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(54) **VACUUM CLEANER**

STAUBSAUGER

ASPIRATEUR

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(73) Proprietor: **LG Electronics Inc.**
Seoul 150-721 (KR)

(72) Inventors:
- **YOO, Myung-Sig**
  Changwon-si
  Gyeongsangnam-do 641-711 (KR)
- **KWON, Hyuk-Min**
  Changwon City
  Gyoungsangnam-do 641-711 (KR)

(74) Representative: **Urner, Peter**
Ter Meer Steinmeister & Partner
Mauerkircherstrasse 45
81679 München (DE)

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Description

Technical Field

[0001] Embodiments relates to a vacuum cleaner.

Background Art

[0002] Generally, vacuum cleaners are used for sucking air and filtering dust from the air using a suction motor installed in a main body.

[0003] A vacuum cleaner includes a suction nozzle for sucking air and dust, a main body connected to the suction nozzle, an extension conduit for guiding air from the suction nozzle toward the main body, and a connection conduit connected between the extension conduit and the main body. A nozzle inlet having a predetermined size is formed on a lower portion of the suction nozzle for easily sucking air and dust from a floor.

[0004] A dust collector is detachably attached to the main body for collecting dust separated from air. In detail, the dust collector separates dust from air sucked through the suction nozzle and stores the separated dust.

[0005] US 2007/0143953 A1 describes a vacuum cleaner. Herein, a pair of pressing plates is provided in a dust collection body to reduce a volume of the dust stored in a main dust storing chamber. A first pressing plate may be a stationery plate fixed on a fixing shaft which is itself mounted on a bottom of the dust collection body. A second pressing plate may be a rotational plate fixed on a rotation shaft coupled to the fixing shaft. A driving gear is coupled to the rotation shaft, and the driving gear is rotated by a driving unit. For instance, the main body may be provided with a driving gear which is engaged with the driving gear when the dust collection body is mounted on the main body. A motor would then rotate the driving gear, and the driving gear would rotate the driving gear. With this type of an arrangement, when the motor is driven, the driving gear and the driving gear would rotate to rotate the rotational plate. The rotational plate could be rotated in two directions so as to compress the dust located on both sides of the stationery plate.

Disclosure of Invention

[0006] It is an object of the present invention to provide a vacuum cleaner, in which a driving unit can be easily repaired and replaced with a new one.

[0007] This object is solved by a vacuum cleaner according to claim 1. Further, advantages, refinements and embodiments of the invention are described in the respective sub-claims.

[0008] Embodiments provide a vacuum cleaner including a dust collector having an increased dust collecting capacity by compressing dust.

[0009] Embodiments also provide a vacuum cleaner in which dust can be removed from a dust collector without scattering the dust.

[0010] There is provided a vacuum cleaner including: a main body; a dust collector detachably attached to the main body and including a dust storage chamber; a pressing member compressing dust stored in the dust storage chamber; and a driving unit disposed at the dust collector for actuating the pressing member.

[0011] There is provided a vacuum cleaner including: a dust separation unit; a dust collection body in which a dust storage chamber is disposed for storing dust separated by the dust separation unit; a pressing member compressing dust stored in the dust storage chamber; a driving unit coupled to the dust collection body and actuating the pressing member; and a main body to which the dust collection body is detachably attached.

[0012] There is provided a vacuum cleaner including: a dust separation unit; a dust collection body in which a dust storage chamber is disposed for storing dust separated by the dust separation unit; a pressing member compressing dust stored in the dust storage chamber; and a driving unit disposed at the dust separation unit for actuating the pressing member.

[0013] There is provided a vacuum cleaner including: a dust separation unit; a dust collector in which a dust storage chamber is disposed for storing dust separated by the dust separation unit; a pressing member compressing dust stored in the dust storage chamber; and a driving unit disposed at an upper side of the dust storage chamber for actuating the pressing member.

[0014] There is provided a vacuum cleaner including: a dust collector including a dust separation unit and a dust storage chamber; a pressing member at the dust storage chamber for compressing dust stored in the dust storage chamber; a driving unit disposed at the dust collector for actuating the pressing member; and a terminal part connected to the driving unit, the terminal part transmitting power to the driving unit when connected to a power supply.

Advantageous Effects

[0015] According to the embodiments, the pressing member compresses dust stored in the dust collector so that the dust collecting capacity of the dust collector can be increased.

[0016] Furthermore, since the dust collecting capacity of the dust collect can be increased by compressing dust using the pressing member, the bothering job of removing dust from the dust collector can be performed less frequently.

[0017] Furthermore, since dust is stored in the dust collector in a compressed state, the dust is not readily scattered when the dust is removed from the dust collector.

[0018] Furthermore, the driving unit for actuating the pressing member can be detachably attached to the dust collector. Therefore, when cleaning the dust collector, the driving unit can be detached from the dust collector for protecting the driving unit from permeation of water.

[0019] In addition, when the driving unit is detached from the dust collector, the driving unit can be easily repaired and replaced with a new one.

Brief Description of the Drawings

[0020]

Fig. 1 is a perspective view illustrating a vacuum cleaner according to a first embodiment.
Fig. 2 is a perspective view illustrating the vacuum cleaner when a dust collector is detached from the vacuum cleaner.
Fig. 3 is a perspective view illustrating the dust collector according to the first embodiment.
Fig. 4 is a sectional view taken along line I-I' of Fig. 3.
Fig. 5 is a perspective view illustrating a dust collector mount according to the first embodiment.
Fig. 6 is a vertical sectional view illustrating the vacuum cleaner according to the first embodiment.
Fig. 7 is a vertical sectional view illustrating a dust collector according to a second embodiment.
Fig. 8 is a sectional view taken along line II-II' of Fig. 7.
Fig. 9 is a vertical sectional view illustrating a dust collector according to a third embodiment.
Fig. 10 is a perspective view illustrating a vacuum cleaner when a dust collector is detached from the vacuum cleaner according to a fourth embodiment.
Fig. 11 is an exploded perspective view illustrating the dust collector according to the fourth embodiment.
Fig. 12 is a sectional view taken along line III-III' of Fig. 10.
Fig. 13 is a perspective view illustrating a vacuum cleaner when a dust collector is detached from the vacuum cleaner according to a fifth embodiment.
Fig. 14 is a perspective view illustrating the dust collector when a cover member is detached from the dust collector according to the fifth embodiment.
Fig. 15 is a vertical sectional view illustrating the dust collector according to the fifth embodiment.
Fig. 16 is a bottom view illustrating the dust collector according to the fifth embodiment.
Fig. 17 is a sectional view illustrating an upper structure of a dust collector mount of a main body of the vacuum cleaner according to the fifth embodiment.
Fig. 18 is a view for explaining how dust is compressed by pressing members in a dust storage chamber of the dust collector according to the fifth embodiment.
Fig. 19 is a sectional view illustrating a coupling structure between a dust collector and a driving unit according to a sixth embodiment.

Mode for the Invention

[0021] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

<First Embodiment>

[0022] Fig. 1 is a perspective view illustrating a vacuum cleaner 10 according to a first embodiment, Fig. 2 is a perspective view illustrating the vacuum cleaner 10 when a dust collector 200 is detached from the vacuum cleaner 10, and Fig. 3 is a perspective view illustrating the dust collector 200 according to the first embodiment.

[0023] Referring to Figs. 1 to 3, the vacuum cleaner 10 of the current embodiment includes a main body 100 and a dust separation unit. A suction motor (not shown) is disposed in the main body 100 for generating a suction force. The dust separation unit separates dust from air sucked into the main body 100.

[0024] The vacuum cleaner 10 further includes a suction nozzle (not shown) for sucking air and dust and a connection unit (not shown) for connecting the suction nozzle to the main body 100. In the current embodiment, detailed descriptions of the suction nozzle and the connection unit will be omitted since the suction nozzle and the connection unit have similar or the same structures as those of the related art.

[0025] In detail, the main body 100 includes a main body inlet 110, a main body outlet (not shown), and main body grip 140. The main body inlet 110 is formed in a front lower portion of the main body 100, and air and dust sucked using the suction nozzle are introduced into the main body 100 through the main body inlet 110. After dust is separated from air, the air is discharged from the main body 100 through the main body outlet. The main body grip 140 is formed on an upper portion of the main body 100 so that a user can easily carry the vacuum cleaner 10 using the main body grip 140.

[0026] Meanwhile, the dust separation unit includes a dust collector 200 and a second cyclone unit 300. The dust collector 200 includes a first cyclone unit 230 (refer to Fig. 4) for primarily separating dust from air, and the second cyclone unit 300 is disposed in the main body 100 for secondly separating dust from the air.

[0027] In detail, the dust collector 200 is detachably attached to a dust collector mount 170 formed at a front portion of the main body 100. To allow detachable mounting of the dust collector 200 on the main body 100, a hook lever 142 is disposed at the main body grip 140, and a hook tap 256 corresponding to the hook lever 142 is formed on the dust collector 200.

[0028] The first cyclone unit 230 of the dust collector 200 generates a cyclone for separating dust from air. The dust collector 200 further includes a dust collection body 210 in which a dust storage chamber is formed. Dust separated from air by the first cyclone unit 230 is stored in the dust storage chamber of the dust collection body 210.

[0029] As explained above, the dust collector 200 can be detachably installed in the main body 100. When the

dust collector 200 is installed in the main body 100, the dust collector 200 communicates with the second cyclone unit 300 of the main body 100.

[0030] In detail, an air outlet 130 is formed in the main body 100, and a first air inlet 218 is formed in the dust collector 200. Air sucked into the main body 100 is discharged to the dust collector 200 through the air outlet 130 and the first air inlet 218.

[0031] In addition, a first air outlet 252 is formed in the dust collector 200 for discharging air from the dust collector 200 after dust is primarily separated from the air by the first cyclone unit 230 of the dust collector 200, and a connection passage 114 is formed in the main body 100 for receiving the air discharged from the dust collector 200 through the first air outlet 252.

[0032] Air introduced into the main body 100 through the connection passage 114 is directed to the second cyclone unit 300. The second cyclone unit 300 includes a plurality of conical cyclones that are connected to each other. Dust separated from air by the second cyclone unit 300 is stored in the dust collector 200. For this, a dust inlet 254 is formed in the dust collector 200 to receive dust separated by the second cyclone unit 300, and then the dust is stored in the dust storage chamber of the dust collection body 210.

[0033] In detail, the dust storage chamber of the dust collection body 210 is divided into a first dust storage chamber 214 (refer to Fig. 4) and a second dust storage chamber 216 (refer to Fig. 4). Dust separated by the first cyclone unit 230 of the dust collector 200 is stored in the first dust storage chamber 214, and dust separated by the second cyclone unit 300 is stored in the second dust storage chamber 216.

[0034] Meanwhile, the dust collector 200 has a structure for reducing the volume of dust stored in the dust storage chamber.

[0035] Fig. 4 is a sectional view taken along line I-I' of Fig. 3, Fig. 5 is a perspective view illustrating the dust collector mount 170 according to the first embodiment.

[0036] Referring to Figs. 4 and 5, the dust collector 200 includes the dust collection body 210 forming the exterior of the dust collector 200, the first cyclone unit 230 detachably attached to the inside of the dust collection body 210 for separating dust from sucked air, and a cover member 250 for selectively covering the top of the dust collection body 210.

[0037] In detail, the dust storage chamber is formed in the dust collection body 210 for storing dust separated from air. The dust storage chamber includes the first dust storage chamber 214 for storing dust separated by the first cyclone unit 230 of the dust collector 200, and the second dust storage chamber 216 for storing dust separated by the second cyclone unit 300.

[0038] The dust collection body 210 includes a first wall 211 for forming the first dust storage chamber 214 and a second wall 212 for forming the second dust storage chamber 216 in association with the first wall 211. The second wall 212 is formed around a portion of the first wall 211 such that the second dust storage chamber 216 is formed around the first dust storage chamber 214.

[0039] Meanwhile, the first cyclone unit 230 includes a dust guide passage 232 for easily discharging dust separated from air to the first dust storage chamber 214. Dust is introduced into the dust guide passage 232 in a tangential direction and is discharged downward from the dust guide passage 232. For this, an inlet 233 of the dust guide passage 232 is formed at a lateral portion of the first cyclone unit 230, and an outlet 234 of the dust guide passage 232 is formed at a lower portion of the first cyclone unit 230.

[0040] The cover member 250 is detachably attached to a top portion of the dust collection body 210. The first dust storage chamber 214 and the second dust storage chamber 216 can be both opened using the cover member 250. The first cyclone unit 230 is coupled to a lower portion of the cover member 250.

[0041] The cover member 250 includes a discharge hole 251 in a lower portion for discharging air from the first cyclone unit 230 after dust is separated from the air. A filter member 260 is attached to the lower portion of the cover member 250. The filter member 260 includes a plurality of penetration holes 262 in an outer surface. Therefore, air is discharged from the first cyclone unit 230 through the filter member 260 and the discharge hole 251 after dust is separated from the air in the first cyclone unit 230.

[0042] The cover member 250 further includes a passage 253 for guiding air discharged from the first cyclone unit 230 through the discharge hole 251 toward the first air outlet 252. That is, the passage 253 is formed between the discharge hole 251 and the first air outlet 252.

[0043] Meanwhile, a pair of pressing members 270 and 280 is disposed in the dust collection body 210 for compressing dust stored in the first dust storage chamber 214.

[0044] The pressing members 270 and 280 interlock with each other to compress dust for reducing the volume of the dust. The density of dust stored in the first dust storage chamber 214 can increase owing to the pressing members 270 and 280, and thus the dust collecting capacity of the dust collection body 210 can increase.

[0045] In the following description, the pressing member 270 will be also referred to as a first pressing member, and the pressing member 280 will be also referred to as a second pressing member for clarity.

[0046] In the current embodiment, at least one of the pressing members 270 and 280 is rotatable in the dust collection body 210 so as to compress dust disposed between the pressing members 270 and 280.

[0047] For example, when the pressing members 270 and 280 are rotatable in the dust collection body 210, the pressing members 270 and 280 can be rotated toward each other to reduce the distance between the pressing members 270 and 280 for compressing dust disposed between the pressing members 270 and 280.

[0048] In the current embodiment, the first pressing

member 270 is rotatable in the dust collection body 210, and the second pressing member 280 is fixed to the inside of the dust collection body 210. That is, the first pressing member 270 is a rotatable member, and the second pressing member 280 is a fixed member.

[0049] In detail, the second pressing member 280 can be disposed between a rotation shaft 272 and an inner surface of the dust collection body 210. Here, the shaft 271 is a rotation center of the first pressing member 270.

[0050] In other words, the second pressing member 280 can be disposed on a plane defined between an inner surface of the first dust storage chamber 214 and a centerline of the rotation shaft 272. The second pressing member 280 can partially or completely screen the space between the inner surface of the first dust storage chamber 214 and the rotation shaft 272. The second pressing member 280 is used together with the first pressing member 270 for compressing dust by rotating the first pressing member 270.

[0051] One side of the second pressing member 280 can be formed integral with the inner surface of the dust collection body 210, and the other side of the second pressing member 280 can be formed integral with a fixed shaft 282 that is coaxial with the rotation shaft 272.

[0052] Alternatively, only one side of the second pressing member 280 can be formed integral with the inner surface of the dust collection body 210, or only the other side of the second pressing member 280 can be formed integral with the fixed shaft 282. That is, the second pressing member 280 is fixed to at least one of the inner surface of the dust collection body 210 and the fixed shaft 282.

[0053] Although one side of the second pressing member 280 is not integral with the inner surface of the dust collection body 210, the side of the second pressing member 280 may be close to the inner surface of the dust collection body 210.

[0054] In addition, although the other side of the second pressing member 280 is not integral with the fixed shaft 282, the other side of the second pressing member 280 may be close to the fixed shaft 282.

[0055] In this case, dust pushed toward the second pressing member 280 by the first pressing member 270 does not readily escape through a gap formed at a lateral side of the second pressing member 280.

[0056] The pressing members 270 and 280 include rectangular plates, and the rotation shaft 272 of the first pressing member 270 may be coaxial with a centerline of the dust collection body 210.

[0057] Meanwhile, the fixed shaft 282 extends upward from a bottom surface of the dust collection body 210 and includes a hole 283 formed in an axial direction for coupling with the rotation shaft 272. The rotation shaft 272 can be coupled to the fixed shaft 282 by inserting a portion of the rotation shaft 272 into the hole 283 from the top of the hole 283.

[0058] In the current embodiment, the dust collector 200 can further include a driving unit 400 for rotating the first pressing member 270.

[0059] The driving unit 400 will now be described in detail.

[0060] The driving unit 400 is detachably attached to a predetermined portion of the dust collector 200. For example, the driving unit 400 can be detachably attached to a lower portion of the dust collector 200. When the driving unit 400 is attached to the dust collector 200, the driving unit 400 is connected to the first pressing member 270.

[0061] Since the driving unit 400 is attached to the dust collector 200, the driving unit 400 can be removed from the main body 100 by detaching the dust collector 200 from the main body 100.

[0062] The driving unit 400 includes a compression motor 410 for generating a driving force, a driving gear 430 for transmitting the driving force from the compression motor 410 to the first pressing member 270, and a motor housing 420 for accommodating the compression motor 410.

[0063] In detail, after disposing the compression motor 410 into the motor housing 420, the motor housing 420 is coupled to a coupling rib 290 formed on a lower portion of the dust collection body 210.

[0064] For this, a coupling protrusion 422 is formed on an outer surface of the motor housing 420, and a protrusion insertion hole 292 is formed in the coupling rib 290 for receiving the coupling protrusion 422.

[0065] The driving gear 430 is coupled to a shaft 412 of the compression motor 410. When the driving unit 400 is attached to the dust collector 200, the driving gear 430 is connected to a lower portion of the rotation shaft 272. A gear coupling portion 273 corresponding to the driving gear 430 is formed on the lower portion of the rotation shaft 272.

[0066] After the driving gear 430 is coupled to the rotation shaft 272, a coupling member 278 is inserted into the rotation shaft 272 from the top of the rotation shaft 272 for joining the driving gear 430 and the rotation shaft 272. The driving gear 430 functions as a power transmission member.

[0067] When the compression motor 410 rotates, the driving gear 430 connected to the compression motor 410 rotates. Therefore, the rotation shaft 272 can be rotated.

[0068] A terminal part 424 is formed at a side of the motor housing 420 and is connected to the compression motor 410. When the dust collector 200 is attached to the dust collector mount 170, the terminal part 424 is connected to a power supply terminal 174 formed on the dust collector mount 170. Therefore, power can be supplied to the compression motor 410 from the main body 100. In the current embodiment, power can be supplied to the compression motor 410 when the dust collector 200 is attached to the dust collector mount 170. In this case, the main body 100 functions as a power supply unit for the compression motor 410.

[0069] The compression motor 410 can rotate in a re-

verse direction. That is, the compression motor 410 may be a bidirectional motor capable of rotating in both directions.

[0070] In this case, the first pressing member 270 can be rotated forwardly and backwardly. Therefore, compressed dust can be deposited on both sides of the second pressing member 280 by rotating the first pressing member 270 forwardly and backwardly.

[0071] For example, a bidirectional synchronous motor can be used as the compression motor 410.

[0072] The synchronous motor can rotate in both directions without using an additional mechanism. When a force applied to the synchronous motor increases to a set value during rotation of the synchronous motor, the synchronous motor rotates in a reverse direction.

[0073] For example, when the first pressing member 270 compresses dust, a reaction torque is applied to the synchronous motor. If the reaction torque increases to a set value, the synchronous motor rotates in a reverse direction.

[0074] The synchronous motor is well kwon to those of skill in the related art. Thus, a detailed description of the synchronous motor will be omitted.

[0075] The compression motor 410 may continuously rotate the first pressing member 270 forward and backward at a predetermined angular velocity for facilitating compression of dust.

[0076] The dust collector mount 170 is formed on the main body 100 for receiving the dust collector 200. A mount recess 172 is formed in the dust collector mount 170 for receiving the driving unit 400 when the dust collector 200 is mounted on the dust collector mount 170. The power supply terminal 174 is formed at the mount recess 172 for selective connection to the terminal part 424 of the driving unit 400.

[0077] Fig. 6 is a vertical sectional view illustrating the vacuum cleaner 10 according to the first embodiment.

[0078] Referring to Fig. 6, the dust collector 200 is coupled to the main body 100 of the vacuum cleaner 10 at a predetermined angle. In other words, the bottom of the dust collector 200 makes a predetermined angle with a plane extending from a front side of the main body 100 to a rear side of the main body 100.

[0079] When the dust collector 200 is coupled to the main body 100, the second pressing member 280 formed in the dust collection body 210 is close to the main body 100. That is, the second pressing member 280 is disposed in a region of the first dust storage chamber 214 from which dust starts to settle.

[0080] Therefore, dust discharged downwards from the first cyclone unit 230 is accumulated on both sides of the second pressing member 280 since the dust collector 200 is inclined. In this case, much dust can be disposed between the first pressing member 270 and the second pressing member 280, and thus dust compression efficiency can increase.

[0081] An exemplary operation of the vacuum cleaner 10 will now be described in association with dust compression procedures with reference to Figs. 1 to 6.

[0082] For cleaning desired areas or things, the dust collector 200 is first mounted on the dust collector mount 170. Then, the terminal part 424 of the driving unit 400 can be connected to the power supply terminal 174 of the dust collector mount 170. Thus, power can be supplied to the driving unit 400 from the main body 100 of the vacuum cleaner 10.

[0083] Next, when powered on, the suction motor (not shown) operates to generate a suction force. Owing to the suction force generated by the suction motor, air and dust can be sucked through the suction nozzle (not shown). The air and dust is guided to the main body 100 through the main body inlet 110 and passes through a predetermined passage. Then, the air and dust enter the dust collector 200.

[0084] Specifically, in the dust collector 200, the air and dust enter the first cyclone unit 230 in a tangential direction through the first air inlet 218 of the dust collection body 210. In the first cyclone unit 230, the air and dust swirl down along the inner surface of the first cyclone unit 230. While swirling down in the first cyclone unit 230, the air and the dust are separated since different centrifugal forces are applied to the air and the dust due to different specific gravities.

[0085] Then, the air passes through the penetration holes 262 of the filter member 260 and is discharged from the dust collector 200 through the discharge hole 251 and the first air outlet 252.

[0086] Meanwhile, the dust is separated from the air while swirling down in the first cyclone unit 230 and enters the dust guide passage 232 in a tangential direction. In the dust guide passage 232, the moving direction of the dust is changed. Thereafter, the dust is discharged downward through the outlet 234 to the first dust storage chamber 214.

[0087] Meanwhile, the air discharged from the first cyclone unit 230 through the first air outlet 252 is introduced back to the main body 100. Thereafter, the air is discharged from the main body 100 to the second cyclone unit 300 through the connection passage 114.

[0088] In detail, the air is introduced into the second cyclone unit 300 through a second air inlet (not shown) connected to an end of the connection passage 114 in a tangential direction of the inner surface of the second cyclone unit 300. In the second cyclone unit 300, dust is secondly separated from the air.

[0089] Thereafter, the air is directed from the second cyclone unit 300 to the main body 100 where the air passes by the suction motor and is discharged to the outside of the vacuum cleaner 10. Meanwhile, the dust secondly separated from the air by the second cyclone unit 300 is directed to the dust collector 200 through the dust inlet 254 and is accumulated in the second dust storage chamber 216.

[0090] While the suction motor is driven to separate dust from air as described above, the driving unit 400 rotates the first pressing member 270 to compress dust

settled in the first dust storage chamber 214.

[0091] In detail, upon or after the operation of the suction motor, power is supplied to the compression motor 410 from the main body 100 to drive the compression motor 410. Then, the driving gear 430 transmits a driving force of the compression motor 410 to the first pressing member 270 to rotate the first pressing member 270 in a predetermined direction so as to compress dust.

[0092] While the first pressing member 270 compresses the dust, a reaction force is applied to the first pressing member 270. If the reaction force reaches or exceeds a preset value, the rotation of the compression motor 410 is reversed. In this case, the first pressing member 270 rotates in a reverse direction to compress the other side dust.

[0093] In this way, the first pressing member 270 compresses dust stored in the first dust storage chamber 214 while rotating in both directions.

[0094] When the suction motor stops, the compression motor 410 also stops.

[0095] In the current embodiment, dust can be compressed using the pressing members 270 and 280 to increase the dust collecting capacity of the dust collector 200. Furthermore, since dust is compressed in the dust collector 200, the possibility of floating or scattering of the dust reduces, and thus the dust can be easily removed from the dust collector 200.

[0096] In addition, since the driving unit 400 is detachably attached to the dust collector 200, the dust collector 200 can be washed after detaching the driving unit 400 for protecting the driving unit 400 from water permeation.

<Second Embodiment>

[0097] Fig. 7 is a vertical sectional view illustrating a dust collector 500 according to a second embodiment, and Fig. 8 is a sectional view taken along line II-II' of Fig. 7.

[0098] Referring to Figs. 7 and 8, in the current embodiment, a driving unit 600 is attached to a sidewall of the dust collector 500.

[0099] The dust collector 500 includes a cylindrical dust collection body 510 in which a dust storage chamber 511 is formed, and a pressing member 550 coupled to a sidewall of the dust collection body 510.

[0100] In detail, the dust collection body 510 includes a mount rib 512 on which a rotation shaft 552 of the pressing member 550 is placed. The mount rib 512 extends inwardly from the sidewall of the dust collection body 510. The mount rib 512 can have a semi-circular shape, and the rotation shaft 552 includes a mount groove 555 for receiving the mount rib 512.

[0101] The centerline of the rotation shaft 552 of the pressing member 550 makes a predetermined angle with a vertical line of the dust collection body 510. For example, the centerline of the rotation shaft 552 can be perpendicular to the vertical line of the dust collection body 510.

[0102] In other words, the rotation shaft 552 of the pressing member 550 can be horizontally disposed in the dust collection body 510. In this case, the pressing member 550 rotates vertically on the horizontal rotation shaft 552. The rotation shaft 552 placed on the mount rib 512 is inserted through the sidewall of the dust collection body 510.

[0103] A motor shaft 612 of a compression motor 610 is coupled to an end of the rotation shaft 552 inserted through the sidewall of the dust collection body 510.

[0104] Alternatively, the motor shaft 612 of the compression motor 610 can be inserted through the sidewall of the dust collection body 510 and then be coupled to the rotation shaft 552.

[0105] The pressing member 550 includes a semi-circular pressing plate 554. Since the dust collection body 510 has a cylindrical shape, dust stored in the dust collection body 510 can be effectively compressed using the semi-circular pressing plate 554.

[0106] The shape of the pressing plate 554 can be changed according to the horizontal section of the dust collection body 510. For example, when the dust collection body 510 has a rectangular shape, the pressing plate 554 can be formed into a rectangular shape.

[0107] A compartment rib 514 is protruded from a bottom surface of the dust collection body 510 to divide the dust storage chamber 511. The compartment rib 514 is formed under the rotation shaft 552.

[0108] Meanwhile, the driving unit 600 includes a motor housing 620 and the compression motor 610. The motor housing 620 is coupled to the sidewall of the dust collection body 510, and the compression motor 610 is disposed in the motor housing 620.

[0109] When the driving unit 600 is coupled to the dust collection body 510, the motor shaft 612 of the compression motor 610 is coupled to the rotation shaft 552. A terminal part 662 is formed at the motor housing 620 for supplying power to the compression motor 610. The structure for supplying power to the compression motor 610 through the terminal part 662 is the same as that described in the first embodiment. Thus, a description thereof will be omitted.

[0110] It will now be described how dust is compressed in the dust collector 500.

[0111] When the compression motor 610 is powered on, the compression motor 610 rotates in a predetermined direction. Then, the pressing member 550 connected to the compression motor 610 is rotated in a predetermined direction (e.g., clockwise in Fig. 8). In this case, a space between the pressing member 550 and a right bottom surface of the dust storage chamber 511 is narrowed such that dust stored at the right side of the compartment rib 514 is compressed.

[0112] When a reaction force applied to the pressing member 550 reaches or exceeds a preset value, the compression motor 610 rotates reversely. Then, the pressing member 550 is rotated counterclockwise as shown in Fig. 8. In this case, a space between the pressing member 550 and a left bottom surface of the dust storage chamber

511 is narrowed such that dust stored at the left side of the compartment rib 514 is compressed. As explained above, the bottom surface of the dust storage chamber 511 functions as a fixed pressing member for compressing dust in interlocking with the pressing member 550. That is, although a fixed pressing member such as the second pressing member 280 of the first embodiment is not used in the current embodiment, dust can be effectively compressed since the bottom surface of the dust storage chamber 511 functions as a fixed pressing member.

[0113] Since the dust storage chamber 511 is divided by the compartment rib 514, dust stored in the dust storage chamber 511 may be not mixed while the dust is compressed by the pressing member 550.

<Third Embodiment>

[0114] Fig. 9 is a vertical sectional view illustrating a dust collector 700 according to a third embodiment.

[0115] Referring to Fig. 9, the dust collector 700 of the current embodiment includes a dust collection body 710, a compartment portion 711, and a cover member 730. The dust collection body 710 forms the exterior of the dust collector 700. The compartment wall 711 divides the inside area of the dust collection body 710 into a dust separation chamber 712 and a dust storage chamber 714. The cover member 730 is coupled to a top portion of the dust collection body 710.

[0116] A pressing member 750 is disposed in the dust storage chamber 714 to compress dust stored in the dust storage chamber 714. The pressing member 750 is connected to a driving unit 800 attached to a sidewall of the dust collection body 710.

[0117] In detail, a suction hole 715 is formed in a lower side of the compartment wall 711 to allow air to flow into the dust separation chamber 712. That is, air is introduced into the dust separation chamber 712 from a lower side. An air discharge hole 717 is formed in a bottom center portion of the dust separation chamber 712 to discharge air after dust is separated from the air. A discharge pipe 716 having a predetermined height is disposed at the air discharge hole 717.

[0118] The discharge pipe 716 is vertically disposed in the dust separation chamber 712 such that air can be discharged from the dust separation chamber 712 in a direction parallel to a vertical centerline of the dust collection body 710. A discharge passage 718 is formed under the dust separation chamber 712. Air discharged from the dust separation chamber 712 flows through the discharge passage 718.

[0119] A spiral flow guide 719 is disposed in the dust separation chamber 712 around the discharge pipe 716.

[0120] Owing to the flow guide 719, air introduced into the dust separation chamber 712 through the lower suction hole 715 can swirl upward to the cover member 730.

[0121] A transportation passage 713 is formed between the compartment wall 711 and the cover member 730 to allow dust separated at the dust separation chamber 712 to flow to the dust storage chamber 714.

[0122] A mount rib 720 is formed on an inner surface of the dust storage chamber 714. A rotation shaft 752 of the pressing member 750 is placed on the mount rib 720. The mount rib 720 can have a semi-circular shape. A mount groove 755 is formed in the rotation shaft 752 for receiving the mount rib 720.

[0123] The centerline of the rotation shaft 752 of the pressing member 750 makes a predetermined angle with a vertical line of the dust storage chamber 714. For example, the centerline of the rotation shaft 752 can be perpendicular to the vertical line of the dust storage chamber 714.

[0124] In other words, the rotation shaft 752 of the pressing member 750 can be horizontally disposed in the dust storage chamber 714. The rotation shaft 752 placed on the mount rib 720 is inserted through the sidewall of the dust collection body 710.

[0125] A motor shaft 822 of a compression motor 820 is coupled to an end of the rotation shaft 752 inserted through the sidewall of the dust collection body 710.

[0126] The pressing member 750 includes a rectangular pressing plate 754. A compartment rib 721 is protruded from a bottom surface of the dust collection body 710 to divide the dust storage chamber 714. The compartment rib 721 is parallel with the rotation shaft 752.

[0127] Meanwhile, the driving unit 800 includes a motor housing 810 and the compression motor 820. The motor housing 810 is coupled to the sidewall of the dust collection body 710, and the compression motor 820 is disposed in the motor housing 810.

[0128] When the driving unit 800 is coupled to the dust collection body 710, the motor shaft 822 of the compression motor 820 is coupled to the rotation shaft 752. A terminal part 812 is formed at the motor housing 810 for supplying power to the compression motor 820. The structure for supplying power to the compression motor 820 through the terminal part 812 is the same as that described in the first embodiment. Thus, a detailed description thereof will be omitted.

[0129] Furthermore, since dust is compressed in the dust collector 700 in the same manner as in the second embodiment, a detailed description there of will be omitted.

[0130] In the current embodiment, the bottom surface of the dust storage chamber 714 functions as a fixed pressing member for compressing dust in interlocking with the pressing member 750. That is, although a fixed pressing member such as the second pressing member 280 of the first embodiment is not used in the current embodiment, dust can be effectively compressed since the bottom surface of the dust storage chamber 714 functions as a fixed pressing member.

<Fourth Embodiment>

[0131] Fig. 10 is a perspective view illustrating a vac-

uum cleaner 900 when a dust collector 1000 is detached from the vacuum cleaner 900 according to a fourth embodiment, and Fig. 11 is an exploded perspective view illustrating the dust collector 1000 according to the fourth embodiment. Fig. 12 is a sectional view taken along line III-III' of Fig. 10.

[0132] Referring to Figs. 10 to 12, the vacuum cleaner 900 of the current embodiment includes a main body 910 and the dust collector 1000. A suction motor (not shown) is disposed in the main body 910. The dust collector 1000 separates dust from sucked air and stores the separated dust.

[0133] In detail, a main body inlet 920 is formed in a front lower portion of the main body 910. Air and dust sucked through a suction nozzle (not shown) are introduced into the main body 910 through the main body inlet 920. A main body outlet 930 is formed at a side of the main body 910 for discharging air from the main body 910 after dust is separated from the air.

[0134] A dust collector mount 940 is formed above the main body inlet 920 for receiving the dust collector 1000, and an air outlet 950 is formed at a predetermined side of the dust collector mount 940 for allowing air introduced into the main body 910 through the main body inlet 920 to flow into the dust collector 1000.

[0135] The dust collector 1000 includes a dust separation unit 1010 for separating dust from sucked air, a dust collection body 1050 detachably coupled to the dust separation unit 1010 for storing the dust separated by the dust separation unit 1010, and an upper cover 1030 coupled to a top portion of the dust separation unit 1010.

[0136] In detail, the dust separation unit 1010 includes a cylindrical cyclone part 1011 for separating dust from sucked air using a cyclone. That is, the cyclone part 1011 separates air and dust by swirling the air and the dust to apply different centrifugal forces to the air and the dust.

[0137] An inlet 1012 is formed at an upper portion of the cyclone part 1011 for introducing air and dust into the cyclone part 1011. The inlet 1012 formed in a tangential direction of the cyclone part 1011 to generate a cyclone in the cyclone part 1011.

[0138] Meanwhile, a discharge hole 1032 is formed in a center portion of the upper cover 1030 for discharging air from the dust separation unit 1010 (i.e., from the cyclone part 1011) after dust is separated from the air. A filter member 1040 is attached to a rear side of the upper cover 1030. The filter member 1040 includes a plurality of penetration holes 1042 in an outer surface for discharging air from the cyclone part 1011. In detail, air is discharged from the cyclone part 1011 through the filter member 1040 and the discharge hole 1032 after dust is separated from the air in the cyclone part 1011.

[0139] A dust outlet 1018 is formed in a lower side of the dust separation unit 1010 for discharging separated dust.

[0140] Meanwhile, the dust collection body 1050 is coupled to a lower side of the dust separation unit 1010. A dust storage chamber 1055 is formed in the dust collection body 1050 for storing dust separated by the dust separation unit 1010.

[0141] An upper grip 1013 and a lower grip 1051 are formed on the dust separation unit 1010 and the dust collection body 1050, respectively. Thus, the dust separation unit 1010 and the dust collection body 1050 can be easily handled and carried using the grips 1013 and 1051.

[0142] The dust collector 1000 has a hook structure for coupling the dust separation unit 1010 and the dust collection body 1050. For example, a hook ring 1014 can be formed on a lower outer surface of the dust separation unit 1010, and a hook latch 1053 corresponding to the hook ring 1014 can be formed on an upper outer surface of the dust collection body 1050.

[0143] First and second pressing members 1060 and 1070 are disposed in the dust collector 1000 for reducing the volume of dust stored in the dust storage chamber 1055 to increase the dust collecting capacity of the dust collector 1000.

[0144] In detail, the first pressing member 1060 is coupled to a lower side of the dust separation unit 1010, and the second pressing member 1070 is formed inside the dust collection body 1050. The first pressing member 1060 is rotated by a driving unit (described later in detail) for pressing dust against both sides of the second pressing member 1070.

[0145] The driving unit is disposed in the dust separation unit 1010 and connected to the first pressing member 1060. The driving unit includes a compression motor 1100 for generating a driving force and a driving gear 1110 for transmitting the driving force of the compression motor 1100 to the first pressing member 1060.

[0146] The compression motor 1100 is disposed in a motor accommodation part 1016 formed at a lower portion of the dust separation unit 1010. After the compression motor 1100 is disposed in the motor accommodation part 1016, a cover member 1020 closes the lower portion of the dust separation unit 1010.

[0147] The cover member 1020 is detachably coupled to the lower portion of the dust separation unit 1010 so that the compression motor 1100 can be easily repaired or replaced with a new one.

[0148] The cover member 1020 includes an opening 1022 to allow dust to fall from the dust outlet 1018 to the dust collection body 1050.

[0149] Meanwhile, the driving gear 1110 is connected between a motor shaft 1102 of the compression motor 1100 and a rotation shaft 1062 of the first pressing member 1060. That is, the driving gear 1110 functions as a power transmission member.

[0150] A gear joint portion 1063 is formed at an end of the rotation shaft 1062. The gear joint portion 1063 has a shape corresponding to the driving gear 1110. After the driving gear 1110 is coupled to the rotation shaft 1062, a fastening member 1064 is inserted from the bottom of the rotation shaft 1062 to fasten the rotation shaft 1062 and the driving gear 1110 together.

[0151] A terminal part 1124 is formed at a side portion of the dust separation unit 1010. The terminal part 1124 is connected to the compression motor 1100 through a connector 1122. When the dust collector 1000 is mounted on the dust collector mount 940, the terminal part 1124 is connected to a power supply terminal 942 formed at the dust collector mount 940. The dust collector 1000 compresses dust in the same manner as those described in the previous embodiments. Thus, a detailed description thereof will be omitted.

[0152] As explained above, the dust separation unit 1010 and the dust collection body 1050 are detachably coupled to each other, and the compression motor 1100 is disposed at the dust separation unit 1010. In this case, the weight of the dust collection body 1050 can be reduced so that dust stored in the dust collection body 1050 can be easily removed.

<Fifth Embodiment>

[0153] Fig. 13 is a perspective view illustrating a vacuum cleaner 1200 when a dust collector 1300 is detached from the vacuum cleaner 1200 according to a fifth embodiment.

[0154] Referring to Fig. 13, the vacuum cleaner 1200 of the current embodiment includes a main body 1210 and the dust collector 1300. A suction motor (not shown) is disposed in the main body 1210 for generating a suction force. The dust collector 1300 separates dust from air sucked into the main body 1210 and stores the separated dust.

[0155] The vacuum cleaner 1200 further includes a suction nozzle 1214 for sucking air and dust, a handle 1211 for handling the suction nozzle 1214, an extension pipe 1212 for connecting the suction nozzle 1214 and the handle 1211, and a connection hose 1213 for connecting the handle 1211 and the main body 1210.

[0156] In the current embodiment, detailed descriptions of basic structures of the suction nozzle 1214, the extension pipe 1212, the handle 1211, and the connection hose 1213 will be omitted.

[0157] A main body inlet 1217 is formed in a front lower portion of the main body 1210 for introducing air and dust sucked through the suction nozzle 1214 into the main body 1210. Air and dust introduced through the main body inlet 1217 is directed to the dust collector 1300 for separating the dust from the air.

[0158] A dust collector mount 1216 is formed at the main body 1210 for receiving the dust collector 1300. An air outlet 1218 is formed in a bottom surface of the dust collector mount 1216 to allow air and dust introduced into the main body 1210 through the main body inlet 1217 to flow to the dust collector 1300.

[0159] The dust collector 1300 includes a dust collection body 1310 in which a dust storage chamber is formed, and a cover member 1330 for selectively closing and opening the top of the dust collection body 1310. A driving unit 1400 is disposed at the cover member 1330 for driving a pressing member (described later in detail) to compress dust stored in the dust storage chamber of the dust collection body 1310.

[0160] A guide 1219 is formed at the main body 1210 for guiding the driving unit 1400 when the dust collector 1300 is mounted on the main body 1210.

[0161] An exemplary structure of the dust collector 1300 will now be described in detail.

[0162] Fig. 14 is a perspective view illustrating the dust collector 1300 when the cover member 1330 is detached from the dust collector 1300 according to the fifth embodiment, and Fig. 15 is a vertical sectional view illustrating the dust collector 1300 according to the fifth embodiment. Fig. 16 is a bottom view illustrating the dust collector 1300 according to the fifth embodiment.

[0163] Referring to Figs. 14 to 16, the dust collector 1300 of the current embodiment includes the dust collection body 1310 forming the exterior of the dust collector 1300, a cyclone part 1321 disposed in the dust collection body 1310 for separating dust from sucked dust, and the cover member 1330 for selectively opening and closing the top of the dust collection body 1310.

[0164] In detail, the dust collection body 1310 can have a cylindrical shape. The cyclone part 1321 is formed at a center portion of the dust collection body 1310, and a dust storage chamber 1322 is formed in the dust collection body 1310 around the cyclone part 1321.

[0165] The dust collection body 1310 includes an outer wall 1311, an inner wall 1313, and a bottom wall 1312 to form the dust storage chamber 1322.

[0166] The cyclone part 1321 is a part in which dust is separated from air by a centrifugal force. The cyclone part 1321 is formed by the inner wall 1313 and the bottom wall 1312.

[0167] The inner wall 1313 may be lower than the outer wall 1311. In this case, a connection passage (P) can be formed to allow movement of separated dust from the cyclone part 1321 to the dust storage chamber 1322.

[0168] An inlet 1314 is formed in the bottom wall 1312 of the cyclone part 1321 to introduce air and dust introduced into the cyclone part 1321. An air outlet 1316 is formed in a center portion of the bottom wall 1312 of the cyclone part 1321 to discharge air from the cyclone part 1321 after dust is separated from the air, and a discharge pipe 1315 having a predetermined height is welded or bonded to the air outlet 1316.

[0169] An air inlet 1220 (refer to Fig. 13) corresponding to the air outlet 1316 is formed at the dust collector mount 1216 for introducing air discharged from the dust collector 1300 into the main body 1210.

[0170] The discharge pipe 1315 is vertically disposed in the cyclone part 1321 such that air can be discharged from the dust collection body 1310 in a direction parallel to the centerline of the dust collection body 1310 after dust is separated from the air.

[0171] The discharge pipe 1315 is lower than the inner wall 1313. In this case, air can be smoothly discharged through the discharge pipe 1315 after dust is separated

from the air.

[0172] The discharge pipe 1315 can be formed integrally with the bottom wall 1312 by molding. The discharge pipe 1315 can have various shapes such as a rectangular shape and a triangular shape, including a circular shape.

[0173] Owing to this structure, air can be discharged from the dust collector 1300 through the discharge pipe 1315 and the air outlet 1316 in the direction of arrow F2 after dust is separated from the air.

[0174] A spiral flow guide 1323 is disposed on the bottom wall 1312 around the discharge pipe 1315.

[0175] Owing to the flow guide 1323, air and dust introduced into the dust collection body 1310 through the inlet 1314 of the bottom wall 1312 can swirl upward toward the cover member 1330.

[0176] The flow guide 1323 can extend from the bottom wall 1312 of the dust collection body 1310. Alternatively, the flow guide 1323 can be prepared as a separate part and then be welded or bonded to the bottom wall 1312.

[0177] Meanwhile, since the dust storage chamber 1322 is formed around the cyclone part 1321, separation and storing of dust can be carried out at different places.

[0178] Therefore, for example, even when the vacuum cleaner 1200 is turned over and dust is discharged downward around the cover member 1330 during cleaning, reverse movement of dust from the dust storage chamber 1322 to the cyclone part 1321 can be prevented.

[0179] Furthermore, since separation and storing of dust are carried out at different places, the possibility of scattering or reverse movement of dust stored in the dust storage chamber 1322 can be reduced.

[0180] Meanwhile, both the cyclone part 1321 and the dust storage chamber 1322 can be opened and closed using the cover member 1330. Therefore, when the cover member 1330 is detached from the dust collection body 1310 to discharge dust stored in the dust storage chamber 1322, the top of the dust collection body 1310 can be completely opened. Then, dust can be easily removed from the dust storage chamber 1322 by holding or placing the dust collection body 1310 upside down.

[0181] Since both the inlet 1314 and the air outlet 1316 are formed in the bottom wall 1312, the structure of the dust collection body 1310 can be simple and neat.

[0182] Furthermore, since the discharge pipe 1315 is formed at the air outlet 1316 of the bottom wall 1312, dust remaining in the cyclone part 1321 is not readily discharged from the cyclone part 1321 through the air outlet 1316 even when the vacuum cleaner 1200 is unexpectedly turned over.

[0183] Meanwhile, a plurality of pressing members is included in the dust collector 1300 to compress dust stored in the dust storage chamber 1322 for increasing the dust collecting capacity of the dust collector 1300.

[0184] The pressing members include a first pressing member 1440 and a second pressing member 1450. The first pressing member 1440 is rotatably disposed in the dust storage chamber 1322, and the second pressing member 1450 is fixedly disposed in the dust storage chamber 1322. The driving unit 1400 rotates the first pressing member 1440.

[0185] In detail, the driving unit 1400 is coupled to the top of the cover member 1330, and a rotatable member 1430 is disposed at the bottom of the cover member 1330. The first pressing member 1440 is formed on the rotatable member 1430. The rotatable member 1430 is connected to the driving unit 1400 through a coupling part 1432.

[0186] In more detail, the driving unit 1400 includes a compression motor 1420 and a motor housing 1410 in which the compression motor 1420 is disposed.

[0187] After the compression motor 1420 is disposed in the motor housing 1410, the motor housing 1410 is coupled to coupling ribs 1332 formed on the top of the cover member 1330.

[0188] Coupling tabs 1412 are formed on an outer surface of the motor housing 1410, and tab insertion holes 1333 are formed in the coupling ribs 1332 for selectively receiving the coupling tabs 1412.

[0189] When the driving unit 1400 is coupled to the top of the cover member 1330, a m otor shaft 1422 of the compression motor 1420 is inserted into the cover member 1330, and the coupling part 1432 of the rotatable member 1430 is coupled to the motor shaft 1422 through the cover member 1330.

[0190] Therefore, when the compression motor 1420 rotates, the rotatable member 1430 connected to the compression motor 1420 is rotated. Thus, the first pressing member 1440 can be also rotated.

[0191] A terminal part 1414 is formed at a side of the compression motor 410 and is connected to the compression motor 1420. When the dust collector 1300 is mounted on the dust collector mount 1216, the terminal part 1414 is connected to a power supply terminal 1221 (refer to Fig. 17) formed at the dust collector mount 1216.

[0192] Meanwhile, the first pressing member 1440 extends downward from the rotatable member 1430 to a predetermined length. The first pressing member 1440 is spaced apart from a rotation centerline of the rotatable member 1430.

[0193] A plurality of first pressing members 1440 can be provided. The first pressing member 1440 may have a width smaller than the distance between the inner wall 1313 and the outer wall 1311 of the dust collection body 1310 so as to be disposed in the dust storage chamber 1322 of the dust collection body 1310 when the cover member 1330 is coupled to the dust collection body 1310.

[0194] The second pressing member 1450 extends upward from the bottom wall 1312 to a predetermined height and is located between the inner wall 1313 and the outer wall 1311. The second pressing member 1450 can be formed integrally with the inner wall 1313 or the outer wall 1311. A plurality of second pressing member 1450 can be provided. In this case, the number of the second pressing members 1450 may correspond to the number of the first pressing members 1440.

[0195] The first pressing member 1440 can extend downward close to the bottom wall 1312, and the second pressing member 1450 can extend upward close to the cover member 1330. In this case, dust can be effectively compressed by interaction between the first and second pressing members 1440 and 1450.

[0196] That is, the first and second pressing members 1440 and 1450 can be shaped to increase an overlapping area between the first and second pressing members 1440 and 1450 is

[0197] Meanwhile, when the cover member 1330 is coupled to the top of the dust collection body 1310, the connection passage (P) is formed between the cover member 1330 and the dust collection body 1310 to connect the cyclone part 1321 and the dust storage chamber 1322. A backflow restriction part 1434 is formed on the bottom surface of the rotatable member 1430 to screen a portion of the connection passage (P). The backflow restriction part 1434 has a circular shape and is located inside the first pressing member 1440.

[0198] When the cover member 1330 is coupled to the dust collection body 1310, the height of the backflow restriction part 1434 is smaller than the width of the connection passage (P) such that the backflow restriction part 1434 can screen the connection passage (P) partially to form a ring-shaped auxiliary passage (P1). Dust separated at the cyclone part 1321 can be discharged downward to the dust storage chamber 1322 through the auxiliary passage (P1).

[0199] The backflow restriction part 1434 has an outer diameter greater than that of the cyclone part 1321. Therefore, dust separated from air and moving in the direction of arrow (A) can be guided by the backflow restriction part 1434 down to the dust storage chamber 1322, but to the cyclone part 1321, through the auxiliary passage (P1) as indicated by arrow (C).

[0200] Owing to the downstream of the dust through the auxiliary passage (P1), a backflow of dust from the dust storage chamber 1322 to the cyclone part 1321 can be prevented.

[0201] Fig. 17 is a sectional view illustrating an upper structure of the dust collector mount 1216 of the main body 1210 according to the fifth embodiment.

[0202] Referring to Fig. 17, as explained above, the dust collector mount 1216 is formed at the main body 1210 for receiving the dust collector 1300. The guide 1219 is formed in the dust collector mount 1216 in a front-to-back direction to guide the dust collector 1300 when the dust collector 1300 is mounted on the dust collector mount 1216 of the main body 1210.

[0203] The power supply terminal 1221 is formed at a rear portion of the dust collector mount 1216. The power supply terminal 1221 can be selectively connected to the terminal part 1414 of the driving unit 1400. The power supply terminal 1221 is connected to a power supply (not shown) through a connection line 1222.

[0204] Fig. 18 is a view for explaining how dust is compressed by the pressing members 1440 and 1450 in the dust storage chamber 1322.

[0205] An exemplary operation of the vacuum cleaner vacuum cleaner 1200 will now be described in association with dust compression procedures with reference to Figs. 15 and 18.

[0206] Before starting cleaning, the dust collector 1300 is mounted on the dust collector mount 1216. Then, the terminal part 1414 of the driving unit 1400 is connected to the power supply terminal 1221 of the dust collector mount 1216.

[0207] Next, the suction motor (not shown) is powered on for sucking air and dust into the cyclone part 1321 through the inlet 1314. In the cyclone part 1321, the air and the dust can swirl upward to the cover member 1330 owing the flow guide 1323.

[0208] While the air and the dust swirl upward, the dust is separated from the air by a centrifugal force and is discharged from the cyclone part 1321 through the connection passage (P). The dust discharged through the connection passage (P) in the direction of arrow (A) collides with the backflow restriction part 1434. Then, the dust moves downward to the dust storage chamber 1322 through the auxiliary passage (P1) as indicated by arrow (C). Also, the dust discharged through the connection passage (P) can move down to the dust storage chamber 1322 through the auxiliary passage (P1) without colliding with the backflow restriction part 1434 as indicated by arrow (B).

[0209] At the same time or sequentially, a stream of air carrying the separated dust collides with the backflow restriction part 1434 as indicated by arrow (A) and moves down to the dust storage chamber 1322 through the auxiliary passage (P1) as indicated by arrow (C).

[0210] Owing to the air stream moving down to the dust storage chamber 1322, dust stored in the dust storage chamber 1322 can be prevented from rising to the cover member 1330.

[0211] After dust is separated from air, the air is discharged from the dust collector 1300 through the discharge pipe 1315 and the air outlet 1316 as indicated by arrow (F2). Then, the air discharged from the dust collector 1300 passes through a discharge filter and then is directed back to the main body 1210.

[0212] While dust is separated from air using a suction force generated by the suction motor, the driving unit 1400 rotates the first pressing member 1440 to compress dust stored in the dust storage chamber 1322.

[0213] In detail, the compression motor 1420 rotates the rotatable member 1430. Then, the first pressing member 1440 is rotated together with the rotatable member 1430 in a predetermined direction to compress dust.

[0214] While the first pressing member 1440 compresses the dust, a reaction force is applied to the first pressing member 1440. If the reaction force reaches or exceeds a preset value, the rotation of the compression motor 1420 is reversed. In this case, the first pressing member 1440 rotates in a reverse direction to compress the other side dust. In this way, the first pressing member

1440 compresses dust stored in the dust storage chamber 1322 while rotating in both directions.

[0215] The compression motor 1420 stops when the suction motor stops.

[0216] According to the above-described embodiments, the vacuum cleaner is characterized in that dust stored in the dust collector is compressed using the driving unit. That is, dust can be separated from air using a structure different from those described in the embodiments, and the dust collector can have a structure different from those described in the embodiments without departing from the spirit and scope of the present disclosure.

<Sixth Embodiment>

[0217] Fig. 19 is a sectional view illustrating a coupling structure between a dust collector 1600 and a driving unit 1700 according to a sixth embodiment.

[0218] Referring to Fig. 19, the dust collector 1600 of the current embodiment includes a dust collection body 1610 and a cover member 1620 selectively coupled to an upper side of the dust collection body 1610. The dust collection body 1610 of the current embodiment has the same structure as the dust collection body 1310 of the fifth embodiment. Thus, a detailed description thereof will be omitted.

[0219] The driving unit 1700 of the current embodiment includes a compression motor 1710 and power transmission members. The power transmission members transmit a driving force of the compression motor 1710 to a first pressing member 1640.

[0220] The power transmission members include a driving gear 1720 and a driven gear 1730. The driven gear 1730 is coupled to the first pressing member 1640, and the driving gear 1720 transmits power to the driven gear 1730. The driving gear 1720 is coupled to a motor shaft 1712 of the compression motor 1710 such that the driving gear 1720 can be rotated by the compression motor 1710.

[0221] In detail, a rotatable member 1630 is coupled to a bottom surface of the cover member 1620, and the first pressing member 1640 is formed on the rotatable member 1630. The rotatable member 1630 includes a coupling part 1632 extending upward through the cover member 1620. A spindle 1732 of the driven gear 1730 is coupled to the coupling part 1632.

[0222] A support rib 1622 is formed on the top of the cover member 1620 for supporting the driven gear 1730 and spacing the driven gear 1730 apart from the top of the cover member 1620.

[0223] Meanwhile, a dust collector mount 1510 is formed at a cleaner main body 1500, and the dust collector 1600 is mounted on the dust collector mount 1510.

[0224] The compression motor 1710 is disposed at the dust collector mount 1510, and the driving gear 1720 coupled to the compression motor 1710 is partially exposed to the dust collector mount 1510 from the cleaner main body 1500. For this, an opening 1520 is formed in the cleaner main body 1500 for partially exposing the periphery of the driving gear 1720 toward the dust collector mount 1510.

[0225] As explained above, the driven gear 1730 is disposed at the top of the dust collector 1600, and the driving gear 1720 is partially exposed from the cleaner main body 1500 to the dust collector mount 1510. Therefore, when the dust collector 1600 is mounted on the dust collector mount 1510, the driven gear 1730 can be engaged with the driving gear 1720.

Industrial Applicability

[0226] According to the embodiments, dust stored in the dust collector is compressed by the pressing member so that the dust collecting capacity of the dust collector can be increased. Thus, the industrilal applicability of the vacuum cleaner is high.

Claims

1. A vacuum cleaner comprising:

a main body (100, 910, 1210, 1500); and dust collector (200, 500, 700, 1000, 1300, 1600) detachably attached to the main body (100, 910, 1210, 1500) and including a dust storage chamber (214, 511, 714, 1055, 1322); wherein the dust collector (200, 500, 700, 1000, 1300, 1600) comprises
a pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) compressing dust stored in the dust storage chamber (214, 511, 714, 1055, 1322); and
a driving unit (400, 600, 800, 1400, 1700) disposed at the dust collector (200, 500, 700, 1000, 1300, 1600) for actuating the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640), **characterized in that**, the driving unit (400, 600, 800, 1400, 1700) comprises a compression motor (410, 610, 820, 110, 1420, 1710) configured to rotate the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) and the driving unit (400, 600, 800, 1400, 1700) is detachably coupled to the dust collector (200, 500, 700, 1000, 1300, 1600) and the driving unit (400, 600, 800, 1400, 1700) can be removed from the main body (100, 910, 1210, 1500) by detaching the dust collector (200, 500, 700, 1000, 1300, 1600) from the main body (100, 910, 1210, 1500).

2. The vacuum cleaner according to claim 1, wherein the driving unit (400, 600, 800, 1400, 1700) is disposed in the dust collector (200, 500, 700, 1000, 1300, 1600).

3. The vacuum cleaner according to claim 1, further comprising:

a power supply terminal (174, 942, 1221) provided at the main body (100, 910, 1210, 1500) for supplying power to the compression motor (410, 610, 820, 110, 1420, 1710); and
a terminal part (424, 662, 812, 1124, 1414) connected to the compression motor (410, 610, 820, 110, 1420, 1710), wherein when the dust collector (200, 500, 700, 1000, 1300, 1600) is attached to the main body (100, 910, 1210, 1500), the terminal part (424, 662, 812, 1124, 1414) is connected to the power supply terminal (174, 942, 1221).

4. The vacuum cleaner according to claim 1, wherein the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) is disposed in the dust storage chamber (214, 511, 714, 1055, 1322) and is bi-directionally rotatable.

5. The vacuum cleaner according to claim 4, wherein the dust collector (200, 500, 700, 1000, 1300, 1600) includes a dust collection body (210, 510, 710, 1050, 1310, 1610), the driving unit (400, 600, 800, 1400, 1700) is connected to a rotation shaft (272, 552, 752, 1062) of the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640), and the driving unit (400, 600, 800, 1400, 1700) or the rotation shaft (272, 552, 752, 1062) is inserted through the dust collection body (210, 510, 710, 1050, 1310, 1610).

6. The vacuum cleaner according to claim 5, wherein the dust storage chamber (214, 511, 714, 1055, 1322) comprises a compartment rib (514, 721) under a rotation shaft (272, 552, 752, 1062) of the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640).

7. The vacuum cleaner according to claim 1, wherein the dust collector (200, 500, 700, 1000, 1300, 1600) comprises a dust separation unit (1010) for separating dust in the air, and the driving unit (400, 600, 800, 1400, 1700) is provided in the dust separation unit (1010).

8. The vacuum cleaner according to claim 7, wherein the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) is connected to the driving unit (400, 600, 800, 1400, 1700) from under the dust separation unit (1010).

9. The vacuum cleaner according to claim 8, wherein the dust separation unit (1010) comprises:

an accommodation part (1016) accommodating the driving unit (400, 600, 800, 1400, 1700); and
a cover member (1020, 1330, 1620) covering the accommodation part (1016).

10. The vacuum cleaner according, to claim 1, wherein the dust collector (200, 500, 700, 1000, 1300, 1600) comprises
a dust separation unit (1010) for separating dust in the air; and
a cover member (1020, 1330, 1620) configured to open and close both the dust separation unit (1010) and the dust storage chamber (214, 511, 714, 1055, 1322), wherein the driving unit (400, 600, 800, 1400, 1700) is disposed at the cover member (1020, 1330, 1620).

11. The vacuum cleaner according to claim 10, further comprising a rotatable member (1430, 1630) disposed at a lower side of the cover member (1020, 1330, 1620) and rotatable by the driving unit (400, 600, 800, 1400, 1700), wherein the pressing member (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) extends downward from the rotatable member (1430, 1630).

12. The vacuum cleaner according to claim 11, wherein the rotatable member (1430, 1630) comprises a coupling part (1632) configured to join the rotatable member (1430, 1630) to the cover member (1020, 1330, 1620), and the coupling part (1632) or the driving unit (400, 600, 800, 1400, 1700) is inserted through the cover member (1020, 1330, 1620).

Patentansprüche

1. Staubsauger, der Folgendes umfasst:

einen Hauptkörper (100, 910, 1210, 1500); einen Staubsammler (200, 500, 700, 1000, 1300, 1600), der an dem Hauptkörper (100, 910, 1210, 1500) abnehmbar befestigt ist und eine Staubaufbewahrungskammer (214, 511, 714, 1055, 1322) enthält; wobei der Staubsammler (200, 500, 700, 1000, 1300, 1600) Folgendes umfasst:

ein Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640), das in der Staubaufbewahrungskammer (214, 511, 714, 1055, 1322) aufbewahrten Staub presst; und
eine Antriebseinheit (400, 600, 800, 1400, 1700), die bei dem Staubsammler (200, 500, 700, 1000, 1300, 1600) angeordnet ist, um das Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) zu betätigen, **dadurch gekennzeichnet, dass** die Antriebseinheit (400, 600, 800, 1400, 1700)

einen Kompressionsmotor (410, 610, 820, 110, 1420, 1710) umfasst, der ausgelegt ist, das Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) zu drehen, und wobei die Antriebseinheit (400, 600, 800, 1400, 1700) an dem Staubsammler (200, 500, 700, 1000, 1300, 1600) abnehmbar befestigt ist und wobei die Antriebseinheit (400, 600, 800, 1400, 1700) von dem Hauptkörper (100, 910, 1210, 1500) abgenommen werden kann, indem der Staubsammler (200, 500, 700, 1000, 1300, 1600) von dem Hauptkörper (100, 910, 1210, 1500) abgelöst wird.

2. Staubsauger nach Anspruch 1, wobei die Antriebseinheit (400, 600, 800, 1400, 1700) in dem Staubsammler (200, 500, 700, 1000, 1300, 1600) angeordnet ist.

3. Staubsauger nach Anspruch 1, der ferner Folgendes umfasst:

einen Leistungsversorgungsanschluss (174, 942, 1221), der an dem Hauptkörper (100, 910, 1210, 1500) vorgesehen ist, um den Kompressionsmotor (410, 610, 820, 110, 1420, 1710) mit Leistung zu versorgen; und
ein Anschlussbauteil (424, 662, 812, 1124, 1414), das mit dem Kompressionsmotor (410, 610, 820, 110, 1420, 1710) verbunden ist, wobei der Staubsammler (200, 500, 700, 1000, 1300, 1600) an dem Hauptkörper (100, 910, 1210, 1500) befestigt ist, wobei das Anschlussbauteil (424, 662, 812, 1124, 1414) mit dem Leistungsversorgungsanschluss (174, 942, 1221) verbunden ist.

4. Staubsauger nach Anspruch 1, wobei das Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) in der Staubaufbewahrungskammer (214, 511, 714, 1055, 1322) angeordnet ist und in zwei Richtungen gedreht werden kann.

5. Staubsauger nach Anspruch 4, wobei der Staubsammler (200, 500, 700, 1000, 1300, 1600) einen Staubsammelkörper (210, 510, 710, 1050, 1310, 1610) enthält, die Antriebseinheit (400, 600, 800, 1400, 1700) mit einer sich drehenden Welle (272, 552, 752, 1062) des Presselements (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) verbunden ist, und die Antriebseinheit (400, 600, 800, 1400, 1700) oder die sich drehende Welle (272, 552, 752, 1062) durch den Staubsammelkörper (210, 510, 710, 1050, 1310, 1610) eingesetzt werden.

6. Staubsauger nach Anspruch 5, wobei die Staubaufbewahrungskammer (214, 511, 714, 1055, 1322) eine Teilungsrippe (514, 712) unter einer sich drehenden Welle (272, 552, 752, 1062) des Presselements (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) umfasst.

7. Staubsauger nach Anspruch 1, wobei der Staubsammler (200, 500, 700, 1000, 1300, 1600) eine Staubtrenneinheit (1010) zum Trennen von Staub in der Luft umfasst, und wobei die Antriebseinheit (400, 600, 800, 1400, 1700) in der Staubtrenneinheit (1010) vorgesehen ist.

8. Staubsauger nach Anspruch 7, wobei das Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) mit der Antriebseinheit (400, 600, 800, 1400, 1700) von unterhalb der Staubtrenneinheit (1010) verbunden ist.

9. Staubsauger nach Anspruch 8, wobei die Staubtrenneinheit (1010) Folgendes umfasst:

ein Aufnahmebauteil (1016), das die Antriebseinheit (400, 600, 800, 1400, 1700) aufnimmt; und
ein Abdeckelement (1020, 1330, 1620), das das Aufnahmebauteil bedeckt.

10. Staubsauger nach Anspruch 1, wobei der Staubsammler (200, 500, 700, 1000, 1300, 1600) Folgendes umfasst:

eine Staubtrenneinheit (1010) zum Trennen von Staub in der Luft; und
ein Abdeckelement (1020, 1330, 1620), das ausgelegt ist, die Staubtrenneinheit (1010) und die Staubaufbewahrungskammer (214, 511, 714, 1055, 1322) zu öffnen und zu schließen, wobei die Antriebseinheit (400, 600, 800, 1400, 1700) an dem Abdeckelement (1020, 1330, 1620) angeordnet ist.

11. Staubsauger nach Anspruch 10, der ferner ein drehbares Element (1430, 1630) umfasst, das an einer unteren Seite des Abdeckelements (1020, 1330, 1620) angeordnet ist und durch die Antriebseinheit (400, 600, 800, 1400, 1700) gedreht werden kann, wobei sich das Presselement (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) von dem drehbaren Element (1430, 1630) abwärts erstreckt.

12. Staubsauger nach Anspruch 11, wobei das drehbare Element (1430, 1630) ein Verbindungsteil (1632) umfasst, das ausgelegt ist, das drehbare Element (1430, 1630) mit dem Abdeckelement (1020, 1330, 1620) zu verbinden, und wobei das Verbindungsteil (1632) oder die Antriebseinheit (400, 600, 800, 1400, 1700) durch das Abdeckelement (1020, 1330, 1620) eingesetzt werden.

Revendications

1. Aspirateur, comprenant :

   un corps principal (100, 910, 1210, 1500) et un collecteur de poussière (200, 500, 700, 1000, 1300, 1600) attaché de façon détachable sur le corps principal (100, 910, 1210, 1500) et incluant une chambre de stockage de poussière (214, 511, 714, 1055, 1322), dans lequel le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) comprend : un élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) qui comprime la poussière stockée dans la chambre de stockage de poussière (214, 511, 714, 1055, 1322), et
   une unité d'entraînement (400, 600, 800, 1400, 1700) disposée au niveau du collecteur de poussière (200, 500, 700, 1000, 1300, 1600) pour actionner l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640),
   caractérisé en ce que l'unité d'entraînement (400, 600, 800, 1400, 1700) comprend un moteur de compression (410, 610, 820, 110, 1420, 1710) configuré pour mettre en rotation l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) et l'unité d'entraînement (400, 600, 800, 1400, 1700) est couplée de manière détachable au collecteur de poussière (200, 500, 700, 1000, 1300, 1600), et l'unité d'entraînement (400, 600, 800, 1400, 1700) peut être enlevée du corps principal (100, 910, 1210, 1500) en détachant le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) depuis le corps principal (100, 910, 1210, 1500).

2. Aspirateur selon la revendication 1, dans lequel l'unité d'entraînement (400, 600, 800, 1400, 1700) est disposée dans le collecteur de poussière (200, 500, 700, 1000, 1300, 1600).

3. Aspirateur selon la revendication 1, comprenant en outre :

   une borne d'alimentation de puissance (174, 942, 1221) prévue au niveau du corps principal (100, 910, 1210, 1500) pour alimenter une puissance au moteur de compression (410, 610, 820, 110, 1420, 1710), et
   une partie formant borne (424, 662, 810, 1124, 1414) connectée au moteur de compression (410, 610, 820, 110, 1420, 1710), de sorte que quand le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) est attaché au corps principal (100, 910, 1210, 1500) la partie formant borne (424, 662, 812, 1124, 1414) est connectée à la borne d'alimentation de puissance (174, 942, 1221).

4. Aspirateur selon la revendication 1, dans lequel l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) est disposé dans la chambre de stockage de poussière (214, 511, 714, 1055, 1322) et est capable de rotation dans les deux directions.

5. Aspirateur selon la revendication 4, dans lequel le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) inclut un corps collecteur de poussière (210, 510, 710, 1050, 1310, 1610), l'unité d'entraînement (400, 600, 800, 1400, 1700) est connectée à un arbre de rotation (272, 552, 752, 1062) de l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640), et l'unité d'entraînement (400, 600, 800, 1400, 1700) ou l'arbre de rotation (272, 552, 752, 1062) est inséré(e) à travers le corps de collecte de poussière (210, 510, 710, 1050, 1310, 1610).

6. Aspirateur selon la revendication 5, dans lequel la chambre de stockage de poussière (210, 510, 714, 1055, 1322) comprend une nervure de compartiment (514, 721) sous un arbre de rotation (272, 552, 752, 1062) de l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640).

7. Aspirateur selon la revendication 1, dans lequel le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) comprend une unité de séparation de poussière (1010) pour séparer la poussière dans l'air, et l'unité d'entraînement (400, 600, 800, 1400, 1700) est prévue dans l'unité de séparation de poussière (1010).

8. Aspirateur selon la revendication 7, dans lequel l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) est connecté à l'unité d'entraînement (400, 600, 800, 1400, 1700) depuis le dessous de l'unité de séparation de poussière (1010).

9. Aspirateur selon la revendication 8, dans lequel l'unité de séparation de poussière (1010) comprend :

   une partie de logement (1016) qui loge l'unité d'entraînement (400, 600, 800, 1400, 1700), et un élément de couverture (1020, 1330, 1620) qui couvre la partie de logement (1016).

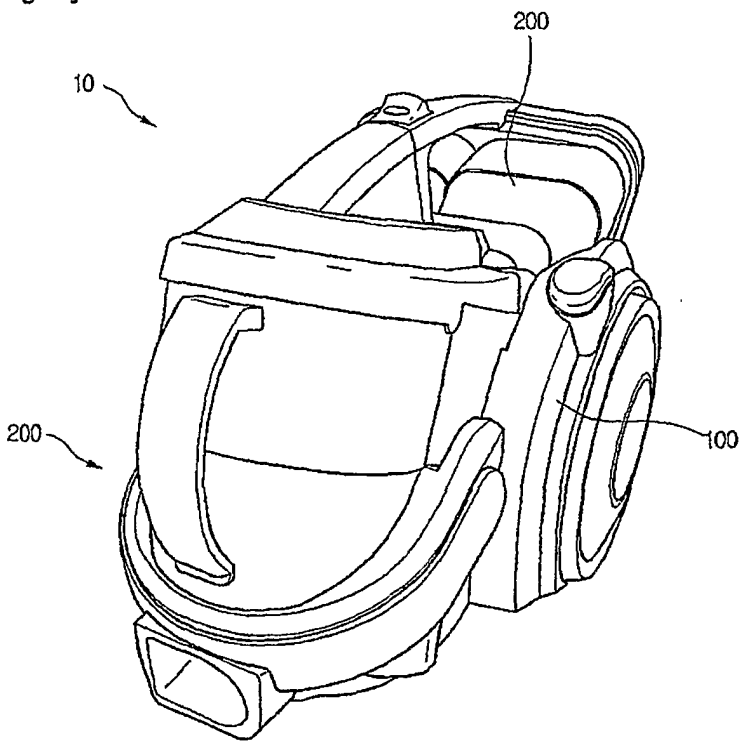
10. Aspirateur selon la revendication 1, dans lequel le collecteur de poussière (200, 500, 700, 1000, 1300, 1600) comprend
    une unité de séparation de poussière (1010) pour séparer les poussières dans l'air, et
    un élément de couverture (1020, 1330, 1620) configuré pour ouvrir et pour fermer à la fois l'unité de séparation de poussière (1010) et la chambre de stockage de poussière (214, 511, 714, 1055, 1322), et dans lequel l'unité d'entraînement (400, 600, 800, 1400, 1700) est disposée au niveau de l'élément de

couverture (1020, 1330, 1620).

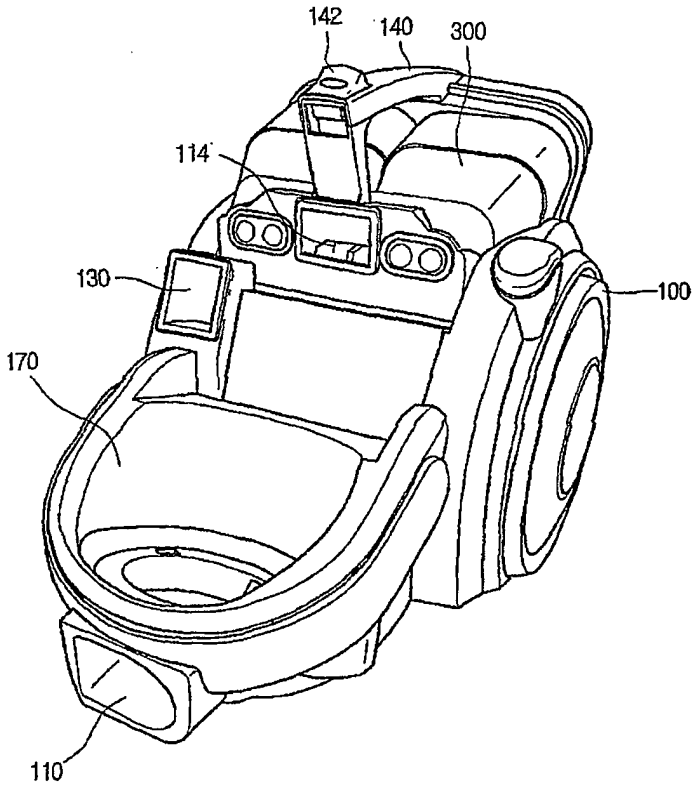
11. Aspirateur selon la revendication 10, comprenant en outre un élément rotatif (1430, 1630) disposé sur un côté inférieur de l'élément de couverture (1020, 1330, 1620) et mis en rotation par l'unité d'entraînement (400, 600, 800, 1400, 1700), dans lequel l'élément de pressage (270, 280, 550, 750, 1060, 1070, 1440, 1450, 1640) s'étend vers le bas depuis l'élément rotatif (1430, 1630).

12. Aspirateur selon la revendication 11, dans lequel l'élément rotatif (1430, 1630) comprend une partie de couplage (1632) configurée pour unir l'élément rotatif (1430, 1630) à l'élément de couverture (1020, 1330, 1620), et la partie de couplage (1632) ou l'unité d'entraînement (400, 600, 800, 1400, 1700) est insérée à travers l'élément de couverture (1020, 1330, 1620).

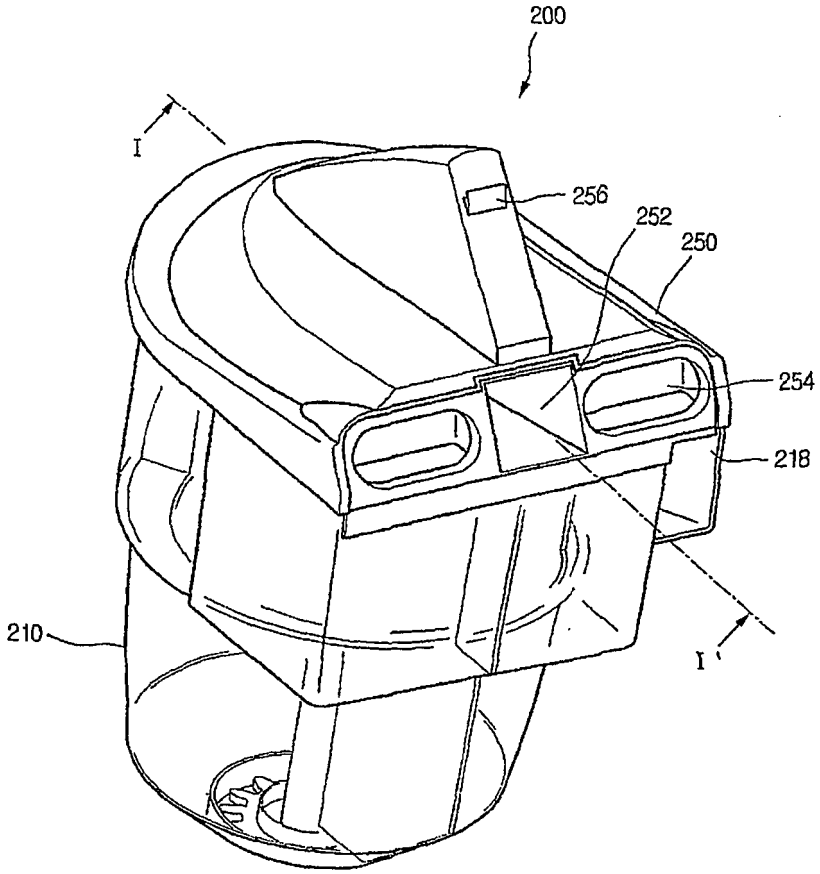
[Fig. 1]



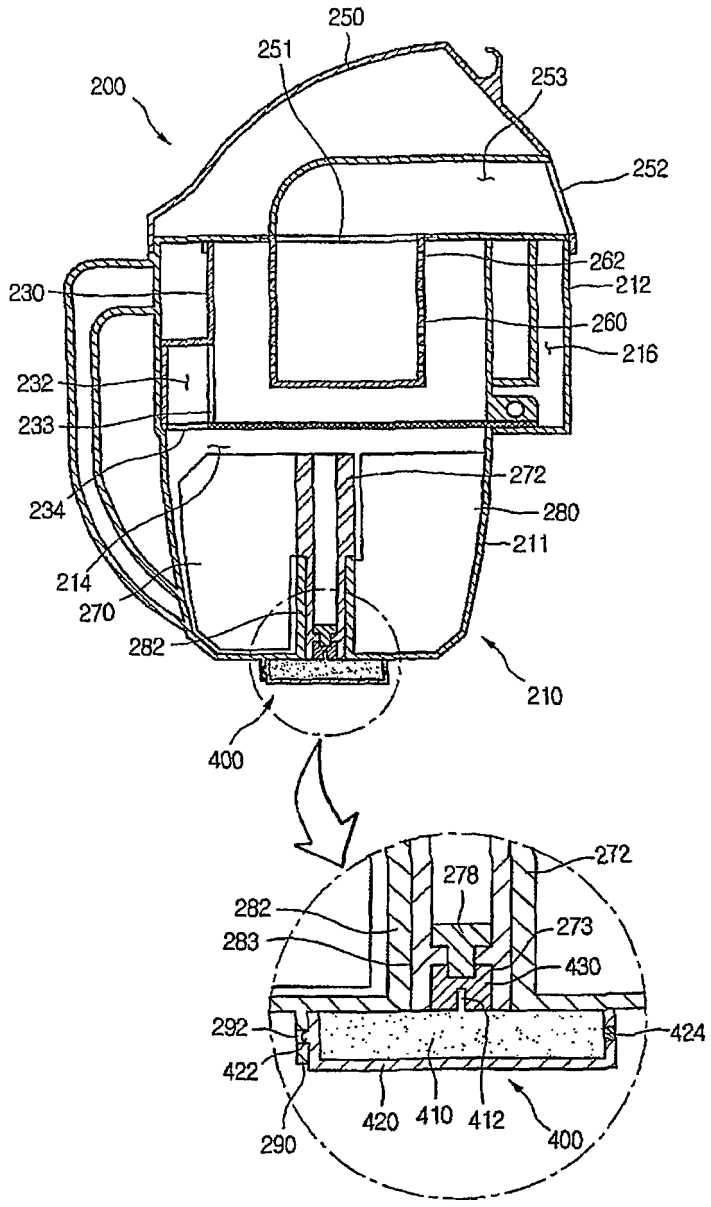
[Fig. 2]



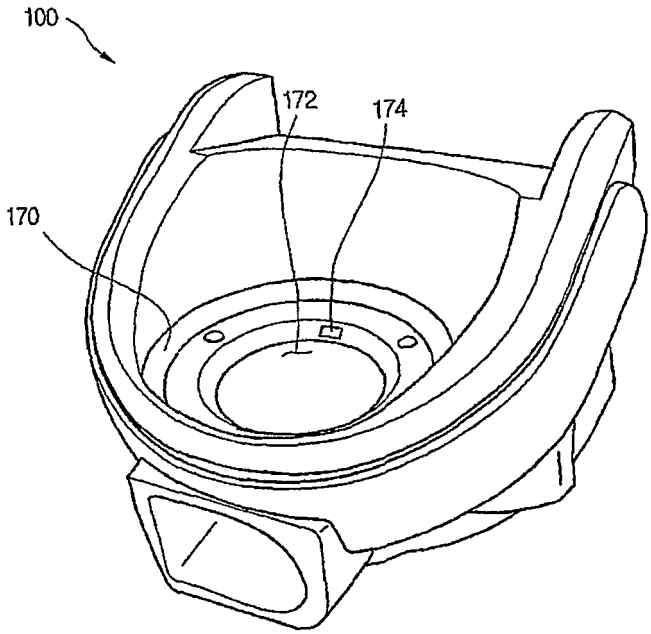
[Fig. 3]



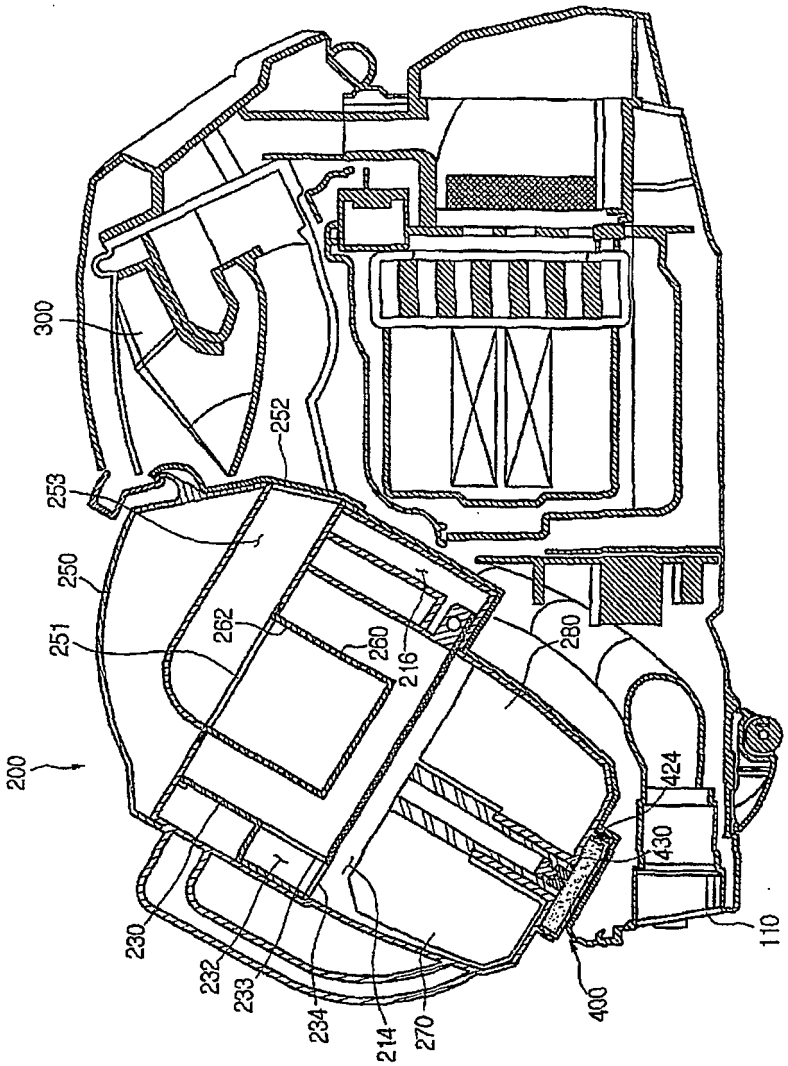
[Fig. 4]


250
251
200
253
252
262
212
230
260
216
232
233
272
280
234
211
214
270
282
210
400
272
278
282
273
283
430
292
424
422
420
410
412
290
400

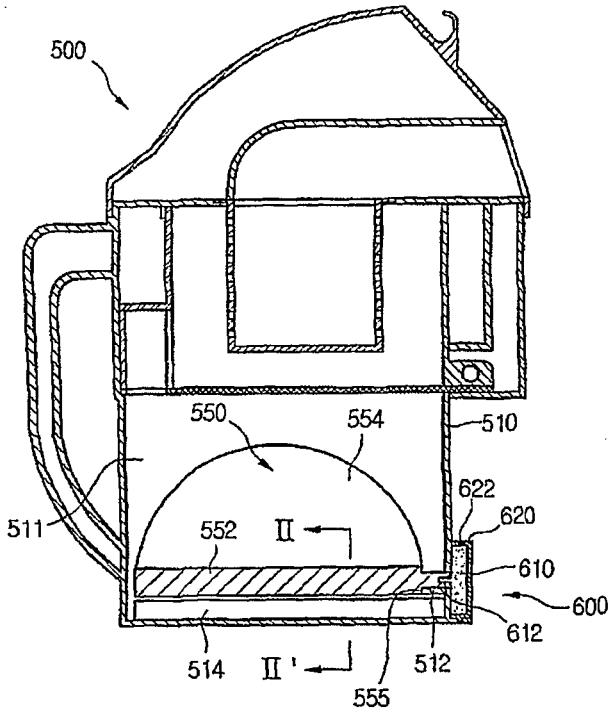
[Fig. 5]



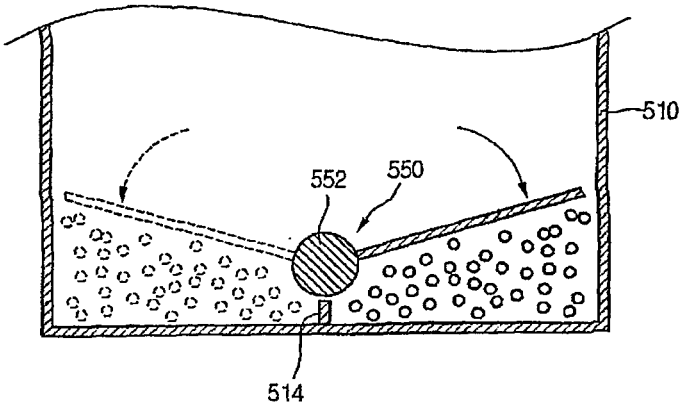
[Fig. 6]


300
252
253
250
251
262
260
216
280
200
424
430
110
230
232
233
234
214
270
400

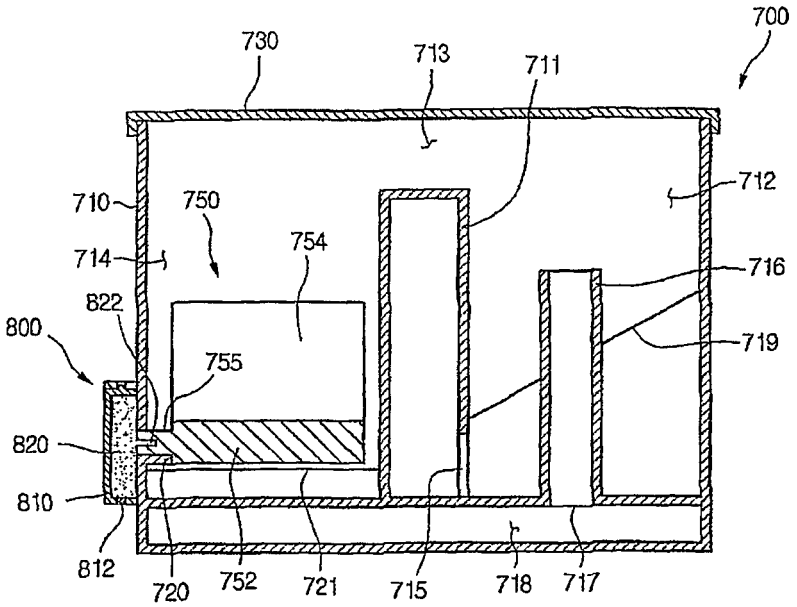
[Fig. 7]


500
550
554
510
622
620
511
552
II
610
600
612
514
II'
512
555

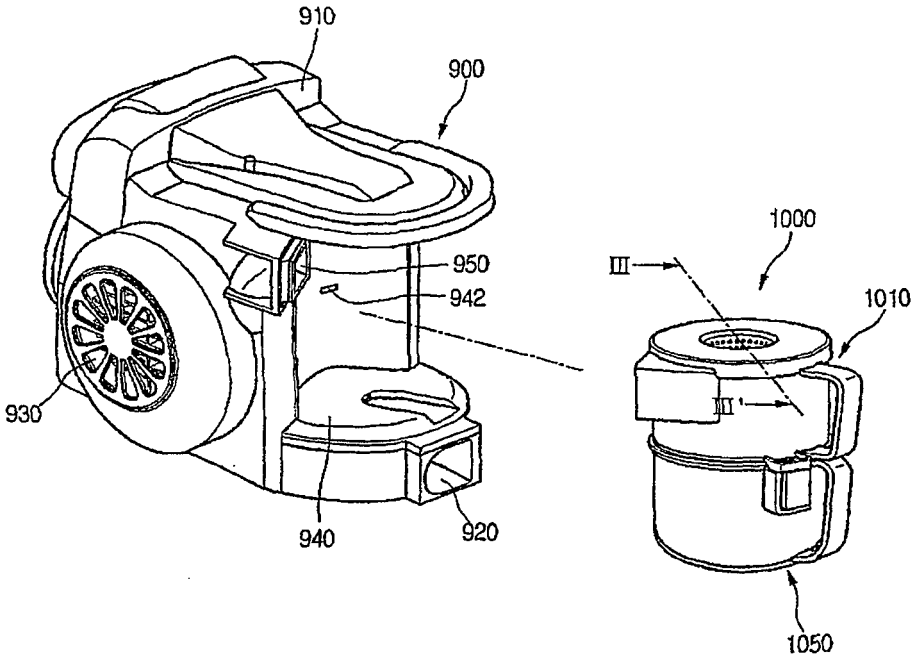
[Fig. 8]


510
552
550
514

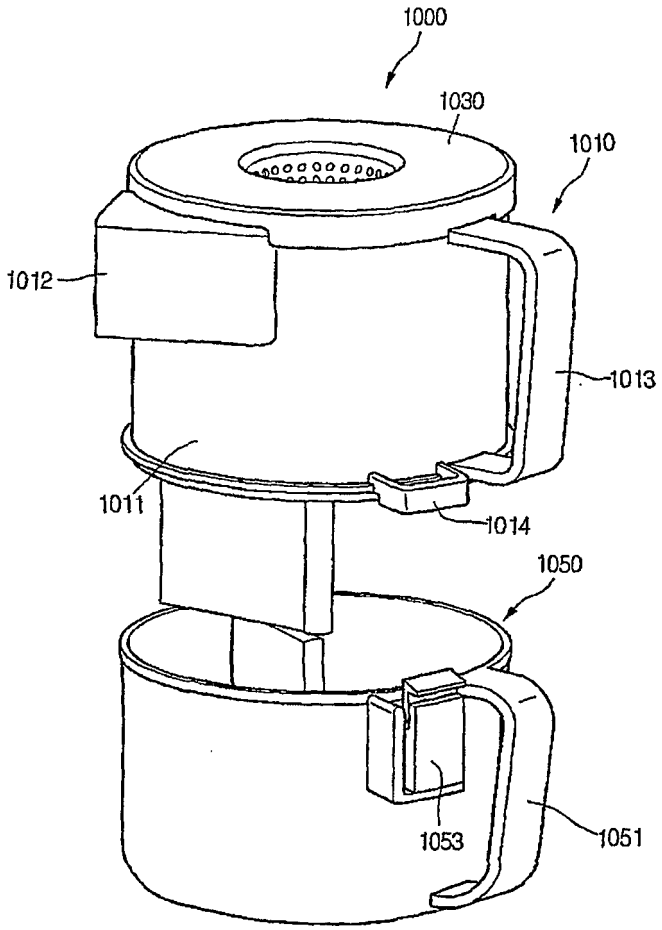
[Fig. 9]


730
713
711
700
710
750
712
714
754
716
822
800
719
755
820
810
812
720
752
721
715
718
717

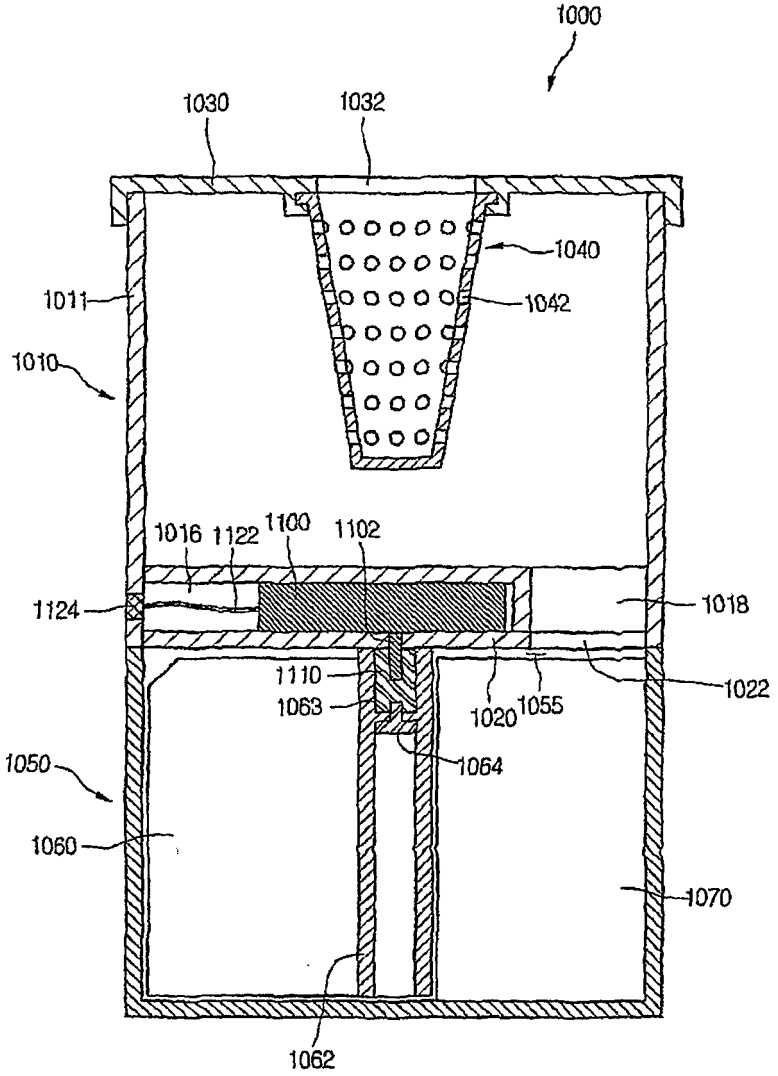
[Fig. 10]


910
900
1000
950
III
1010
942
930
III
940
920
1050

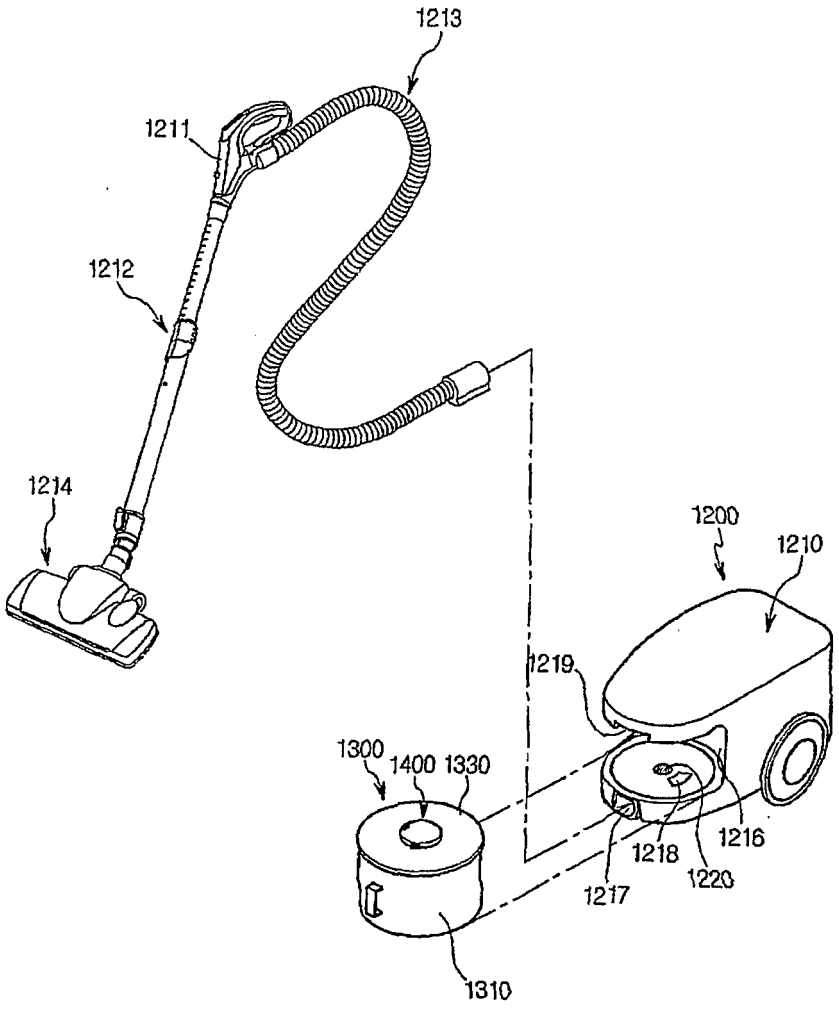
[Fig. 11]



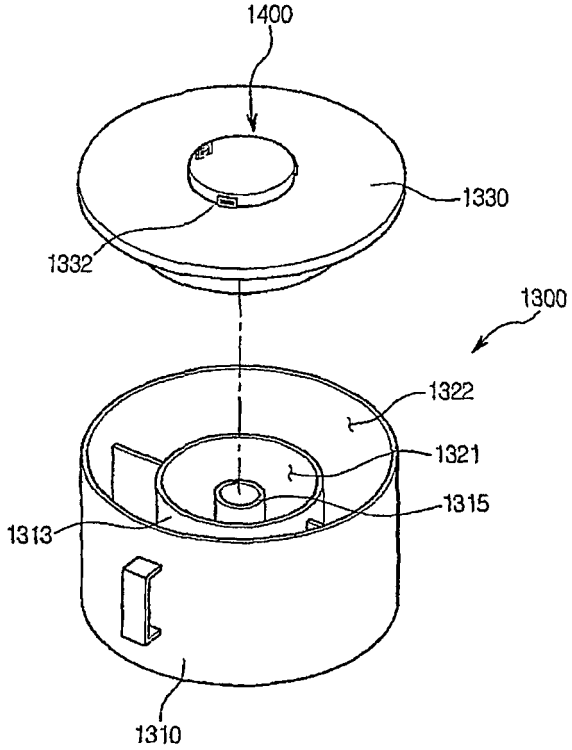
[Fig. 12]


1000
1030
1032
1040
1042
1011
1010
1016
1122
1100
1102
1124
1018
1110
1063
1020
1055
1022
1064
1050
1060
1070
1062

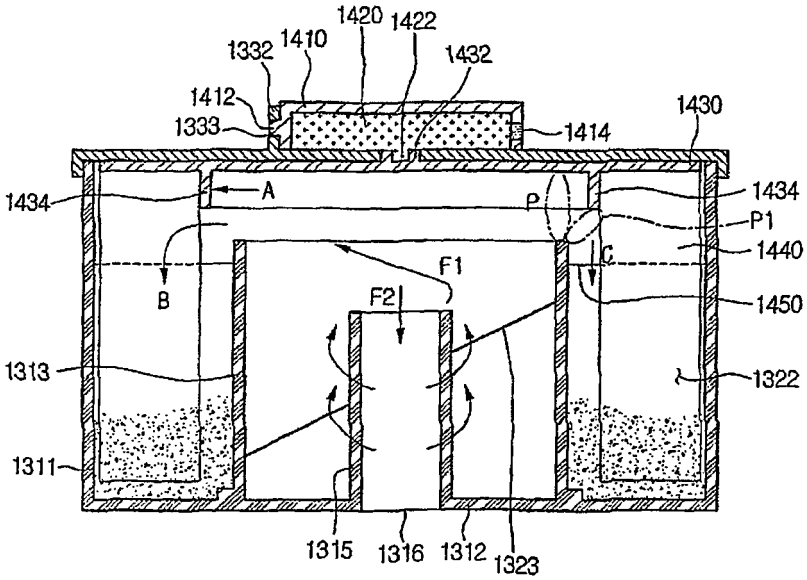
[Fig. 13]


1213
1211
1212
1214
1200
1210
1219
1300
1400
1330
1216
1218
1220
1217
1310

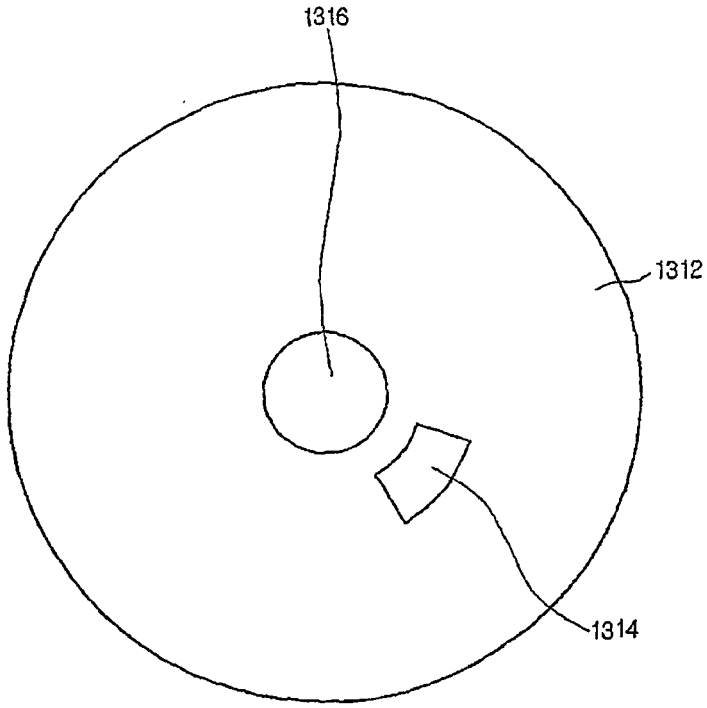
[Fig. 14]


1400
1330
1332
1300
1322
1321
1315
1313
1310

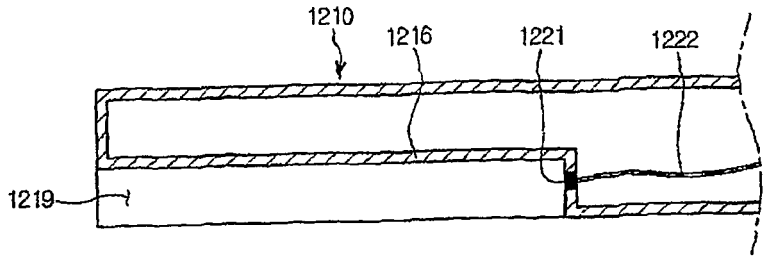
[Fig. 15]


1420
1422
1332
1410
1432
1412
1333
1414
1430
1434
A
P
1434
P1
1440
C
F1
B
F2
1450
1313
1322
1311
1315
1316
1312
1323

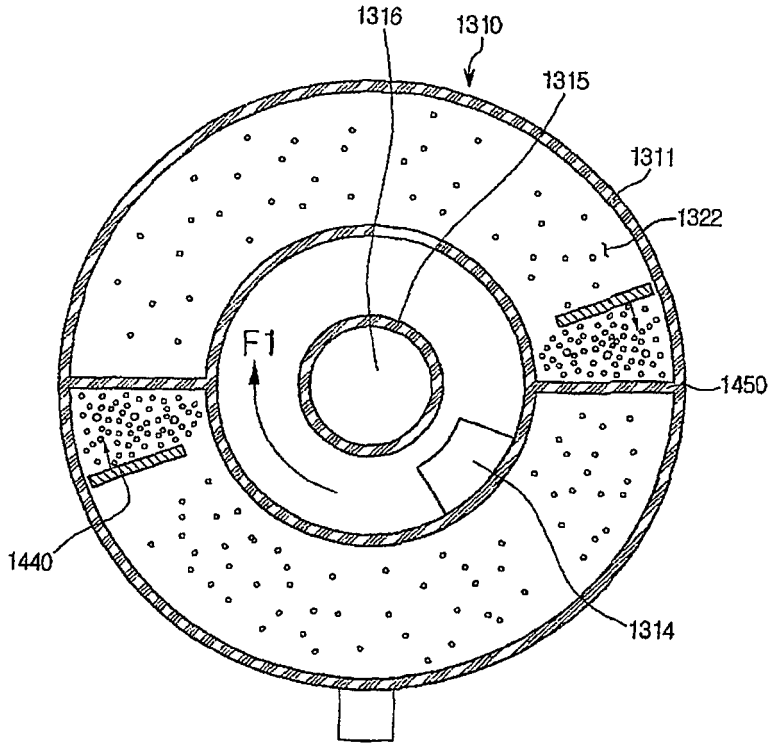
[Fig. 16]



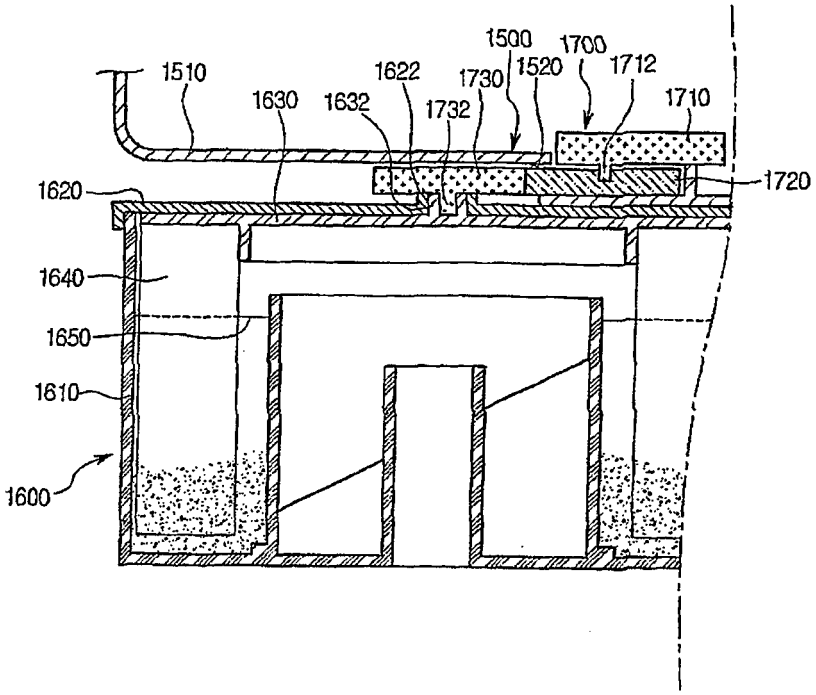
[Fig. 17]



[Fig. 18]


1316
1310
1315
1311
1322
F1
1450
1440
1314

[Fig. 19]


1500
1700
1510
1622
1730
1520
1712
1630
1632
1732
1710
1620
1720
1640
1650
1610
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20070143953 A1 **[0005]**