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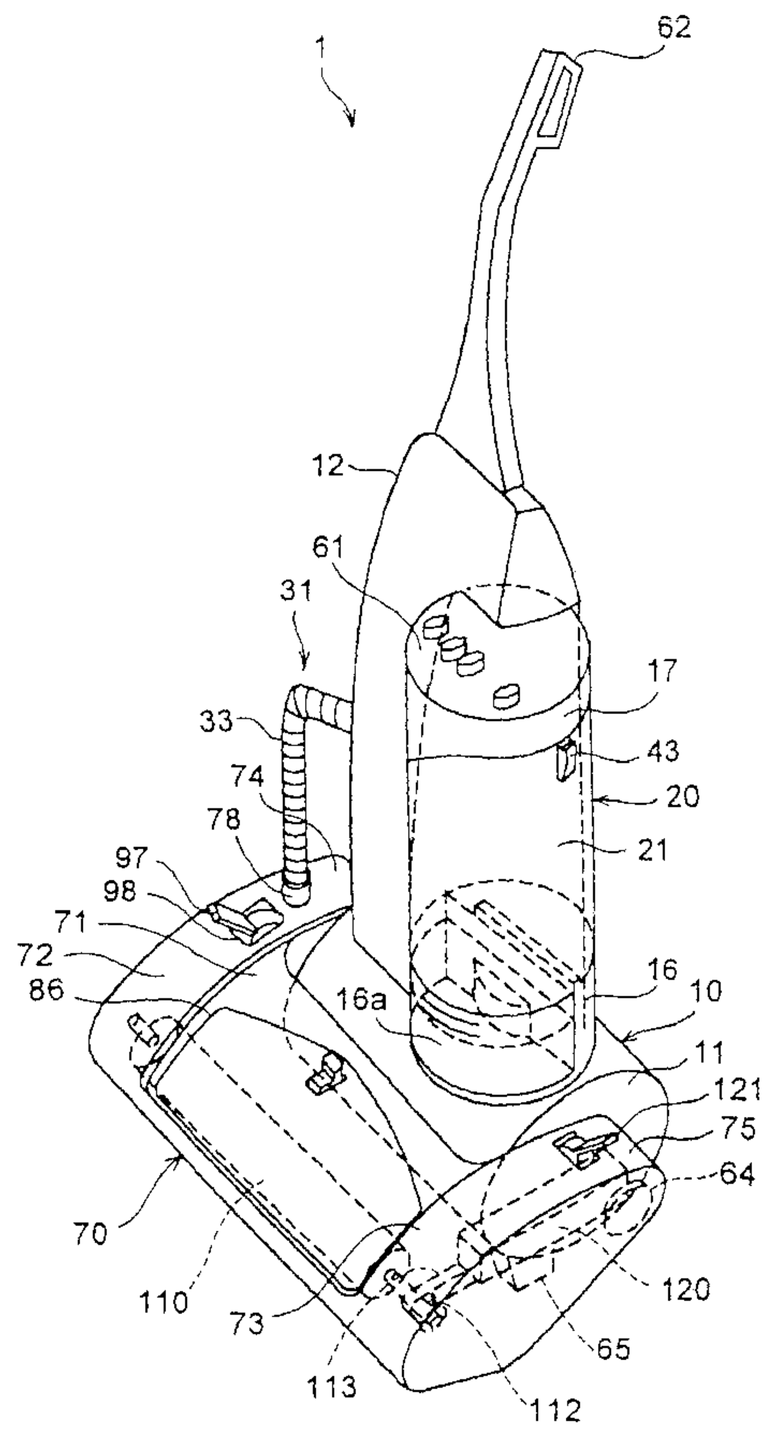

(57) Abrégé/Abstract:
A suction cleaner that sucks in dust, from a suction mouth, with airflow generated through operation of an electric air blower and introduces the sucked airflow into a dust collection device to collect the dust. The suction mouth is provided with a first suction

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(57) Abrégé(suite)/Abstract(continued):
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.

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.

SPECIFICATION

SUCTION CLEANER

Technical field

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

Background art

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.

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

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, the second suction mouth is given a smaller opening area than the first suction mouth and is formed parallel to and in front of the first suction mouth, and the suction passage for the second suction mouth is arranged so as to overlap the suction passage for 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 the second suction mouth, through which the air stream speed is high, is formed parallel to and in front of the first suction mouth, it is easy to perform cleaning in the corners of a room and along the edges thereof where walls stand.

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.

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.

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.

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.

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.

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.

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 inside the suction mouth unit.

Brief description of drawings

Fig. 1 is an external perspective view of the suction cleaner of a first embodiment.

Fig. 2 is a partial vertical sectional view of a suction mouth unit of the suction cleaner.

Fig. 3 is an exploded external perspective view of the suction cleaner.

Fig. 4 is a vertical sectional view of the suction cleaner.

Fig. 5 is a vertical sectional view of the suction cleaner, cut along a plane perpendicular to Fig. 4.

Fig. 6 is a partial horizontal sectional view of a cleaner main unit of the suction cleaner.

Fig. 7 is a side view of the suction cleaner, with the suction mouth unit shown in a section thereof.

Fig. 8 is a side view similar to Fig. 7, showing a different operation state.

Fig. 9 is a partial enlarged sectional view of the suction mouth unit in the operation state shown in Fig. 8.

Fig. 10 is a side view similar to Fig. 8, showing the suction cleaner of a second embodiment of the invention.

Fig. 11 is an external perspective view of the suction cleaner of a third embodiment of the invention.

Fig. 12 is a vertical sectional view of the suction mouth unit of the suction cleaner of the third embodiment.

Fig. 13 is an internal partial perspective view of the suction mouth unit of the suction cleaner of a fourth embodiment of the invention.

Fig. 14 is a vertical sectional view of the suction mouth unit of the suction cleaner of the fourth embodiment.

Fig. 15 is an internal partial perspective view of the suction mouth unit of the suction cleaner of a fifth embodiment of the invention.

Fig. 16 is an internal partial perspective view of the suction mouth unit of the suction cleaner of a sixth embodiment of the invention.

Fig. 17 is an internal partial perspective view of the suction mouth unit of the suction cleaner of a seventh embodiment of the invention.

Fig. 18 is an internal partial perspective view of the suction mouth unit of the suction cleaner of an eighth embodiment of the invention.

Fig. 19 is an vertical sectional view of the suction mouth unit of the suction cleaner of a ninth embodiment of the invention.

Fig. 20 is an vertical sectional view of the suction mouth unit of the suction cleaner of a tenth embodiment of the invention.

Fig. 21 is an vertical sectional view of the suction mouth unit of the suction cleaner of an eleventh embodiment of the invention.

Fig. 22 is an vertical sectional view of the suction mouth unit of the suction cleaner of a twelfth embodiment of the invention.

Fig. 23 is a perspective view of the suction mouth unit of the suction cleaner of a thirteenth embodiment of the invention.

Fig. 24 is a vertical sectional view of the suction mouth unit of the suction cleaner of the thirteenth embodiment.

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

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.

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.

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.

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 14a 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 14b 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 14a and 14b, the blower shell 11 is rotatably coupled to the suction mouth unit 70.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 12a (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.

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 13a of the electric blower 13 with an anti-vibration cushion 40 interposed therebetween that also serves to achieve air-tight connection.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 16a 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 16a removed, the maintenance, such as replacement, of the illuminator 55 can easily be performed.

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.

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.

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

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.

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 80a of the bottom plate 80 are formed a plurality of suction mouths. The rear portion 80b of the bottom plate 80 is slanted so as to be increasingly higher rearward.

In the first embodiment, in the front portion 80a 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.

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.

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.

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.

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.

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.

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.

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.

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 80b 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.

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.

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.

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.

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.

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.

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.

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 14a and 14b as the point of action thereof, with the result that the pivot shafts 14a and 14b lift up the rear portion of the suction mouth unit 70. The support feet 65 move off the floor.

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 80a 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.

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.

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 13a, the second air passage 32, the dust collecting device 20, and the first air passage 31.

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.

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.

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.

As described above, on a carpet, the first bottom support 101 sinks into the pile of the carpet, and the front portion 80a 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.

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 80a 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.

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.

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.

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.

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 13a of the electric blower 13, and thus the air stream flows therethrough straight to the suction port 13a 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.

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.

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.

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.

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.

In addition to forming the illumination cover 16a 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.

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.

When the second suction mouth 82 is used, the air stream sucked in passes below the transparent or semitransparent 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.

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.

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.

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.

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.

Fig. 10 shows the suction cleaner 1a of a second embodiment of the invention. The suction cleaner 1a 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 1a of the first and this embodiment are identified with the same reference numerals, and their explanations will not be repeated.

The suction cleaner 1a 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 1a of the second embodiment, the connection pipe 78a is so arranged as to incline rearward.

The inclination angle of the connection pipe 78a 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 78a points to the connection pipe 34.

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 1a, 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 78a. This helps simplify the construction and make the assembly easy.

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.

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.

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.

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.

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.

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.

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.

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).

Figs. 13 and 14 show a fourth embodiment of the invention. In this end 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.

In the fourth embodiment, the shutter 221 is slid by the following mechanism. As shown in Fig. 13, gutter-shaped guides 222a and 222b 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.

In one side edge of the shutter 221 are formed a plurality of notches 227. An unillustrated click-stop device provided inside the guide 222a 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 222a and 222b, 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.

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.

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.

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

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.

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.

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

With this construction, it is possible to suck in dust through the suction mouths 216a 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 216a can be sucked in so large a volume of air as not to cause overheating of the electric blower.

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

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

With this construction, it is possible to apply a suction pressure through the slits 229a 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 229a keeps open the suction mouth opening with the "minimum opening area."

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 221a. The shutter 221a 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 221a 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.

Though not illustrated, an operation lever or dial for rotating the cylindrical shutter 221a protrudes out of the shell 211, and, by operating that, it is possible to vary the angle of the cylindrical shutter 221a 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.

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 216b is formed in front of the suction mouth 216. The suction mouth 216b has the "minimum opening area." Inside the shell 211 is provided a shutter 234 that is so biased as to keep the suction mouth 216b normally closed. The shutter 234 may be biased by a spring or by gravitation.

Between the suction mouths 216 and 216b is formed an air stream guide 235 by which the air sucked in through the suction mouth 216b 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.

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 216b. 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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 242a is provided, and is thus shaped like a boomerang. The short-hand portions 243a of the arms 243 face a projection 251a 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.

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.

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 251a presses the short-hand portions 243a 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.

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.

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.

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.

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.

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.

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."

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.

With the cover 260 detached and replaced with the cover 261 (see Fig. 25), a powerful 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.

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.

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.

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

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 216a or 216b) 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.

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.

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

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.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. 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, the second suction mouth has a smaller opening area than the first suction mouth and is formed parallel to and in front of the first suction mouth, and the suction passage for the second suction mouth is arranged so as to overlap the suction passage for the first suction mouth.

2. The suction cleaner according to claim 1, 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.

3. The suction cleaner according to claim 1, 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.

4. The suction cleaner according to claim 1, 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.

5. 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.

6. 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.

7. The suction cleaner according to claim 6, 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.

8. The suction cleaner according to claim 5, 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.

FIG.1

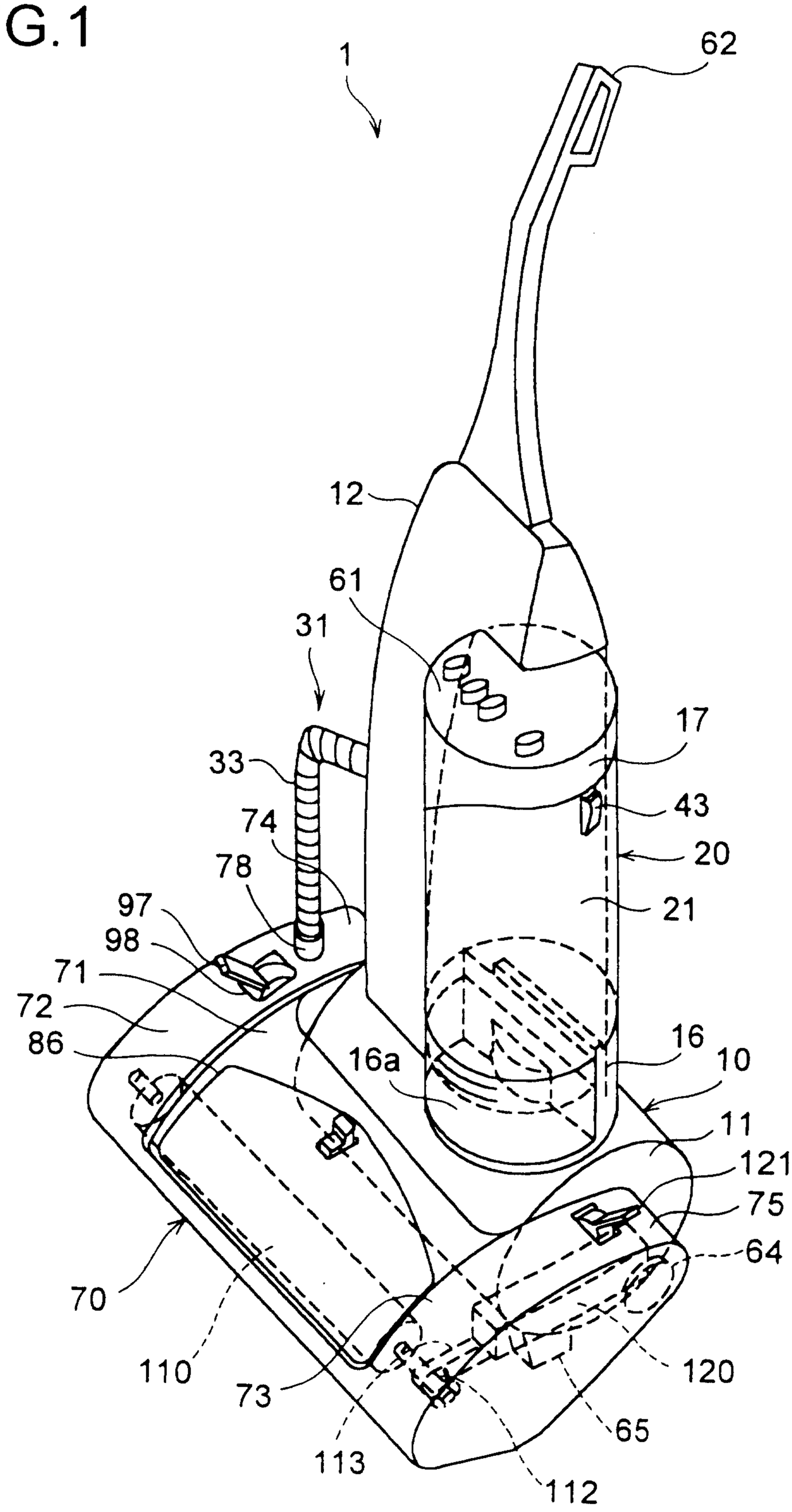
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FIG.2

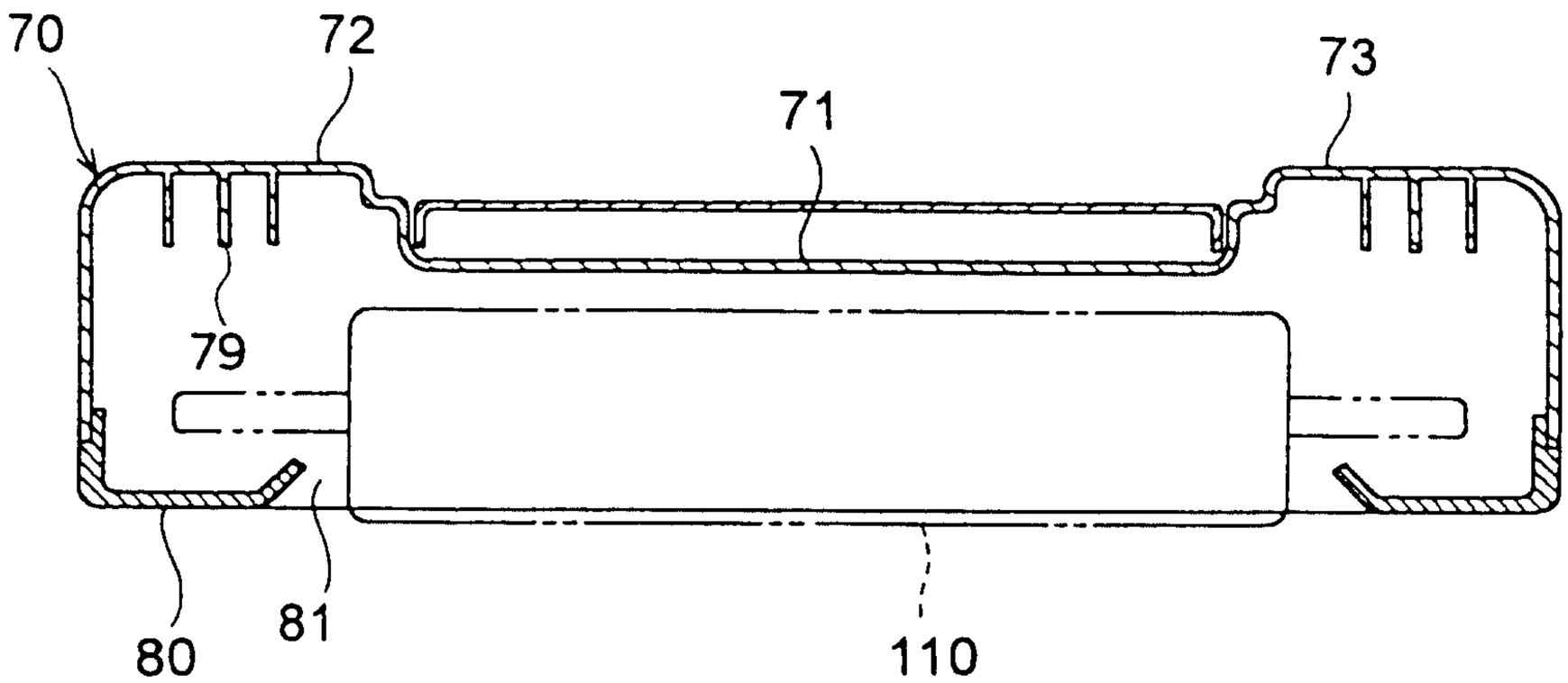
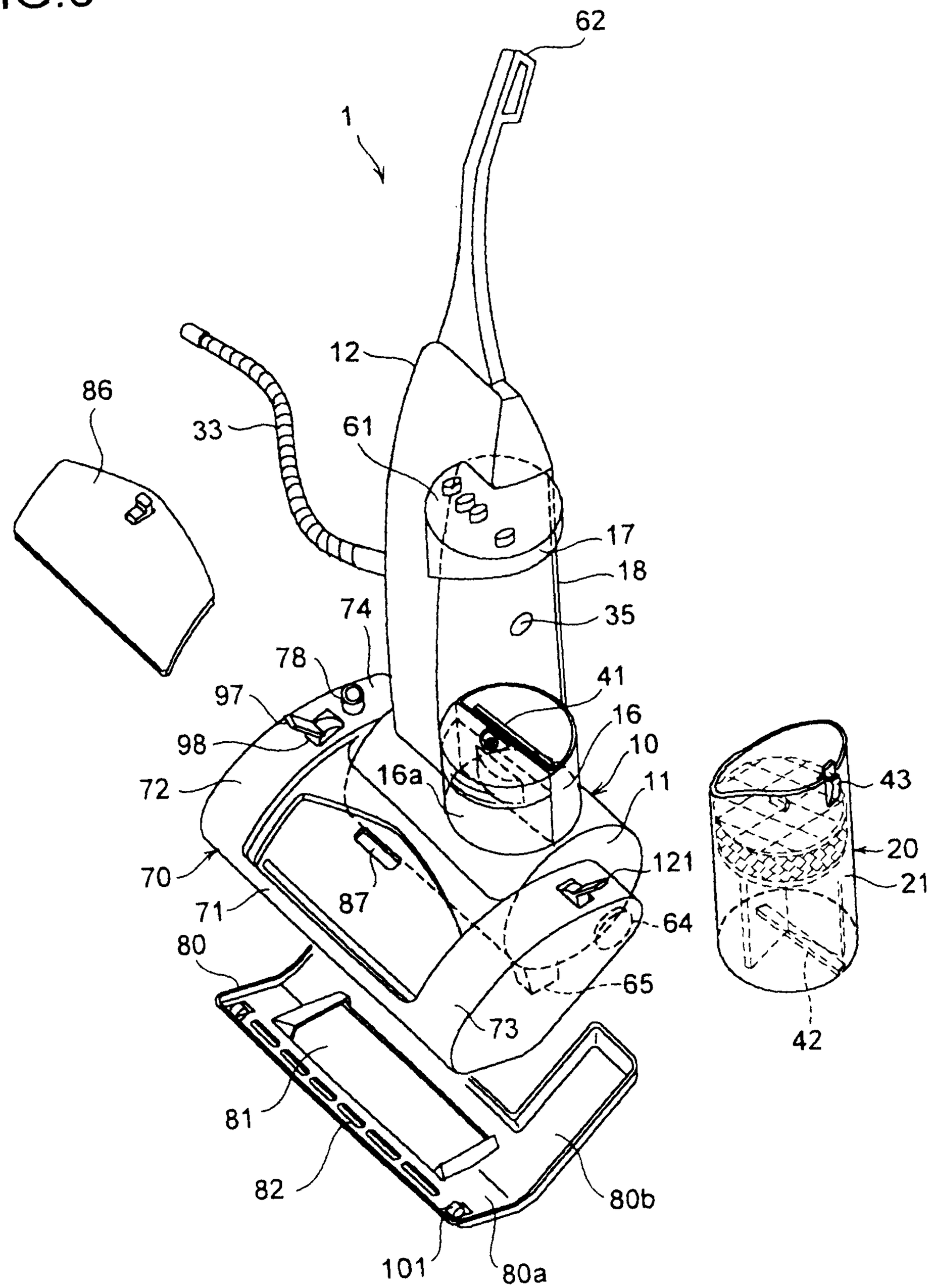


FIG.3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80b
101
80a

FIG.4

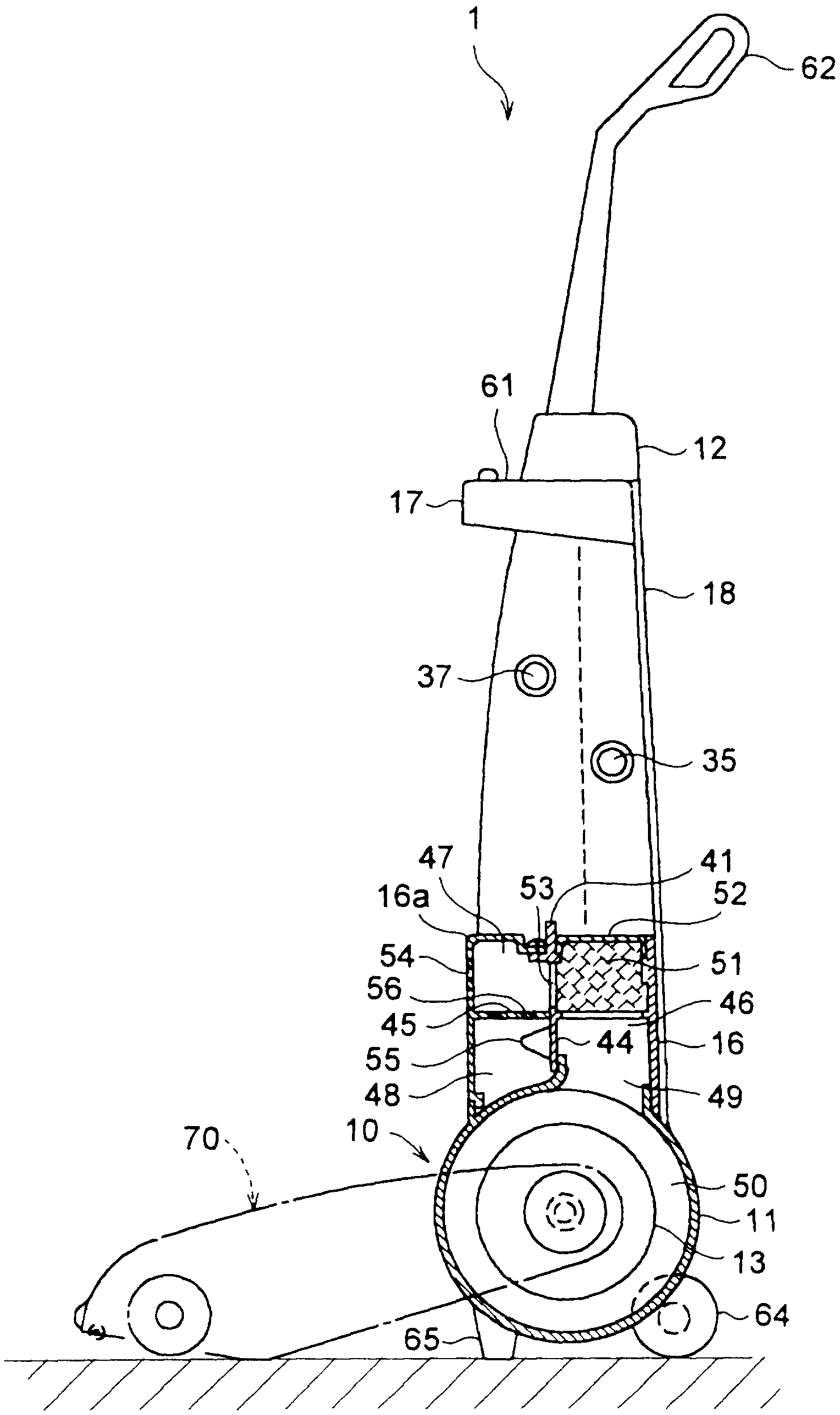
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FIG.5

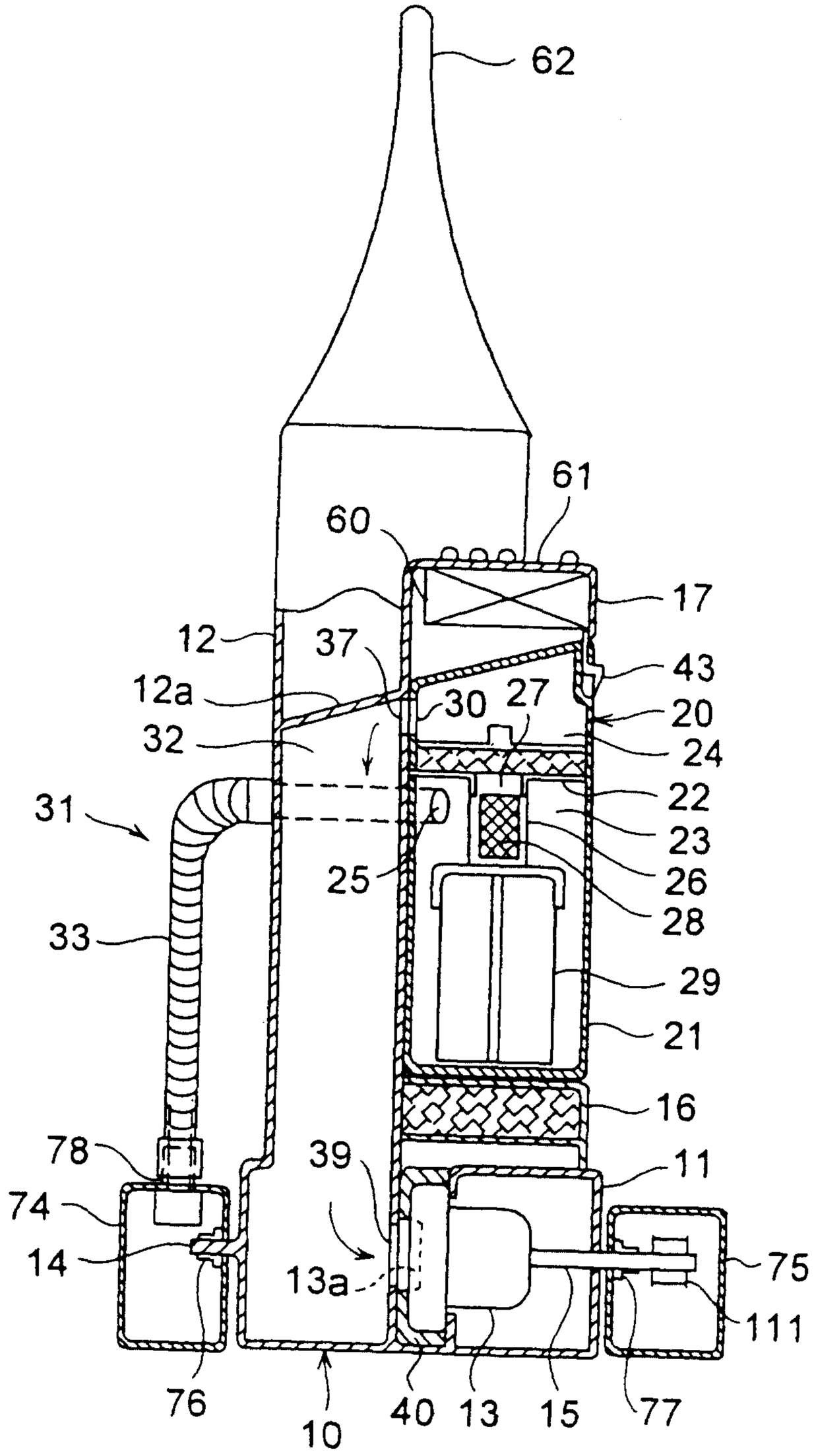
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FIG.6

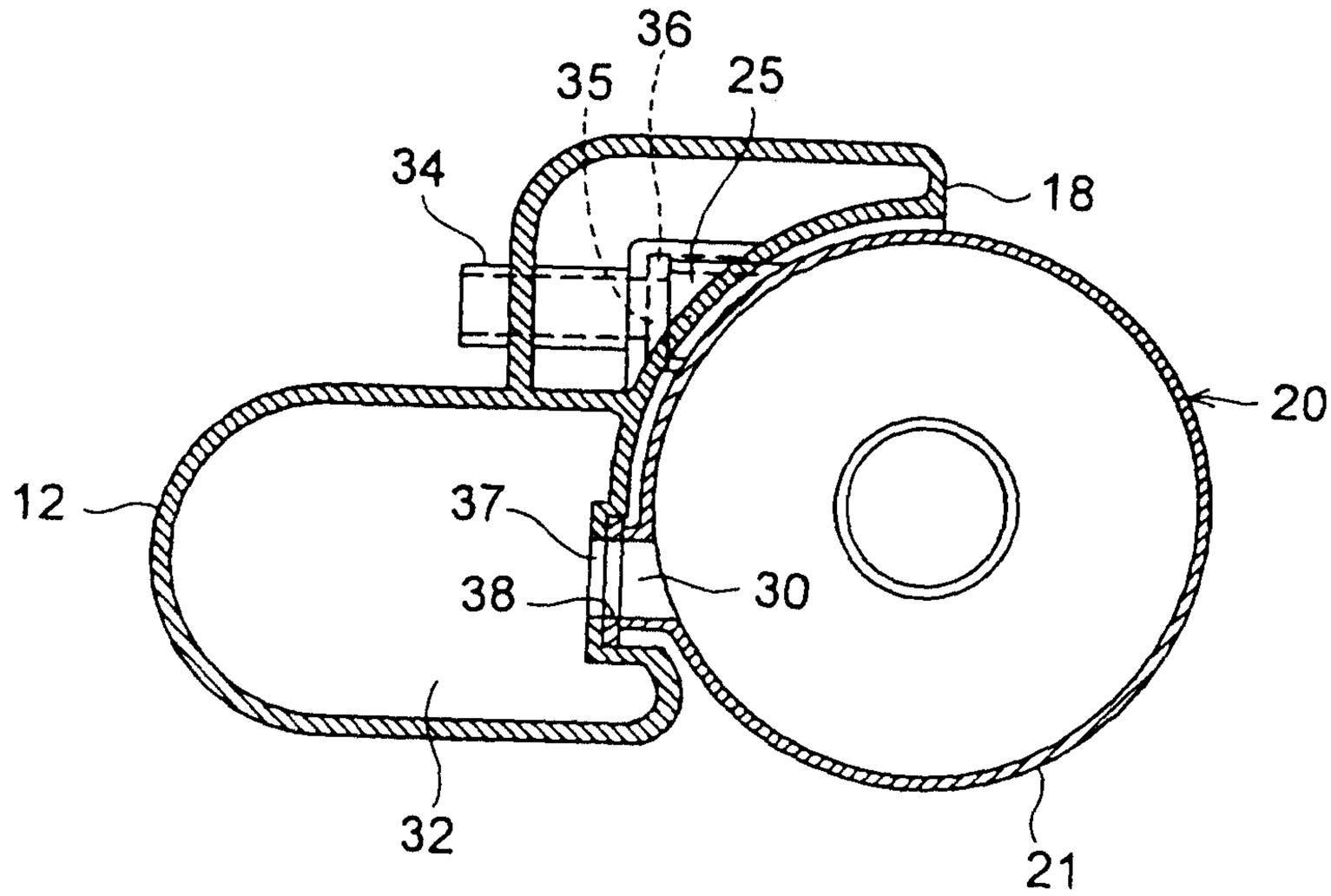

FIG.7

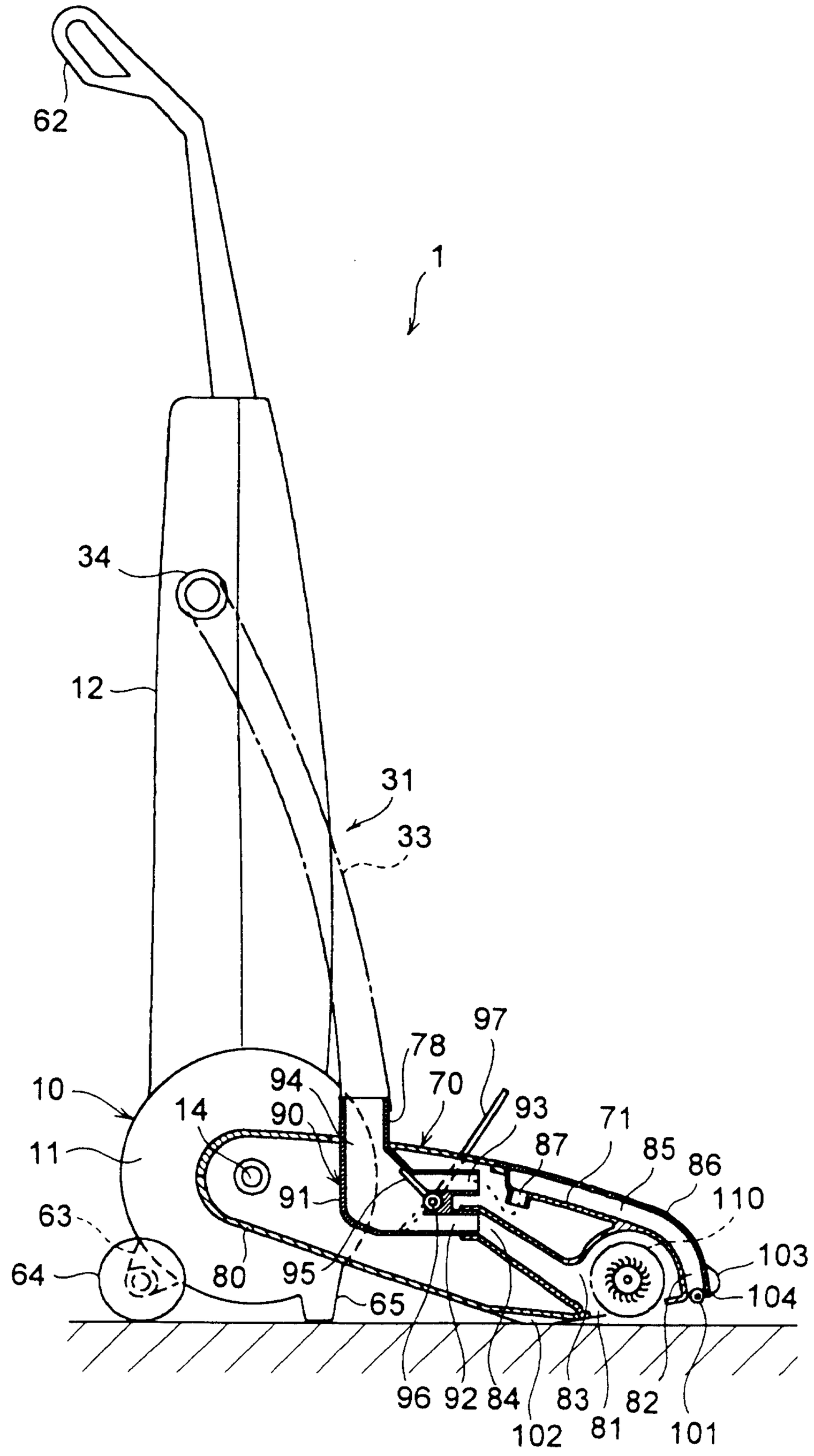
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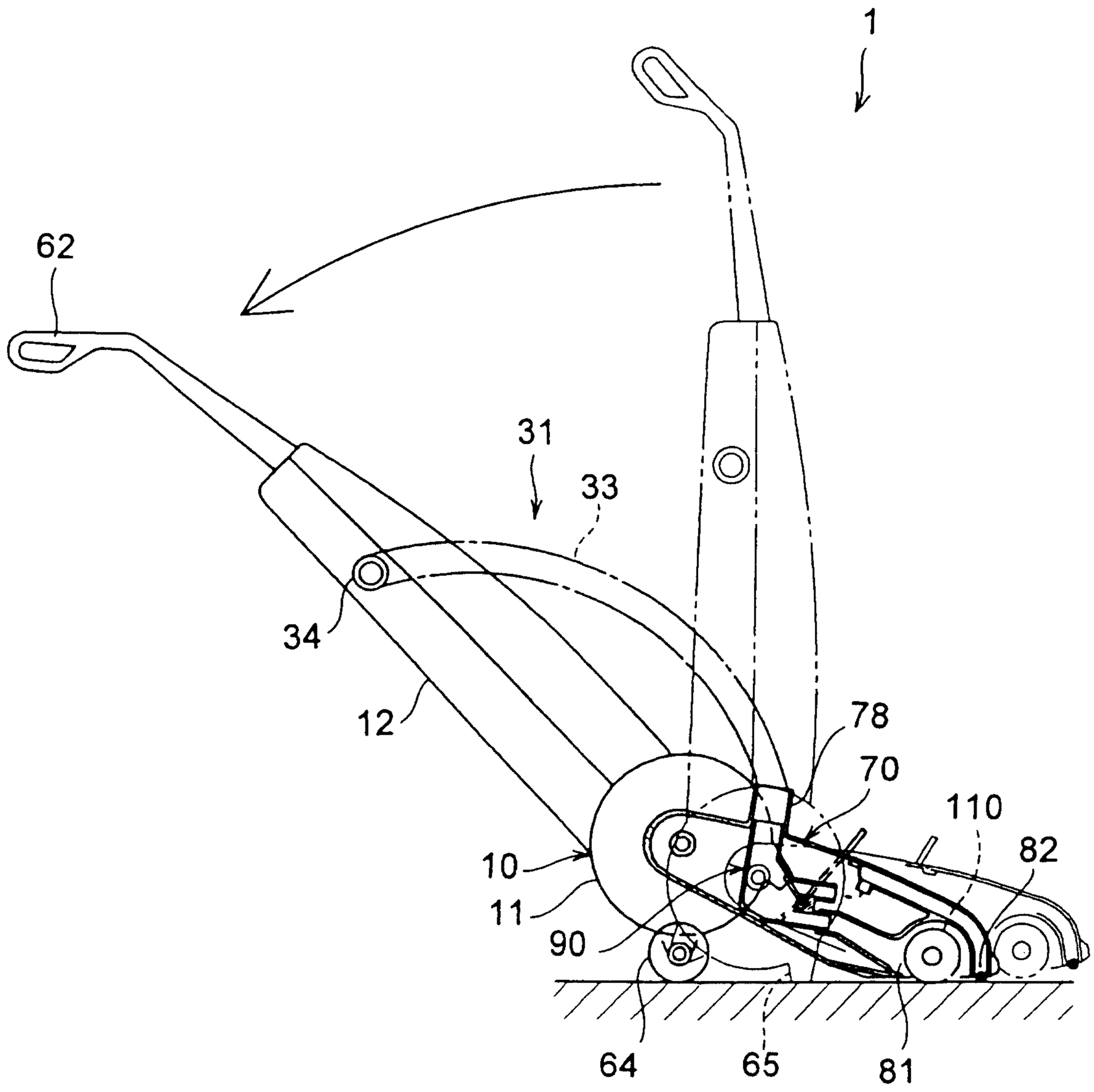
FIG.8



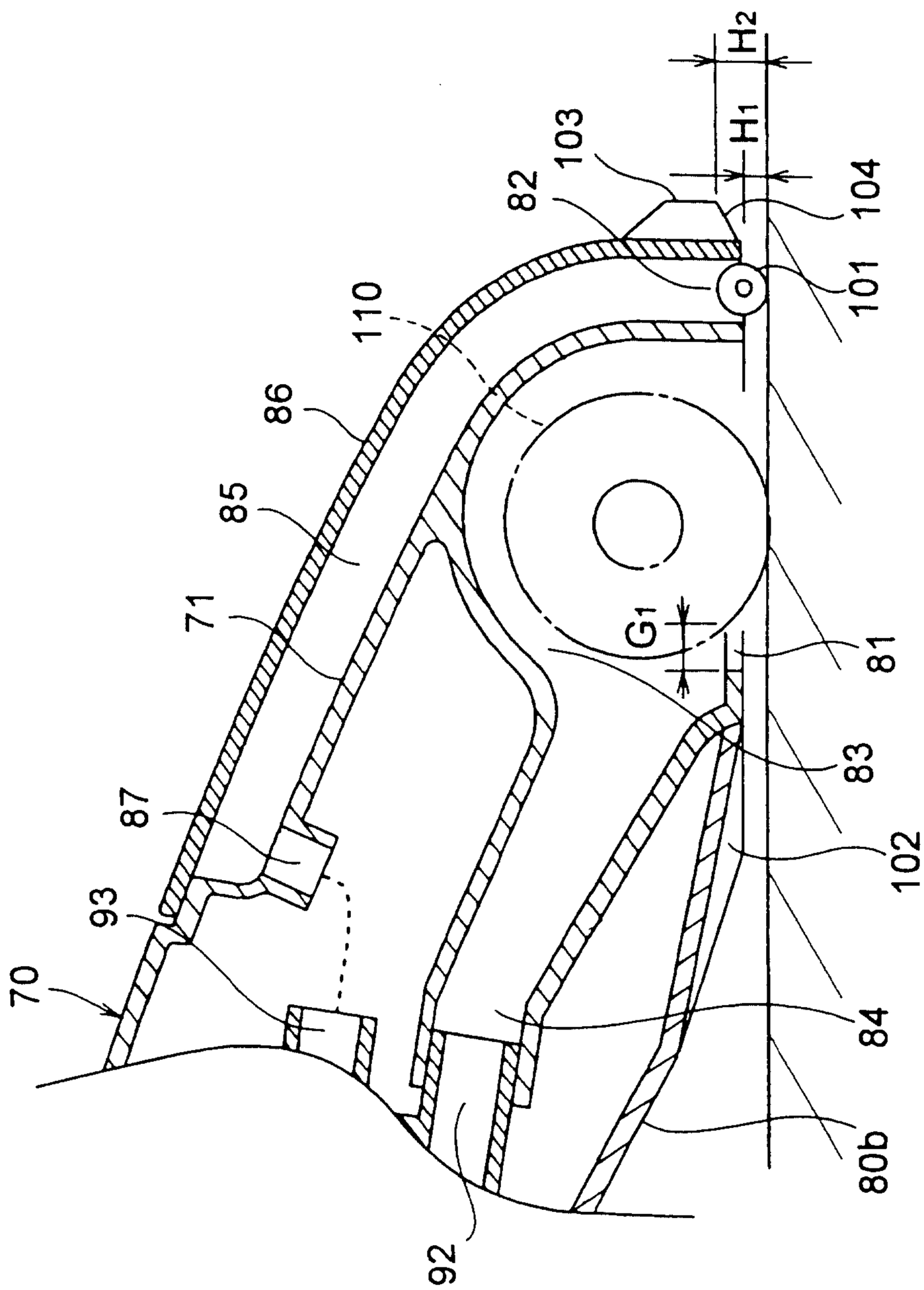


FIG. 9

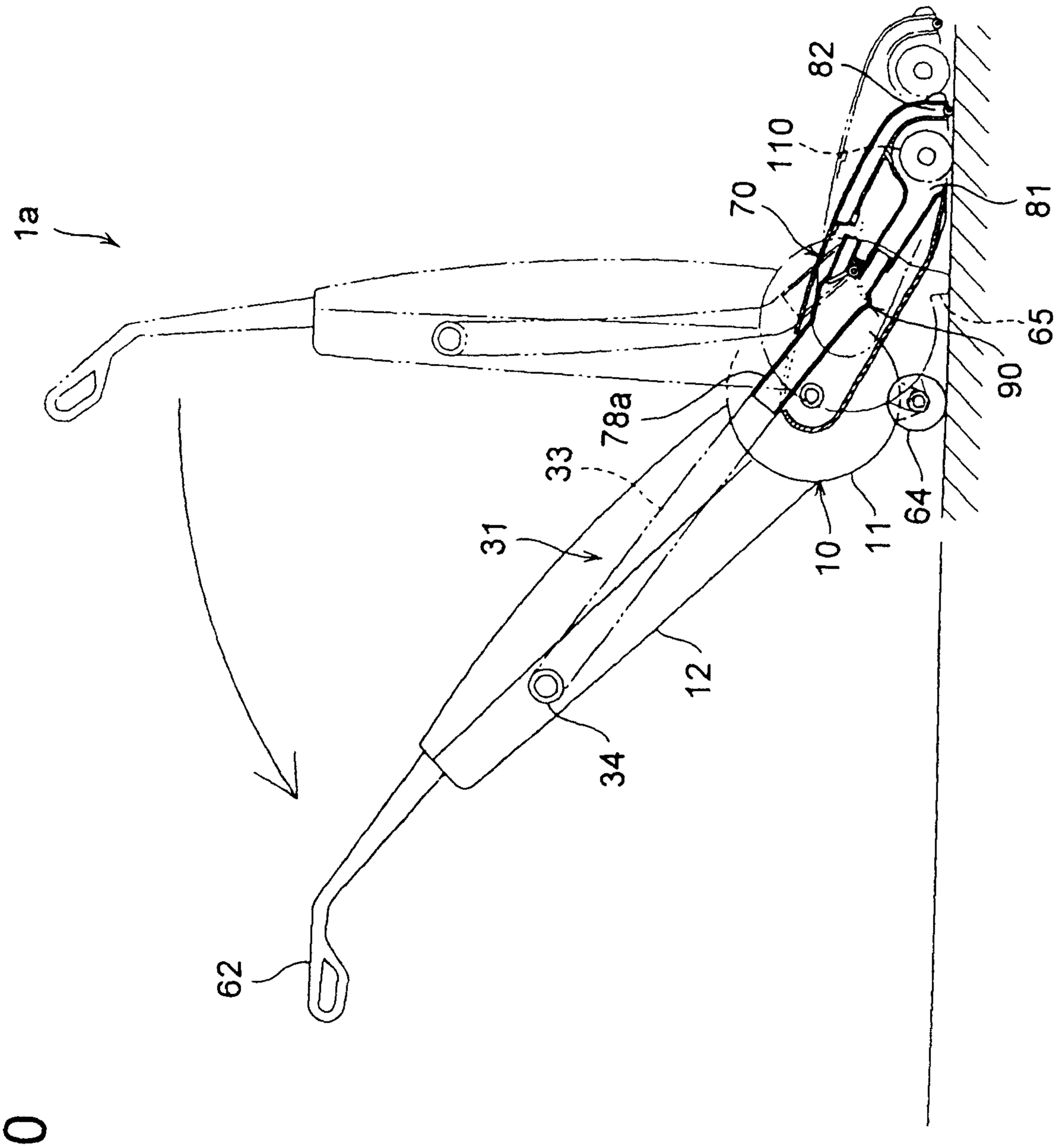
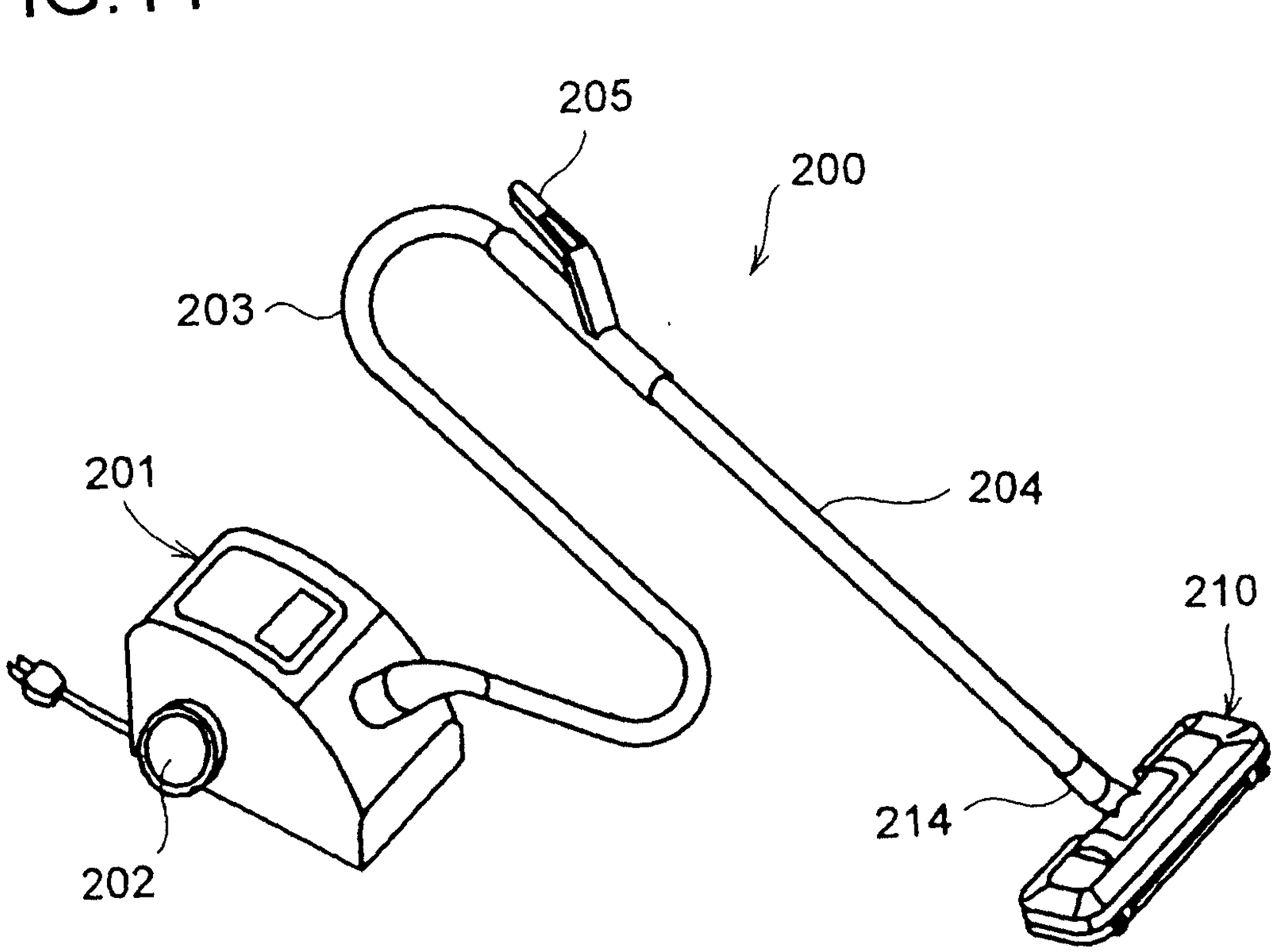


FIG.1

FIG.11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202

FIG.12

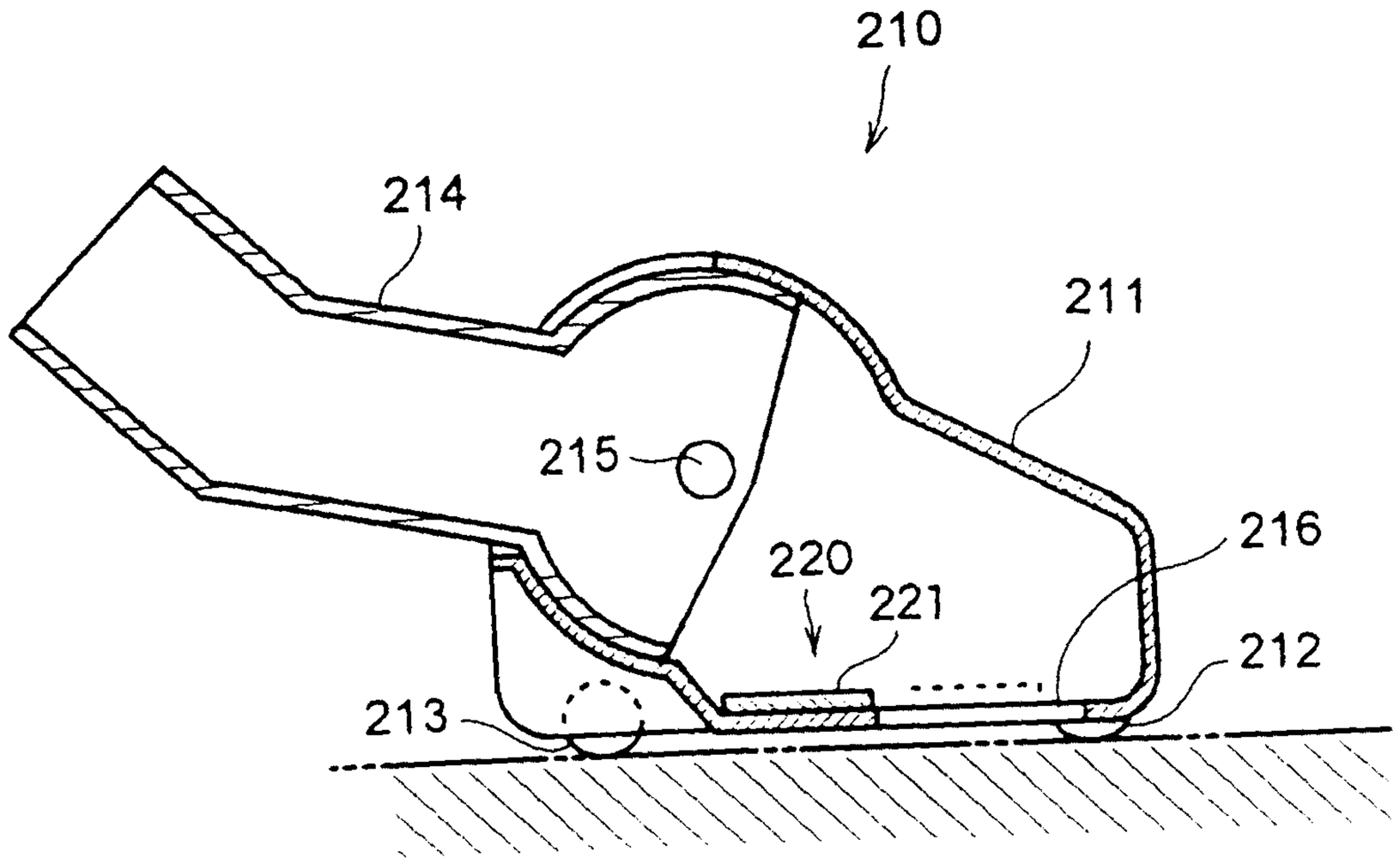
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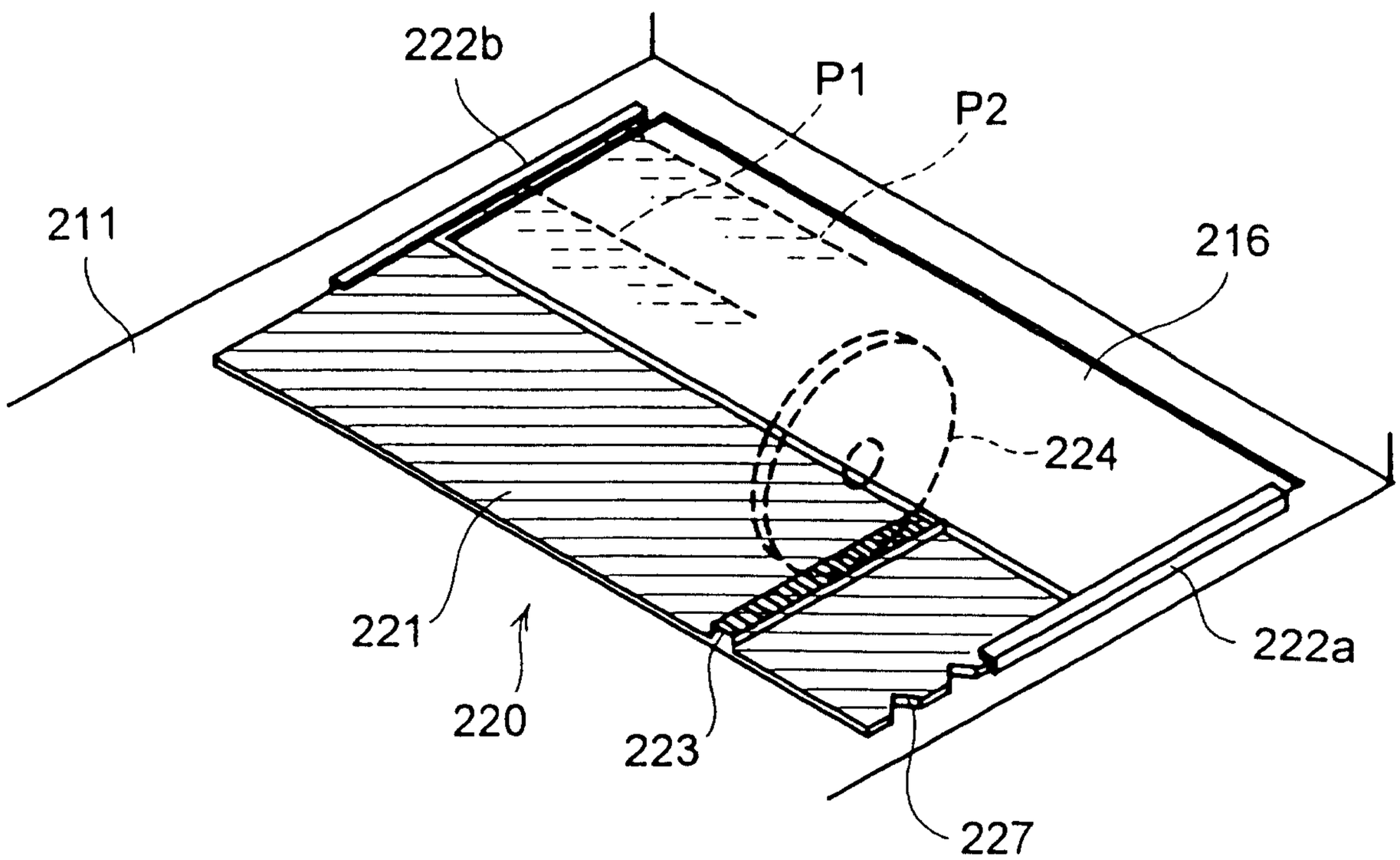
FIG.13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P1
P2
211
216
224
221
220
223
222a
227

FIG.14

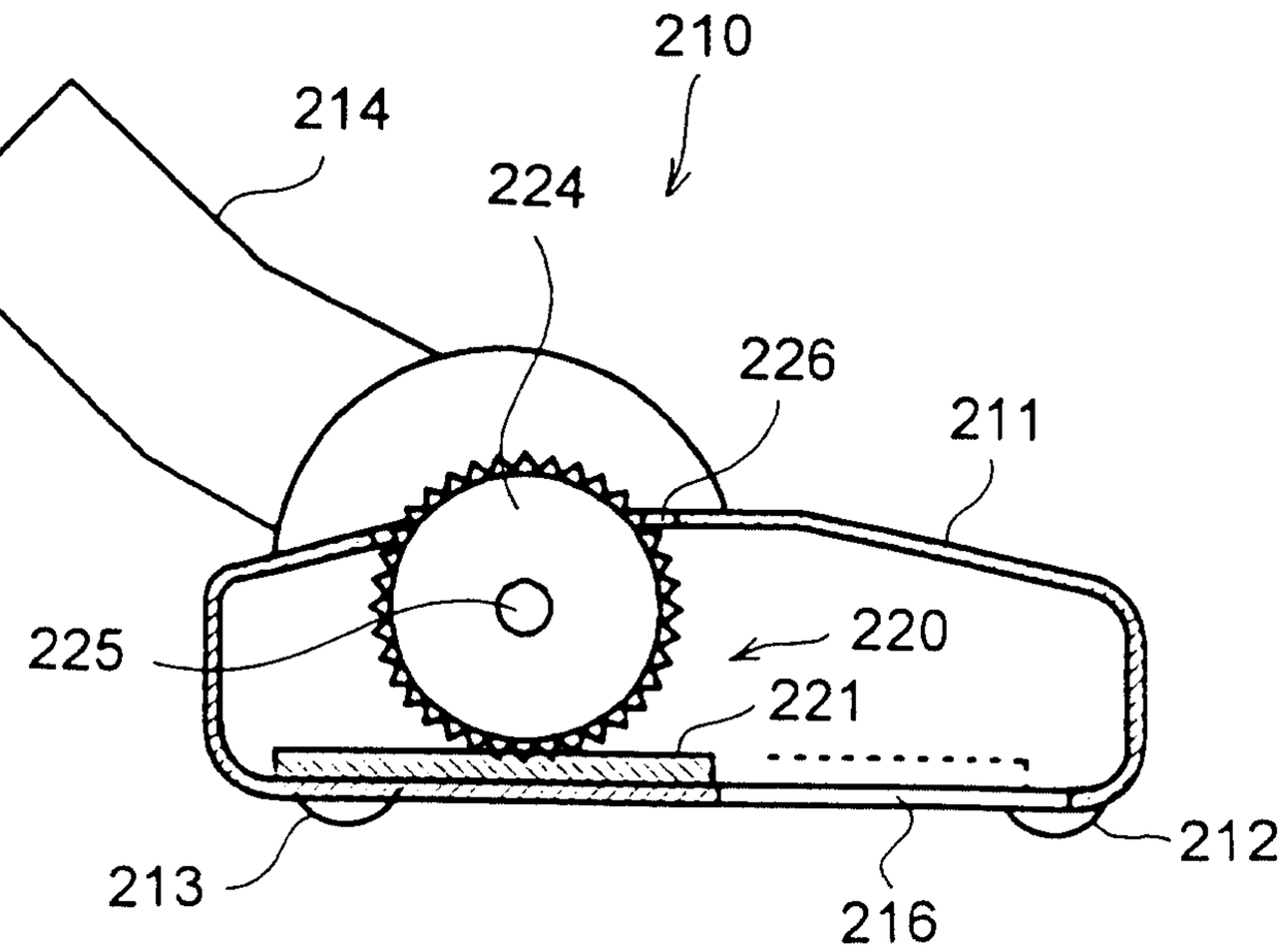
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FIG.15

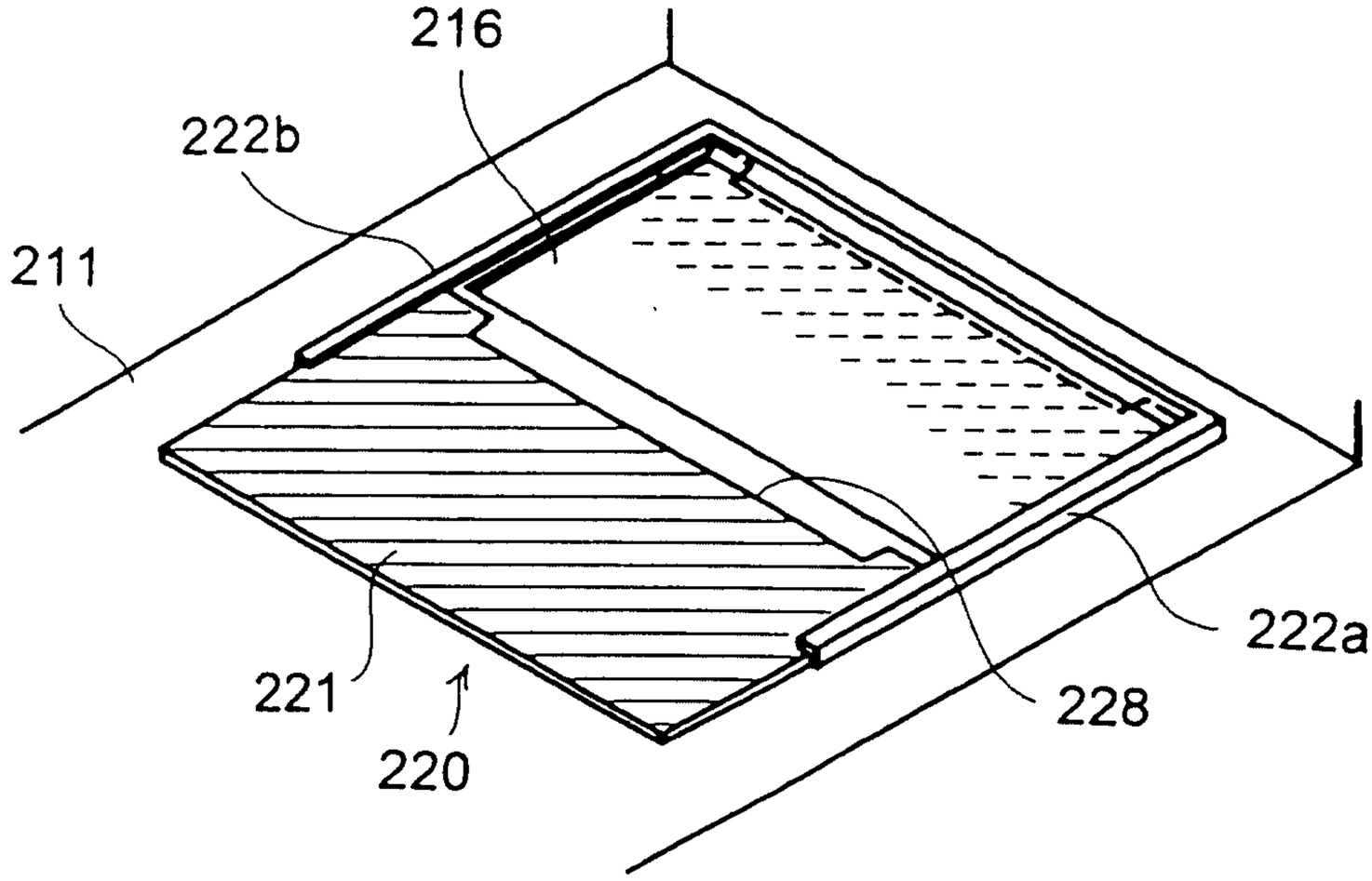

FIG.16

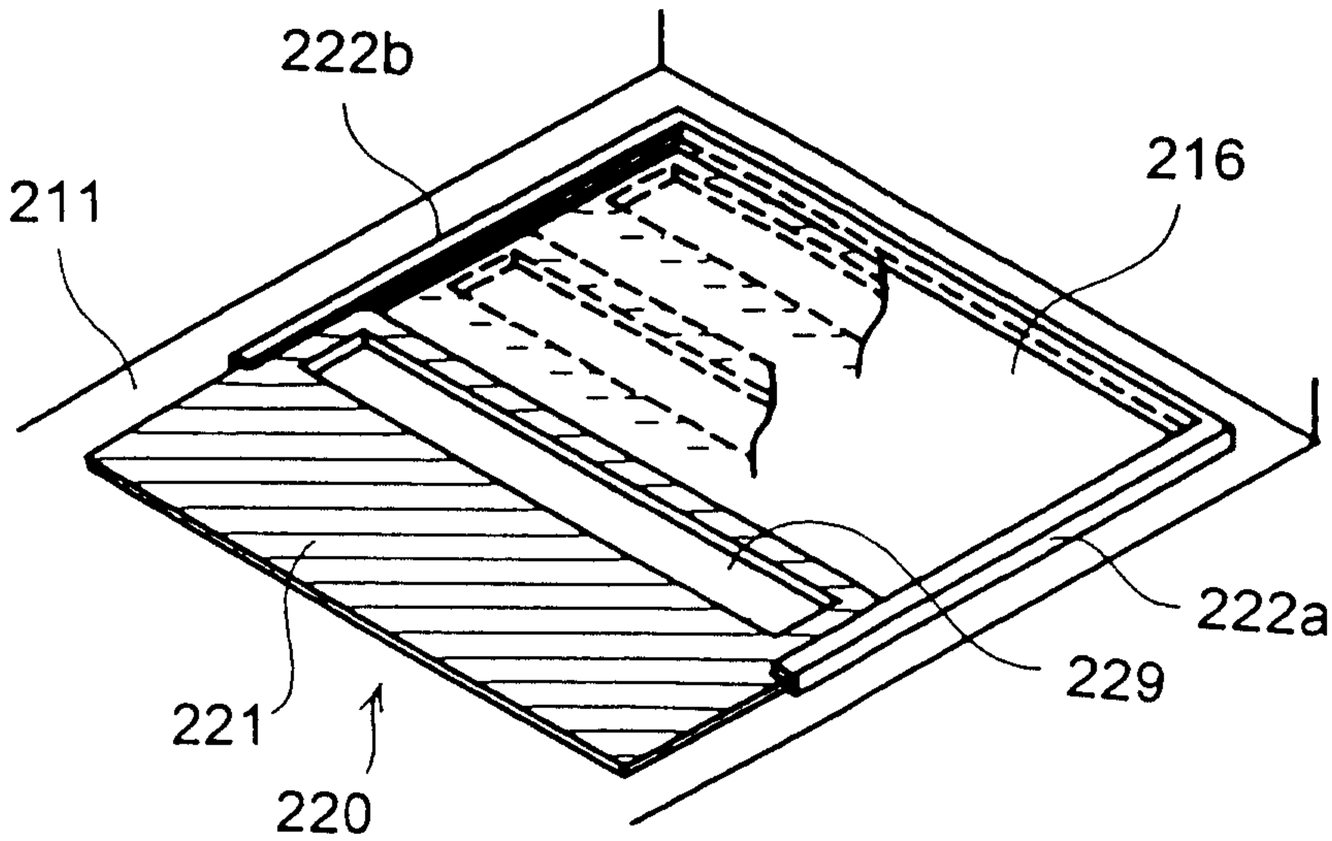

FIG.17

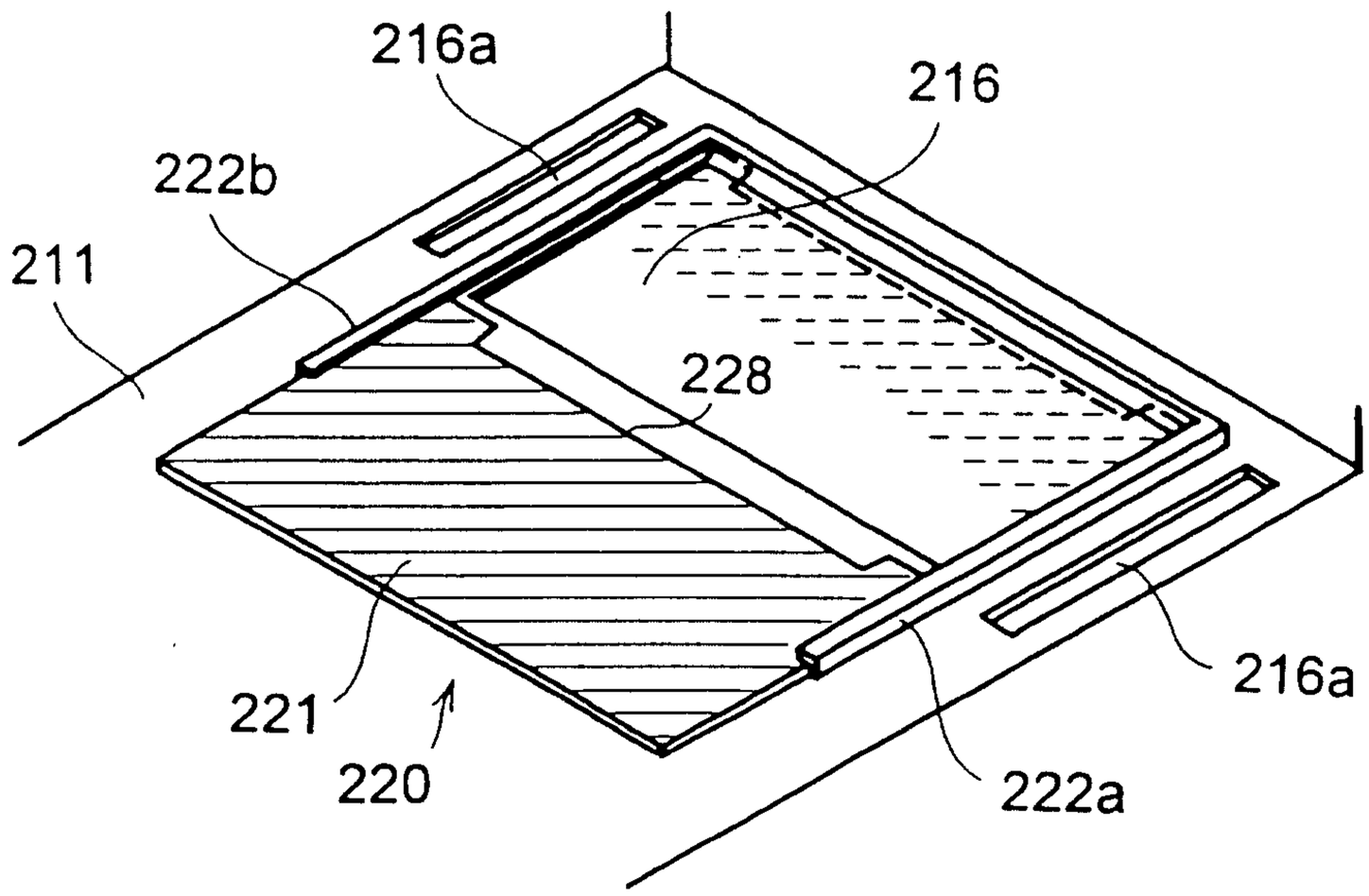
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FIG.18

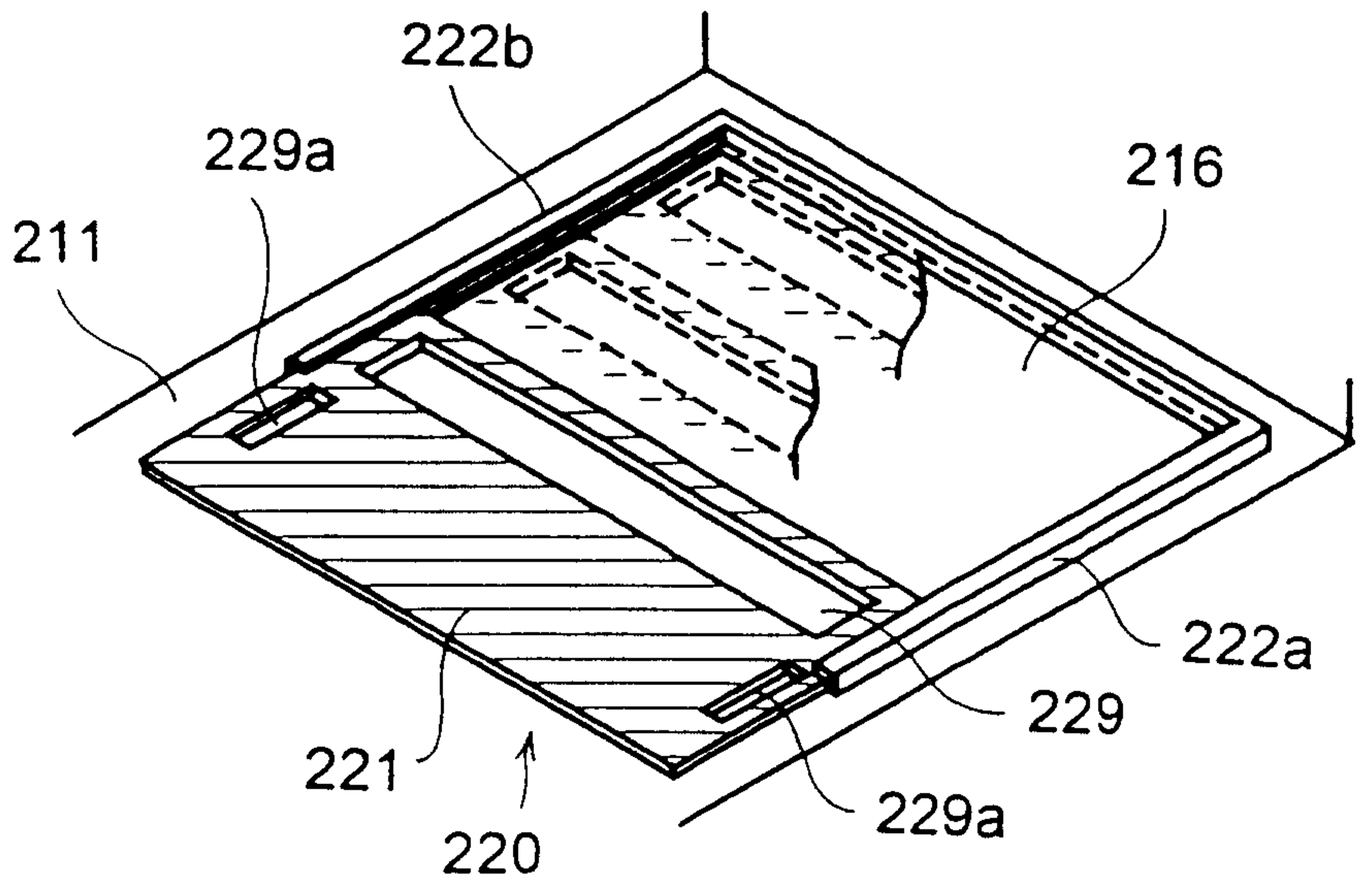
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FIG.19

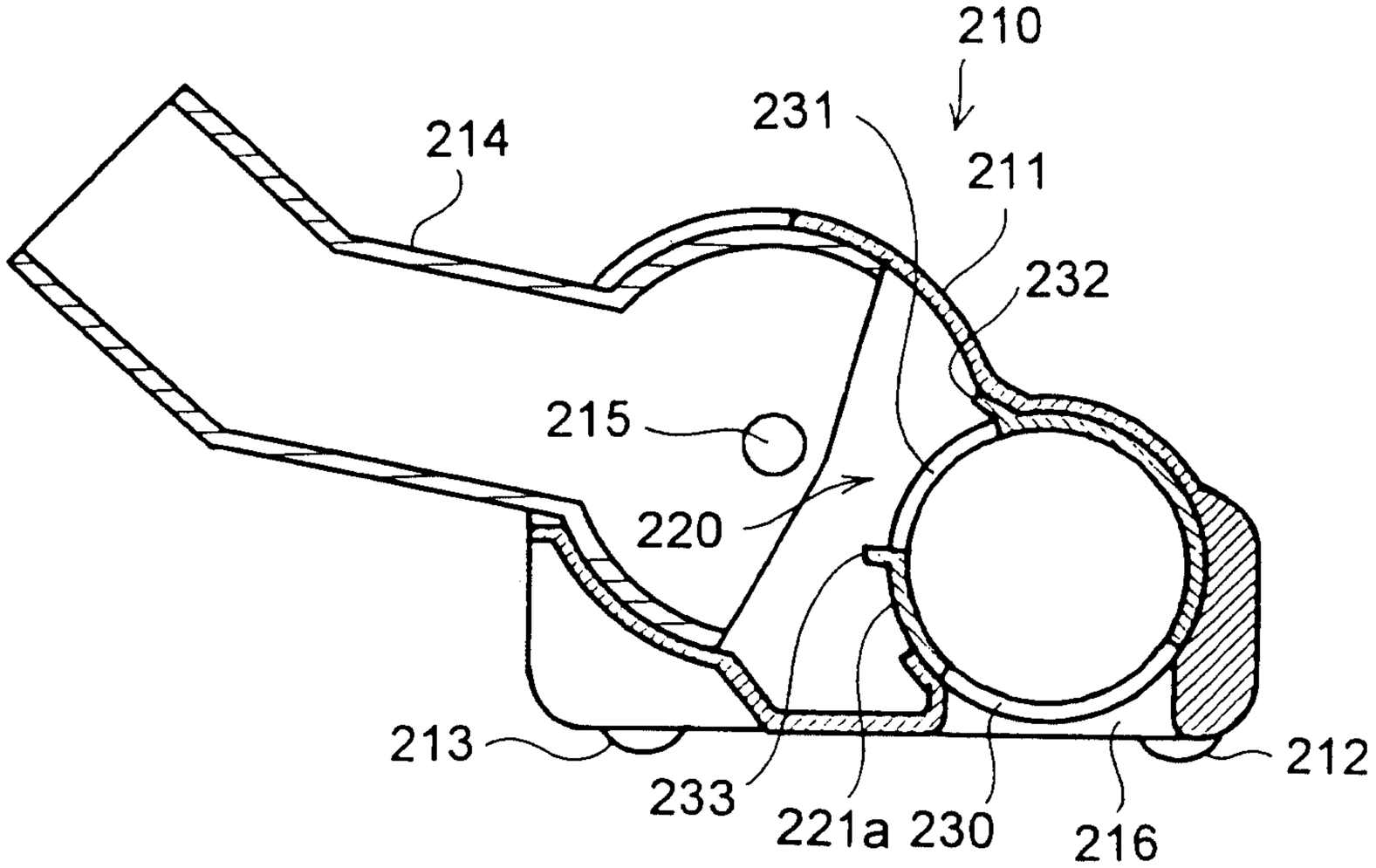
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FIG.20

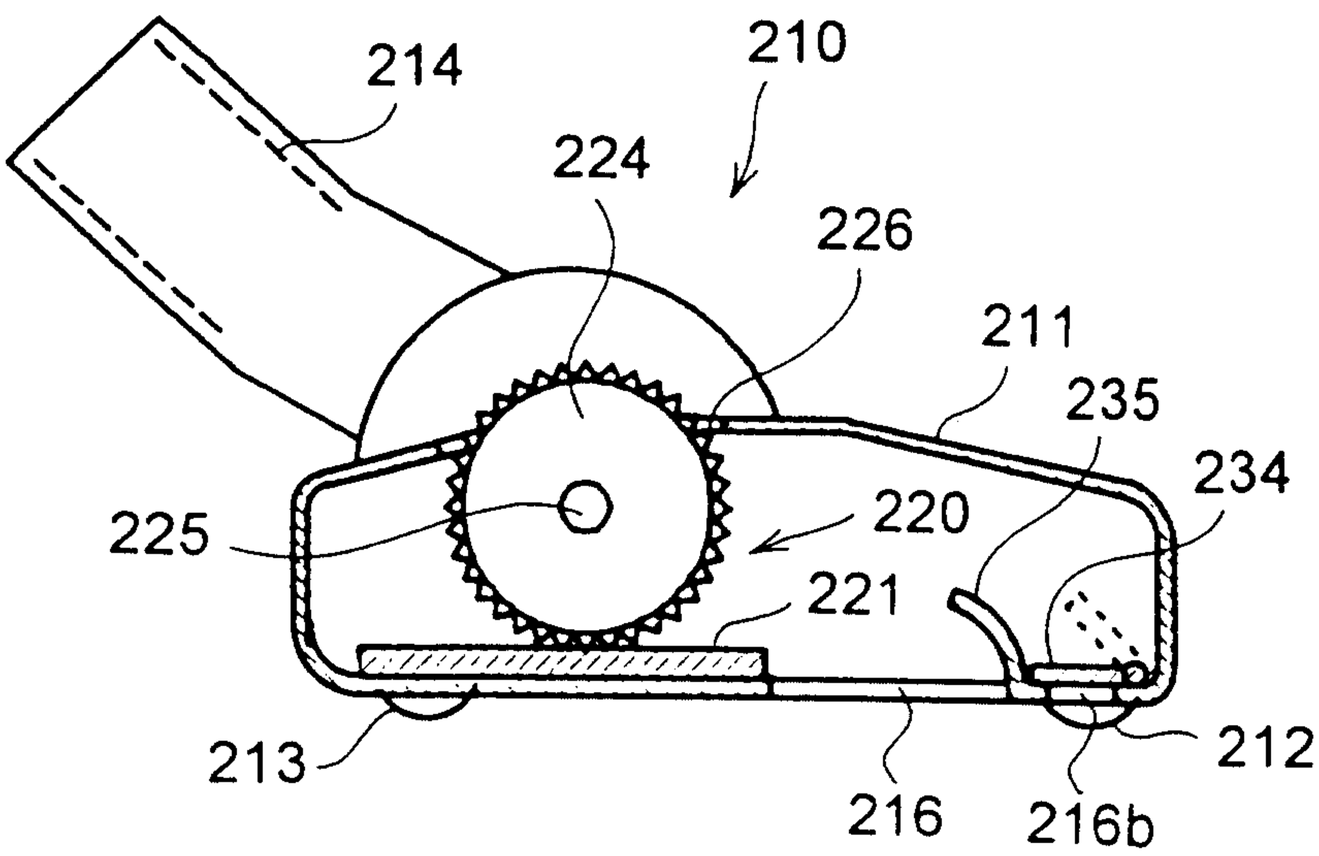
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FIG.21

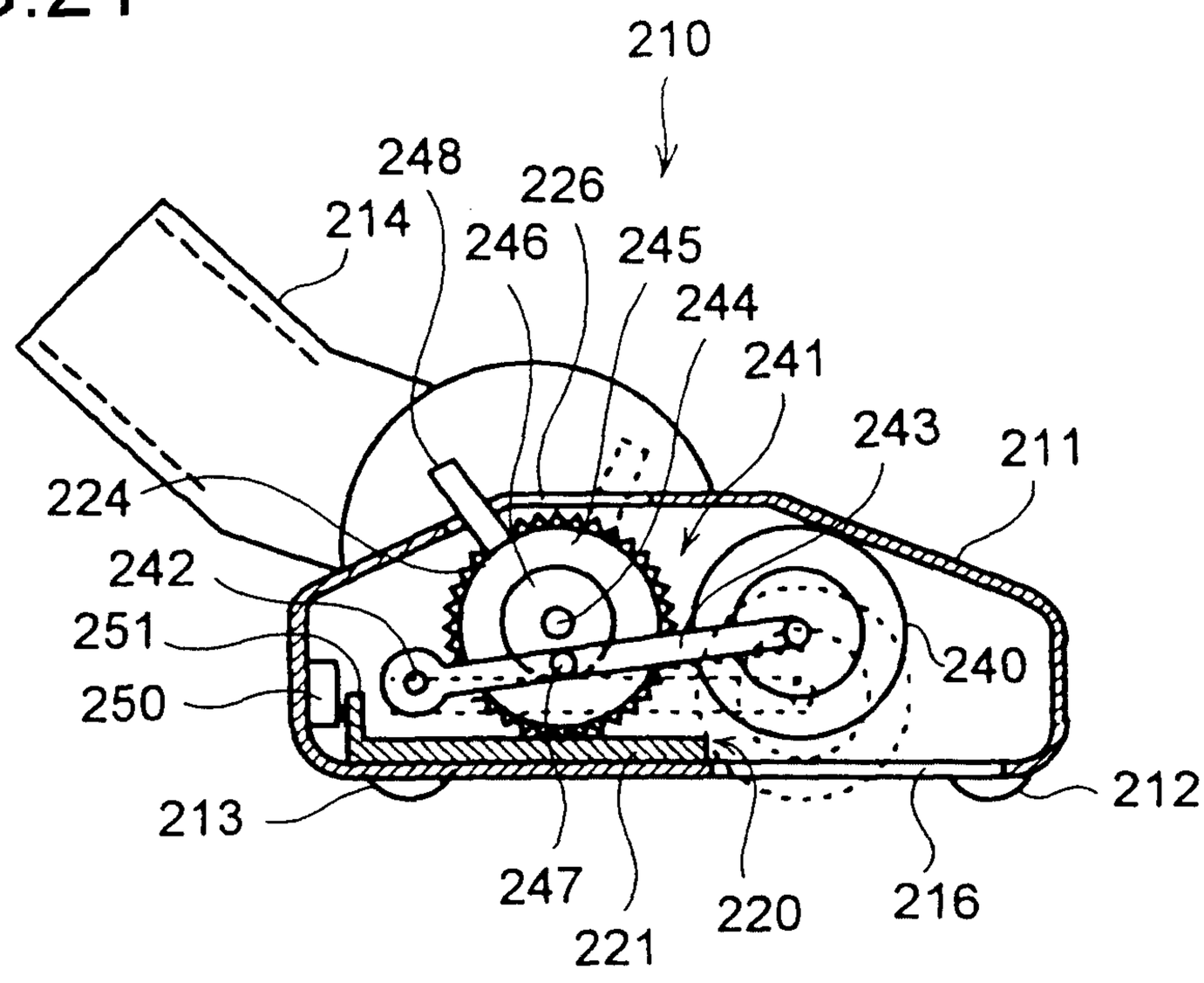
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FIG.22

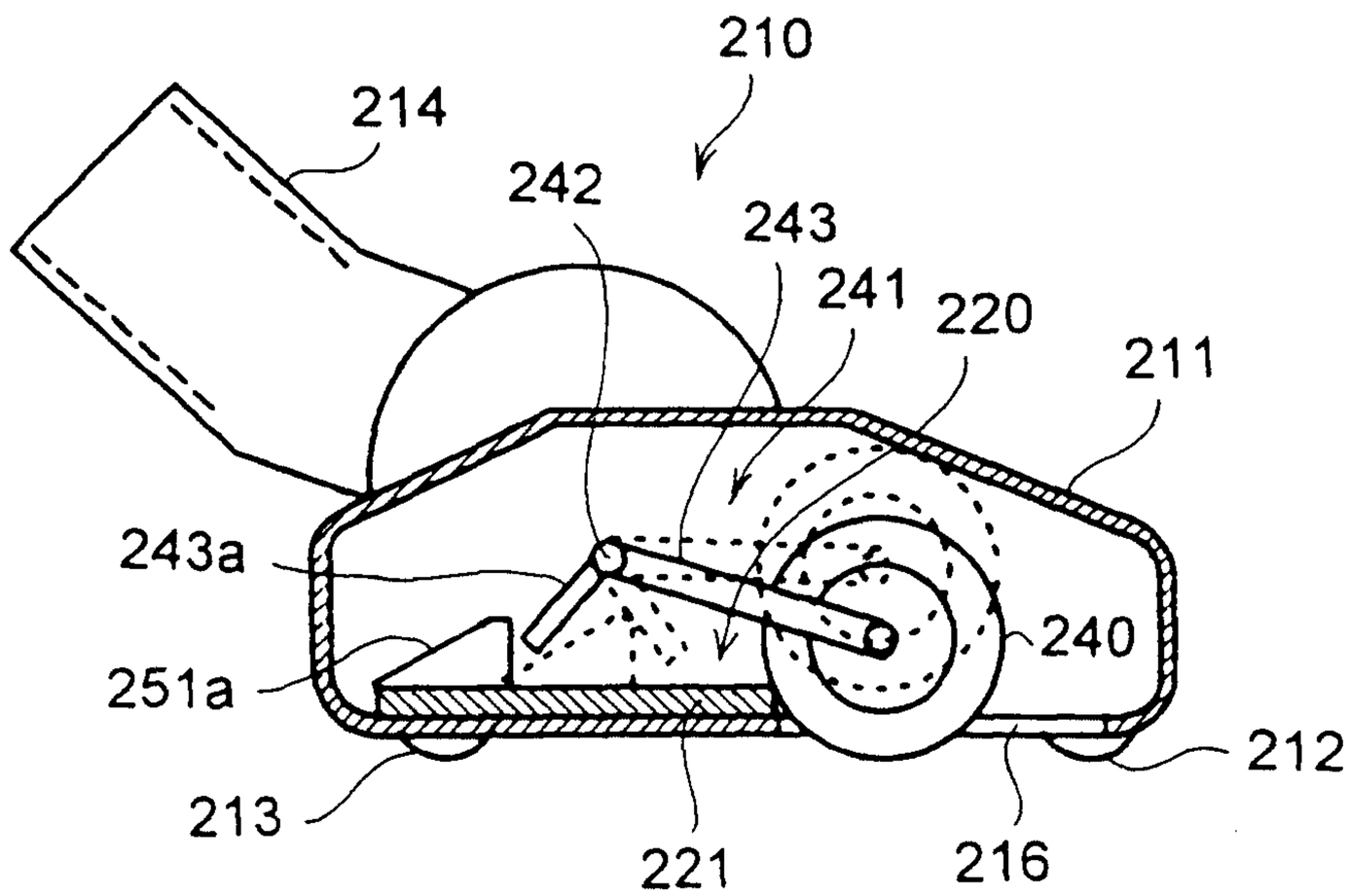
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FIG.23

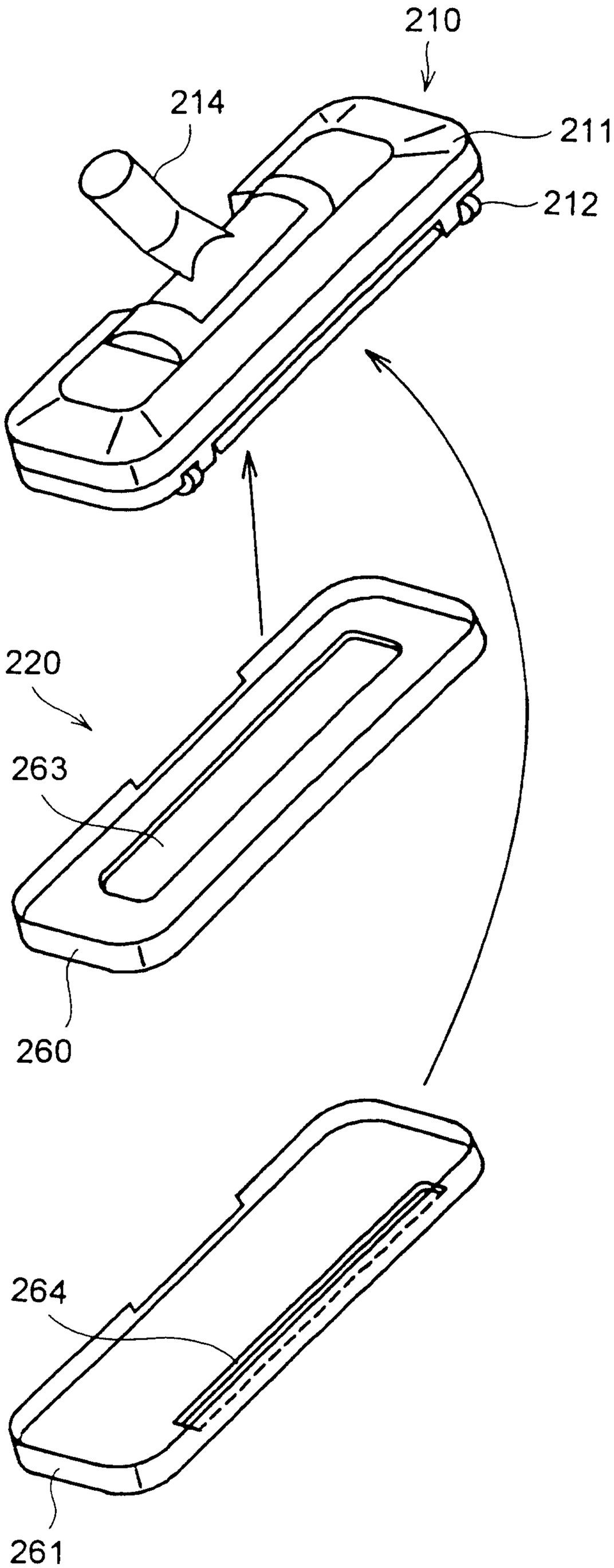


FIG.24

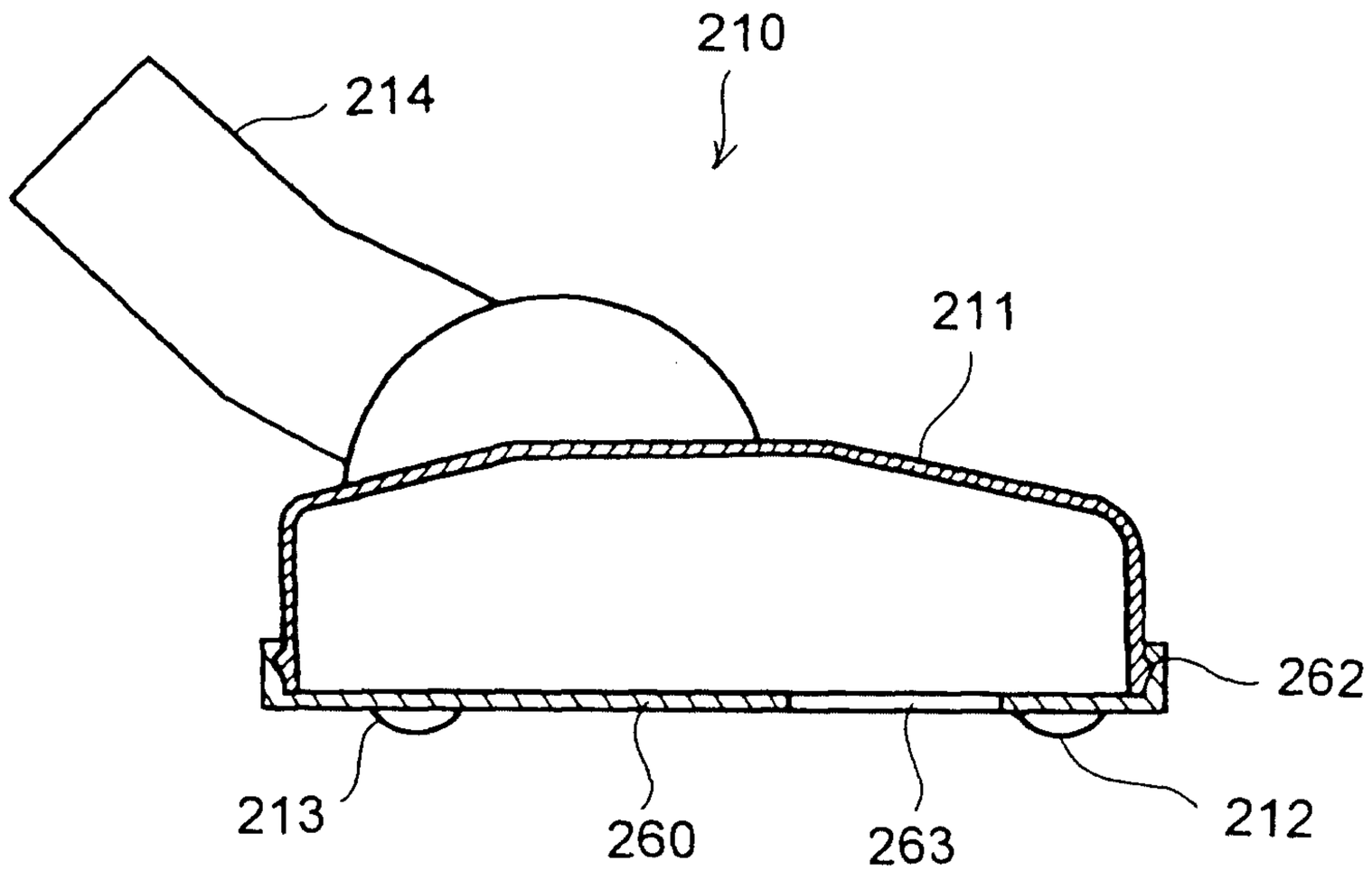
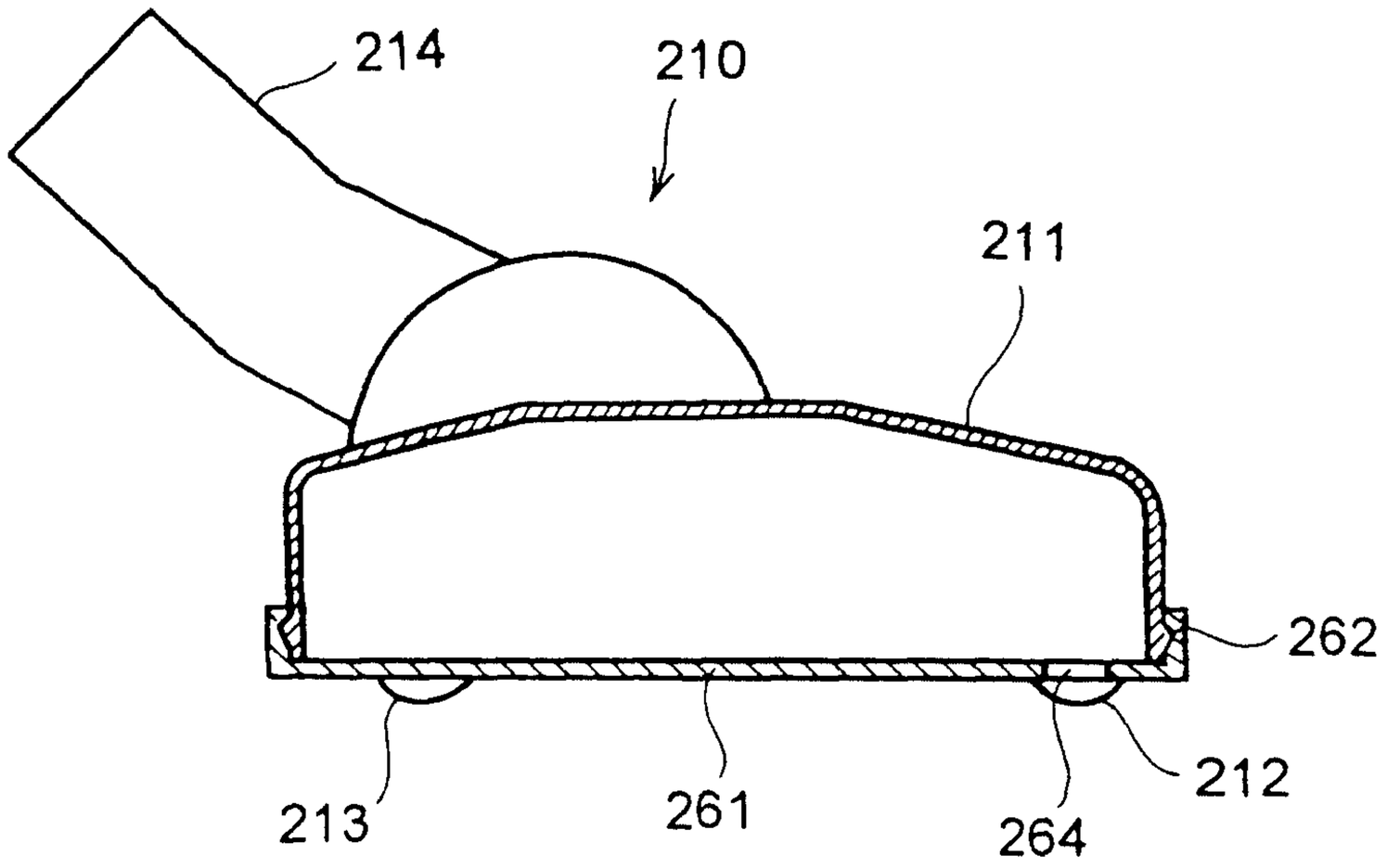
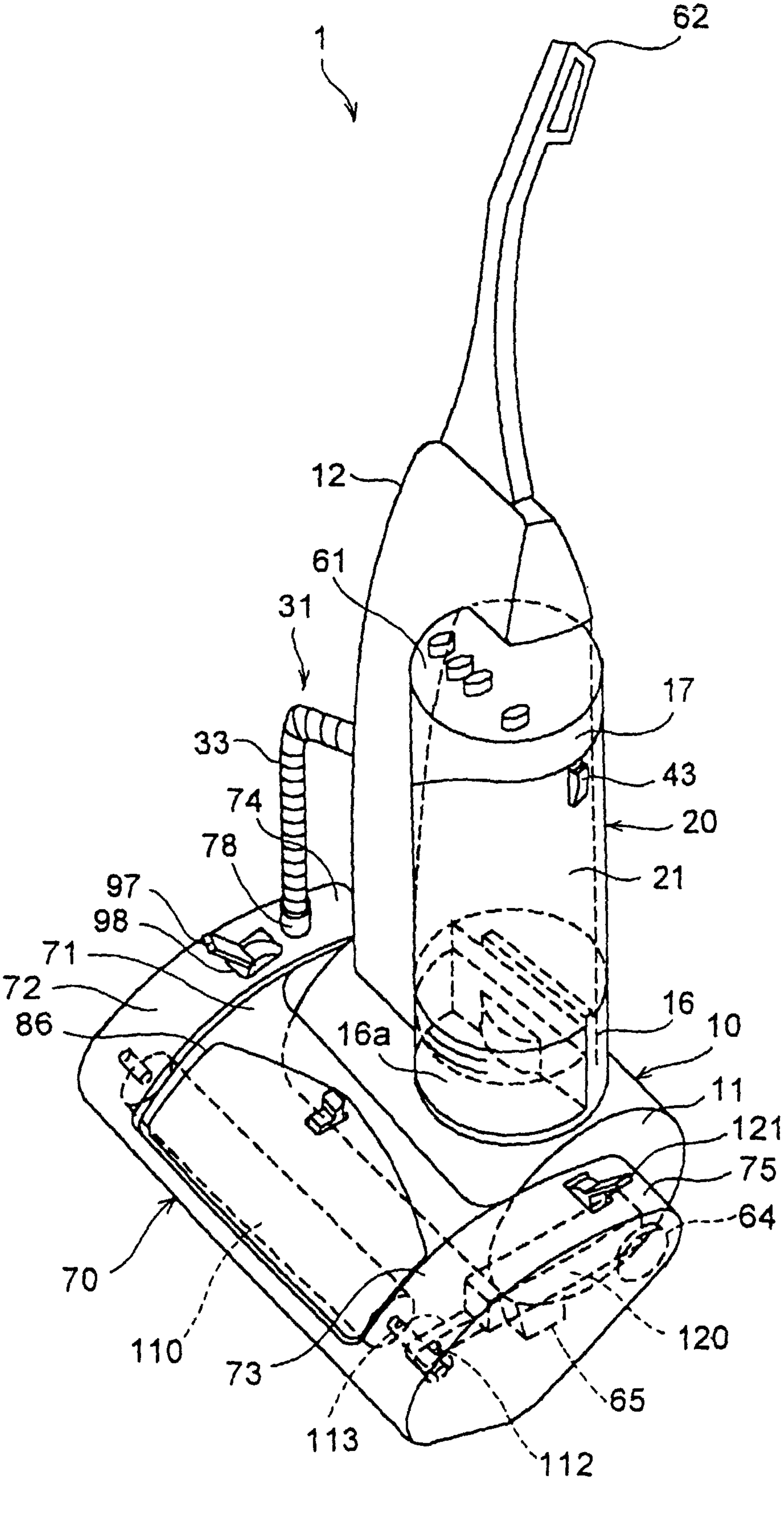


FIG.25

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