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(54) **ELECTRIC VACUUM CLEANER AND DUST COLLECTING UNIT FOR USE THEREIN**

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(57) **ABSTRACT**

An electric vacuum cleaner **100** and a dust collecting unit **5** for use therein of the present invention include a dust collecting container **51** into which air sucked at the time of cleaning is led and a cyclone mechanism **52** for causing the air led into the dust collecting container **51** to swirl to separate dust contained in the air from the air, and are further provided with a filter **25** outside the dust collecting container **51** for catching minute dust contained in the air discharged from the dust collecting container **51.**

According to the electric vacuum cleaner **100** and the dust collecting unit **5** for use therein of the present invention, minute dust not removed from the air in the dust collecting container **51** by the cyclone mechanism **52** can be surely caught by the filter **25** provided outside the dust collecting container **51.** And since the filter **25** is provided outside the dust collecting container **51,** it has a preferable maintenance property for cleaning, exchange and the like.

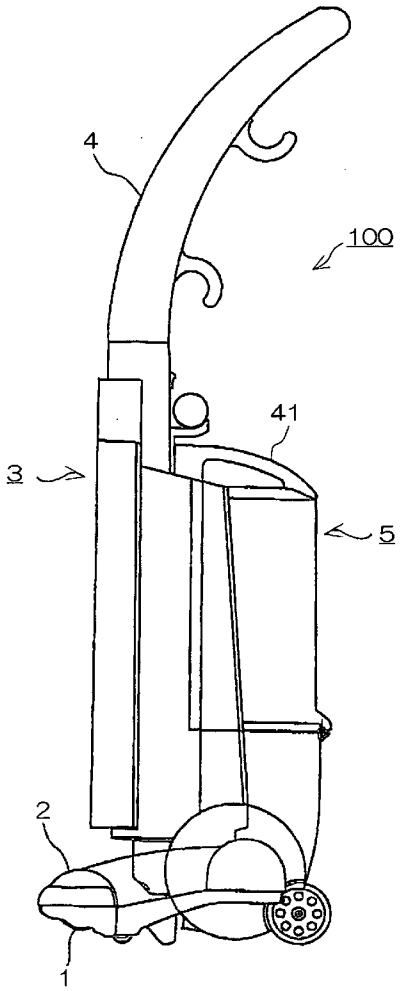

FIG.1

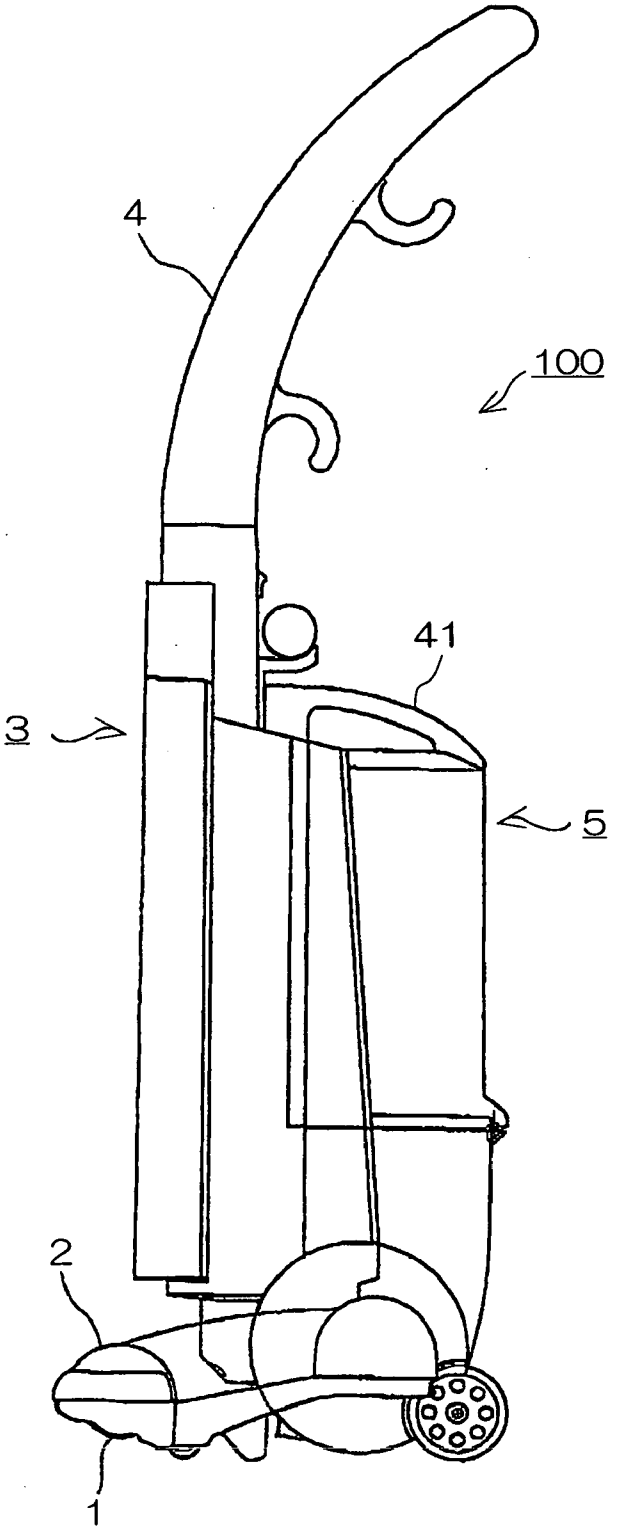

FIG.2

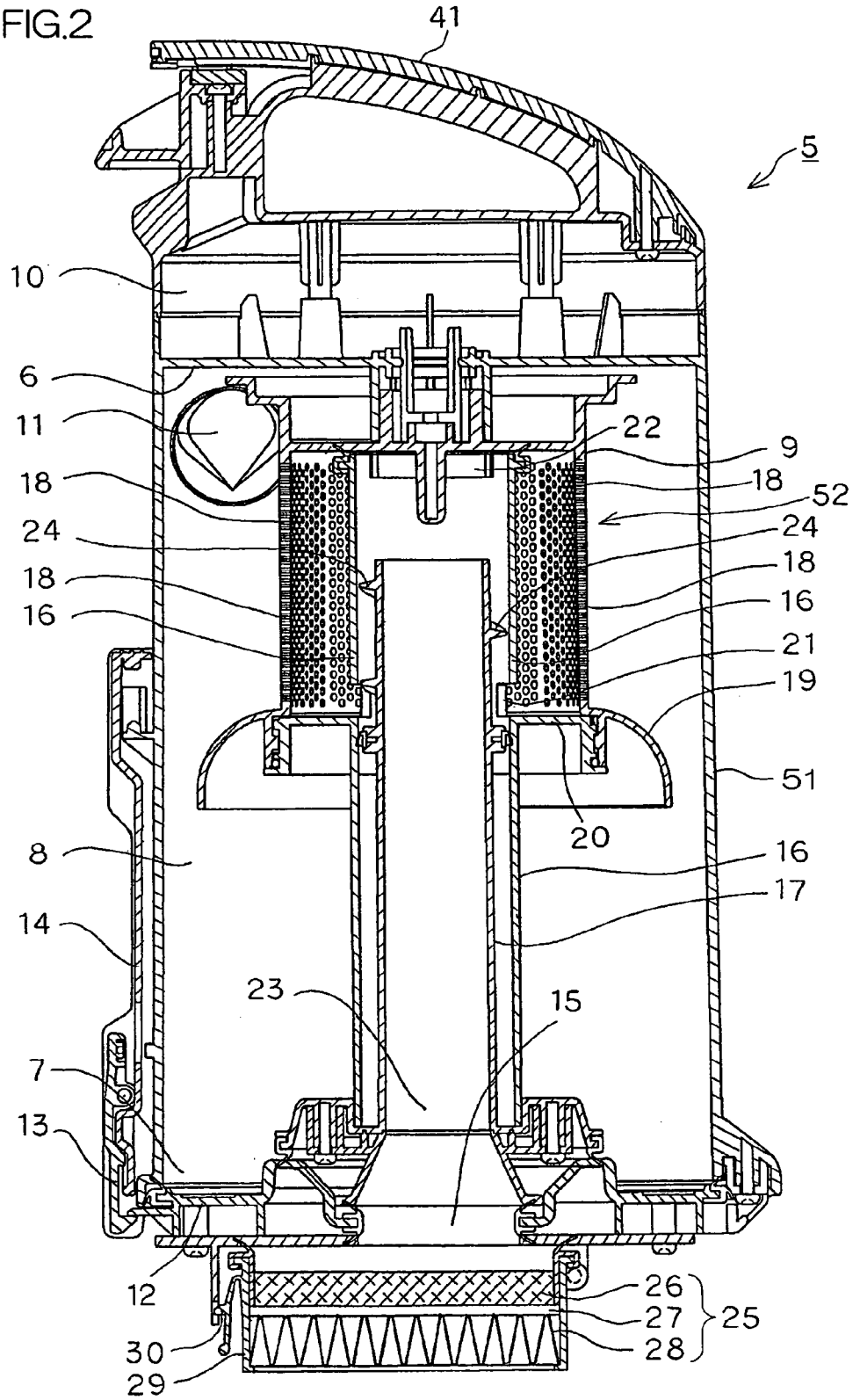
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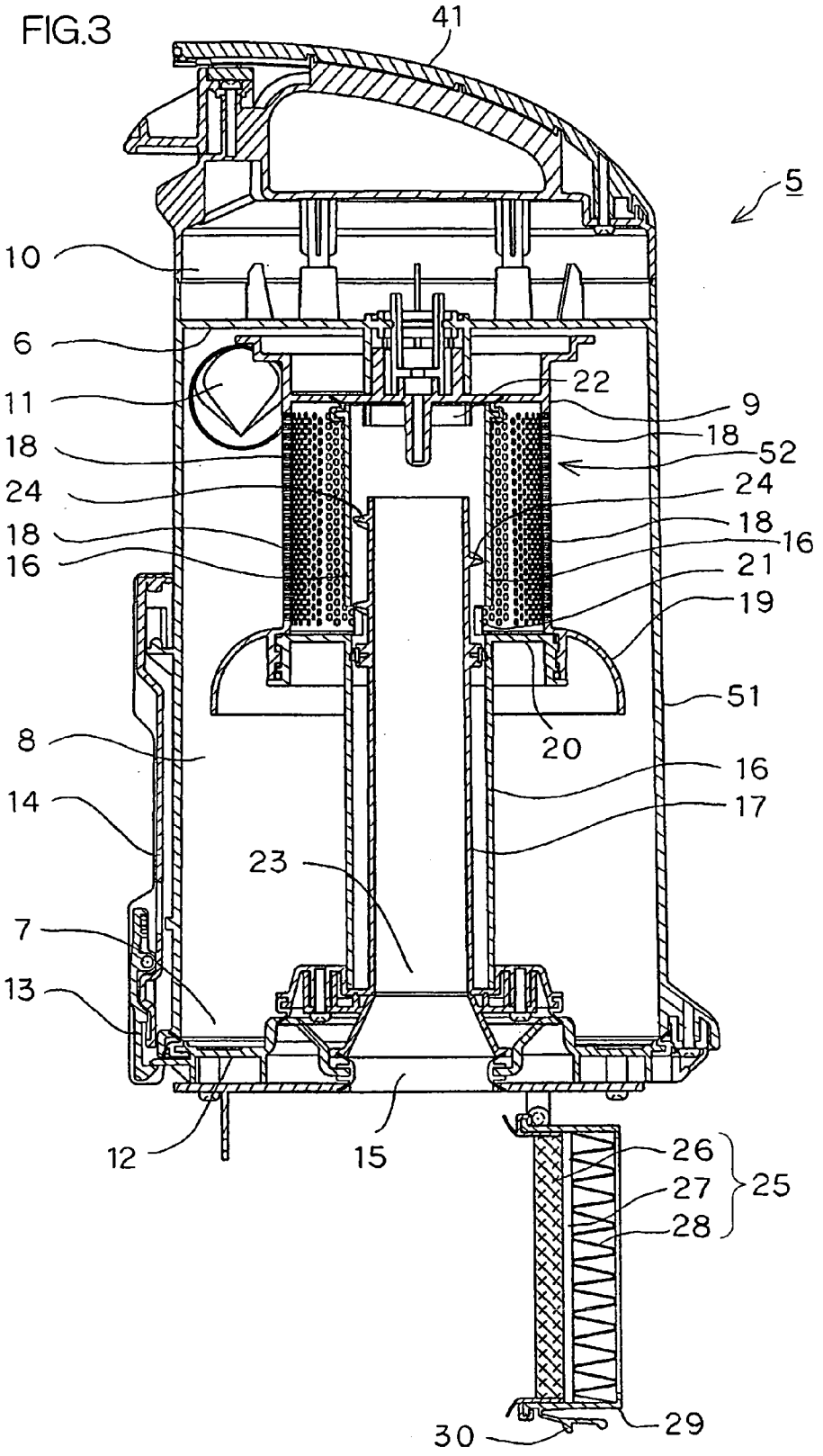
FIG.3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ELECTRIC VACUUM CLEANER AND DUST COLLECTING UNIT FOR USE THEREIN

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an electric vacuum cleaner and a dust collecting unit for use therein, and especially to so-called a cyclone type electric vacuum cleaner and a dust collecting unit for use therein.

[0003] 2. Description of the Related Art

[0004] The inventors of the present application have proposed a prior invention of so-called a cyclone type electric vacuum cleaner in Japanese Patent Application No. 2003-94416. This proposed electric vacuum cleaner has a cyclone cylindrical body disposed in the center of a dust collecting chamber and an air discharge cylinder disposed in the center of the cyclone cylindrical body, and performs operations of causing air led into the dust collecting chamber to swirl along the outer circumferential surface of the cyclone cylindrical body and thereby separating relatively large-sized or coarse dust from air. Then, air from which relatively large-sized dust has been separated is led into the cyclone cylindrical body, and the air is swirled in the space between the air discharge cylinder and the cyclone cylindrical body by a swirl air flow generating means. Thereby, minute dust is separated from the air and accumulated in the lower part inside the cyclone cylindrical body. The air from which minute dust has been separated is led through the air discharge cylinder to the outside of the dust collecting container. With such a structure, the axial length of the cyclone cylindrical body disposed in the dust collecting chamber can be shortened and thereby the dust collecting unit can be miniaturized.

[0005] However, in the invention of the abovementioned prior application, since the axial length of the cyclone cylindrical body is short, minute dust, though in a little amount, is not separated from air and apt to be discharged together with the air to the outside of the dust collecting container. For solving this problem, it can be proposed that a dust collecting filter is provided in a stream of the dust collecting unit. However, such an arrangement causes a new problem that troublesome operations are required for attaching and detaching such dust collecting filter or the like at the maintenance time.

SUMMARY OF THE INVENTION

[0006] The present invention has been made in order to solve the abovementioned problems. And an object of the present invention is to provide an electric vacuum cleaner of a high dust collecting efficiency though it has a miniaturized dust collecting unit.

[0007] Another object of the present invention is to provide an electric vacuum cleaner having a dust collecting filter of an improved maintenance property, and a dust collecting unit for use in the electric vacuum cleaner.

[0008] A further object of the present invention is to provide a dust collecting unit suitable for use in a cyclone type electric vacuum cleaner.

[0009] The present invention is, to sum up, an electric vacuum cleaner and a dust collecting unit for use therein, the electric vacuum cleaner includes a dust collecting container into which air sucked at the cleaning time is led and a cyclone mechanism for causing air entering into the dust collecting container to swirl thereby to separate dust contained in the air from the air, and is characterized by further including a filter outside the dust collecting container for catching minute dust contained in air discharged from the dust collecting container.

[0010] According to the present invention, minute dust not removed from air by the cyclone mechanism in the dust collecting container can be surely caught by the filter provided outside the dust collecting container. Further, since the filter is provided outside the dust collecting container, it has a good maintenance property for cleaning, exchange and the like.

[0011] Preferred embodiments of the present invention will be described below with reference to the appended drawings. The description of the embodiments below does not limit the claims of the present invention but is only for understanding of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a view showing the schematical structure of an upright type electric vacuum cleaner according to an embodiment of the present invention.

[0013] **FIG. 2** is a vertical sectional view showing the structure of a dust collecting unit according to an embodiment of the present invention in which a filter is in the closed state.

[0014] **FIG. 3** is a vertical sectional view showing the structure of a dust collecting unit according to an embodiment of the present invention in which the filter is in the opened state.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] The structure of an upright type electric vacuum cleaner according to an embodiment of the present invention will be now described.

[0016] **FIG. 1** is a schematical view of an upright type electric vacuum cleaner according to an embodiment of the present invention. The electric vacuum cleaner **100** includes a suction section **2** movable along floor surfaces. The suction section **2** has a suction port **1** open to the floor surfaces, and a rotary brush (not shown) is provided within the suction port **1**. The suction section **2** is pivotally supported by a cleaner main body **3** of the electric vacuum cleaner **100** and communicated with the inside of the cleaner main body **3**. Provided in the upper portion of the cleaner main body **3** is a handle **4** extending upward. A dust collecting unit **5** is removably mounted on the cleaner main body **3**. Within the cleaner main body **3** provided is an electric blower (not shown) below the dust collecting unit **5**. When the electric blower is operated, air containing dust is sucked through the suction section **2** and led into the dust collecting unit **5**. Then, the dust is separated from the air in the dust collecting unit **5** and the cleaned air is discharged from the lower portion of the cleaner main body **3**.

[0017] The dust collecting unit **5** has a grip **41** in the upper portion, so that a user can detach the dust collecting unit **5**

from the cleaner main body **3** by holding the grip **41** with his or her hand. The main part of the dust collecting unit **5** is formed into a cylindrical shape of a transparent or semi-transparent resin.

[**0018**] **FIG. 2** is a vertical sectional view of the dust collecting unit **5** detached from the cleaner main body **3** in which a filter **25** is in the closed state. Further, **FIG. 3** is a vertical sectional view of the dust collecting unit **5** in which the filter **25** is in the open state. Now, the structure of the dust collecting unit **5** will be described in detail with reference to **FIGS. 2 and 3**.

[**0019**] The dust collecting unit **5** includes a cylindrical container **51**. The container **51** has so-called a vertical cylindrical shape in which the central axis thereof extends in the vertical direction. The container **51** is formed of a transparent or semi-transparent resin. Provided in the upper portion of the inside of the container **51** is a partition wall **6** spreading in the horizontal direction. A holding mechanism room **10** is provided above the partition wall **6**. Within the holding mechanism room **10**, though not shown, contained is a mechanism for holding a cyclone mechanism **52** disposed in the space below the partition wall **6**. The holding mechanism is operated from outside the container **51** so as to attach the cyclone mechanism **52** to the container **51** or detach the cyclone mechanism **52** from the container **51**. However, since it is not the main subject of the present invention, further detailed description thereof is omitted.

[**0020**] A space defined by a lower surface of the partition wall **6** and the container **51** constitutes a dust collecting chamber **8**. Being defined by the inner circumferential surface of the cylindrical container **51**, the side surface of the dust collecting chamber **8** is formed into a cylindrical shape. The container **51** has an air suction port **11** so that air can be sucked along the inner circumferential surface of the cylindrical dust collecting chamber **8**. The air suction port **11** is provided in the upper portion of the dust collecting chamber **8**. An opening **7** is formed at the bottom portion of the dust collecting chamber **8** and the opening **7** is covered by closing a lid **12**. The lid **12** is pivoted to one side of the bottom portion of the container **51** so as to make pivotal movement. At the other side of the bottom portion of the container **51**, a clamp **13** is provided. The clamp **13** holds (locks) the lid **12** in the state in which the lid **12** closes the lower opening **7** of the container **51**. An operating member **14** is provided near the clamp **13**. By pressing the operating member **14** in the downward direction, the clamp **13** pivotally moves and the lid **12** is unlocked. An air outlet port **15** is provided substantially in the center of the lid **12**. The air outlet port **15** is communicated with a lower end **23** of an air discharge cylinder **17** which will be mentioned below.

[**0021**] The outside of the dust collecting chamber **8**, namely, the lower opening **7** of the dust collecting chamber **8** is closed by the lid **12**, and the filter **25** is provided below the lid **12**. The filter **25** is disposed so as to oppose to the air outlet port **15** provided in the lid **12**. And as mentioned below, air discharged from the air outlet port **15** is led through the filter **25** to the electric blower (not shown).

[**0022**] Now, the structure of the cyclone mechanism **52** provided in the dust collecting chamber **8** will be described.

[**0023**] The cyclone mechanism **52** includes a primary separation cylinder **9** having a vertical central axis and formed in a circular cylindrical shape, a circular cylinder **16** coaxially disposed inside the primary separation cylinder **9**, and the air discharge cylinder **17** formed in a cylindrical shape and coaxially disposed inside the circular cylinder **16**.

[**0024**] The vertical length of the primary separation cylinder **9** is about the upper half of the vertical length of the dust collecting chamber **8**. A plurality of air holes **18** are provided in the circumferential surface of the primary separation cylinder **9** except the upper circumferential surface opposed to the air suction port **11**. A downwardly and outwardly spreading skirt **19** is extended from the lower end of the primary separation cylinder **9**. The space between the skirt **19** and the inner circumferential surface of the container **51** becomes narrow since the skirt **19** spreads downwardly and outwardly from the lower end of the primary separation cylinder **9**. As a result, the region below the skirt **19** in the dust collecting chamber **8** serves as a region for storing dust.

[**0025**] Air (air containing dust) introduced through the air suction port **11** into the dust collecting chamber **8** swirls along the inner circumferential surface of the container **51** and enters through the plurality of air holes **18** provided in the circumferential surface of the primary separation cylinder **9** into the primary separation cylinder **9**. At this time, due to the swirling of the air along the inner circumferential surface of the container **51**, dust in rather large sizes contained in the air is separated below and drops through the space between the skirt **19** and the inner circumferential surface of the container **51** downwardly to be accumulated at the bottom of the dust collecting chamber **8**.

[**0026**] The upper part of the circular cylinder **16** provided in the primary separation cylinder **9** is coaxially disposed inside the primary separation cylinder **9** and the lower part thereof extends to the bottom of the dust collecting chamber **8**. And the circular cylinder **16** and the skirt **19** of the primary separation cylinder **9** are removably connected to each other through an outwardly stretched flange **20** disposed substantially in the center of the circular cylinder **16**.

[**0027**] Above the flange **20**, an air inlet port **21** is provided so as to open a part of the circumferential surface of the circular cylinder **16**. Further, the circular cylinder **16** is provided with a dust outlet port **22** near the upper end of the circumferential surface thereof.

[**0028**] Air introduced into the primary separation cylinder **9** through the air holes **18** thereof enters into the circular cylinder **16** through the air inlet port **21** provided in the circular cylinder **16**. Then, swirling in the ring-shaped space when seen in a plan view defined by the inner circumferential surface of the circular cylinder **16** and the outer circumferential surface of the air discharge cylinder **17** disposed in the circular cylinder **16**, the air flows upwardly, so that dust in the air is separated and the separated dust is discharged through the dust outlet port **22** to the outside of the circular cylinder **16**. And the discharged dust drops down to the lower part of the dust collecting chamber **8**.

[**0029**] The upper end of the air discharge cylinder **17** coaxially disposed inside the circular cylinder **16** opens at a position a little higher than the middle position of the height of the circular cylinder **16**. Further, the lower part of the air discharge cylinder **17** extends downwardly similarly to the lower part of the circular cylinder **16**, and the lower end **23** thereof is communicated with the air outlet port **15** provided in the lid **12**.

[0030] The position of the opened upper end of the air discharge cylinder **17** has only to be higher than the air inlet port **21** of the circular cylinder **16** and lower than the dust outlet port **22**.

[0031] Further, in the space defined by the inner circumferential surface of the circular cylinder **16** and the outer circumferential surface of the air discharge cylinder **17**, a spiral blade **24** is provided as a swirl air flow generating means. The spiral blade **24** is an elongated projection on the outer circumferential surface of the air discharge cylinder **17**, and it starts from a position opposed to the air inlet port **21** of the circular cylinder **16** and spirally extends upwardly on the outer circumferential surface of the air discharge cylinder **17**. The top (ridge) of the elongated projection is close to or in contact with the inner circumferential surface of the circular cylinder **16**. Therefore, air entering through the air inlet port **21** is guided by the spiral blade **24** to flow swirling in the upward direction. Thereby minute dust is separated from the air. The separated minute dust is discharged to the outside of the circular cylinder **16** through the dust outlet port **22** provided at the upper position of the circular cylinder **16**. And air which flows swirling upwardly enters the air discharge cylinder **17** through the upper opening of the air discharge cylinder **17** and flows downwardly to be discharged through the air outlet port **15** to the outside of the container **51**.

[0032] The filter **25** is provided outside the container **51**, namely, below the lid **12**. The filter **25** is disposed in a position opposed to the air outlet port **15** as abovementioned, so that air discharged from the air outlet port **15** passes through the filter **25**.

[0033] The filter **25** has a triple layer structure comprising a first filter **26** formed of rough urethane or the like, a second filter **27** formed of unwoven cloth or the like and a third filter **28** of a pleated structure for removing minute dust, in the order seen from the upstream side. The filter **25** is contained in a filter case **29**. The filter case **29** is pivoted at one side by the lid **12** so as to make pivotal movement. The other side of the filter case **29** is provided with a click **30** which can engage with a projection provided on the lid **12**.

[0034] With such arrangements, the filter case **29** can be shifted between the closed state in which the filter case **29** is disposed in the horizontal direction below the lid **12** thereby to close the air outlet port **15** as shown in **FIG. 2** and the open state in which the filter case **29** is disposed in the vertical direction thereby to open the air outlet port **15** as shown in **FIG. 3**.

[0035] Further, though not shown, the filter case **29** containing the filter **25** inside may be adapted to be removable from the lid **12**.

[0036] The filter **25** has the triple layer structure as abovementioned. The third filter **28** is of the pleated structure for improving the dust collecting efficiency. With such a structure, in a case the second filter **27** is not present and the space between the first filter **26** and the third filter **28** is so narrow that, for example, the first filter **26** and the third filter **28** are in contact with each other, air is liable not to flow through the part of the third filter **28** corresponds to a plugged part of the first filter **26**when the first filter **26** is plugged. In such a case, the dust collecting efficiency of the third filter **28** is lowered and at the same time the life of the third filter **28** becomes shorter.

[0037] Therefore, in this embodiment, the second filter **27** is provided between the first filter **26** and the third filter **28**. In addition to the main function of catching dust, the second filter **27** has another function as a spacer keeping a predetermined space between the first filter **26** and the third filter **28**. With such a structure, even if a part of the first filter **26** is plugged, air can flow through the third filter **28** in correspondence to the plugged part of the first filter **26** by means of the second filter **27**. As a result, the life of the third filter **28** can be prevented from becoming shorter and at the same time the dust collecting efficiency can be prevented from being lowered.

[0038] With reference to **FIGS. 1 and 2**, the whole air flow in the electric vacuum cleaner **100** will be briefly explained. Air containing dust sucked through the suction port **1** of the suction section **2** is introduced into the dust collecting chamber **8** of the dust collecting unit **5**. At this time, while the air enters the dust collecting chamber **8** in the swirling direction along the inner circumferential surface of the container **51**, relatively large-sized dust and the like is separated from the air and falls down to the lower region of the dust collecting chamber **8** defined by the skirt **19** thus to be accumulated on the lid **12**.

[0039] Air from which relatively large-sized dust is removed is led through the air holes **18** of the primary separation cylinder **9** and the air inlet port **21** of the circular cylinder **16** into the circular cylinder **16**. Then, the air is guided by the spiral blade **24** provided on the outer circumferential surface of the air discharge cylinder **17** to become a swirl air flow, which goes swirling upwardly in the circular cylinder **16**. By this upward swirl air flow, minute dust is separated from the air. The separated minute dust is discharged through the dust outlet port **22** to the outside of the circular cylinder **16** to be accumulated in the lower part of the dust collecting chamber **8**.

[0040] The air from which the minute dust is removed passes through the upper opening of the air discharge cylinder **17**, falls down in the air discharge cylinder **17**, is discharged below from the air outlet port **15** and flows through the filter **25** to the electric blower (not shown). If a slight amount of minute dust is left in the air passing through the filter **25**, the filter **25** catches such minute dust.

[0041] In order to removing away dust accumulated in the dust collecting unit **5**, the lid **12** has only to be opened. When the lid **12** is opened, dust accumulated in the lower part of the dust collecting chamber **8** falls down by its own weight.

[0042] In this embodiment, the filter **25** is disposed outside of the dust collecting chamber **8**, namely, on the lower side of the lid **12**. In other words, the filter **25** is disposed outside the dust collecting chamber **8** and on the downstream side of the air outlet port **15** when seen in the direction of air flow. Therefore, if the dust collecting unit **5** is miniaturized and a slight amount of minute dust is still left in air from which dust has been separated by the cyclone mechanism, such dust left in the air can be surely caught by the filter **25**. As a result, the dust collecting unit **5** can be miniaturized without lowering the dust collecting efficiency thereof.

[0043] In order to clean, exchange or the like the filter **25**, the filter case **29** has only to be opened as shown in **FIG. 3**. By opening the filter case **29**, the condition of the filter **25** can be easily confirmed from outside of the dust collecting unit **5**, so that the maintenance property of the filter **25** can be improved.

[0044] In the abovementioned embodiment, the dust collecting chamber **8** is formed by the container **51** and the lid **12**, but it is not limited to such a structure. It is also possible that the container is in the shape of a cylinder having closed bottom and opened upper end and the lid for closing the opened upper end of the container is not provided on the container so as to be closed and opened but provided on the cleaner main body side. In this case, it is possible that the air outlet port of the dust collecting unit is provided, for example, in the circumferential surface of the container and the filter is fitted to the outside of the container.

[0045] Further, in the abovementioned embodiment, the air outlet port is provided at the bottom of the dust collecting unit **5**. However, the air outlet port can be provided in the upper surface, side surface or the like of the dust collecting unit **5**. In such cases, the fitting position of the filter can be changed in correspondence with the position of the air outlet port.

[0046] In the above-described structure, the spiral blade **24** as a swirl air flow generating means within the dust collecting chamber **8** is provided on the outer circumferential surface of the air discharge cylinder **17**. However, the spiral blade **24** may be provided on the inner circumferential surface of the circular cylinder **16**.

[0047] Further, the present invention can be applied not only to an upright type electric vacuum cleaner but also to a canister type electric vacuum cleaner.

What is claimed is:

1. An electric vacuum cleaner including

a suction means,

a cleaner main body communicated with the suction means,

a dust collecting chamber provided in the cleaner main body and having an air suction port and an air outlet port,

a cyclone mechanism provided in the dust collecting chamber for causing air led into the dust collecting chamber to swirl thereby to separate dust from the air, and

a filter for catching minute dust contained in the air discharged from the air outlet port, the filter being provided outside the dust collecting chamber and on the downstream side of the air outlet port seen in the air flow direction.

2. An electric vacuum cleaner according to claim 1, in which the cyclone mechanism includes

a circular cylinder disposed substantially in the center of the dust collecting chamber and provided with an air inlet port in the circumferential surface thereof,

an air discharge cylinder disposed substantially coaxially in the circular cylinder, one end of the air discharge cylinder being disposed in the circular cylinder and the other end being communicated with the air outlet port,

a swirl air flow generating means for causing air entering through the air inlet port into a space defined by the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder to swirl along the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder, and

a dust outlet port provided in the circular cylinder for discharging dust separated from the air swirled by the swirl air flow generating means to the outside of the circular cylinder.

3. An electric vacuum cleaner according to claim 2, in which

the swirl air flow generating means includes a spiral blade provided in the space defined by the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder and adapted to lead air to swirl and flow in the axial direction of the circular cylinder and the air discharge cylinder.

4. An electric vacuum cleaner according to claim 3, in which

the dust collecting chamber is defined by a container including a cylindrical part and the container is attachable to and detachable from the cleaner main body.

5. An electric vacuum cleaner according to claim 4, in which

the container is provided with the air suction port so that air can flow into the container along the inner circumferential surface of the cylindrical part, and

a primary separation cylinder having a plural air holes in the circumferential surface thereof is provided so as to coaxially enclose the circular cylinder, for separating large-sized dust from the air entering through the air suction port.

6. An electric vacuum cleaner according to claim 5, in which

the filter is provided on the outer surface of one end of the container in an attachable and detachable manner.

7. An electric vacuum cleaner according to claim 5, in which

the air outlet port is provided at one end face of the container, and

the filter is provided on the outer surface of one end of the container in such a manner that it can be shifted between the closed state in which the air outlet port is closed and the open state in which the air outlet port is opened.

8. An electric vacuum cleaner according to claim 7, in which

the filter has a triple layer structure comprising a first filter, a second filter and a third filter in the order seen in the air stream direction, and the second filter has an additional function as a spacer for providing a predetermined space between the first filter and the third filter.

9. A dust collecting unit including

a dust collecting container having an air suction port and an air outlet port and defining a dust collecting chamber,

a cyclone mechanism for causing air led through the air suction port into the dust collecting chamber to swirl thereby to separate dust contained in the air from the air, and

a filter for catching minute dust contained in the air discharged from the air outlet port, the filter being provided outside the dust collecting container.

10. A dust collecting unit according to claim 9, in which

the filter can be shifted between the closed state in which the air outlet port is closed and the open state in which the air outlet port is opened.

11. A dust collecting unit according to claim 10, in which

the filter is attachable to and detachable from the dust collecting container.

12. A dust collecting unit according to claim 11, in which

the filter has a triple layer structure comprising a first filter, a second filter and a third filter in the order seen in the air stream direction, and the second filter has an additional function as a spacer for providing a predetermined space between the first filter and the third filter.

13. A dust collecting unit according to claim 9, in which

the dust collecting container has a circular cylindrical shape, and

the dust collecting unit includes

a primary separation cylinder having a plural air holes in the circumferential surface thereof and coaxially provided in the dust collecting container for separating large-sized dust from air entering through the air suction port,

a circular cylinder disposed coaxially in the primary separation cylinder and provided with an air inlet port in the circumferential surface thereof, and

an air discharge cylinder disposed coaxially in the circular cylinder, one end of the air discharge cylinder being disposed in the circular cylinder and the other end being communicated with the air outlet port.

14. A dust collecting unit according to claim 13 including

a swirl air flow generating means for causing air entering through the air inlet port of the circular cylinder into a space defined by the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder to swirl along the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder, and

a dust outlet port provided in the circular cylinder for discharging dust separated from the air swirled by the swirl air flow generating means to the outside of the circular cylinder.

15. A dust collecting unit according to claim 14 in which

the swirl air flow generating means includes a spiral blade provided in the space defined by the inner circumferential surface of the circular cylinder and the outer circumferential surface of the air discharge cylinder and adapted to lead swirl air in the axial direction of the circular cylinder and the air discharge cylinder.

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