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(54) SUCTION CLEANER

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(57) **ABSTRACT**

A suction cleaner that sucks in dust, from a suction mouth, with airflow generated through operation of an electric air blower and introduces the sucked airflow into a dust collection device to collect the dust. The suction mouth is provided with a first suction mouth and a second suction mouth, and, when in use, one of the suction mouths are selected by a suction mouth-switching device. The second suction mouth has a smaller opening area than the first suction mouth and a high-speed suction airflow is generated. A suction passage is provided between the first suction mouth and the suction mouth-switching device, a suction passage is also provided between the second suction mouth and the suction mouth switching-device, the latter suction mouth being arranged on top of the former suction mouth. Part of the latter suction mouth is structured by a detachable cap formed of a transparent or semitransparent material. Further, the suction mouth can be provided with an opening area-adjusting device that adjusts the opening area of the suction mouth.

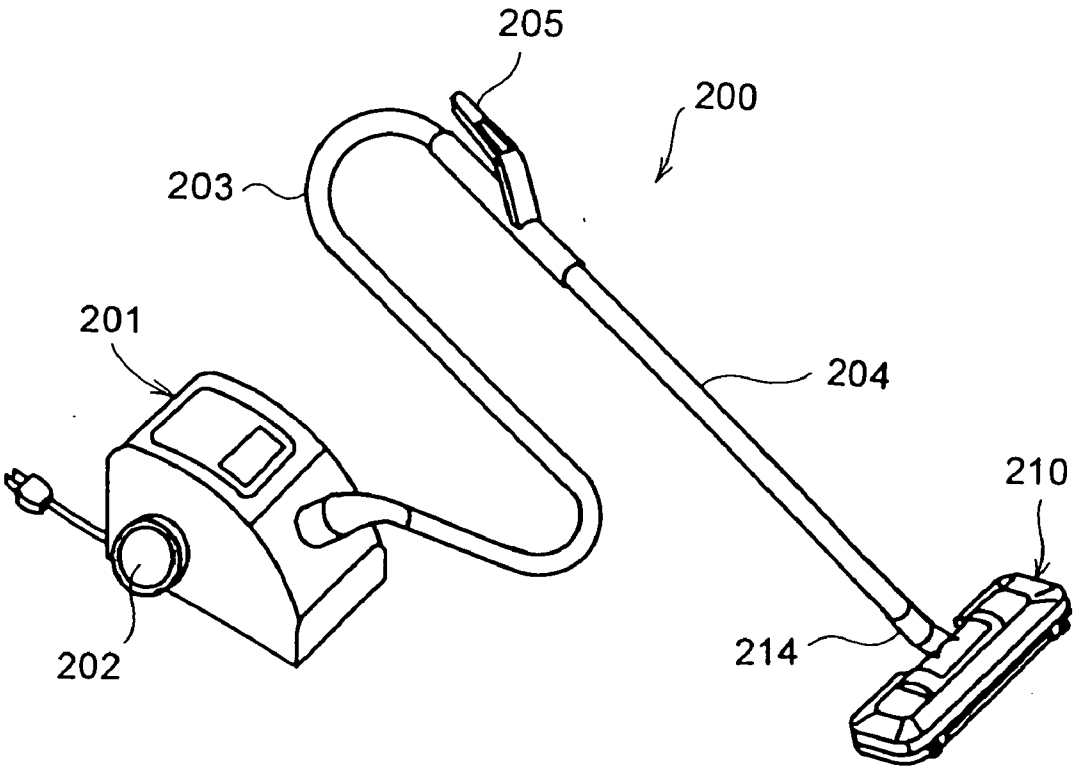

FIG.1

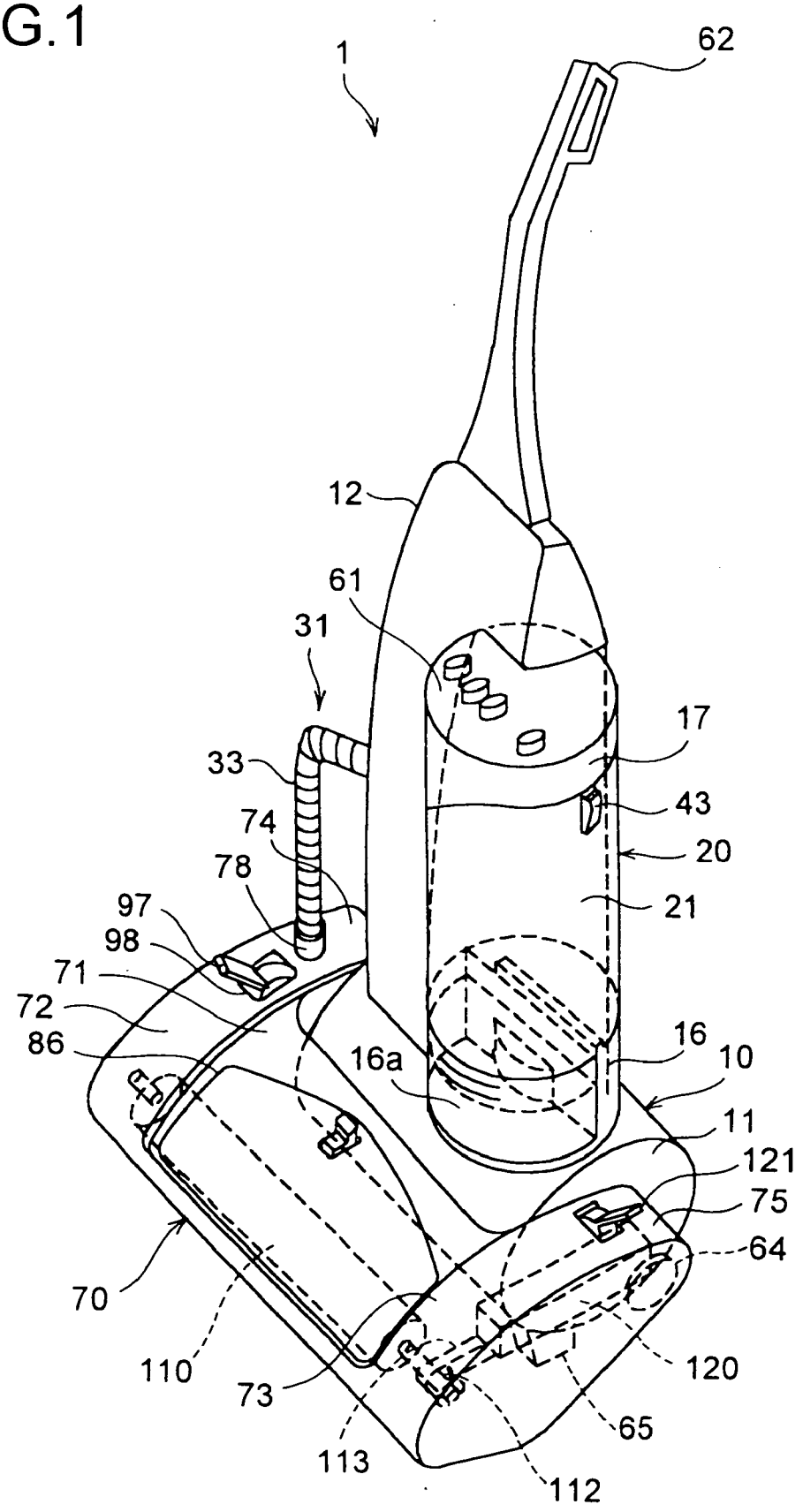
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FIG.2

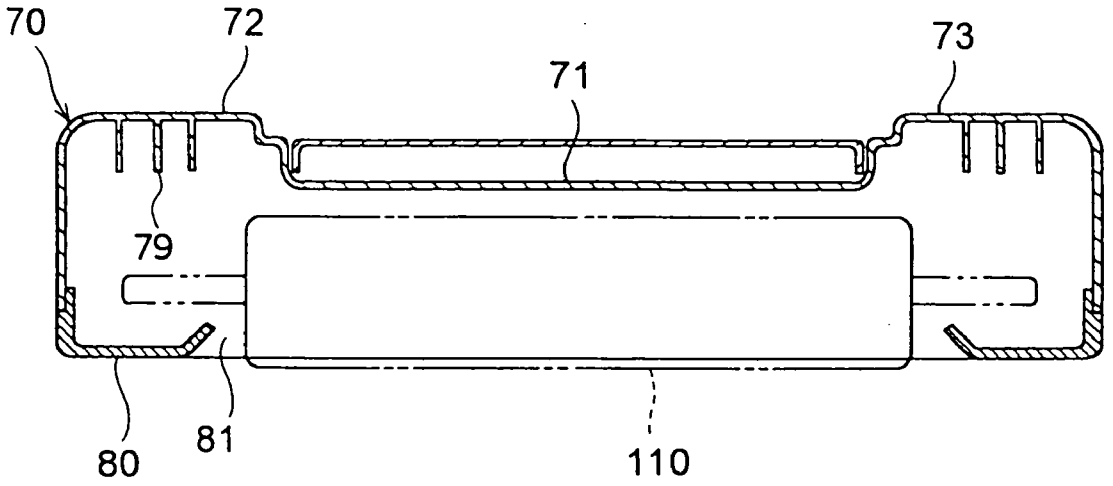

FIG.3

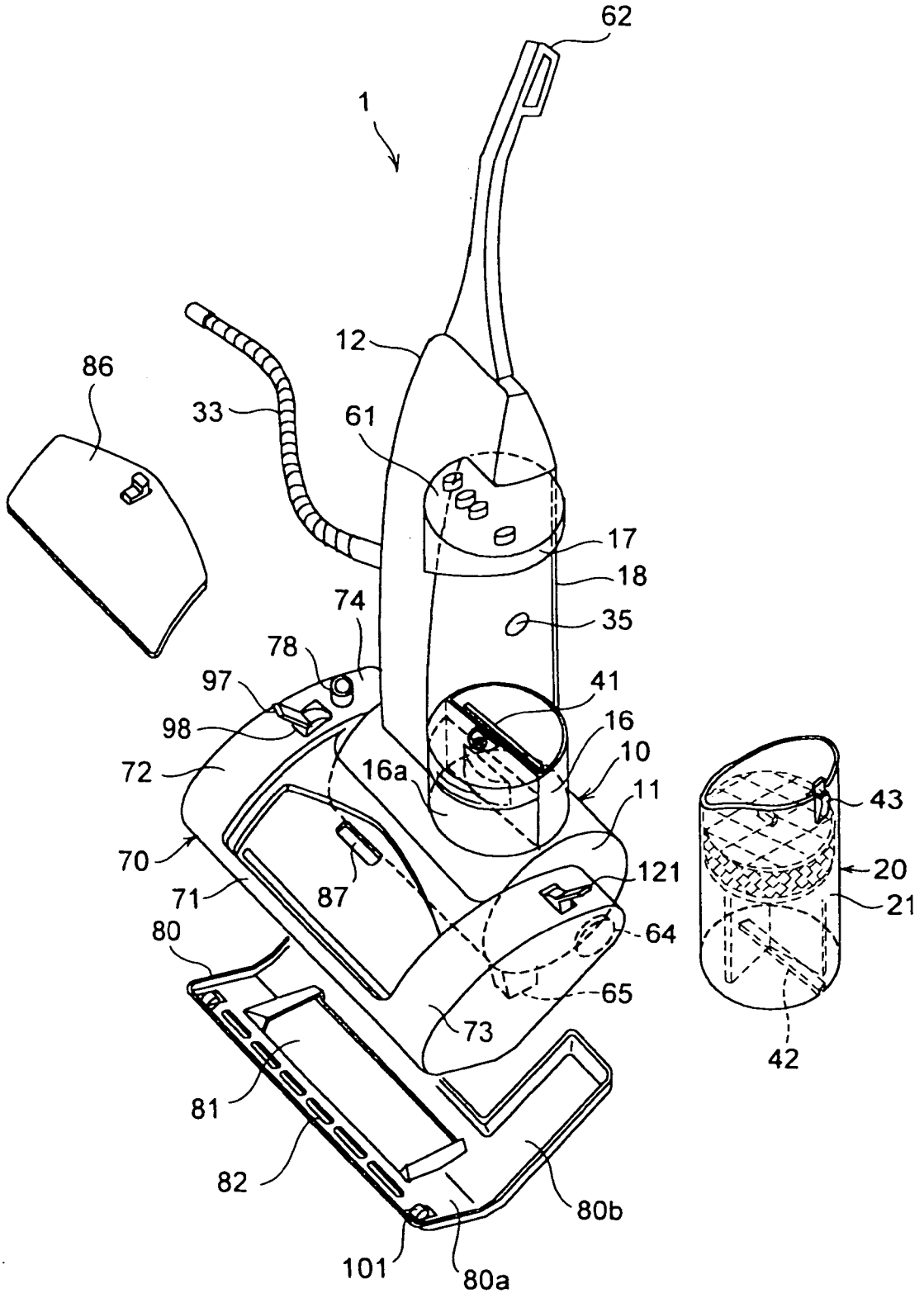
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FIG.4

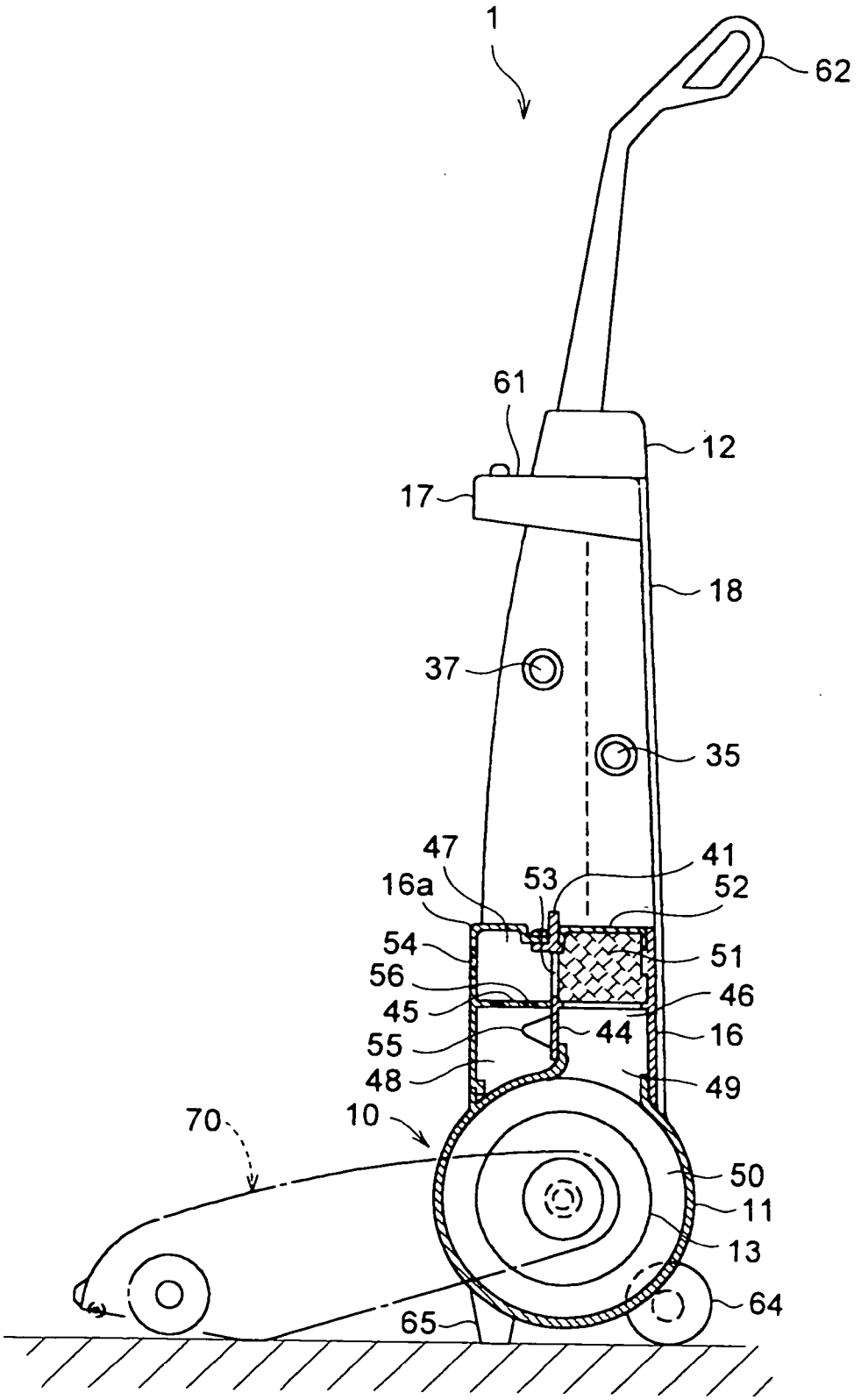
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FIG.5

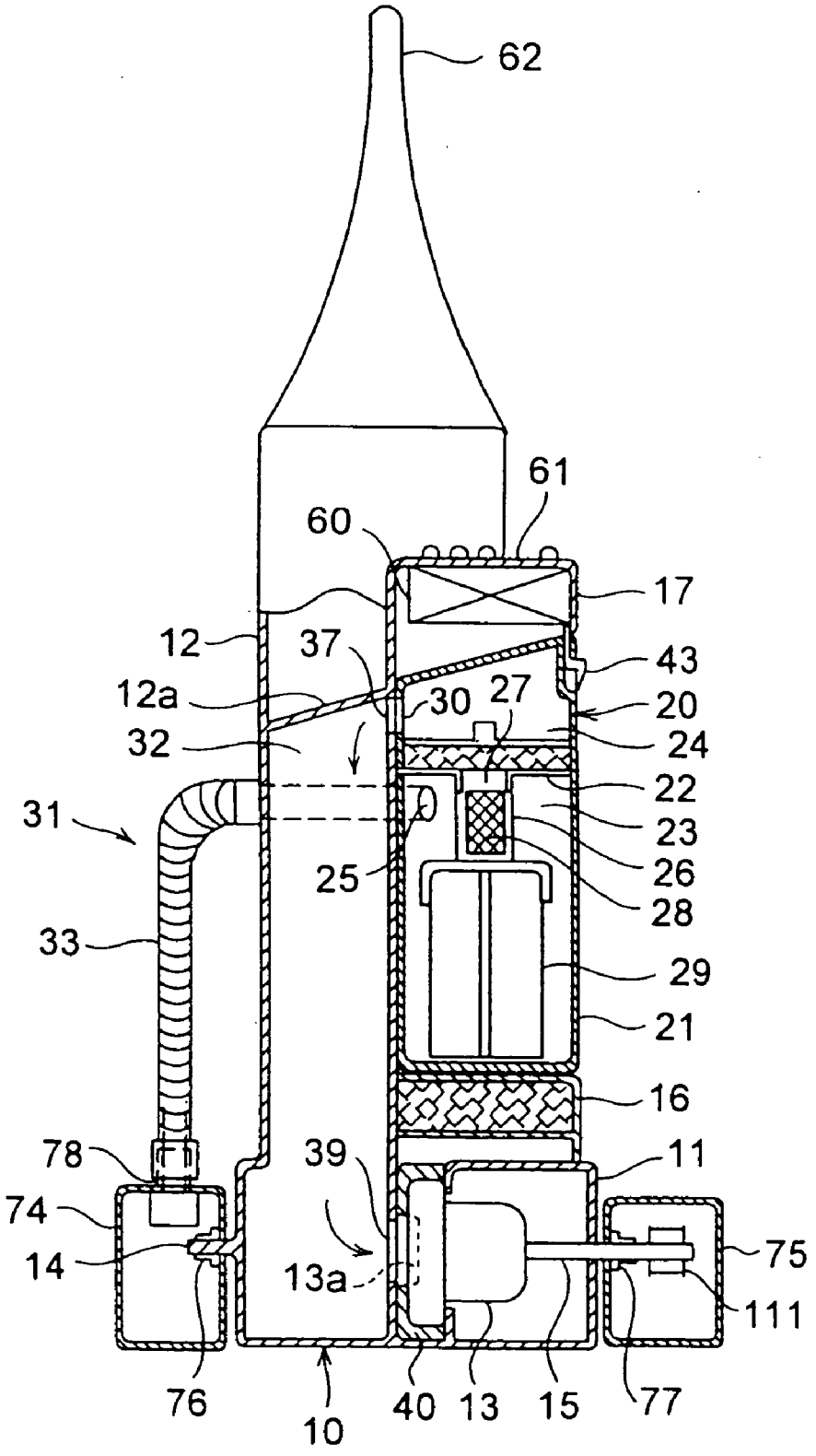
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FIG.6

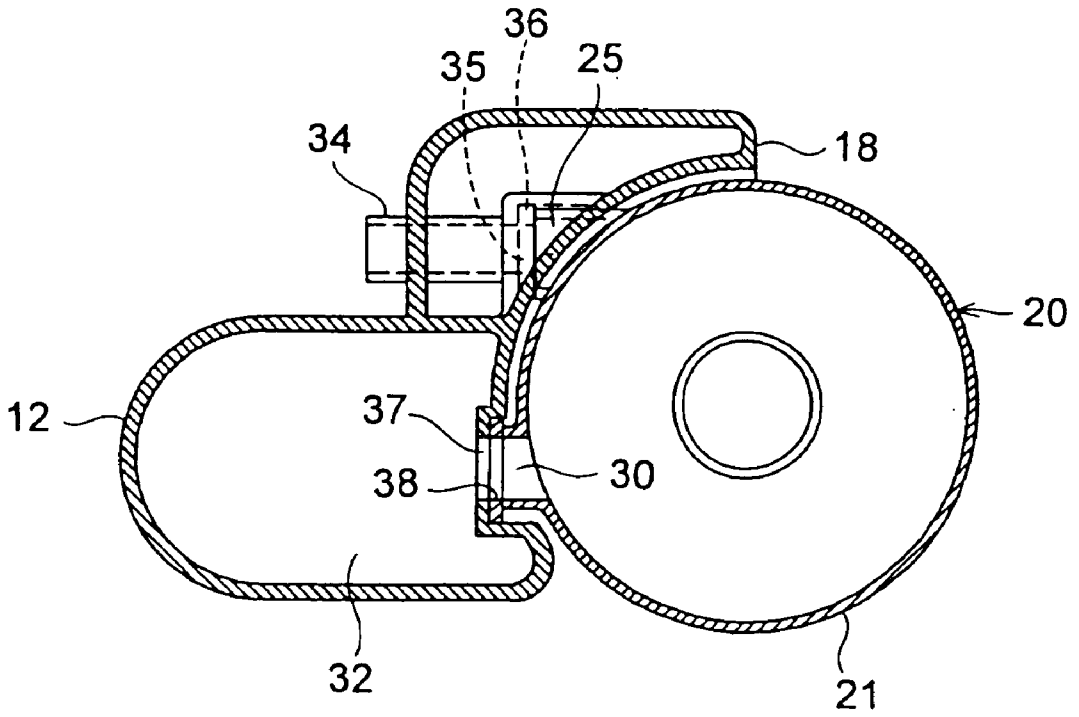

FIG.7

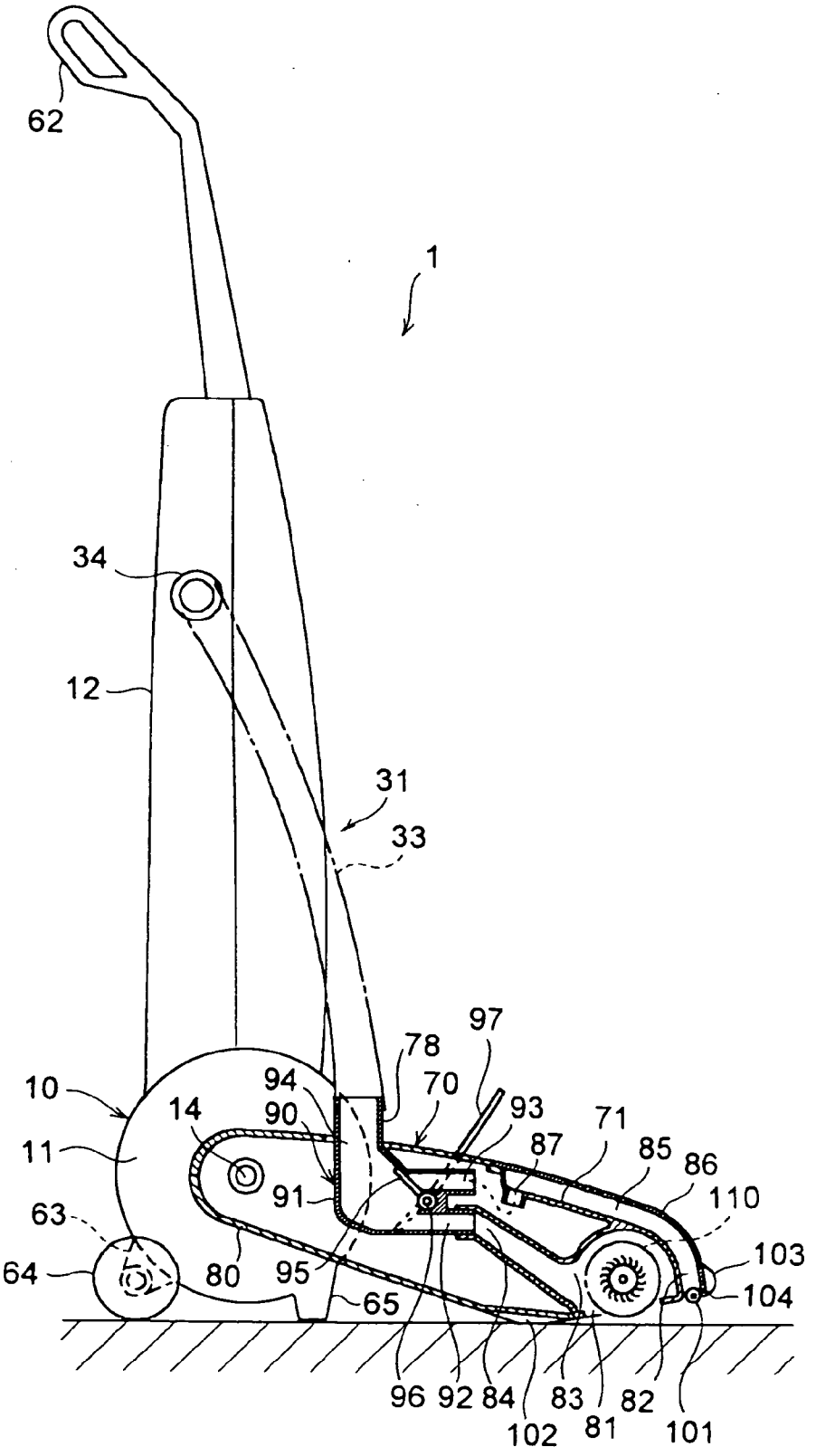
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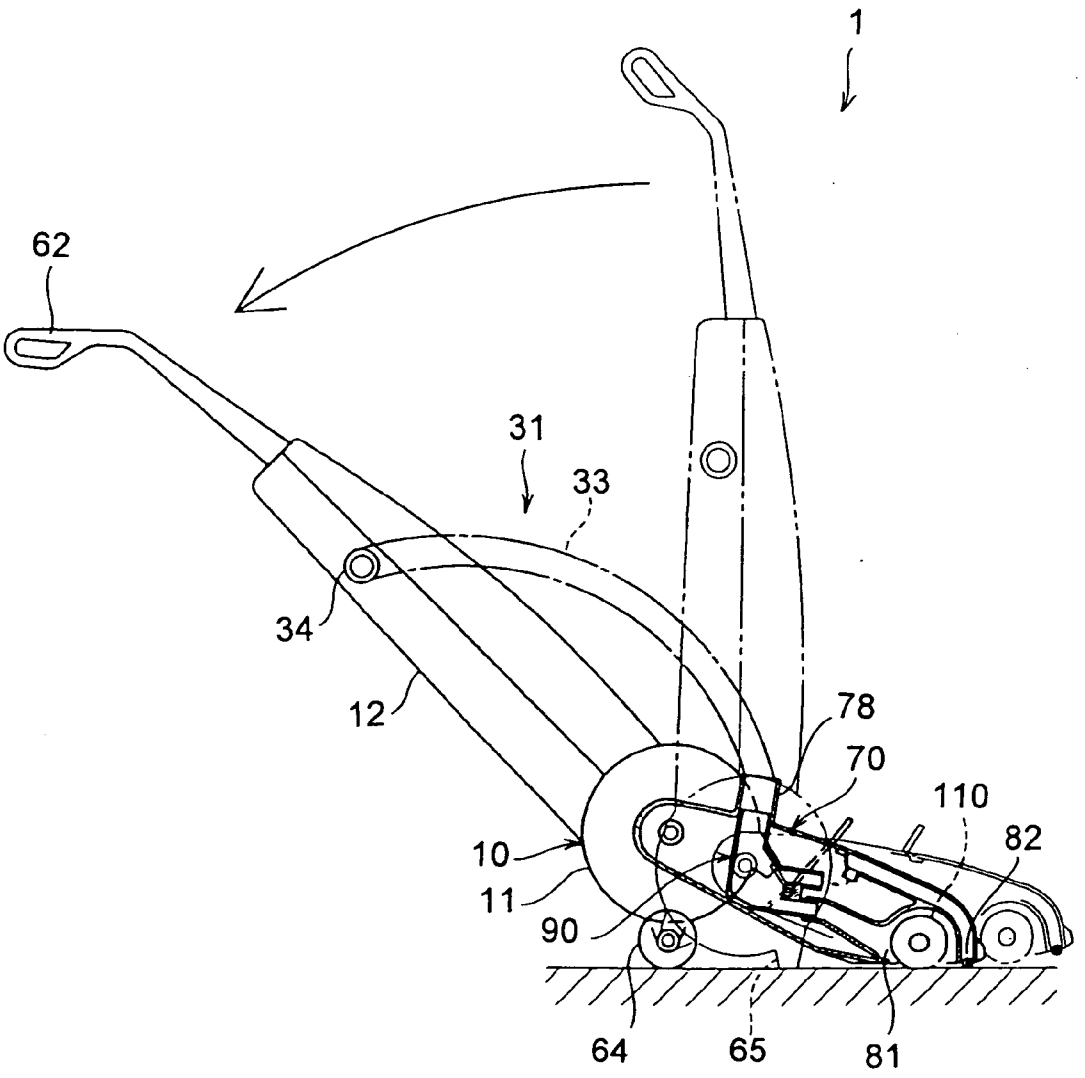
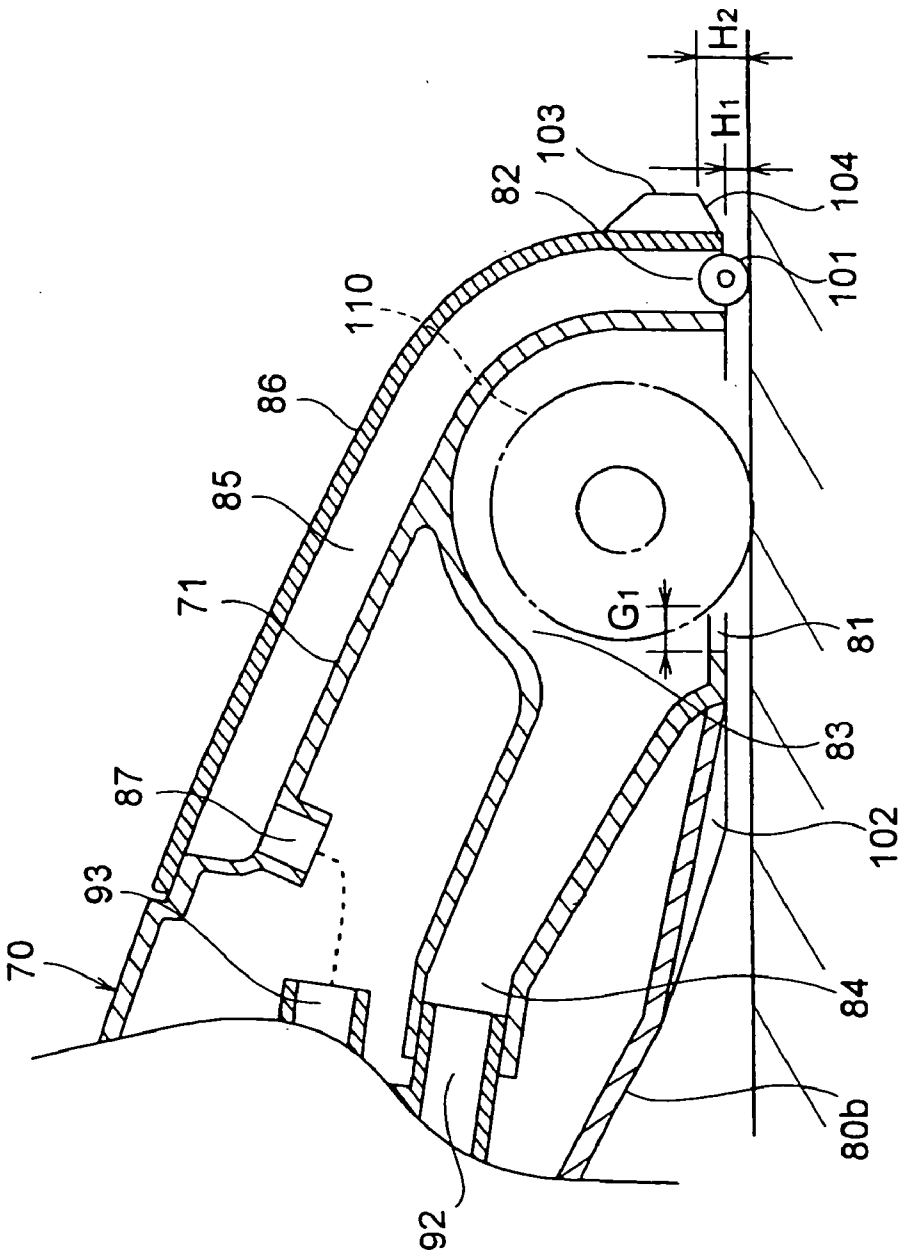
FIG.8





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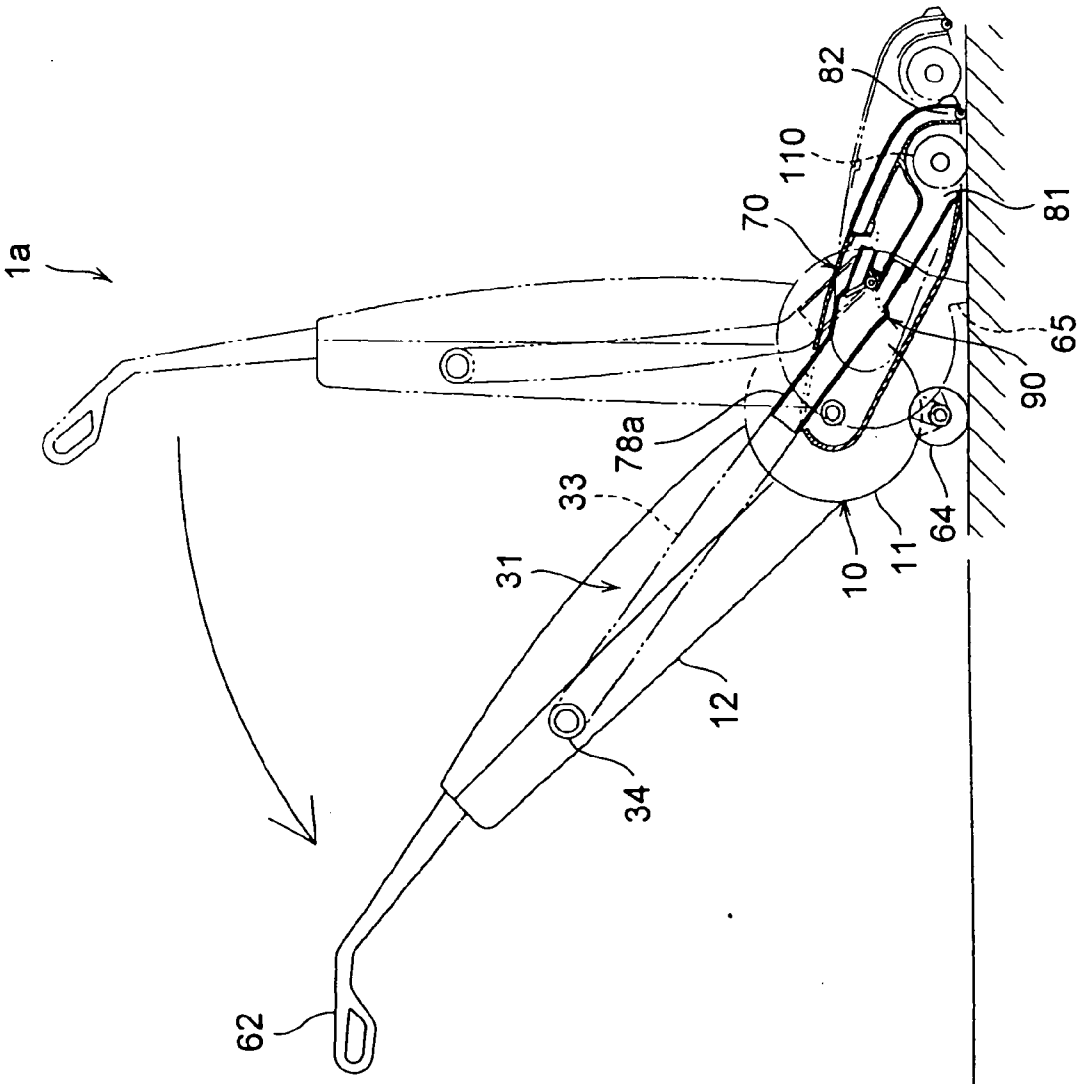

FIG.10

FIG.11

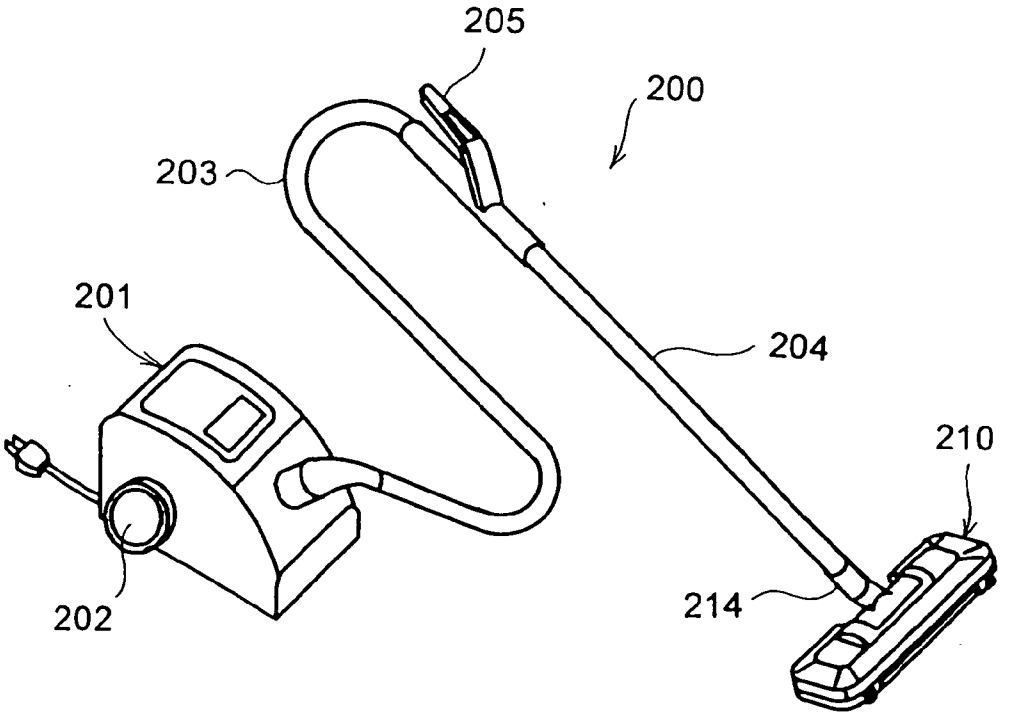
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FIG.12

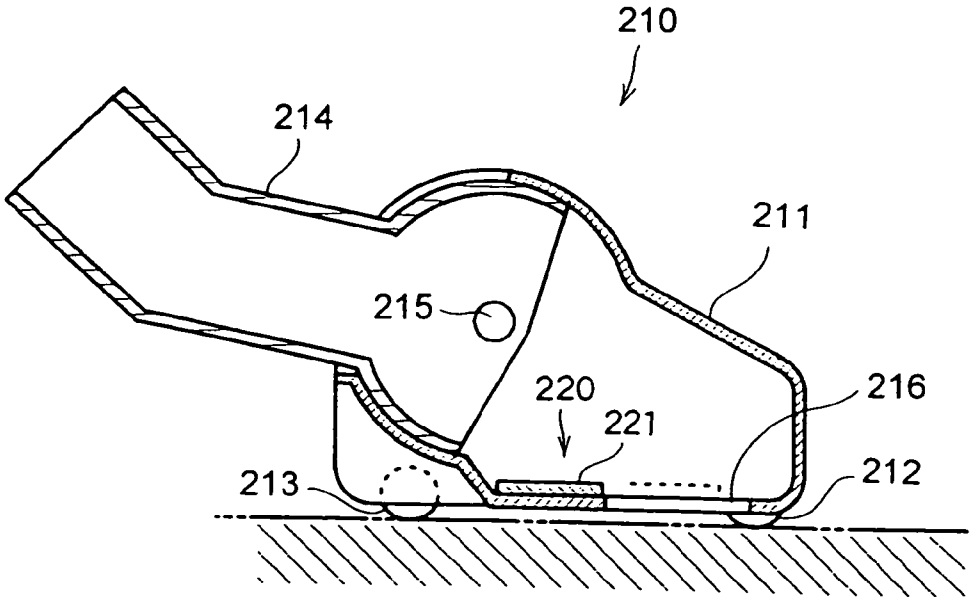
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FIG.13

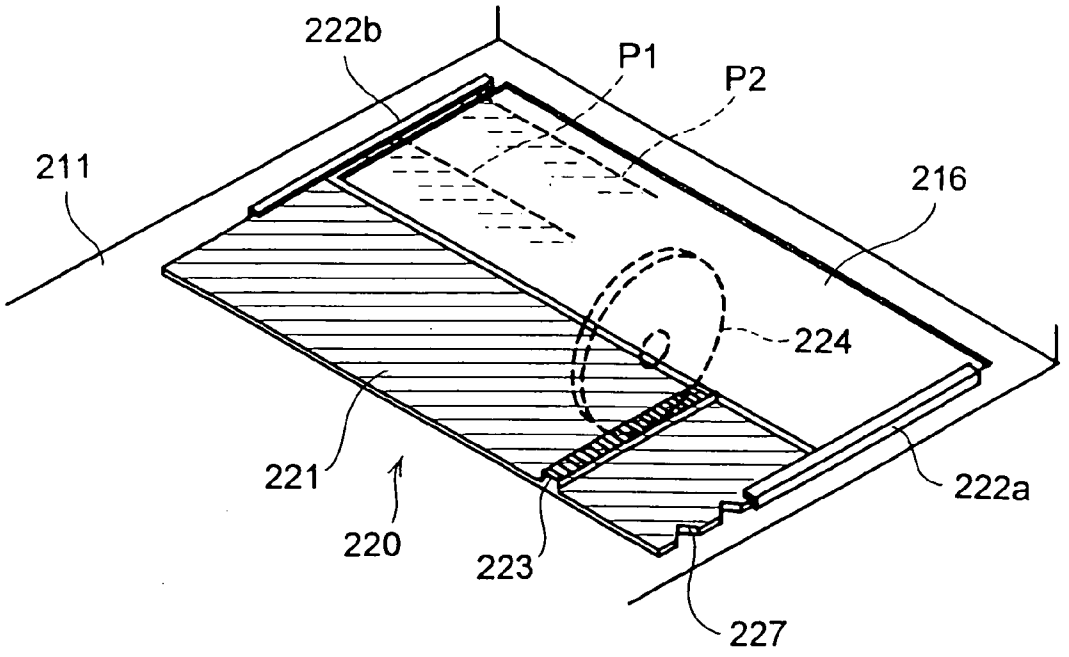
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FIG.14

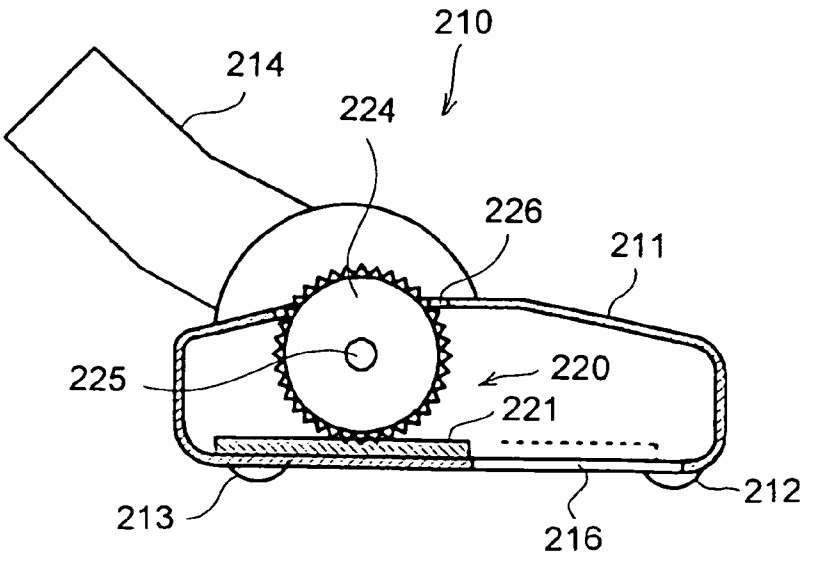
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FIG.15

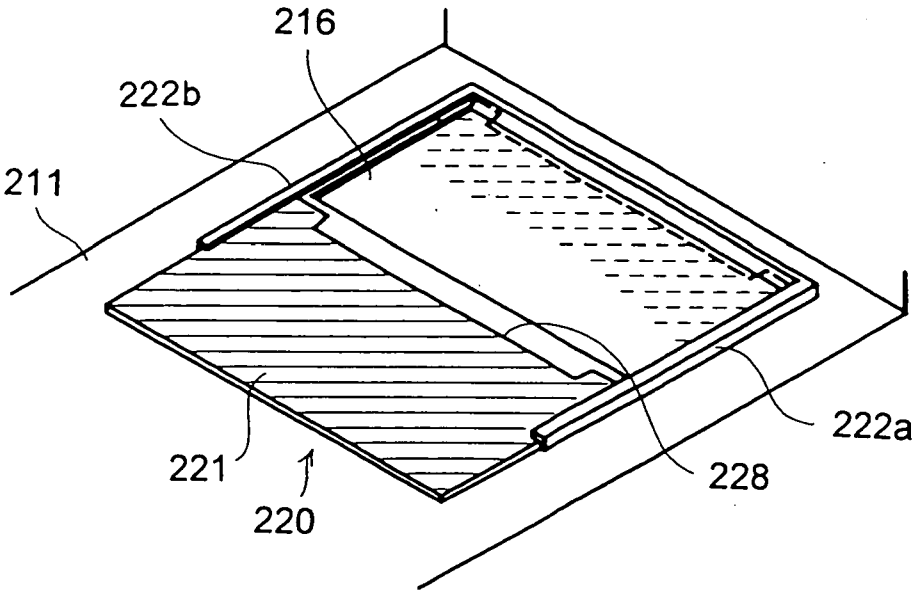
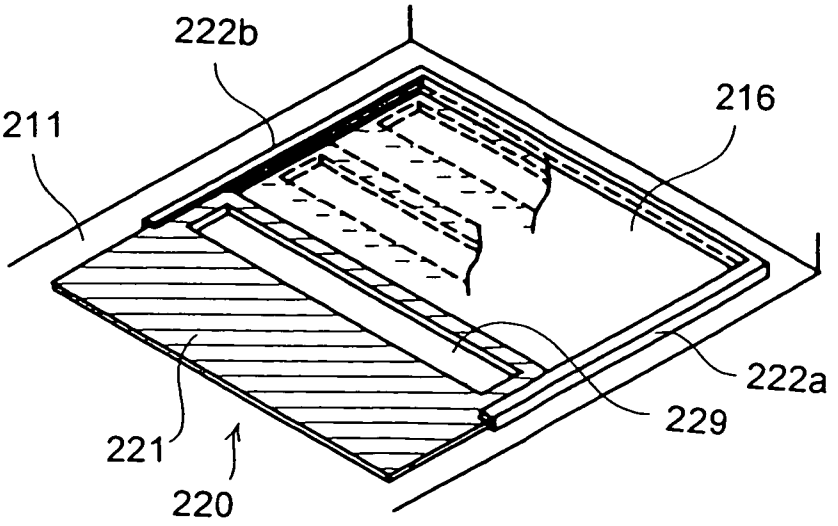


FIG.16



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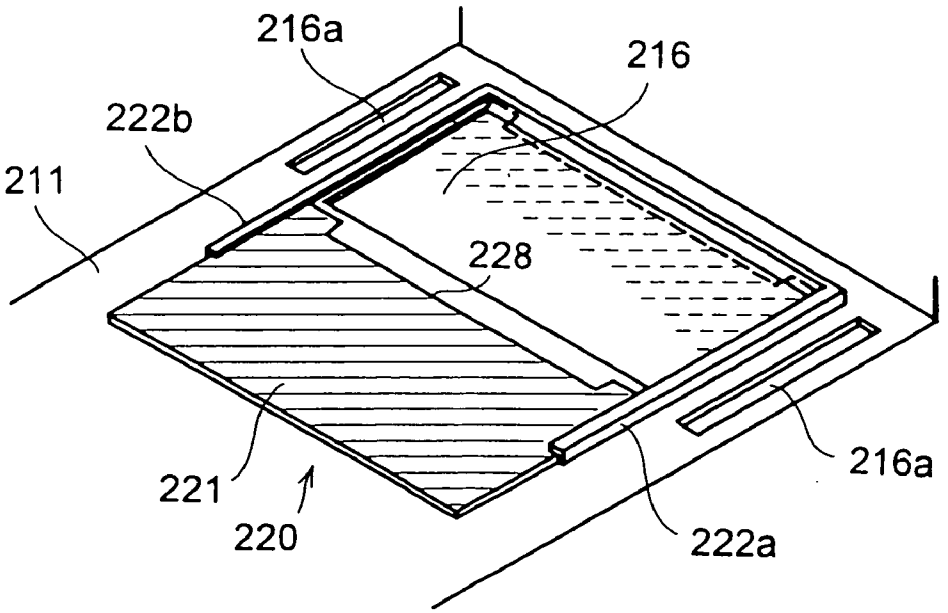
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FIG.18

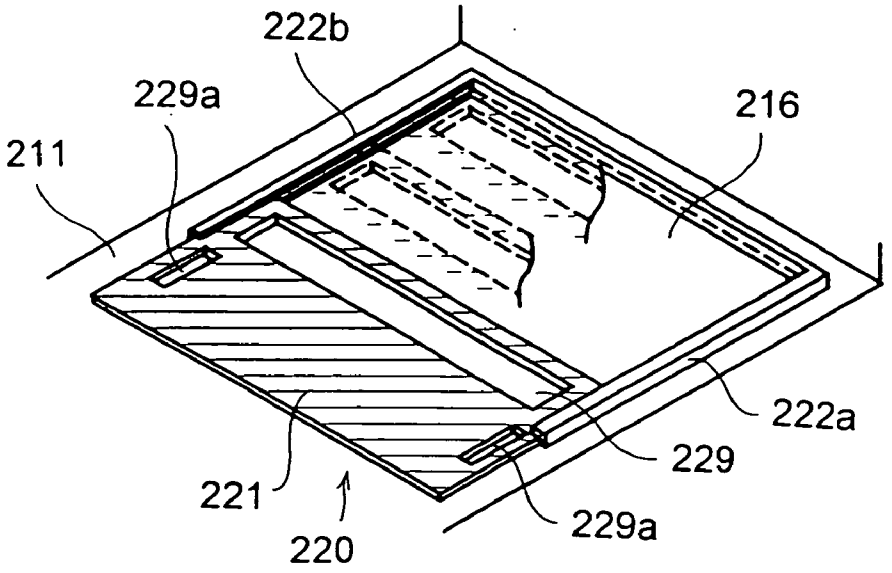
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FIG.19

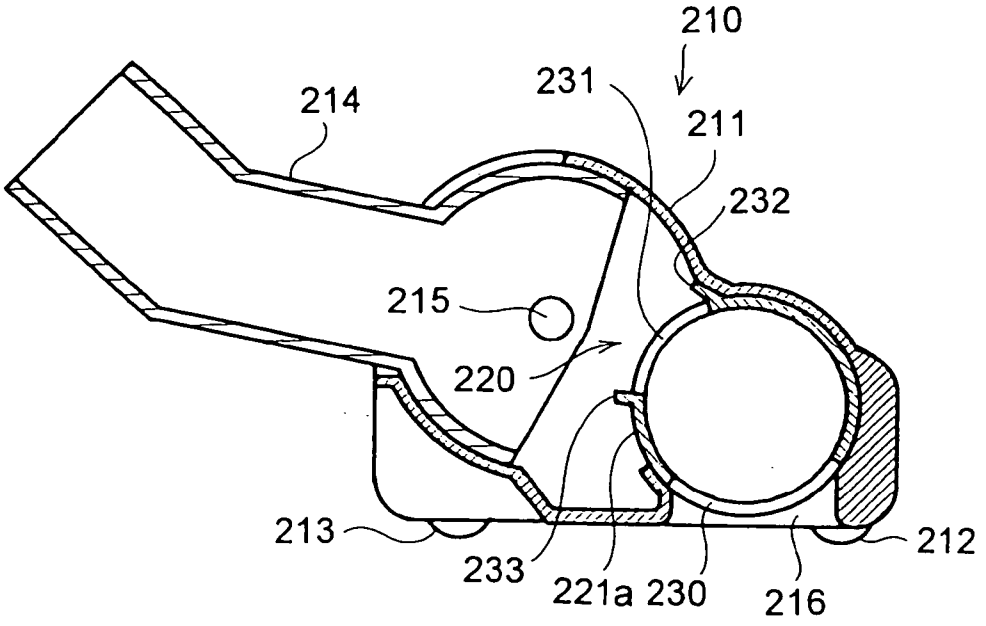
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FIG.20

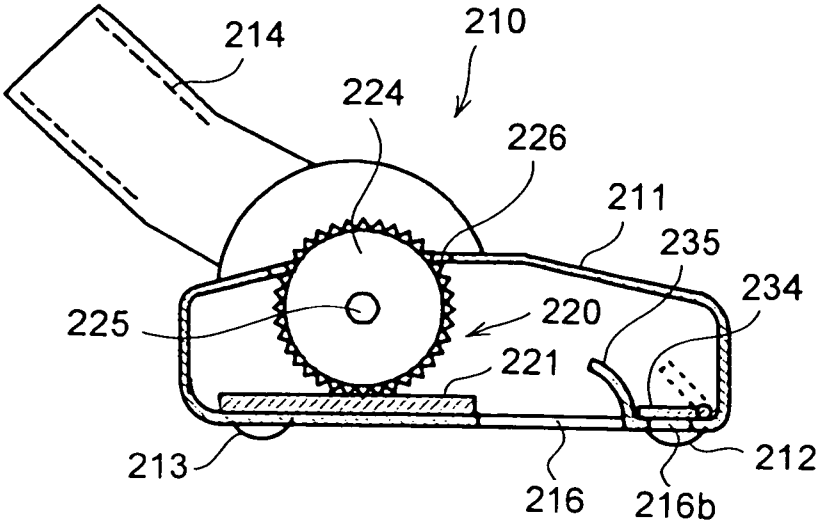
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FIG.21

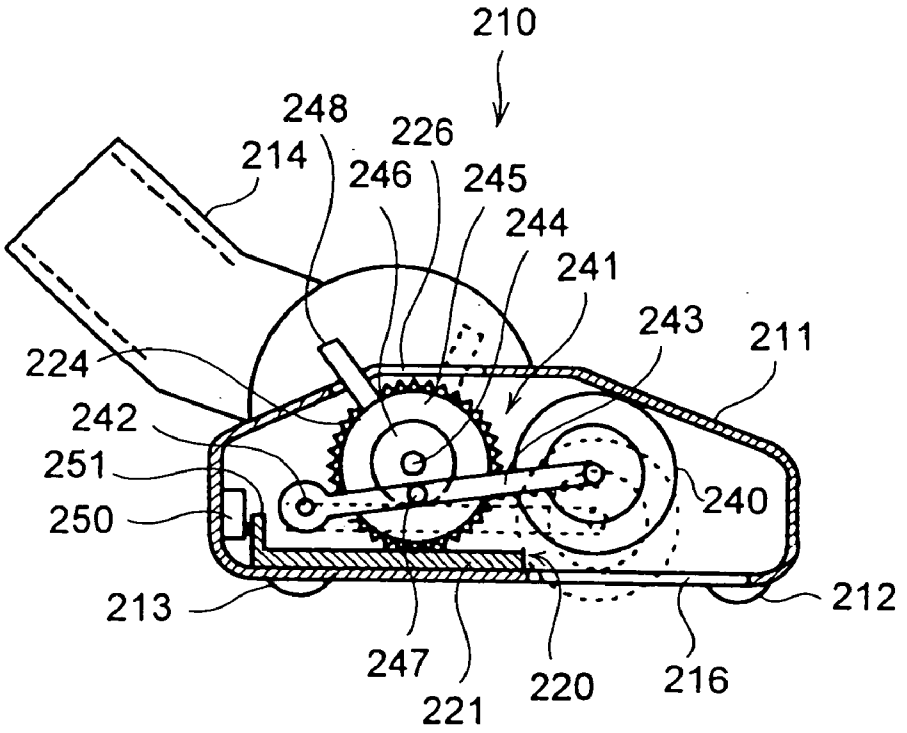
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FIG.22

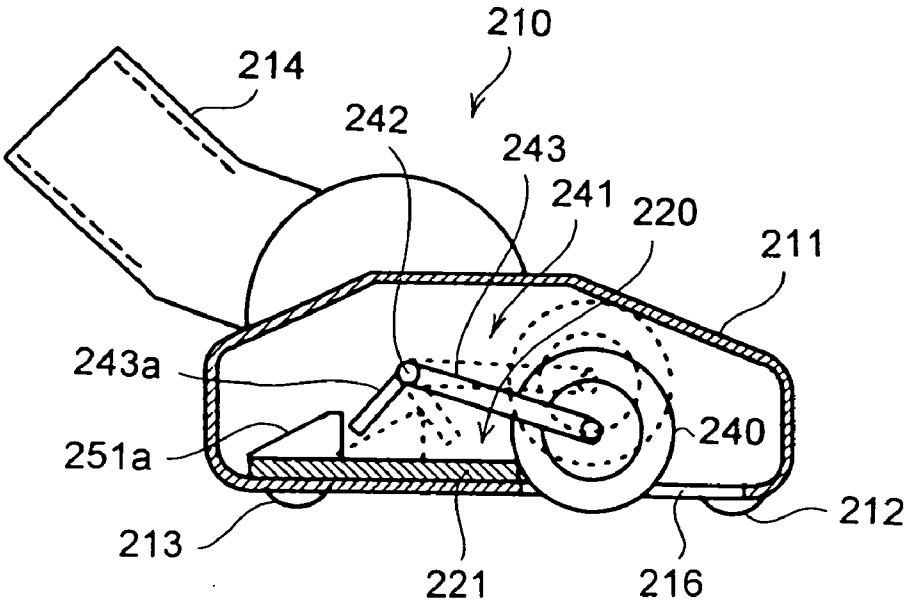
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FIG.23

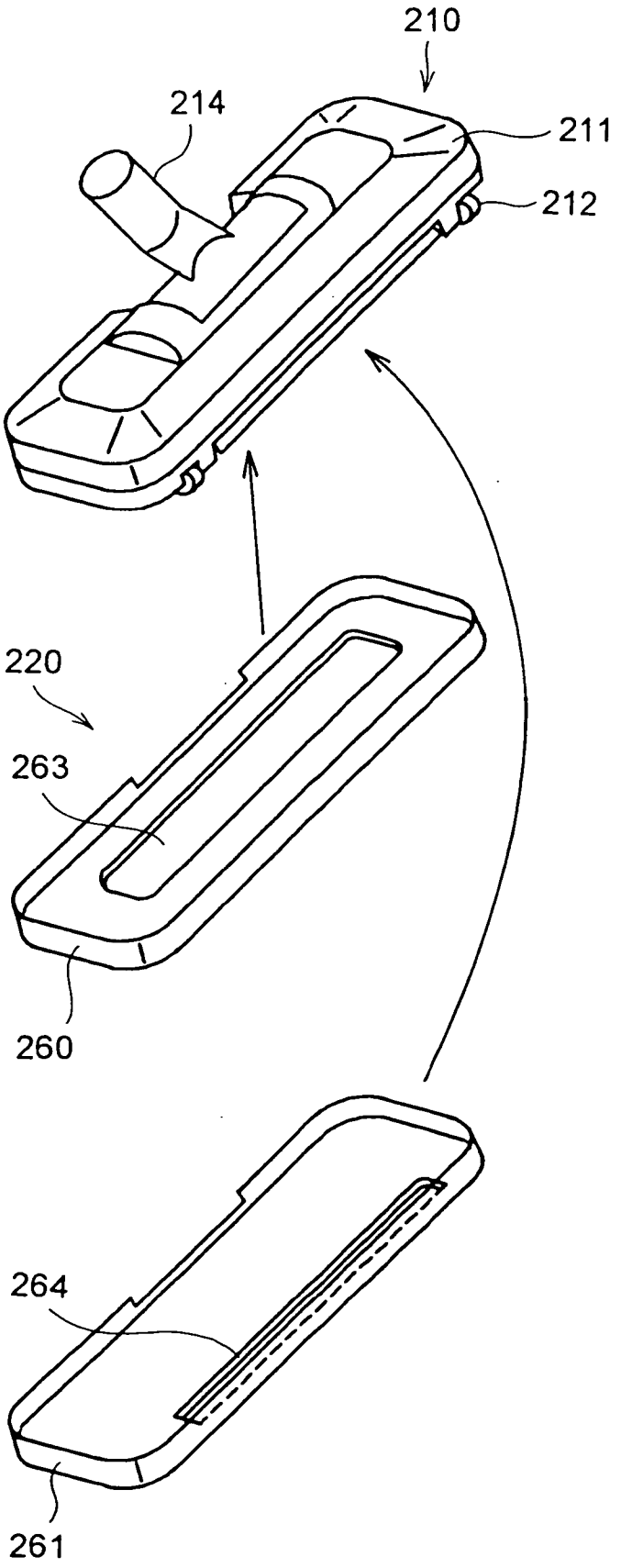


FIG.24

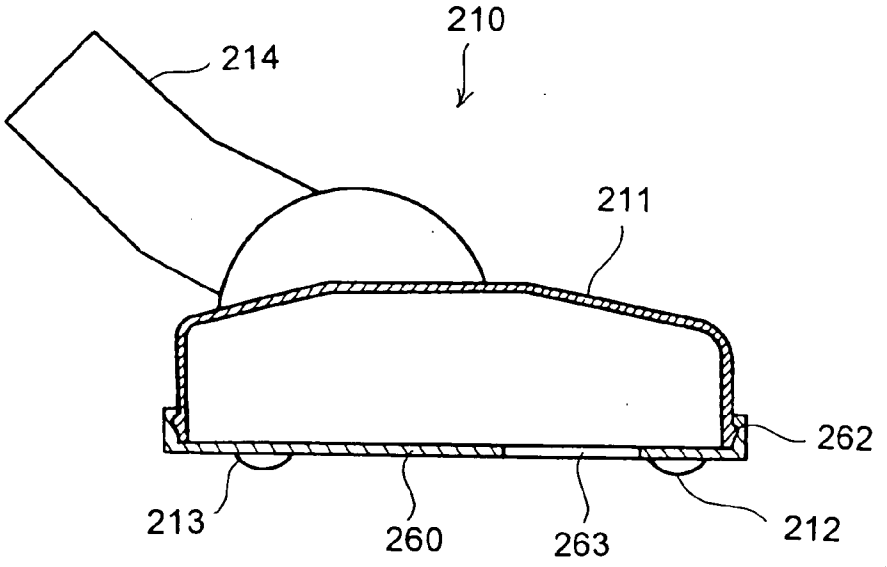
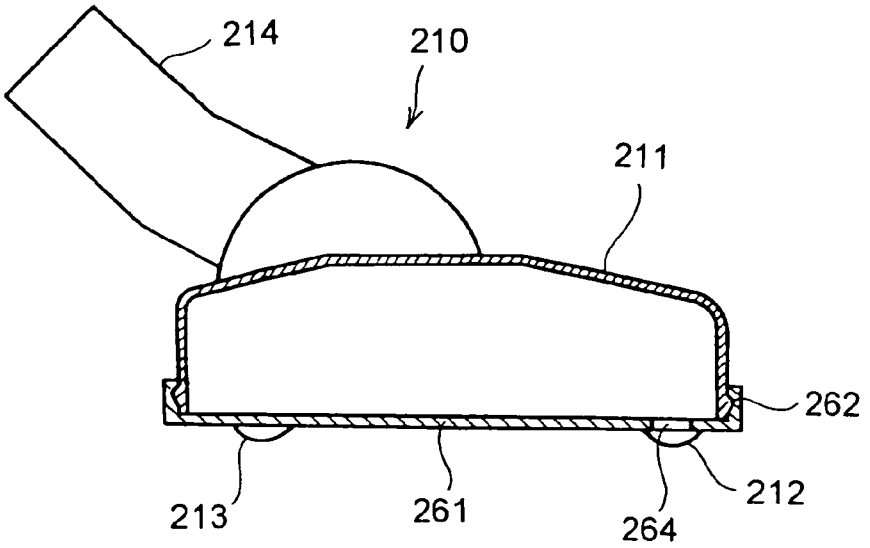


FIG.25



SUCTION CLEANER

TECHNICAL FIELD

[0001] The present invention relates to a suction cleaner, and particularly to the suction mouth portion thereof.

BACKGROUND ART

[0002] A suction cleaner sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth, and then introduces the air stream thus sucked in into a dust collecting device to collect the dust. These days, for houses fitted with carpets, many cleaners are, at their suction mouth, provided with an agitator for raking dust off a carpet. Examples of suction cleaners provided with an agitator are disclosed in Japanese Patent Applications Laid-Open Nos. S61-191329 and H8-164095.

[0003] In a house, the condition of the floor differs from place to place. In some places flooring or linoleum is exposed, while in other places the floor is covered with carpets or rugs. For optimum cleaning efficacy, the structure of the suction mouth of a suction cleaner should ideally be altered by whether it is used on flooring or linoleum or used on a carpet or rug. In most cases, it is not advisable to attempt to adapt a single suction mouth for all types of floor. On the other hand, it is troublesome to interchange suction mouths every time a different type of floor is encountered. Compared with a large-scale building with expanses of a single type of floor, an average house tends to more frequently require the interchanging of suction mouths, and improvements have been sought to overcome this inconvenience.

DISCLOSURE OF THE INVENTION

[0004] According to the present invention, in a suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust, the suction mouth unit is provided with a plurality of suction mouths that communicate individually with different suction passages that are independent of one another, the opening area of the second suction mouth is made smaller than the opening area of the first suction mouth, and at least part of the second suction mouth is located in front of the first suction mouth. With this construction, it is possible to use two types of suction mouth by the use of a single suction mouth unit. Moreover, by the use of the first suction mouth, which has the larger opening area, it is possible to apply a suction pressure in a wide area and, by the use of the second suction mouth, which has the smaller opening area, it is possible to produce a high-speed suction air stream. Furthermore, since part of the second suction mouth is located in front of the first suction mouth, the second suction mouth, through which a high-speed air stream flows, is located in front of the first suction mouth. This makes cleaning in a corner of a room easy.

[0005] In the suction cleaner constructed as described above, there is provided a suction mouth switching device that permits selective use of the first and second suction mouths, and part of the suction passage leading from the second suction mouth to the suction mouth switching device is formed as a removable lid. With this construction, it is possible to select and use the desired one among the plurality of suction mouths by operating the suction mouth switching device, and thus there is no need to bother to interchange suction mouth units. Moreover, since part of the suction passage leading from the second suction mouth to the suction mouth switching device is formed as a removable lid, when the lid is removed, it is easy to dispose of dust obstructing the suction passage. Even if the dust clings to the suction passage, it can easily be removed.

[0006] In the suction cleaner constructed as described above, there is provided a suction mouth switching device that permits selective use of the first and second suction mouths, the suction mouth switching device includes a switch valve that selectively closes the suction passages that communicate respectively with the first and second suction mouths, and the rotation shaft of the switch valve is arranged on the upstream side of the air stream. With this construction, dust is less likely to be caught on the rotation shaft. This helps reduce the incidence of faults such as unsmooth movement or incomplete closure of the switch valve.

[0007] In the suction cleaner constructed as described above, a left-hand protruding portion and a right-hand protruding portion are formed on the suction mouth unit, and a cleaner main unit is arranged between the left-hand and right-hand protruding portions and is rotatably coupled to the suction mouth unit, with the suction mouth switching device arranged in one of the left-hand and right-hand protruding portions. With this construction, it is possible to arrange the suction mouths and the suction mouth switching device in basically separate places. Thus, in spite of the provision of the plurality of suction mouths, it is possible to make the construction around the suction mouths compact. In particular, it is possible to shorten the width of the suction mouth unit in the front/rear direction thereof.

[0008] According to the present invention, in a suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust, the suction mouth is provided with an opening area adjusting device that adjusts the opening area of the suction mouth, an agitator is provided inside the suction mouth unit, and the agitator can be driven when the opening area of the suction mouth is adjusted by the opening area adjusting device to a size suitable for the agitator to be driven. With this construction, it is possible to adjust the opening area according to the type of floor to obtain a suction air stream speed that suits the type of floor. Moreover, it is possible to drive the agitator while keeping the suction mouth so wide open as to be suitable for the driving of the agitator. This makes it possible to make the most of the function of the agitator.

[0009] According to the present invention, in a suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust, the suction mouth is provided with an opening area adjusting device that adjusts the opening area of the suction mouth, and inside the suction mouth unit are provided an agitator and a height controlling device that controls the degree in which the agitator protrudes from the suction

mouth. With this construction, it is possible to protrude the agitator only when necessary and to retract it into the suction mouth when not necessary. This helps prevent the agitator from unnecessarily damaging the floor and from being unnecessarily worn.

[0010] In the suction cleaner constructed as described above, the agitator is protruded to an operation position by the height controlling device when the opening area of the suction mouth is adjusted by the opening area adjusting device to a size suitable for the agitator to be driven. With this construction, it is possible, only when necessary, to protrude the agitator through the suction mouth adjusted to an area suitable for its driving and, when not necessary, to retract it into the suction mouth. This makes it possible not only to make the most of the function of the agitator but also to prevent the agitator from unnecessarily damaging the floor and from being unnecessarily worn.

[0011] In the suction cleaner constructed as described above, a plurality of covers are provided that each have a suction mouth opening and that are removably coupled to the suction mouth unit, and the opening area adjusting device is realized by varying the areas of the suction mouth openings of the individual covers. With this construction, it is possible to adjust the opening area of the suction mouth without providing a complicated mechanism the suction mouth openings of the individual covers. With this construction, it is possible to adjust the opening area of the suction mouth without providing a complicated mechanism inside the suction mouth unit.

BRIEF DESCRIPTION OF DRAWINGS

[0012] **FIG. 1** is an external perspective view of the suction cleaner of a first embodiment.

[0013] **FIG. 2** is a partial vertical sectional view of a suction mouth unit of the suction cleaner.

[0014] **FIG. 3** is an exploded external perspective view of the suction cleaner.

[0015] **FIG. 4** is a vertical sectional view of the suction cleaner.

[0016] **FIG. 5** is a vertical sectional view of the suction cleaner, cut along a plane perpendicular to **FIG. 4**.

[0017] **FIG. 6** is a partial horizontal sectional view of a cleaner main unit of the suction cleaner.

[0018] **FIG. 7** is a side view of the suction cleaner, with the suction mouth unit shown in a section thereof.

[0019] **FIG. 8** is a side view similar to **FIG. 7**, showing a different operation state.

[0020] **FIG. 9** is a partial enlarged sectional view of the suction mouth unit in the operation state shown in **FIG. 8**.

[0021] **FIG. 10** is a side view similar to **FIG. 8**, showing the suction cleaner of a second embodiment of the invention.

[0022] **FIG. 11** is an external perspective view of the suction cleaner of a third embodiment of the invention.

[0023] **FIG. 12** is a vertical sectional view of the suction mouth unit of the suction cleaner of the third embodiment.

[0024] **FIG. 13** is an internal partial perspective view of the suction mouth unit of the suction cleaner of a fourth embodiment of the invention.

[0025] **FIG. 14** is a vertical sectional view of the suction mouth unit of the suction cleaner of the fourth embodiment.

[0026] **FIG. 15** is an internal partial perspective view of the suction mouth unit of the suction cleaner of a fifth embodiment of the invention.

[0027] **FIG. 16** is an internal partial perspective view of the suction mouth unit of the suction cleaner of a sixth embodiment of the invention.

[0028] **FIG. 17** is an internal partial perspective view of the suction mouth unit of the suction cleaner of a seventh embodiment of the invention.

[0029] **FIG. 18** is an internal partial perspective view of the suction mouth unit of the suction cleaner of an eighth embodiment of the invention.

[0030] **FIG. 19** is an vertical sectional view of the suction mouth unit of the suction cleaner of a ninth embodiment of the invention.

[0031] **FIG. 20** is an vertical sectional view of the suction mouth unit of the suction cleaner of a tenth embodiment of the invention.

[0032] **FIG. 21** is an vertical sectional view of the suction mouth unit of the suction cleaner of an eleventh embodiment of the invention.

[0033] **FIG. 22** is an vertical sectional view of the suction mouth unit of the suction cleaner of a twelfth embodiment of the invention.

[0034] **FIG. 23** is a perspective view of the suction mouth unit of the suction cleaner of a thirteenth embodiment of the invention.

[0035] **FIG. 24** is a vertical sectional view of the suction mouth unit of the suction cleaner of the thirteenth embodiment.

[0036] **FIG. 25** is a vertical sectional view of the suction mouth unit of the suction cleaner of the thirteenth embodiment, showing a use state different from that shown in **FIG. 24**.

BEST MODE FOR CARRYING OUT THE INVENTION

[0037] Hereinafter, the construction of the suction cleaner **1** of a first embodiment of the invention will be described with reference to FIGS. **1** to **9**. The suction cleaner **1** is of a so-called upright type. In the following descriptions of the construction of the suction cleaner **1**, the directions are defined as follows: assuming that the suction cleaner **1** is placed in front of a user, who is thus standing behind the suction cleaner **1** so as to operate it from behind, the side of the suction cleaner **1** at which the user is standing is referred to as the rear side of the suction cleaner **1**, and the side opposite thereto is referred to as the front side of the suction cleaner **1**, when the suction cleaner **1** is observed from the front side thereof, the side thereof located at the same side as the observer's left hand is referred to as the left-hand side of the suction cleaner **1**, and the side opposite thereto is referred to as the right-hand side of the suction cleaner **1**.

[0038] The suction cleaner **1** divides roughly into two parts, namely a cleaner main unit **10** and a suction mouth unit **70**. The suction mouth unit **70** is formed as a shell (for example, a molding of synthetic resin) that is structured as follows. At the center is provided a flat-box-shaped shell center piece **71**, and on the left-hand and right-hand sides thereof are provided shell side pieces **72** and **73**. The rear portions of the shell side pieces **72** and **73** protrude further rearward than the shell center piece **71** so as to form rearward protruding portions **74** and **75**. The suction mouth unit **70** as a whole has a C-shaped horizontal section so as to receive the cleaner main unit **10** between the rearward protruding portions **74** and **75**. In the following descriptions of the construction of the cleaner main unit **10**, in particular those directed to how the individual components are spatially arranged, it is assumed that the cleaner main unit **10** is held with its length direction vertically aligned.

[0039] The cleaner main unit **10** is composed of two shell portions, namely a cylindrical blower shell **11** and a dust collecting device holder **12** that protrudes from the blower shell **11**. Inside the blower shell **11** is arranged an electric blower **13** (see **FIG. 5**). The axial line of the electric blower **13** is substantially parallel to the axial line of the blower shell **11**, and their axial lines are both substantially horizontal.

[0040] The blower shell **11** is arranged, with its axial line aligned substantially horizontally, behind the suction mouth unit **70**, between the rearward protruding portion **74** and **75**. The blower shell **11** has pivot shafts arranged along its axial line and fitted into the rearward protruding portions **74** and **75**. Fitted into the rearward protruding portion **74** so as to be pivoted in a bearing **76** formed therein is a pivot shaft **14***a* that protrudes from an end surface of the blower shell **11**. Fitted into the rearward protruding portion **75** is a drive axis **15**, which is an extension of the motor spindle of the electric blower **13**. This drive axis **15** is enclosed in a cylindrical pivot shaft **14***b* that protrudes from an end surface of the blower shell **11** and that is pivoted in a bearing **77** formed in the rearward protruding portion **75**. Thus, with the left-hand and right-hand pivot shafts **14***a* and **14***b*, the blower shell **11** is rotatably coupled to the suction mouth unit **70**.

[0041] The dust collecting device holder **12** is hollow, and is elongate as a whole so as to have a lengthwise direction. Its lengthwise direction is substantially perpendicular to the axial line of the blower shell **11**. The dust collecting device holder **12** protrudes from the blower shell **11** not at the center thereof but at a position deviated either leftward or rightward therefrom. In the first embodiment, the dust collecting device holder **12** protrudes from a left-hand portion of the blower shell **11**.

[0042] In one side face of the dust collecting device holder **12** are formed a base **16** and an overhang **17** for supporting the bottom and top, respectively, of a dust collecting device, which will be described later. The base **16** is formed as an elevation on the blower shell **11**, and the overhang **17** is formed in the side face of the dust collecting device holder **12**. The base **16** and the overhang **17** are located above the blower shell **11**, and are thus located on the right-hand side of the dust collecting device holder **12**. Between the base **16** and the overhang **17** is formed a rear support wall **18** (see **FIGS. 3 and 6**). The rear support wall **18** is formed in the side face of the dust collecting device holder **12**.

[0043] The dust collecting device holder **12** holds a dust collecting device **20**. The dust collecting device **20** collects dust on the principle of a cyclone, i.e., by making an air stream swirl at a high speed inside an elongate cylindrical dust cup **21**. As shown in **FIG. 5**, the interior of the dust cup **21** is divided by a horizontal partition wall **22** into two, i.e., upper and lower, sections. The lower section is a centrifugal separation chamber **23** and the upper section is an exhaust chamber **24**.

[0044] The centrifugal separation chamber **23** has an inflow port **25** formed in the side surface thereof. The inflow port **25** is formed at such a position and an angle as to produce a swirling air stream along the inner circumferential wall of the centrifugal separation chamber **23**.

[0045] At the center of the centrifugal separation chamber **23** is arranged an exhaust cylinder **26**. The exhaust cylinder **26** is a cylindrical, basket-like member that is closed at the lower end and open at the upper end. The upper, open end of the exhaust cylinder **26** is joined to a throughflow port **27** formed at the center of the partition wall **22**, so that the exhaust cylinder **26** is supported by the partition wall **22** by being suspended therefrom. Over the outer circumferential surface of the exhaust cylinder **26** is laid a filter with a fine mesh woven of synthetic resin such as nylon.

[0046] At the lower end of the exhaust cylinder **26** is fitted a stabilizer **29**. The stabilizer **29** is composed of four wing pieces combined together so as to have a cross-shaped horizontal section, and reaches, at the lower end, close to the bottom surface of the dust cup **21**. The stabilizer **29** promotes the separation of dust from the air stream, and also suppresses the movement of the dust collected at the bottom of the dust cup **21**.

[0047] In the exhaust chamber **24** is formed an outflow port **30**. As shown in **FIG. 6**, the inflow port **25** and the outflow port **30** are formed in the portion of the side surface of the dust collecting device **20** facing the dust collecting device holder **12**. The inflow port **25** and the outflow port **30** point in the same direction, specifically substantially leftward.

[0048] For the inflow port **25** of the dust collecting device **20** is provided a first air passage **31**, and for the outflow port **30** is provided a second air passage **32**. The first air passage **31** communicates with an inflow port of the suction mouth unit **70** (which will be described in detail later) so that the air stream sucked in through a suction mouth is fed to the inflow port **25**. The second air passage **32** communicates with the suction port of the electric blower **13** so that the air stream exiting from the outflow port **30** is fed to the electric blower **13**.

[0049] The principal portion of the first air passage **31** is formed with a flexible hose **33**. One end of the flexible hose **33** is connected to one end of a connection pipe **34** (see **FIG. 6**) formed horizontally on the dust collecting device holder **12**. The other end of the connection pipe **34** serves as an outlet **35** of the first air passage **31**, and is connected to the inflow port **25** of the dust collecting device **20**. To achieve air-tight connection of the inflow port **25**, the outlet **35** is fitted with a seal ring **36**. The other end of the flexible hose **33** is removably fitted to a connection pipe **78** that protrudes from the upper surface of the shell side piece **72**. The connection pipe **78** communicates with the suction mouth described later.

[0050] The principal portion of the first air passage **31** may be formed with any other tubular member than a flexible hose. For example, it is possible to use instead a plurality of hard pipes that are telescopically connected together. What is important here is that any tubular member can be used instead so long as it can absorb the variation of the distance between the connection pipe **34** and the connection pipe **78** between when the cleaner main unit **10** is held upright and when it is inclined, and so long as it does not collapse when the pressure inside it becomes lower than the atmospheric pressure.

[0051] The second air passage **32** is formed with the hollow space inside the dust collecting device holder **12** itself This hollow space is, at the upper end, separated by a partition wall **12***a* (see **FIG. 5**), and thus the second air passage **32** does not communicate with the space around the overhang **17**. In the side surface of the dust collecting device holder **12**, at a position corresponding to the outflow port **30** of the dust collecting device **20**, is formed an inlet **37** to the second air passage **32**. To achieve air-tight connection of the outflow port **30**, the inlet **37** is fitted with a seal ring **38**.

[0052] As shown in **FIG. 5**, the lower end of the second air passage **32** reaches the bottom of the blower shell **11**. In the side wall at the lower end of the second air passage **32** is formed an outlet **39**. To the outlet **39** is directly connected the suction port **13***a* of the electric blower **13** with an anti-vibration cushion **40** interposed therebetween that also serves to achieve air-tight connection.

[0053] The dust collecting device **20** is fitted to the dust collecting device holder **12** by being pressed onto it with the lengthwise direction of the former aligned with the lengthwise direction of the latter. More specifically, the dust collecting device **20** is fitted into position by being inserted into the space surrounded by the base **16**, the overhang **17**, and the rear support wall **18**. For easy insertion, and for secure holding, special consideration is given to the following details.

[0054] The lower surface of the overhang **17** is slanted so as to rise rightward so that the gap between the overhang **17** and the base **16** increases rightward. Correspondingly, the upper surface of the dust collecting device **20** is slanted so as to rise rightward so that the height of the dust collecting device **20** decreases leftward and increases rightward. This makes it easy to insert the dust collecting device **20** from the right side, and also, at the last stage of insertion, the dust collecting device **20** to be pressed downward by a wedge effect exerted by the slanted surfaces so as to be securely seated on the base **16**.

[0055] Making the lower surface of the overhang **17** and the upper surface of the dust collecting device **20** slant also offers the following advantage. When the dust collecting device **20** is inserted, unless it is held in a predetermined orientation, i.e., unless it is held at a predetermined angle in the horizontal plane, it cannot be inserted to the end. This permits the inflow port **25** and the outflow port **30** to be snugly fitted to the outlet **35** of the first air passage **31** and the inlet **37** of the second air passage **32**.

[0056] On the upper surface of the base **16** is formed a low-profile guide rib **41** so as to extend in the left/right direction. In the bottom surface of the dust collecting device **20** is formed a groove **42** that engages with the guide rib **41** (see **FIG. 3**). The guide rib **41** is so long as to almost reach the dust collecting device holder **12**, and the groove **42** is correspondingly long.

[0057] The guide rib **41** serves as a guide for the insertion of the dust collecting device **20**. When the dust collecting device **20** is inserted until it reaches a certain position, an end of the guide rib **41** meets an end of the groove **42**, and the dust collecting device **20** drops by the depth of the groove **42**. In this state, the dust collecting device **20** cannot be moved rightward unless raised by the depth of the groove **42** or more. Thanks to the engagement between the groove **42** and the guide rib **41**, the lower end of the dust collecting device **20** also resists a force applied in the front/rear direction (in particular against a force applied frontward, because the rear support wall **18** exists behind), and is therefore less likely to come off unintendedly.

[0058] At the upper end of the right-hand side surface of the dust collecting device **20** is fitted a slide-type latch **43**. The latch **43** is kept pressed upward by an unillustrated spring, and engages the rim of the overhang **17** at the last stage of the insertion of the dust collecting device **20**. In this state, the dust collecting device **20** cannot be removed from the dust collecting device holder **12** unless the latch **43** is pressed down against the unillustrated spring so as to be released from the overhang **17**.

[0059] **FIG. 4** shows the internal construction of the base **16**. The base **16** is formed as a component separate from the blower shell **11** and the dust collecting device holder **12**, and is fixed to the blower shell **11**. The interior of the base **16** is divided, by a vertical partition wall **44** extending in the left/right direction and a horizontal partition wall **45** provided in front of the horizontal partition wall **45**, into three chambers, namely a filter chamber **46**, an exhaust chamber **47**, and an illuminator chamber **48**.

[0060] The filter chamber **46** communicates, through a throughflow port **49** formed in the blower shell **11**, with an exhaust space **50** into which the electric blower **13** discharges air. In an upper portion of the filter is inserted a filter **51**. The filter **51** is for collecting fine dust that has passed through the filter **28** of the dust collecting device **20**, and is realized with a filter, for example a HEPA (high-efficiency particular air) filter, that has higher filtering performance than the filter **28**. The ceiling of the filter chamber **46** is formed with an operable lid **52**. Thus, when the filter **51** is clogged, the lid **52** is opened, and the filter **51** is taken out for cleaning or replacement.

[0061] The air stream having been removed dust therefrom by the filter **51** flows through a throughflow port **53** formed in the vertical partition wall **44** into the exhaust chamber **47**. In front of the exhaust chamber **47** is formed an exhaust port **54** having a plurality of horizontal slits lined in the vertical direction, so that the air stream is exhausted through those slits.

[0062] The illuminator chamber **48** is located right below the exhaust chamber **47**, and has an illuminator **55** housed inside it. Used as the illuminator **55** is a commonly used one such as an incandescent lamp, fluorescent lamp, or LED. To permit the light emitted from the illuminator **55** to illuminate, the front-half and upper-surface portion of the base **16**, i.e., the portion thereof corresponding to the exhaust chamber **47** and the illuminator chamber **48**, is formed as an

illumination cover **16***a* formed out of transparent or semitransparent synthetic resin. The dust cup **21** may also be formed out of transparent or semitransparent synthetic resin. This permits the light that travels from the illuminator chamber **48** through the exhaust chamber **47** and further upward to illuminate the interior of the dust cup **21**, and this makes the checking of the collected dust easier. With the illumination cover **16***a* removed, the maintenance, such as replacement, of the illuminator **55** can easily be performed.

[**0063**] Instead of making the entire front-half portion of the base **16** transparent or semitransparent, it is also possible to form only the front face of the illuminator chamber **48** out of a transparent or semitransparent material. In the ceiling of the illuminator chamber **48** and in the side wall surface of the throughflow port **49** is formed a small-diameter throughflow port **56** that leads to the exhaust chamber **47**.

[**0064**] Inside the overhang **17** is arranged a controller **60** (see **FIG. 5**). The controller **60** is connected to the electric blower **13** by leads. The controller **60** controls the entire suction cleaner **1**. The front portion of the upper surface of the overhang **17** is formed into an operation panel **61** having various switch buttons arranged thereon. Arranging the operation panel **61** on the overhang **17** offers easy operation.

[**0065**] At the top end of the dust collecting device holder **12** is fixed a separately formed handle **62**. Obliquely downward from a rear portion of the lower surface of the blower shell **11** protrude brackets **63**, to which are fitted wheels **64** (see **FIG. 7**). The wheels **64** are provided one at each of the left-hand and right-hand ends of the blower shell **11**. In front of the wheels **64** are formed support feet **65**, one on the left and one on the right. When the dust collecting device holder **12** is held upright, the wheels **64** and the support feet **65** permit the cleaner main unit **10** to sit on the floor at four points

[**0066**] Next, the construction of the suction mouth unit **70** will be described. As described earlier, the suction mouth unit **70** has a shell center piece **71** and shell side pieces **72** and **73** arranged on the left-hand and right-hand sides thereof, with the rear portions of the shell side pieces **72** and **73** formed into rearward protruding portions **74** and **75**. The shell center piece **71** and the shell side pieces **72** and **73** are formed integrally, for example, by molding synthetic resin. As shown in **FIG. 2**, on the inner ceiling surfaces of the shell side pieces **72** and **73** are formed a plurality of reinforcement ribs **79** so as to extend in the front/rear direction. The front ends of the reinforcement ribs **79** reach the front edges of the shell side pieces **72** and **73**. This helps increase the toughness of the suction mouth unit **70** against collision.

[**0067**] The shell center piece **71** and the shell side piece **72** have an opening at the bottom, and this opening is shut by a bottom plate **80** having a shape as shown in **FIG. 3**. In the front portion **80***a* of the bottom plate **80** are formed a plurality of suction mouths. The rear portion **80***b* of the bottom plate **80** is slanted so as to be increasingly higher rearward.

[**0068**] In the first embodiment, in the front portion **80***a* of the bottom plate **80** are formed two suction mouths, one in front of the other. The first suction mouth **81** is elongate in the left/right direction, and has a width nearly equal to the width of the suction mouth unit **70** excluding the later-described belt drive. The second suction mouth **82** is formed parallel to and in front of the first suction mouth **81**. The second suction mouth **82** has a plurality of slits arranged in series, and the sum of the opening areas of all those slits is far smaller than the opening area of the first suction mouth **81**.

[**0069**] For each of the first and second suction mouths **81** and **82**, an independent suction passage is provided. The suction passage **83** for the first suction mouth **81** is formed on the lower surface of the shell center piece **71** (see **FIG. 7**). The suction passage **83** has a funnel-like shape, and has an outflow port **84** formed at a position deviated leftward as seen from the front.

[**0070**] The suction passage **85** for the second suction mouth **82** is arranged above the suction passage **83** so as to overlap it. The suction passage **85** is formed between the upper surface of the shell center piece **71** and a lid **86** that is removably fitted at a distance therefrom. The lid **86** is formed out of a transparent or semitransparent material so that the interior of the suction passage **85** can be observed from outside. The suction passage **85** has an outflow port **87** near the center of the rear portion of the suction passage **85**. The lid **86** may be openable instead of being removable. Specifically, it may be pivotably coupled to the shell center piece **71** with a hinge, or may be slidably coupled thereto.

[**0071**] Inside the rearward protruding portion **74** of the shell side piece **72** is arranged a suction mouth switching device **90**. The suction mouth switching device **90** has a valve case **91** having two, i.e., an upper and a lower, inflow ports **92** and **93** formed in the front surface thereof. The lower inflow port **92** is connected to the outflow port **84** of the suction passage **83**, and the upper inflow port **93** is connected, through an unillustrated hose, to the outflow port **87** of the suction passage **85**.

[**0072**] In the upper surface of the valve case **91** is formed an outflow ports **94** that is shared between the inflow ports **92** and **93**. The outflow port **94** is connected to the connection pipe **78**, at which starts the first air passage **31**. The connection pipe **78** is formed integrally with the shell side piece **72**. The connection pipe **78** may be formed integrally with the valve case **91**.

[**0073**] In the valve case **91** is arranged a switch valve **95** that rotates in a vertical plane. The switch valve **95** is fitted on a rotation shaft **96** so as to rotate together. The switch valve **95** so rotates as to selectively close one of the inflow ports **92** and **93** and open the other. One end of the rotation shaft **96** protrudes out of the valve case **91**, and has a lever **97** fixed thereto. The free end of the lever **97** protrudes from the upper surface of the shell side piece **72** through a window **98** formed therein.

[**0074**] To ensure crisp switching operation of the switch valve **95**, to the rotation shaft **96** or the lever **97** is connected an unillustrated toggle spring. The rotation shaft **96** is arranged on the upstream side of the air stream inside the valve case **91** so that the function of the switch valve **95** is not hindered.

[**0075**] On the bottom surface of the suction mouth unit **70** are formed a first and a second bottom support. The first bottom support **101** is realized with wheels provided near the second suction mouth **82**, in this case at both ends of the second suction mouth **82**.

[0076] The second bottom support **102** is realized with a pair of, i.e., a left-hand and a right-hand, projections formed on the bottom plate **80**. The second bottom support **102** is formed behind the first suction mouth **81**. This position is where the inclination of the rear portion **80***b* of the bottom plate **80** starts. When the dust collecting device holder **12** is held upright, as shown in **FIG. 7**, the second bottom support **102** supports the suction mouth unit **70**, while the first bottom support **101** stays off the floor.

[0077] Reference numeral **103** represents a guide that protrudes from the front end of the suction mouth unit **70**. The guide **103** is located in front of the second suction mouth **82**, and has a width nearly equal to the total width of the suction mouth unit **70**. The lower surface of the guide **103** is a slanted surface **104** that is increasingly lowered toward the second suction mouth **82**. The front end of the slanted surface **104** is about 3 mm higher than the entrance of the second suction mouth **82**.

[0078] In the first suction mouth **81** is provided an agitator **110**. A typical example of the agitator **110** is one composed of a cylindrical rotary member having bristles planted around it forming a plurality of rows arranged at a predetermined skew angle. Instead of rows of bristles, blades of rubber or soft synthetic resin may be used. The agitator **110** has its axial line aligned with the width direction of the first suction mouth **81**, and is pivoted inside the suction mouth unit **70** with part of the outer circumferential portion of the agitator **110** protruding out of the first suction mouth **81**.

[0079] The motive power that drives the agitator **110** to rotate is derived from the drive axis **15** of the electric blower **13**. As shown in **FIG. 5**, to the drive axis **15** is fixed a source pulley **111**, and on this source pulley **111** and on a drive pulley **112** (see **FIG. 1**) fixed to the shaft of the agitator **110** is wound a belt **113**. The source pulley **111** and the belt **113** are located inside the shell side piece **73**. Instead of fixing a separate source pulley **111** to the drive axis **15**, the belt **113** may be wound directly on the drive axis **15**.

[0080] To permit the rotation of the agitator **110** to be stopped while the electric blower **13** is operating, an idler (not illustrated) is arranged by the side of the drive pulley **112**. When the belt **113** is wound on the idler, simply the idler rotates idly, and no motive power is transmitted to the agitator **110**.

[0081] A belt shifting device **120** for shifting the belt **113** is provided inside the shell side piece **73**. The belt shifting device **120** holds the belt **113** between the tongs of a fork, and, by moving the fork, shifts the belt **113** from the drive pulley **112** to the idler and vice versa. No further explanation will be given of the belt shifting device **120**. From the upper surface of the shell side piece **73** protrudes a lever **121** that is operated for belt shifting.

[0082] Next, the operation of the suction cleaner **1** will be described. When the suction cleaner **1** is not in use, i.e., when it is stored away, the dust collecting device holder **12** stands upright, and the cleaner main unit **10** sits on the floor by being supported at four points by the two wheels **64** and the two support feet **65**. In the suction mouth unit **70**, the second bottom support **102** supports the suction mouth unit **70**, while the first bottom support **101** stays off the floor (see **FIG. 7**). Also off the floor stays the agitator **110**.

[0083] When the suction cleaner **1** is used, an unillustrated power cord is extended and is connected to a power outlet, and, with the handle **62** held in one hand, the dust collecting device holder **12** is tilted as shown in **FIG. 8**. This brings the suction cleaner **1** into a cleaning operation posture. Now, the cleaner main unit **10** acts on the principle of a lever. Specifically, the handle **62** serves as the point of effort of a lever, the wheels **64** as the fulcrum thereof, and the pivot shafts **14***a* and **14***b* as the point of action thereof, with the result that the pivot shafts **14***a* and **14***b* lift up the rear portion of the suction mouth unit **70**. The support feet **65** move off the floor.

[0084] When the cleaner main unit **10** is tilted until the height of the handle **62** from the floor is about 60 to 80 cm, the second bottom support **102** moves off the floor, and the front portion **80***a* of the bottom plate **80**, where the first and second suction mouths **81** are formed, becomes nearly parallel to the floor. Thus, the first bottom support **101** and the agitator **110** make contact with the floor (see **FIG. 9**). The height of 60 to 80 cm is the height at which the handle **62** is located when an adult of average height moves the suction cleaner **1** back and forth to perform cleaning.

[0085] The degree of protrusion of the first bottom support **101** is so set that, in this state, the height (H_1 in **FIG. 9**) of the entrance of the second suction mouth **82** from the floor is 0.8 mm to 2 mm. Thus, the second suction mouth **82** can come so close to the floor as to be at that distance (0.8 mm to 2 mm) therefrom, but then the first bottom support **101** makes contact with the floor and thereby prevents the second suction mouth **82** from coming closer.

[0086] Now, a predetermined switch on the operation panel **61** is operated to drive the electric blower **13**. The electric blower **13** produces a suction pressure that reaches the suction mouth unit **70** through the suction port **13***a*, the second air passage **32**, the dust collecting device **20**, and the first air passage **31**.

[0087] If the suction mouth switching device **90** is in the state in which it selects the first suction mouth **81**, an air stream is sucked in through the first suction mouth **81**. If the suction mouth switching device **90** is in the state in which it selects the second suction mouth **82**, an air stream is sucked in through the second suction mouth **82**. When the belt shifting device **120** is so operated that the belt **113** is wound on the drive pulley **112**, the agitator **110** is driven.

[0088] Advisably, the suction mouth switching device **90** and the belt shifting device **120** are operated in an coordinated fashion so that, when the first suction mouth **81** is selected, the agitator **110** can or cannot be driven but, when the second suction mouth **82** is selected, the agitator cannot be driven at all.

[0089] The following description assumes that the suction mouth switching device **90** selects the first suction mouth **81** and the belt shifting device **120** selects the driving of the agitator. When rotating, the agitator **110** rakes dust off the floor or the covering laid thereon. When the agitator **110** is rotated on a soft flooring material (for example, a carpet with 4 mm to 20 mm long pile), the first bottom support **101** sinks into the soft flooring material. This permits the agitator **110** and the first suction mouth **81** to come close to the soft flooring material, resulting in powerful raking-off of dust and powerful suction. By setting a limit to the width of the first bottom support **101** as seen from the front (for example, by making the total width of the first bottom support **101** as

seen from the front equal to or smaller than the width of the first suction mouth **81**, or by making the width of each part of the first bottom support **101** equal to 10 mm to 20 mm), it is possible to ensure that the **101** sinks into the soft flooring material.

[**0090**] As described above, on a carpet, the first bottom support **101** sinks into the pile of the carpet, and the front portion **80***a* of the bottom plate **80** supports the suction mouth unit **70**. This helps obtain satisfactory operability on a carpet. By making the gap (G_1 in **FIG. 9**) between the outer circumference of the agitator **110** and the rear edge of the first suction mouth **81** equal to 5 mm to 10 mm, it is possible to obtain satisfactory operability and satisfactory suction performance simultaneously.

[**0091**] Moreover, the height (H_2 in **FIG. 9**) from the floor to the lower front edge of the guide **103** is about 3 mm (which may be about 3 mm to 4.5 mm) greater than the height (H_1 in **FIG. 9**) from the floor to the entrance of the second suction mouth **82**. Thus, even with the front portion **80***a* of the bottom plate **80** kept in contact with the carpet, the guide **103** does not push around dust on the carpet. The guide **103** rides over a piece of dust, if it has the size of a rice grain, and invites it into the first suction mouth **81**. To obtain satisfactory dust riding-over performance, the slanted surface **104** is advisably given an inclination not larger than 40° to 50° relative to the horizontal plane.

[**0092**] The dust raked off by the agitator **110**, along with the air stream that flows in through the first suction mouth **81**, flows through the inflow port **92** into the suction mouth switching device **90**, and then flows through the outflow port **94** of the suction mouth switching device **90** into the first air passage **31**. Having passed through the first air passage **31**, the air stream flows through the inflow port **25** into the centrifugal separation chamber **23**.

[**0093**] The air stream that has flowed in through the inflow port **25** swirls at a high speed around the exhaust cylinder **26**. The dust contained in the air stream is separated from the air stream by centrifugal force and accumulate at the bottom of the dust cup **21**. The swirling air stream having been removed dust therefrom is sucked into the exhaust cylinder **26**, and then flows into the exhaust chamber **24**. The dust that has not been separated by centrifugal force is filtered out by the filter **28**. The air stream that has flowed into the exhaust chamber **24** flows out of it through the outflow port **30**.

[**0094**] The air stream that swirls inside the centrifugal separation chamber **23** swirls not only around the exhaust cylinder **26** but also around the stabilizer **29**. Meanwhile, when the air stream collides with the wing pieces of the stabilizer **29**, the dust contained in the air stream separates therefrom and drops onto the bottom of the dust cup **21**. As the suction of dust is continued, a lump of dust grows from the bottom of the dust cup **21**. The stabilizer **29** suppresses the movement of this lump of dust so as to prevent dust from being blown up back into the air.

[**0095**] The air stream that has exited from the dust collecting device **20** flows into the second air passage **32**. The second air passage **32** runs substantially along a straight line until it finally connects to the suction port **13***a* of the electric blower **13**, and thus the air stream flows therethrough straight to the suction port **13***a* without being obstructed or intercepted in any way. Since the second air passage **32** is formed by the hollow space inside the dust collecting device holder **12** itself, it has a large cross-sectional area. This helps increase the flow efficiency of the air stream.

[**0096**] The air stream sucked into the electric blower **13** is discharged into the exhaust space **50** (see **FIG. 4**), and then flows through the throughflow port **49** into the filter chamber **46** of the base **16**. After fine dust that has not been filtered out by the filter **28** is filtered out by the filter **51**, the air stream flows into the exhaust chamber **47**, and is then exhausted through the exhaust port **54**.

[**0097**] When cleaning is performed in the dark, the illuminator **55** is lit to illuminate around the suction cleaner **1** so that the condition around can be checked. This helps prevent accidental suction of articles that should not be sucked in. As the cleaner main unit **10** is rotated, the light swings vertically, making it possible to illuminate a wide area.

[**0098**] When the illuminator **55** is lit, the horizontal partition wall **45** located above it becomes hot. However, in the first embodiment, exhaust air passes outside (above) the illuminator chamber **48**. This ensures satisfactory dissipation of heat, and thus prevents the horizontal partition wall **45** from becoming too hot. Accordingly, even when the illuminator **55** is realized with one that consumes much power to obtain bright illumination, it is possible to prevent overheating.

[**0099**] Moreover, as described earlier, in the horizontal partition wall **45** is formed the small-diameter throughflow port **56** through which the exhaust chamber **47** and the illuminator chamber **48** communicate with each other. Thanks to this throughflow port **56**, when exhaust air passes through the exhaust chamber **47** at a high speed, air is sucked out of the illuminator chamber **48**. This helps achieve a higher cooling effect. To compensate for the air thus sucked out, the illuminator chamber **48** has an air inflow port formed in a lower portion thereof.

[**0100**] In addition to forming the illumination cover **16***a* out of transparent or semitransparent synthetic resin, it is also possible to form the dust cup **21** out of transparent or semitransparent synthetic resin. This permits, when the illuminator **55** is lit, the interior of the dust cup **21** to be illuminated by the light emitted from the illuminator **55**. This makes it easier to check how much dust accumulate in the dust cup **21**.

[**0101**] When cleaning is performed in a corner of a room, the lever **97** is so operated that the suction mouth switching device **90** is switched to the second suction mouth **82**. On a hard flooring material, the first bottom support **101** keeps the entrance of the second suction mouth **82** stably at a predetermined distance (0.8 mm to 2 mm) from the floor. Thus, a passage for dust is secured between the second suction mouth **82** and the floor. The second suction mouth **82** has a smaller opening area than the first suction mouth **81**, and therefore the suction pressure concentrates in a narrow area. Accordingly, a high-speed suction air stream is produced at the entrance of the second suction mouth **82**, and thus dust is acted upon by a suction pressure more powerful than by suction accompanied by the rotation of the agitator.

[**0102**] When the second suction mouth **82** is used, the air stream sucked in passes below the transparent or semitrans-

parent lid **86**. This makes it possible to check directly and visually how dust is being sucked in. When dust obstructs the suction passage **85**, it is possible to remove the lid **86** and dispose of the obstructing dust.

[**0103**] Dust can be sucked in not only by the use of the first suction mouth **81** or the second suction mouth **82** but also by the use of the flexible hose **33**. As shown in **FIG. 3**, the flexible hose **33** is detached from the connection pipe **78**, and instead a suction tool such as a crevice nozzle or furniture brush is attached thereto. In this state, it is possible to perform cleaning in a narrow or high space that is difficult to reach with the suction mouth unit **70**.

[**0104**] When cleaning is finished, the suction cleaner **1** is carried to a place where it is stored when not in use, and the dust collecting device holder **12** is held upright. This causes the rear portion of the suction mouth unit **70** to move down, with the result that the second bottom support **102** makes contact with the floor to support the suction mouth unit **70** and the first bottom support **101** moves off the floor. Also off the floor moves the outer circumference of the agitator **110**. Accordingly, in this state, even if the electric blower **13** is still operating, the agitator **110** never rakes the floor and thus never damages it.

[**0105**] So long as the dust collecting device holder **12** is held upright, the outer circumference of the agitator **110** never makes contact with the floor. Accordingly, even if it is left in this state for a long time, the bristles (or blades of rubber or soft synthetic resin) planted on the agitator **110** are never deformed.

[**0106**] When a large amount of dust has been collected in the dust collecting device **20**, the latch **43** is released, and the dust collecting device **20** is pulled out to dispose of the dust inside. If necessary, the filter **28** is also cleaned. Then, the dust collecting device **20** is put back in position. As described earlier, forming the dust cup **21** out of a transparent or semitransparent material makes it easy to check how dust is collected.

[**0107**] **FIG. 10** shows the suction cleaner **1***a* of a second embodiment of the invention. The suction cleaner **1***a* has almost the same construction as the suction cleaner **1** of the first embodiment. Therefore, such components as are found in both of the suction cleaners **1** and **1***a* of the first and this embodiment are identified with the same reference numerals, and their explanations will not be repeated.

[**0108**] The suction cleaner **1***a* is characterized by the angle at which the flexible hose **33** runs from the suction mouth unit **70**. In the suction cleaner **1** of the first embodiment, the connection pipe **78** to which the flexible hose **33** is connected protrudes nearly right upward; by contrast, in the suction cleaner **1***a* of the second embodiment, the connection pipe **78***a* is so arranged as to incline rearward.

[**0109**] The inclination angle of the connection pipe **78***a* is such that, when the dust collecting device holder **12** is inclined to assume the cleaning operation posture, i.e., when the handle **62** is brought down to a height of 60 cm to 80 cm from the floor, the spatial arrangement of the flexible hose **33** leading from the suction mouth unit **70** to the dust collecting device holder **12** is substantially straight as seen from the side. In other words, the inclination angle is such that, as seen from the side, the connection pipe **78***a* points to the connection pipe **34**.

[**0110**] Setting in this way the angle at which the flexible hose **33** runs from the suction mouth unit **70** helps make the first air passage **31** more straight when dust is sucked in, and thus helps increase the flow efficiency of the air stream. Moreover, in the suction cleaner **1***a*, the portion around the outflow port of the suction mouth switching device **90** is extended obliquely rearward so as to protrude out of the suction mouth unit **70**, and this portion is used as the connection pipe **78***a*. This helps simplify the construction and make the assembly easy.

[**0111**] In either of the first and second embodiments, the second suction mouth **82** and the suction passage **85** may be given the greatest possible widths. Specifically, the second suction mouth **82** and the suction passage **85** (at its entrance) may be made so wide as to leave only the thickness of the left-hand and right-hand side walls of the suction mouth unit **70**. This slightly diminishes the strength of the suction mouth unit **70**, but helps widen the suction width of the second suction mouth **82**, and thus helps further increase the suction ability.

[**0112**] **FIGS. 11 and 12** show the suction cleaner **200** of a third embodiment of the invention. The suction cleaner **200** is of a so-called canister type. That is, inside a cleaner main unit **201** supported on the floor surface by two large wheels **202** and one front caster (not illustrated), there are housed an electric blower and a dust collecting device (neither is illustrated). To this cleaner main unit **201** is connected, through a suction hose **203** and a connection pipe **204**, a suction mouth unit **210**. The connection pipe **204** is fitted with a handle **205**.

[**0113**] The suction mouth unit **210** has a shell **211** that is elongate in the left/right direction. On the bottom surface of the shell **211** are formed a first bottom support and a second bottom support. The first bottom support **212** is realized with a pair of, i.e., a left-hand and a right-hand, wheels provided in a front portion of the suction mouth unit **210**, and the second bottom support **213** is realized with a pair of, i.e., a left-hand and a right-hand, wheels provided in a rear portion of the suction mouth unit **210**. Instead of wheels, it is possible to use any other members, for example sled-like projections, so long as they offer satisfactory sliding on the floor surface.

[**0114**] Reference numeral **214** represents a joint pipe that connects the suction mouth unit **210** to the connection pipe **204**. The joint pipe **214** is semicylindrical at the base thereof, and is coupled to the suction mouth unit **210** by a shaft **215**. The joint pipe **214** is pivotable within a predetermined range of angles in a plane perpendicular to the suction mouth unit **210**. That is, the suction mouth unit **210** can swing within the predetermined range of angles relative to the connection pipe **204**.

[**0115**] In the suction mouth unit **210** is formed a suction mouth **216** that faces the floor. Moreover, inside the suction mouth unit **210** is provided an opening area adjusting device **220** that permits adjustment of the opening area of the suction mouth **216**.

[**0116**] The opening area adjusting device **220** is built with a shutter **221** that slides in the front/rear direction. When the shutter **221** is slid rearward to the position indicated by solid lines, the suction mouth **216** is fully open, and thus the suction pressure is applied in a wide area. The suction

pressure here is set to be not so powerful as to cause a carpet to stick fast to the suction mouth **216**.

[**0117**] When the shutter **221** is slid frontward to the position indicated by broken lines, the opening of the suction mouth **216** is narrowed, and thus a powerful suction pressure is applied in a narrow area. This produces a high-speed, powerful suction air stream, and thereby makes it possible to perform cleaning efficiently on flooring and in a corner of a room.

[**0118**] The shutter **221** is slid, for example, by operation of a lever. Instead, the shutter **221** may be fitted with a knob that protrudes out of the shell **211**. For crisp switching of the shutter **221** between the front and rear positions, and for stable holding of the position reached, the shutter **221** may be fitted with an appropriate snapping mechanism (for example, a toggle spring).

[**0119**] **FIGS. 13 and 14** show a fourth embodiment of the invention. In this and the following embodiments, only the suction mouth unit is illustrated. The fourth embodiment differs from the third embodiment chiefly in the construction of the suction mouth unit **210**, and, in many other respects, the fourth embodiment shares common features with the third embodiment. Accordingly, to avoid overlapping explanations, the same reference numerals will be stuck to for such components as have already been explained in connection with the third embodiment, and their explanations will not be repeated. The same applies also to the fifth and following embodiments; that is, the same reference numerals will be stuck to for such components as have already been explained earlier, and their explanations will not be repeated.

[**0120**] In the fourth embodiment, the shutter **221** is slid by the following mechanism. As shown in **FIG. 13**, gutter-shaped guides **222***a* and **222***b* that receive both side edges of the shutter **221** are formed on the inner surface of the shell **211**. On the upper surface of the shutter **221** is formed a rack **223** that extends in the front/rear direction. A pinion **224** that meshes with the rack **223** is rotatably supported by a shaft **225** inside the suction mouth unit **210**. In the upper surface of the suction mouth unit **210** is formed a window **226**, through which part of the pinion **224** is exposed. By rotating the pinion **224** with a finger put thereon, it is possible to slide the shutter **221**.

[**0121**] In one side edge of the shutter **221** are formed a plurality of notches **227**. An unillustrated click-stop device provided inside the guide **222***a* engages with the notches **227**, and this ensures crispy movement of the shutter **221** and stable holding thereof in predetermined positions. Specifically, in the example shown in **FIG. 13**, the shutter **221** is held at a retracted position indicated by solid lines, a first forward position indicated by broken lines **P1**, or a second forward position indicated by solid broken lines **P2** (here is the dead end of the guides **222***a* and **222***b*, and thus the shutter **221** does not move any further frontward). As the shutter **221** moves frontward from the retracted position to the first forward position **P1** and then to the second forward position **P2**, the opening area of the suction mouth **216** decreases.

[**0122**] When the shutter **221** moves to the second forward position **P2**, the suction mouth **216** has the "minimum opening area." The "minimum opening area" is such as to let out so large a volume of air as not to cause overheating of the electric blower.

[**0123**] The click-stop device is realized, for example, with a flat spring. Depending on the material of the shell **211**, the spring may be formed integrally therewith. It is also possible to use instead a combination of a steel ball and a compression coil spring.

[**0124**] Instead of providing the shutter **221** with a click-stop device, it is possible to provide the pinion **224** with one.

[**0125**] **FIG. 15** shows a fifth embodiment of the invention. In this embodiment, in the front edge of the shutter **221** is formed a cut **228**. The shutter **221** itself can move to the end of the suction mouth **216**, but, even then, the cut **228** keeps open the suction mouth opening with the "minimum opening area." The shutter **221** can be slid by one of the sliding mechanisms described in connection with the third and fourth embodiments.

[**0126**] **FIG. 16** shows a sixth embodiment of the invention. In this embodiment, in the shutter **221** is formed a slit **229**. The slit **229**, like the cut **228** in the fifth embodiment, serves to keep open the suction mouth opening with the "minimum opening area" even when the shutter **221** moves to the end of the suction mouth **216**. As in the fifth embodiment, the shutter **221** can be slid by one of the sliding mechanisms described in connection with the third and fourth embodiments.

[**0127**] **FIG. 17** shows a seventh embodiment of the invention. In this embodiment, in addition to the construction of the fifth embodiment, additional suction mouths **216***a* are formed on the left-hand and right-hand sides of the suction mouth **216**. The length direction of the suction mouths **216***a* runs along the front/rear direction of the shell **211**.

[**0128**] With this construction, it is possible to suck in dust through the suction mouths **216***a* from a place where the suction pressure through the suction mouth **216** does not reach. Moreover, even when a carpet or a piece of bedclothes sticks to the suction mouth **216** and stops suction, through the suction mouths **216***a* can be sucked in so large a volume of air as not to cause overheating of the electric blower.

[**0129**] The suction mouths **216***a* may be kept always open, or may be made closable with shutters.

[**0130**] **FIG. 18** shows an eighth embodiment of the invention. In this embodiment, in addition to the construction of the sixth embodiment, additional slits **229***a* are formed near the left-hand and right-hand edges of the shutter **221**. The length direction of the slits **229***a* runs along the front/rear direction of the shell **211**.

[**0131**] With this construction, it is possible to apply a suction pressure through the slits **229***a* in a place where the suction pressure through the slit **229** does not reach. Moreover, even when a carpet or a piece of bedclothes sticks to the slit **229** and stops suction, the slits **229***a* keeps open the suction mouth opening with the "minimum opening area."

[**0132**] **FIG. 19** shows a ninth embodiment of the invention. In this embodiment, inside the shell **211** is arranged, instead of a flat-plate-shaped shutter, a cylindrical shutter **221***a*. The shutter **221***a* has an opening **230** that faces the suction mouth **216** and an opening **231** that faces the joint pipe **214**. At the front and rear edges of the opening **231** are formed stoppers **232** and **233**. The cylindrical shutter **221***a* is rotatable between the position where the stopper **232** hits

the ceiling surface of the shell **211** and the position where the stopper **233** hits the edge of the suction mouth **216**.

[**0133**] Though not illustrated, an operation lever or dial for rotating the cylindrical shutter **221***a* protrudes out of the shell **211**, and, by operating that, it is possible to vary the angle of the cylindrical shutter **221***a* and thereby vary the degree of overlap between the opening **230** and the suction mouth **216**. This permits adjustment of the opening area of the suction mouth **216**.

[**0134**] **FIG. 20** shows a tenth embodiment of the invention. In this embodiment, in addition to the construction of the fourth embodiment, an additional suction mouth **216***b* is formed in front of the suction mouth **216**. The suction mouth **216***b* has the "minimum opening area." Inside the shell **211** is provided a shutter **234** that is so biased as to keep the suction mouth **216***b* normally closed. The shutter **234** may be biased by a spring or by gravitation.

[**0135**] Between the suction mouths **216** and **216***b* is formed an air stream guide **235** by which the air sucked in through the suction mouth **216***b* is guided toward the joint pipe **214**. As opposed to in the fourth embodiment, the shutter **221** can move forward to a position where it completely closes the suction mouth **216**.

[**0136**] With the suction mouth **216** completely closed, when a suction pressure is applied to the suction mouth unit **210**, the shutter **234** lifts up against the force with which it is biased, and lets air in through the suction mouth **216***b*. This keeps open the suction mouth opening with the "minimum opening area." Moreover, it is possible to apply a powerful suction pressure in a front portion of the suction mouth unit **210**.

[**0137**] The shutters **221** and **234** may be linked together by a linking mechanism or gear mechanism so that, when the shutter **221** moves forward, the shutter **234** is opened and, when the shutter **221** moves backward, the shutter **234** is closed. In this case, the shutter **221** may be driven by a motor.

[**0138**] **FIG. 21** shows en eleventh embodiment of the invention. In this embodiment, inside the suction mouth unit **210** is arranged an agitator **240**. The agitator **240** is so located as to face the suction mouth **216**, and rotates by using the motive force produced by an unillustrated motor.

[**0139**] The agitator **240**, when operated, is protruded a predetermined distance (5 mm to 10 mm) from the suction mouth **216**, and, when not in use, is retracted into the shell **211**. The degree of protrusion of the agitator **240** is controlled by a height controlling device **241**, which is constructed as follows.

[**0140**] Inside the shell **211** is provided a pair of, i.e., a left-hand and right-hand, arms **243** that pivots about a shaft **242** in a vertical plane. At the swinging ends of the arms **243** is rotatably supported the agitator **240**. The arms **243** are swung by a cam disk **245** that rotates about a shaft **244**. In the side surface of the cam disk **245** is formed a closed-loop-shaped groove cam **246**, and with this groove cam **246** engages a roller-shaped cam follower **247** fitted to an arm **243**.

[**0141**] To the cam disk **245** is fixed an operation lever **248**. The operation lever **248** protrudes from the window **226**, and, by operating it with a finger, it is possible to rotate the cam disk **245** and thereby swing the arms **243**. This permits the agitator **240** to move from the height of the retracted position indicated by solid lines to the height of the protruded position indicated by broken lines and vice versa.

[**0142**] In a rear portion of the shell **211** is arranged a switch **250** that is connected to the power supply circuit for the motor that drives the agitator **240**. The switch **250** is normally open. When the shutter **221** moves rearward until the suction mouth **216** is fully open, a projection **251** formed on the shutter **221** presses the switch **250** and thereby closes it. In this way, it is only when the opening area of the suction mouth **216** becomes the size suitable for the driving of the agitator **240** that the motor becomes ready to be energized.

[**0143**] As described above, with the suction mouth **216** fully open, the operation lever **248** is operated to protrude the agitator **240** a predetermined distance from the suction mouth **216**. Then, an unillustrated hand switch provided in a handle **205** is operated to energize the electric motor and thereby rotate the agitator **240**. Now, it is possible to rake dust off a carpet or the like and suck it in. By varying the angle of the operation lever **248**, it is possible to finely adjust the degree of protrusion of the agitator **240**.

[**0144**] When cleaning is performed on flooring or on tatami mats, the agitator **240** is retracted into the shell **211**, and the shutter **221** is moved frontward to narrow the opening area of the suction mouth **216**. Here, before the shutter **221** is moved frontward, the agitator **240** needs to be lifted up to clear the space where the shutter **221** passes. However, even if the shutter **221** starts moving frontward before the agitator **240** lifts up, this causes the switch **250** to open, and therefore, even when the hand switch is on, the motor that drives the agitator **240** stops. This prevents the rotating agitator **240** from touching the shutter **221**, and thereby prevents noise and damage to the agitator **240** or to the shutter **221**.

[**0145**] The hand switch may be omitted, in which case the motor is turned on and off only by the switch **250**. The interval between the shutter **221** and the agitator **240** is so set that, when the shutter **221** is moved frontward, the switch **250** surely opens before the front edge of the shutter **221** reaches the agitator **240**.

[**0146**] The shutter **221** can be slid by one of the sliding mechanisms described in connection with the third and fourth embodiments. In case the pinion **224** of the fourth embodiment is adopted, the pinion **224** and the cam disk **245** may be linked together, or may be integrally molded. This permits the height controlling device **241** and the shutter **221** to operate in an coordinated fashion so that, when the shutter **221** widens the opening area of the suction mouth **216** to the size suitable for the driving of the agitator, the height controlling device **241** protrudes the agitator **240** to the operating position.

[**0147**] **FIG. 22** shows a twelfth embodiment of the invention. In this embodiment, as in the eleventh endowment, inside the suction mouth unit **210** is provided an agitator **240** that is driven by an unillustrated motor. Here, the height controlling device **241** is constructed differently than in the eleventh embodiment.

[**0148**] The pair of, i.e., the left-hand and right-hand, arms **243**, which rotatably supports the agitator **240**, is bent at the position where a shaft **242***a* is provided, and is thus shaped

like a boomerang. The short-hand portions **243***a* of the arms **243** face a projection **251***a* formed on the shutter **221**. The arms **243** are biased with a force that tends to rotate them clockwise, as seen in **FIG. 22**, by an unillustrated spring or the like.

[**0149**] When the shutter **221** moves rearward until the suction mouth **216** is fully open, the force with which the arms **243** are biased rotates them to their limit of rotation, and thus the agitator **240** protrudes a predetermined distance from the suction mouth **216** (as indicated by solid lines in **FIG. 22**). In this state, when the agitator **240** is driven, it is possible to rake dust off a carpet or the like and suck it in.

[**0150**] When cleaning is performed on flooring or on tatami mats, the shutter **221** is moved frontward to narrow the opening area of the suction mouth **216**. At this time, the projection **251***a* presses the short-hand portions **243***a* of the arms **243**, and thus the arms **243** rotates counter-clockwise against the force with which they are biased until they are lifted up to the position indicated by broken lines in **FIG. 22**. Thus, the agitator **240** is retracted into the shell **211**, and therefore the shutter **221** can move forward without being interfered.

[**0151**] In this way, the height controlling device **241** and the shutter **221** operate in a coordinated fashion so that, when the shutter **221** widens the opening area of the suction mouth **216** to the size suitable for the driving of the agitator, the height controlling device **241** protrudes the agitator **240** to the operating position.

[**0152**] In the twelfth embodiment, as in the eleventh embodiment, advisably, a switch is connected to the power supply circuit for the motor that drives the agitator **240**, and is opened and closed by the shutter **221** so that, when the shutter **221** moves rearward until the suction mouth **216** is fully open, the motor becomes ready to be energized. Alternatively, the motor is turned on and off by this switch.

[**0153**] FIGS. **23** to **25** show a thirteenth embodiment of the invention. The thirteenth embodiment is characterized in that the opening area adjusting device **220** is composed of a plurality of covers that are removably coupled to the suction mouth unit **210**.

[**0154**] In **FIG. 23**, there are shown two covers **260** and **261**. The covers **260** and **261** are fitted on the bottom face of the shell **211**. As shown in **FIGS. 24 and 25**, the shell **211** is completely open at its bottom face.

[**0155**] The covers **260** and **261** are molded out of highly elastic synthetic resin, and are formed to have raised rims so as to enclose the shell **211** from outside. Between the inner surface of the raised rims and the outer surface of the shell **211** are provided ridge/groove engagement portions **262**. This keeps the covers **260** and **261** in a coupled state.

[**0156**] In the cover **260** is formed a suction mouth opening **263** with a large opening area. In the cover **261**, in a front end portion thereof, is formed a suction mouth opening **264** with the "minimum opening area."

[**0157**] With the cover **260** attached to the shell **211** (see **FIG. 24**), a suction pressure is applied in a wide area through the suction mouth opening **263**. The suction pressure here is set to be not so powerful as to cause a carpet to stick fast to the suction mouth opening **263**.

[**0158**] With the cover **260** detached and replaced with the cover **261** (see **FIG. 25**), a powerfill suction pressure is applied in a narrow area through the suction mouth opening **264**. This produces a high-speed, powerful suction air stream, and thereby makes it possible to perform cleaning efficiently on flooring and in a corner of a room.

[**0159**] In the construction described above, two covers **260** and **261** are used to switch the area of the suction mouth opening in two steps, i.e., between large and small. By increasing the number of covers used, it is possible to adjust the suction mouth opening area in a larger number of steps.

[**0160**] In the construction described above, the shell **211** is completely open at its bottom face. Instead of making it completely open there, it is also possible, as in the third to twelfth embodiments, to form a suction mouth **216** in the bottom surface of the shell **211** and adjust the opening area of the suction mouth **216** by the use of a plurality of covers.

[**0161**] The construction of the thirteenth embodiment may be combined with the agitator **240** of the eleventh or twelfth embodiment. In that case, advisably, when a cover with a suction mouth opening so large as to permit the driving of the agitator **240** is attached, the agitator **240** is protruded to the operating position, and, when a cover with a suction mouth opening so small as not to permit the driving of the agitator **240** is attached, a projection formed on the

[**0162**] In the third to thirteenth embodiments, the opening area adjusting device **220** is provided only for one suction mouth (the suction mouth **216**) formed in the suction mouth unit **210**. Even in cases where an additional suction mouth (the suction mouth **216***a* or **216***b*) is provided, whereas there are provided a plurality of suction mouths, there is provided only one suction passage. This may be modified so that, as in the first embodiment, a plurality of suction mouths are provided that communicate respectively with different suction passages that are independent of one another, with an opening area adjusting device **220** provided for one or more of the suction mouths.

[**0163**] It is to be understood that the present invention may be carried out in any other manner than specifically described above as embodiments, and that many modifications and variations are possible within the scope of the subject matter of the invention.

[**0164**] It is also to be understood that, of all the claims of the present application, those comprising a cleaner main unit and a suction mouth unit coupled together are applicable only to upright-type suction cleaners but all the other claims are applicably equally to both upright-type suction cleaners and canister-type suction cleaners, i.e., those in which a cleaner main unit and a suction mouth unit are coupled together by a hose.

INDUSTRIAL APPLICABILITY

[**0165**] As described above, according to the present invention, in a suction cleaner, a plurality of types of suction mouth suitable for a plurality of types of floor are formed in a single suction mouth unit, and selective use of those different types of suction mouth is achieved easily. Thus, the present invention is very useful for the maintenance of a comfortable living space.

INDUSTRIAL APPLICABILITY

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mouth suitable for a plurality of types of floor are formed in a single suction mouth unit, and selective use of those different types of suction mouth is achieved easily. Thus, the present invention is very useful for the maintenance of a comfortable living space.

1. (canceled)

2. (canceled)

3. (canceled)

4. A suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust,

wherein the suction mouth unit is provided with a first suction mouth and a second suction mouth that communicate individually with different suction passages that are independent of each other, an opening area of the second suction mouth is smaller than an opening area of the first suction mouth, and at least part of the second suction mouth is located in front of the first suction mouth.

5. (canceled)

6. (canceled)

7. (canceled)

8. (canceled)

9. (canceled)

10. (canceled)

11. The suction cleaner according to claim 4, wherein there is provided a suction mouth switching device that permits selective use of the first and second suction mouths, and part of the suction passage leading from the second suction mouth to the suction mouth switching device is formed as a removable lid.

12. (canceled)

13. The suction cleaner according to claim 4, wherein there is provided a suction mouth switching device that permits selective use of the first and second suction mouths, the suction mouth switching device includes a switch valve that selectively closes suction passages that communicate respectively with the first and second suction mouths, and a rotation shaft of the switch valve is arranged on an upstream side of an air stream.

14. The suction cleaner according to claim 4, wherein a left-hand protruding portion and a right-hand protruding portion are formed on the suction mouth unit, and a cleaner main unit is arranged between the left-hand and right-hand protruding portions and is rotatably coupled to the suction mouth unit, with the suction mouth switching device that permits selective use of the first and second suction mouths arranged in one of the left-hand and right-hand protruding portions.

15. (canceled)

16. A suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust,

wherein the suction mouth is provided with an opening area adjusting device that adjusts an opening area of the suction mouth, an agitator is provided inside the suction mouth unit, and the agitator can be driven when the opening area of the suction mouth is adjusted by the opening area adjusting device to a size suitable for the agitator to be driven.

17. A suction cleaner that sucks in, along with an air stream produced as an electric blower is operated, dust through a suction mouth formed in a suction mouth unit and then introduces the air stream thus sucked in into a dust collecting device to collect the dust,

wherein the suction mouth is provided with an opening area adjusting device that adjusts an opening area of the suction mouth, and inside the suction mouth unit are provided an agitator and a height controlling device that controls a degree in which the agitator protrudes from the suction mouth.

18. The suction cleaner according to claim 17, wherein the agitator is protruded to an operation position by the height controlling device when the opening area of the suction mouth is adjusted by the opening area adjusting device to a size suitable for the agitator to be driven.

19. (canceled)

20. The suction cleaner according to claim 16, wherein a plurality of covers are provided that each have a suction mouth opening and that are removably coupled to the suction mouth unit, and the opening area adjusting device is realized by varying areas of the suction mouth openings of the individual covers.

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