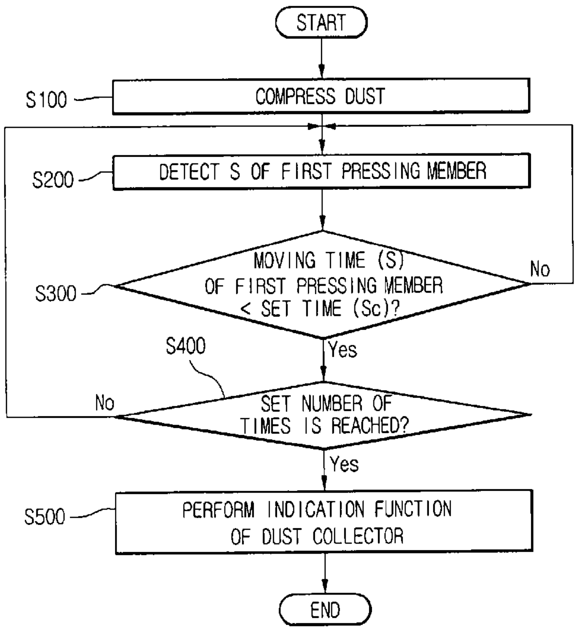
START
S100
COMPRESS DUST
S200
DETECT S OF FIRST PRESSING MEMBER
S300
MOVING TIME (S) OF FIRST PRESSING MEMBER < SET TIME (Sc)?
No
Yes
S400
No
SET NUMBER OF TIMES IS REACHED?
Yes
S500
PERFORM INDICATION FUNCTION OF DUST COLLECTOR
END

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Fig.15

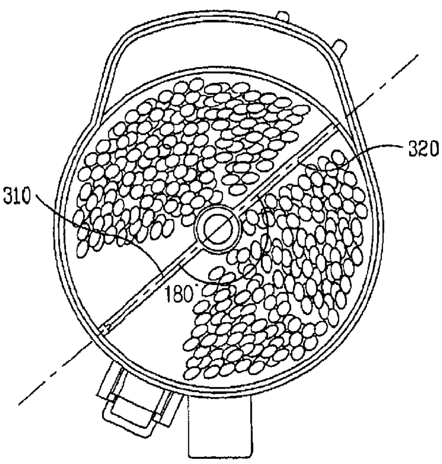

Fig.16

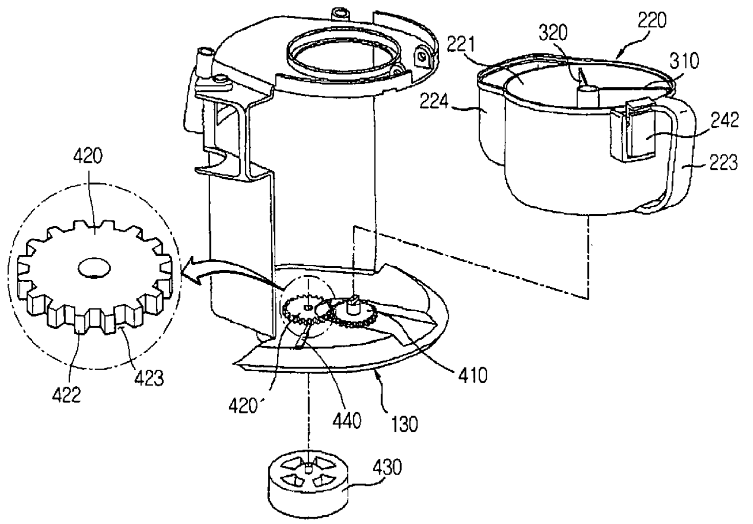

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Fig.17

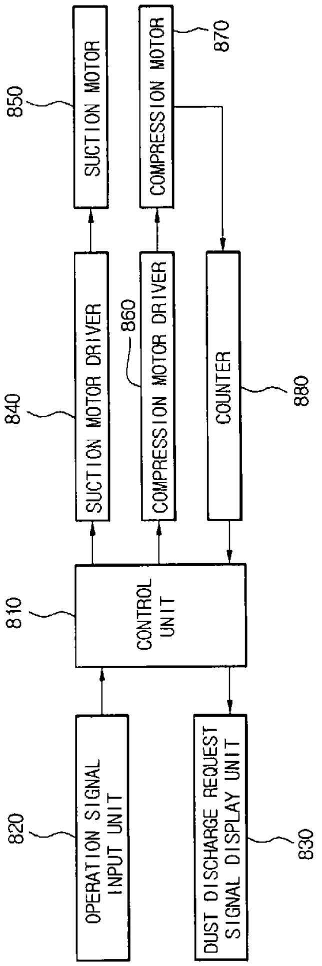

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Fig.18

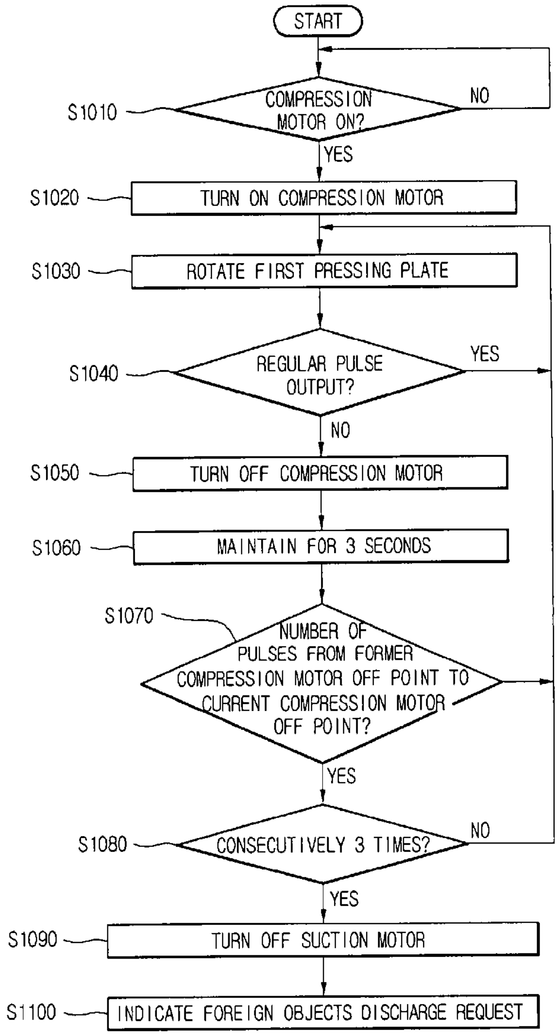

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Fig.19

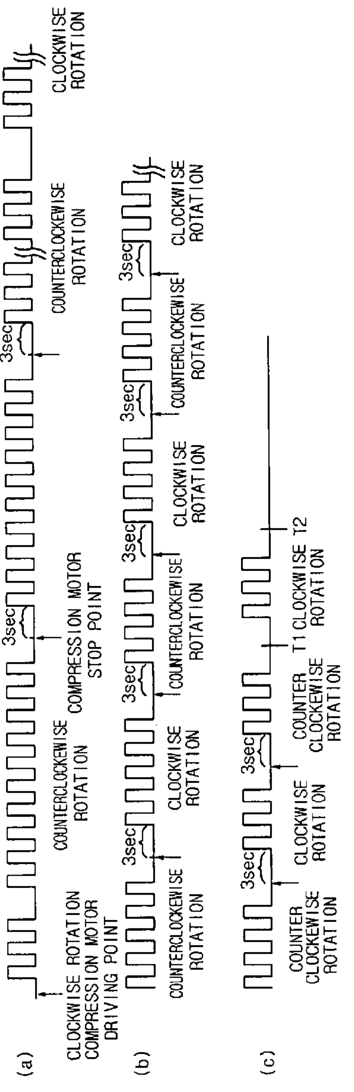

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Fig.20

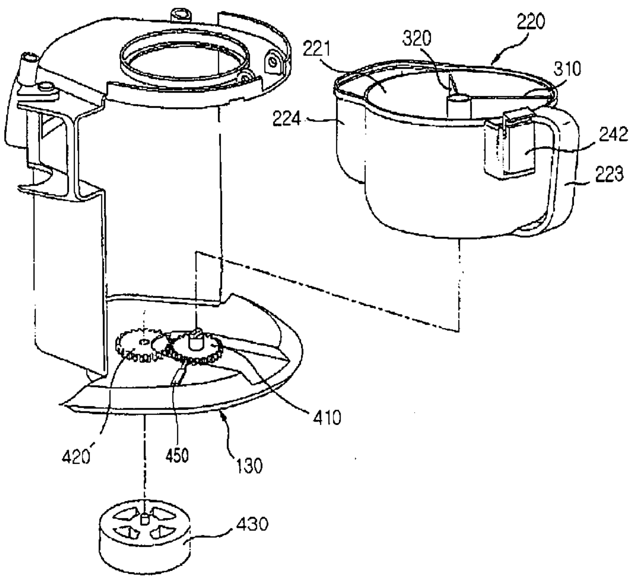

Fig.21

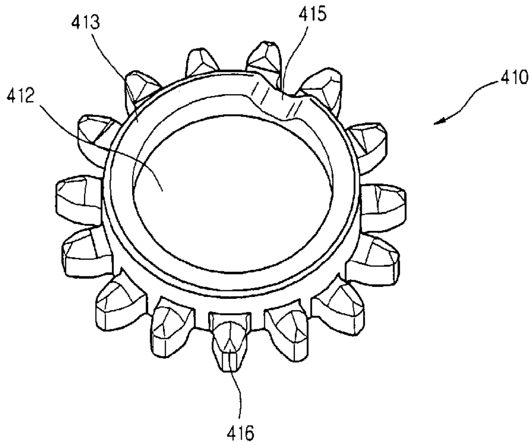

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Fig.22

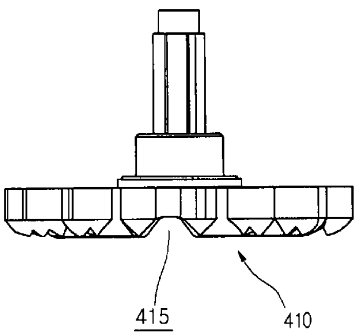

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Fig.23

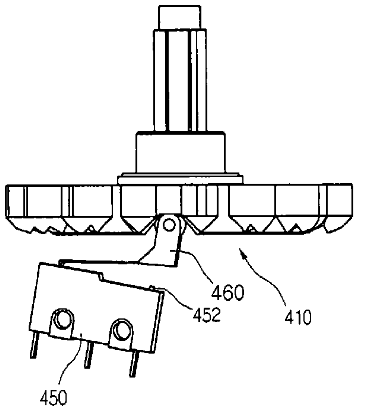

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Fig.24

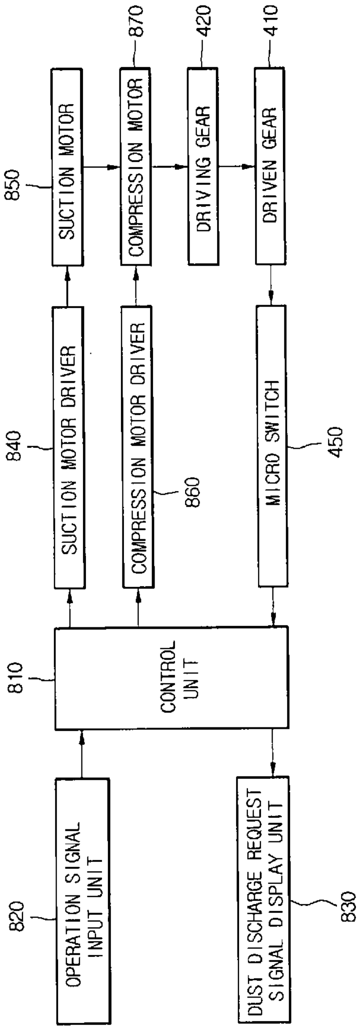

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Fig.25

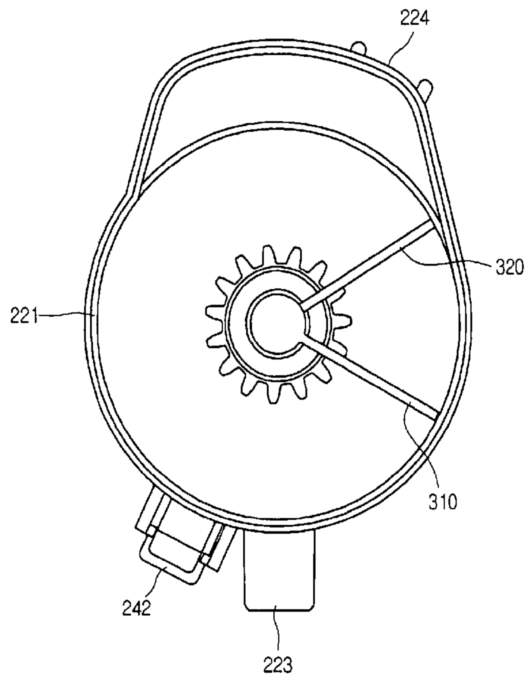

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Fig.26

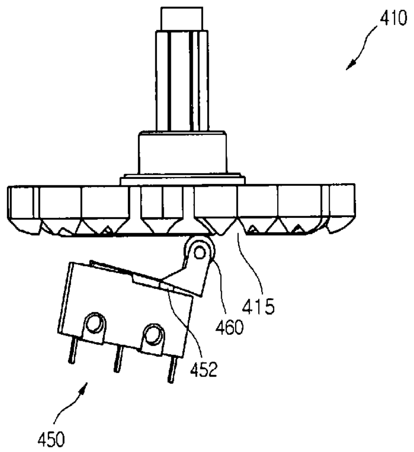

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Fig.27

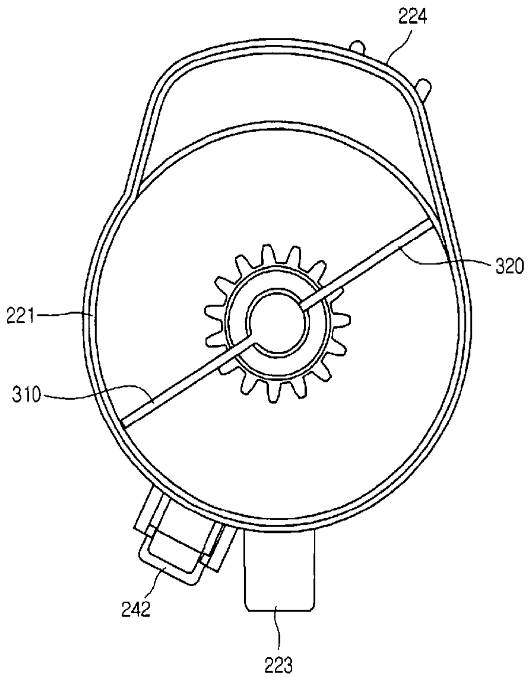

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Fig.28

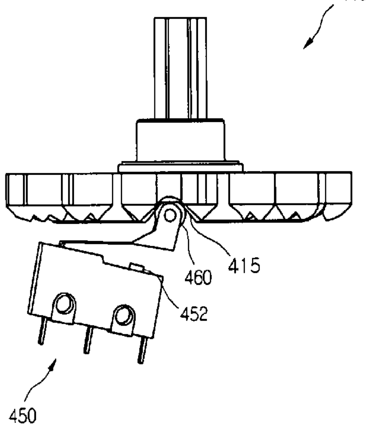

Fig.29

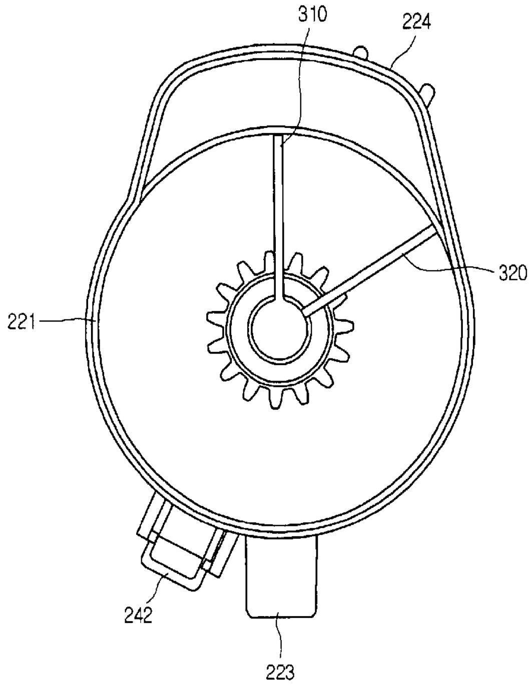

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Fig.30

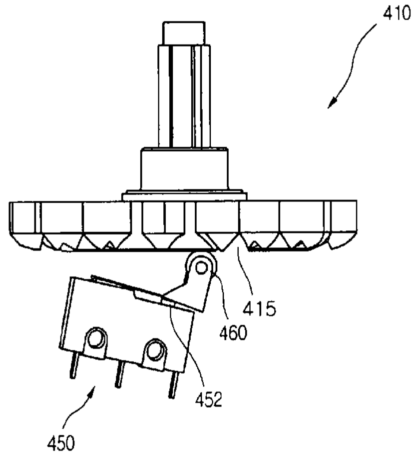


Fig.31

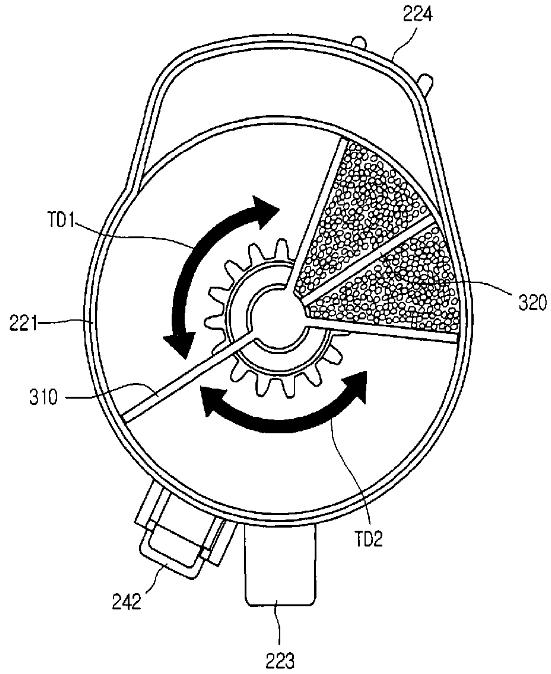
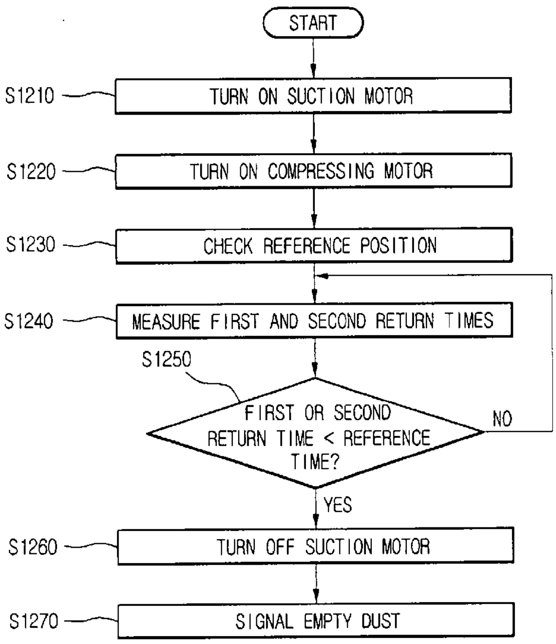


Fig.32


START
S1210
TURN ON SUCTION MOTOR
S1220
TURN ON COMPRESSING MOTOR
S1230
CHECK REFERENCE POSITION
S1240
MEASURE FIRST AND SECOND RETURN TIMES
S1250
FIRST OR SECOND RETURN TIME < REFERENCE TIME?
NO
YES
S1260
TURN OFF SUCTION MOTOR
S1270
SIGNAL EMPTY DUST