



European Patent Office



EP 0 728 434 A1

published in accordance with Art. 158(3) EPC

(87) International publication number:
WO 96/08192 (21.03.1996 Gazette 1996/13)

(74) Representative: **Paget, Hugh Charles Edward et al**
MEWBURN ELLIS
York House
23 Kingsway
London WC2B 6HP (GB)

inside the main body of suction nozzle. By evacuating the air inside the suction chamber by suction means, a spiral air flow is generated in the longitudinal direction of the main body of suction nozzle, and dust staying on the surface to be cleaned are removed and sucked with high-speed airflow.

Description

Technical Field

The present invention relates to a vacuum cleaner having a sucking means for cleaning by sucking dust on a surface to be cleaned.

Prior Art

In the prior art, what is often used is an electric vacuum cleaner which has a rotating brush installed in the sucking chamber of the main body of the suction port and made to be driven with a separated motor or an air turbine, in order to increase suction performance in sucking dust especially on a carpet. This kind of vacuum cleaner is aimed for increasing suction performance by combing up dust with the rotating brush and sucking dust on the cleaning area.

For example, in Japanese Patent Application Laid-Open Number 1-297030, what is disclosed is a technology used in the vacuum cleaner with a rotating turbine driven by suction air flow in which the rotary brush is driven by the rotating turbine. In Japanese Patent Application Laid-Open Number 2-274218, what is disclosed is a technology for the vacuum cleaner in which the rotating brush is driven by the brush motor.

On the other hand, in Japanese Patent Laid-Open Number 62-139450, what is disclosed is a dust suction apparatus which generates a spiral air flow having its rotating axis so as to extend in the vertical direction to the surface to be cleaned. In this apparatus, a projected part is formed in the suction port and a spiral air flow is generated with this projected part.

Because it is necessary in the prior art vacuum cleaners using a rotary brush to install a rotary brush, a separated motor or an air turbine for driving the rotary brush inside the suction port itself, there is such a problem that the weight and volume of the suction port become larger, and hence that the operability of the vacuum cleaner become worse. In addition, the rotating noise due to the rotation of the rotary brush and the vibration noise due to the friction between the rotary brush and the floor surface to be cleaned become larger, and this makes a major unsatisfactory factor of the vacuum cleaner.

In case of the apparatus in which generates a spiral air flow having its rotating axis so as to extend in the vertical direction to the surface to be cleaned, it is required to make the aspect ratio of the cross-section shape of the suction port substantially as close to 1 as possible, or preferably, to make the shape of the cross-section circular. The cross-section shape of the suction port adopted in many conventional-type vacuum cleaners is a oblong rectangle, it is possible to suck dust in the wider area efficiently by moving the suction port relative to the floor surface in the direction perpendicular to the longer axis of the suction port. However, with respect to the shape of the suction port for generating a spiral air

flow, it is required to make the cross-section of the suction port larger while the aspect ratio of the rectangle shape of this cross-section of the suction port, in order to suck dust in the wider area efficiently. In the prior art apparatus using spiral air flow, there is such a problem that the weight of the suction port gets larger and the operation of the vacuum cleaner is made to be difficult because the rectangle shape of the suction port is inevitably larger than that of the suction port shaped in a rectangle having the identical aspect ratio. In case of the suction port shaped in a circle, there is such a problem that dust staying on the floor close to the side wall can not efficiently sucked.

Disclosure of the Present Invention

An object of the present invention is to provide a vacuum cleaner enabling to reduce the mechanical noise from the cleaner, and another object is to provide a vacuum cleaner having a suction port with its size and weight enabled to be smaller.

In order to attain the above object, the present invention comprises

a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and

a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port;

and a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between a lower face of the main body of suction nozzle and the surface to be cleaned.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and a suction nozzle for connecting the outside part of the main body of a suction nozzle and an inside of the suction chamber, being formed so as to extend along a direction in which the continuous surface and the open port intersect with each other toward the fluid path.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an

outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and a concave part, being formed so as to extend along an edge in which the continuous surface and the open port intersect with each other, defined in a whole region of an lower face of the main body of suction nozzle in an direction crossing over the edge from one side of the edge.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; a shield part for restricting a fluid flowing into the suction chamber through a gap between a lower face of the main body of suction nozzle and the surface to be cleaned; and a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between the lower face of the main body of suction nozzle and the surface to be cleaned.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between the lower face of the main body of suction nozzle and the surface to be cleaned; and a shield member, being formed at a lower face of the main body of suction nozzle, for restricting a fluid flowing into the suction chamber through a gap between the lower face of the main body of suction nozzle and the surface to be cleaned.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main

body of suction nozzle comprises the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and a shield member having an open port along an edge in which the continuous surface and the open port intersect with each other around the open port.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises a suction nozzle, being formed to be along the open port, for leading a straight air flow from an outside of the main body of suction nozzle to the suction chamber; and a suction chamber having an internal face for converting a kinetic energy of the straight air flow to a rotation energy for generating a spiral flow developed in a longitudinal direction of the suction chamber.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the suction chamber is formed so as to have a continuous and smooth internal face bridging between the open ports; the fluid route connects between a central part of a direction in which the continuous surface and the open port of the suction chamber intersect with each other and an outside of the main body of suction nozzle; a concave part is formed from one end side of an edge in which the continuous surface and the open port intersect with each other and in a whole region of an lower face of the main body of suction nozzle in an direction crossing over the edge; a rubber-made skirt for shielding a gap between the lower face of the main body of suction nozzle and the surface to be cleaned, being formed so as to cover the open port from one step part to another step part defined by the concave part; a roller for make smooth a movement of the main body of suction nozzle is formed is installed in a lower face in a opposite position to the open port of the concave part formed in the lower face of the main body of suction nozzle; the suction means is composed of an extension tube connected to the fluid path and a blower; and a symmetrical and continuous spiral air flow developed from an end side in a direction in which the continuous surface and the open port of the suction chamber intersect with each other toward the fluid path is made to be generated by evacuating an air inside the suction chamber by the blower.

And the present invention comprises a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; and a suction means for sucking an air inside the suction cham-

ber,
wherein a spiral air flow is generated in the suction chamber including an edge of the open port along a longitudinal direction of the suction chamber, the air flow developed in the longitudinal direction; the spiral air flow is made to be collided directly with the surface to be cleaned; and a reflected air flow after collision is evacuated thereby.

The means for generating a spiral air flow is composed of a smooth and continuous surface so configured as to hold an open port formed in the lower face of the main body of suction nozzle against the surface to be cleaned, and a suction nozzle leading a fluid flow on the continuous surface from the outside part of the main body of suction nozzle.

After the air inside the suction chamber is evacuated by the suction means, the suction nozzle leads the evacuated air into the suction chamber so that the evacuated air may travel in a straightforward way from the outside part of the main body of suction nozzle. The continuous surface transfers the kinetic energy of the air flow led in a straightforward way by the suction nozzle into the rotation energy, whereby the air forms a spiral air flow.

The suction nozzle is installed so as to extend along the direction in which the continuous surface and the open port intersect with each other. The direction in which the continuous surface and the open port intersect with each other is taken to be in the longitudinal direction of the main body of suction nozzle, the suction chamber or the open port.

In case that the open port of the fluid path connecting between the suction chamber and the main body of suction nozzle located at the side of the suction chamber is located in the central part of the longitudinal direction, the spiral air flow directs forward to the open port of the fluid path at the center of the suction chamber from the both end sides of the longitudinal direction of the main body of suction nozzle and soon, and makes a couple of symmetrical and continuous spiral air flows. In addition, in case that the open port of the fluid path is located at the both end face of the longitudinal direction of the suction chamber, the spiral air flow directs forward to the both end sides of the longitudinal direction from the center of the suction chamber, and makes a couple of symmetrical and continuous spiral air flow.

When the suction nozzle is located in the lower face of the main body of suction nozzle, the structure and configuration of the suction nozzle may be determined in responsive to the position relationship to the surface to be cleaned. For example, a gap defined between the surface to be cleaned and the lower surface of the main body of suction nozzle is so configured as to extend from the front end part or the rear end part of the main body of the suction nozzle and connect to the open port, and this gap can lead the gaseous fluid into the inside of the suction chamber from the outside part of the main body of suction nozzle with its flowing direction being guided. In this configuration, the front end part or the

rear end part corresponds to the outer perimeter of the lower surface of the main body of suction nozzle so configured as to extend along the longitudinal direction of the main body.

In the above case, it is required that the air flow led into the suction chamber is guided from the tangential direction of the generated spiral air flow to the direction of the spiral flow, and that the external air flowing other than through the suction nozzle is shielded. In order to meet this requirement, in configuring the suction nozzle in responsive to the relation between the lower surface of the main body of suction nozzle and the surface to be cleaned, the structure of the lower surface of the main body of suction nozzle at the opposite side over the open port and at the side parts of the open port (both end parts of the main body in the longitudinal direction) is so defined as to prevent the air outside the main body of suction nozzle from flowing into the suction chamber.

In addition, it is allowed to install a shielding member for preventing the air from flowing into the suction chamber at the opposite side over the open port and at the side parts, that is, both end parts of the main body in the longitudinal direction.

It is also allowed to configure the suction nozzle by installing a concave part extending along the longitudinal direction of the main body in the lower surface part of the main body of suction nozzle where a suction nozzle is defined, so that the bridging part from the front end part or the rear end part of the main body of suction nozzle to the open port may be established.

The spiral air flow makes a fluid path from the continuous surface to the surface to be cleaned, and this air flow plays an role as rotary brushes which have ever been conventionally installed in the main body of suction nozzle in the prior art vacuum cleaners. Thus, the spiral air flow operates as if the air flow hits the surface of the floor to be cleaned and dust can be removed from the floor surface.

Though the continuous surface surely forms a surface extending along the longitudinal direction of the suction chamber, the shape of this continuous surface is not necessarily cylindrical shell, but allowed to be a quadrilateral column. In addition, as the suction nozzle is so directed as to lead the air fluid from outside along the continuous surface, a spiral air flow can be generated effectively.

And furthermore, in the present invention, by installing a suction power control means for controlling the suction power of the suction means, it is possible to control the magnitude or power of the spiral air flow. In this control, with suction power instruction means for directing the designated suction power to the suction power control means by operating the in-hand operation part, the operability of the vacuum cleaner can be increased. In this case, it is allowed to transfer the instruction signals through the wired signal lines connected between the suction power control means and the suction power instruction means, or without wiring cables, the instruction signals can be transmitted. As for the no-wiring data

transmission, infrared rays, ultrasonic waves or electronic radio waves can be used.

The class of fluid described in above is assumed to be gaseous air in case of applying the vacuum cleaner into the home use. However, depending on the usage condition, it may be possible to handle another kind of gaseous fluid or liquid. It is also allowed for the fluid to be handled to contain air, gas or liquid, and their mixture containing dust and any kind of wasted materials and impurities.

Brief Description of the Drawings

FIG. 1 is a perspective drafting of the suction nozzle of the first embodiment of the present invention.

FIG. 2 is an external view of the vacuum cleaner of the present invention.

FIG. 3 is a cross-sectional view of the main body of suction nozzle of the first embodiment of the present invention.

FIG. 4 is a perspective view from the top of the main body of suction nozzle of the first embodiment of the present invention.

FIG. 5 is a cross-sectional view of the main body of suction nozzle of the second embodiment of the present invention.

FIG. 6 is a cross-sectional view of the main body of suction nozzle of the third embodiment of the present invention.

FIG. 7 is a cross-sectional view of the main body of suction nozzle of the fourth embodiment of the present invention.

FIG. 8 is a perspective view from the top of the main body of suction nozzle of the second embodiment of the present invention.

FIG. 9 is a perspective view from the top of the second main body of suction nozzle of the second embodiment of the present invention.

FIG. 10 is a cross-sectional view of the main body of suction nozzle showing one embodiment of the present invention.

Preferred Embodiment of the Present Invention

[Embodiment 1]

In the followings, the first embodiment of the present invention is described in detail with drawings.

FIG. 1 shows a perspective view of the nozzle body. Inside the nozzle body 101 place on the floor surface (a surface to be cleaned) 102, a spiral air flow 103 is established by the suction operation of the suction means (not shown). Component 104 is a central axis of the spiral air flow 103, component 105 is a suction chamber, and the arrow 106 represents the rotation direction of the spiral air flow 103.

FIG. 2 shows an external view of the vacuum cleaner of this embodiment.

A hose 202 is connected to the body of the vacuum cleaner, and the extension tube 204 and the body of the nozzle 101 are connected to the hose 202. In the middle way of the hose, a switch operation part 203 is installed.

FIG. 3 is a III-III direction cross-sectional view of the body of the nozzle 101 shown in FIG. 1.

An air gap between the front end part of the body of the nozzle 101 and the floor 301 is formed so that a suction nozzle may be established. A continuous and smooth surface 306 shaped in a cylinder is configured from the end part of the suction nozzle 302 extending from the front end of the main body of the nozzle 101 to the inside part of the main body of the nozzle 101, and this surface 306 extends until the back end side of the main body of the nozzle 101. As shown in FIG. 3, the suction chamber composed of the continuous surface 306 has an open port facing against the floor 301. In addition, the arrows 304 and 305 represent the direction of air flow.

The main body of the nozzle 101 and the extension tube 204 are connected by the joint 209, and the extension tube 204 is so formed as to move in the direction shown by the arrow A in relative to the main body of the nozzle 101. And furthermore, in the neighboring area of the open port facing downward defined by the suction chamber below where the suction nozzle 302 of the body of the nozzle 101 is not formed, a skirt 307 is installed in order to restrict the inlet flow of air from the rear end of the body of the nozzle 101, and a roller 308 is installed at the rear end of the bottom face of the body of the nozzle 101 in order to make the movement of the body of the nozzle 101 easier. It is allowed to compose the skirt 307 with rubber or other elastic materials.

In FIG. 4, a perspective view from the top of the main body of the nozzle 101 is shown.

In FIG. 4, at the both end faces of the suction chamber in its longitudinal direction, open ports 401 and 402 of the fluid path 107, and the fluid path 107 extending from the open ports 401 and 402 has a junction point at the rear end of the main body of the nozzle 101 which continues to the outside of the main body of the nozzle 101. In FIG. 4, the arrows 403 and 404 represent the direction of the air flow, and the parts 405 and 406 represent spiral air flow generated inside the suction chamber.

Next, what is described is the operation of the first embodiment of the present invention.

When the operator of the vacuum cleaner operates the switch operation part 203 located at the grip part of the hose, the electric blower in the main body of the vacuum cleaner 201 is operated in the operation mode in responsive to the designated switch operations.

The evacuation force developed by the electric blower reaches the main body of the nozzle 101 through the hose 202 and the extension tube 204. As shown in FIG. 3, as the main body of nozzle 101 has an air gap 302 used as a suction nozzle in a forward direction, the inlet air is always evacuated in the tangent direction on

the hypothetical cylinder 303 as shown with the arrow 304.

The evacuated air is accelerated with the rotational angular velocity of the blower, and rotates in high speed in the direction shown with the arrow 305, and thus, blows off the dust staying on the floor 301. At the same time, as shown in FIG. 4, as the inlet air is so evacuated from the open ports 401 and 402 on the fluid path 107, a couple velocity vectors 403 and 404 defined from the center of the longitudinal extension of the suction chamber to the individual open ports 401 and 402 are generated, and thus, the evacuated air flow and dust are caught by the spiral air flows 405 and 406 which have a common central axis almost parallel to the floor surface 301, and finally, the evacuated air flow and dust are sucked through the open ports 401 and 402 into the main body of the vacuum cleaner 201.

In other words, in this embodiment, a couple of continuous spiral air flows are developed so as to extend from the center of the longitudinal length part of the suction chamber to its both end sides, and over the almost whole region of the longitudinal direction of the suction chamber.

In this embodiment, a couple of open ports 401 and 402 of the fluid path 107 are installed, and spiral air flows in the suction chamber are extracted at the both end parts. However, it may be allowed to use only one of the open ports 401 and 402 for evacuating the air from one side of the suction chamber. In this case, it is required to keep out the air flow from one of a couple of both end sides of the suction chamber in which an open port is not installed.

In addition, though the suction nozzle 302 is defined at the whole area of the front end of the suction chamber as shown in FIG. 4, it is not required to form the suction nozzle at this whole area, it is allowed to form an open port in the central area of the front end of the suction chamber in order to increase the air flow speed.

The suction nozzle is so formed as the component 501 shown in FIG. 5, and the rotation direction of the spiral air flow may be reversed in comparison with the former case shown in FIG. 3. And also, the suction nozzle is so formed as the component 601 in FIG. 6 where the inlet air port is directed upward, or a couple of suction nozzle are formed in two different ways, upward and downward as the components 701 and 702 shown in FIG. 7. In those cases, the suction nozzles 50, 601, 701 and 702 may be formed as an open port defined at the whole area of the front end of the suction chamber or at the partial area. What are shown in FIGS. 5, 6 and 7 have a similar cross-sectional view to that in FIG. 3, where the fluid path 107 and the open port for the extension tube and so on are not shown.

As described above, according to this embodiment, it will be appreciated that a spiral air flow which has a central axis almost parallel to the surface to be cleaned can be generated inside the nozzle, and that dust laying on the floor surface to be cleaned can be removed and

sucked with high-speed spiral air blow. Therefore, a light-weight and silent suction nozzle for the vacuum cleaner which has a suction performance equal to or higher than that of the prior art can be provided even without rotary brushes.

In addition, by installing a means for transferring signals from the switch operation part 203 to the main body of the vacuum cleaner with infrared rays, ultrasonic waves or electronic radio waves in stead of using wired signal lines, there is no wiring cable in the hose 202 and the extension tube 204, which brings another effect such that the weight of the extension tube and the hose can be reduced and that the operability of the vacuum cleaner can be increased.

And furthermore, what can be seen as another advantageous aspect includes that, as the structure of the hose can be relatively simplified because there is no need for connecting electrically between the hose and its end couplers, and that the flexible part of the hose can be replaced without specific tools and devices.

[Embodiment 2]

In the followings, the second embodiment of the present invention is described in detail with drawings.

FIG. 8 shows a perspective top view of the nozzle.

In FIG. 8, the fluid path 107 is connected to the central part of the suction chamber extending in its longitudinal direction installed in the main body of the nozzle 801. In this configuration, partitions are placed in order to form the open ports 802 and 803 to be connected to the fluid path 107 at the center of the shorter extension in relative to the longer extension of the suction chamber. And furthermore, a suction nozzle 302 is established below the front end part of the main body of the nozzle 101. In addition, the arrows 804 and 805 represent the direction of the air flow, the symbols 806 and 807 represent spiral air flows, and the components 808 and 809 are side walls for shielding the air flowing.

Next, what is described is the operation of the second embodiment of the present invention.

When the operator of the vacuum cleaner operates the switch operation part 203 located at the grip part of the hose, the electric blower in the main body of the vacuum cleaner 201 is operated in the operation mode in responsive to the designated switch operations.

The evacuation force developed by the electric blower reaches the main body of the nozzle 801 through the hose 202 and the extension tube 204. As the evacuated air from the main body of the nozzle 801 is shielded from outside by the side walls 808 and 809 of the suction chamber, the air outside the suction chamber can not flow into the suction chamber from the axial direction of the hypothetical cylinder but the inlet air is always evacuated in the tangent direction on the hypothetical cylinder. Therefore, in the similar manner to the first embodiment, the evacuated air is accelerated with the rotational angular velocity of the blower, and rotates

in high speed in the direction shown with the arrow 305, and thus, blows off the dust staying on the floor.

At the same time, as the inlet air is so evacuated from the open ports 801 and 802, a couple velocity vectors 804 and 805 defined in the axial direction are generated, and thus, the evacuated air flow and dust are caught by the spiral air flows 806 and 807, and finally, the evacuated air flow and dust are sucked through the open ports 802 and 803 into the main body of the vacuum cleaner 201.

The connection between the suction chamber and the fluid path 107 shown in FIG. 8 may be altered in another way shown in FIG. 9. In FIG. 9, a separation shield plate 902 is placed at the center of the longitudinal extension of the suction chamber in order to separate the evacuation chamber into a couple of individual sub-chambers. The open port of the fluid path 107 is formed at the part where the separation shield plate 902 is placed so as to evacuate the air in the individual separated evacuation chambers. With this configuration, a couple of spiral air flows 903 and 906 can be generated. It is also enabled to generate a couple of spiral air flows 903 and 906 without the separation shield plate 902, in which the power of the spiral air flow becomes smaller.

As described above, according to this embodiment, it will be appreciated that a spiral air flow which has a central axis almost parallel to the surface to be cleaned can be generated inside the nozzle, and that dust laying on the floor surface to be cleaned can be removed and sucked with high-speed spiral air blow. Therefore, a light-weight and silent suction nozzle for the vacuum cleaner which has a suction performance equal to or higher than that of the prior art can be provided even without rotary brushes.

In the embodiment shown in FIGS. 8 and 9, a couple of continuous spiral air flow which develops from the end part of the suction chamber in the longitudinal direction to the open port of the fluid path located in the center of the suction chamber are generated in the whole area of the longitudinal direction of the suction chamber.

As the connection between the suction chamber and the extension tube is established at the central part of the suction chamber, the length of the fluid path can be shortened, and therefore, the pressure loss can be reduced to be smaller. In addition, as the main body of the suction nozzle can be small, there may be also such an advantageous effect that the operability is increased.

As shown in FIG. 10, it is also allowed to make the main body of the suction nozzle 101 an empty structure, and to form the continuous surface 306 of the suction chamber 101A and the fluid path 101B with the inner wall of the empty structure. In addition, it may be possible to form the suction chamber and the fluid path with another structural member other than the main body of the suction nozzle 101.

In the present invention, a rotary brush can be used together with the spiral air flow itself in the main body of the suction nozzle generating the spiral air flow.

It will be appreciated that the vacuum cleaner of the present invention can generate a spiral air flow inside the suction chamber of the main body of the suction nozzle in the longitudinal direction, and that dust laying on the floor surface to be cleaned can be removed and sucked with high-speed spiral air blow. Therefore, a light-weight and silent suction nozzle for the vacuum cleaner can be provided without installing rotary brushes.

Claims

1. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and
 - a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises
 - the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and
 - a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between a lower face of the main body of suction nozzle and the surface to be cleaned.
2. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and
 - a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein the main body of suction nozzle comprises
 - the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and
 - a suction nozzle for connecting the outside part of the main body of a suction nozzle and an inside of the suction chamber, being formed so as to extend along a direction in which the continuous surface and the open port intersect with each other toward the fluid path.
3. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be

cleaned;

a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and

a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein

the main body of suction nozzle comprises

the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and

a concave part, being formed so as to extend along an edge in which the continuous surface and the open port intersect with each other, defined in a whole region of an lower face of the main body of suction nozzle in an direction crossing over the edge from one side of the edge.

4. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and
 - a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein
 - the main body of suction nozzle comprises
 - the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port;
 - a shield part for restricting a fluid flowing into the suction chamber through a gap between a lower face of the main body of suction nozzle and the surface to be cleaned; and
 - a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between the lower face of the main body of suction nozzle and the surface to be cleaned.

5. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and
 - a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein
 - the main body of suction nozzle comprises
 - the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port;

a suction nozzle for leading a fluid from outside of the main body of suction nozzle toward the fluid path, being formed so as to extend along a direction in which the continuous surface and the open port of the suction chamber intersect with each other in responsive to a relation between the lower face of the main body of suction nozzle and the surface to be cleaned; and

a shield member, being formed at a lower face of the main body of suction nozzle, for restricting a fluid flowing into the suction chamber through a gap between the lower face of the main body of suction nozzle and the surface to be cleaned.

6. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and
 - a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein
 - the main body of suction nozzle comprises
 - the suction chamber including a fluid path composed of a smooth continuous surface bridging the open port; and
 - a shield member having an open port along an edge in which the continuous surface and the open port intersect with each other around the open port.
7. A vacuum cleaner of either of Claims 1 to 6, wherein
 - the fluid path is connected to a central position in a direction which the continuous surface and the open port of the suction chamber intersect with each other, whereby a continuous spiral air flow developing toward the fluid path from an end side of the direction of the suction chamber.
8. A vacuum cleaner of either of Claims 1 to 6, wherein
 - the fluid path is made to be branched; and
 - each of branched end part of the fluid path are connected both end faces in a direction in which the continuous surface and the open port of the suction chamber intersect with each other, whereby a symmetrical and continuous spiral air flow developing toward the fluid path from a central part of the direction of the suction chamber.
9. A vacuum cleaner comprising
 - a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;
 - a fluid flow path connecting between the suction chamber and an outside part of the main body of

suction nozzle; and

a suction means for sucking an air inside the suction chamber through the fluid flow path, wherein

the main body of suction nozzle comprises

a suction nozzle, being formed to be along the open port, for leading a straight air flow from an outside of the main body of suction nozzle to the suction chamber; and

a suction chamber having an internal face for converting a kinetic energy of the straight air flow to a rotation energy for generating a spiral flow developed in a longitudinal direction of the suction chamber.

10. A vacuum cleaner of either of Claims 1 to 9, further comprising

a evacuation power control means for controlling a suction power of the suction means.

11. A vacuum cleaner of either of Claims 10, wherein

a evacuation power instruction means for directing the suction power without direct connection to the evacuation power control means is formed at an in-hand operation part.

12. A vacuum cleaner comprising

a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned;

a fluid flow path connecting between the suction chamber and an outside part of the main body of suction nozzle; and

a suction means for sucking an air inside the suction chamber through the fluid flow path,

wherein

the suction chamber is formed so as to have a continuous and smooth internal face bridging between the open ports;

the fluid route connects between a central part of a direction in which the continuous surface and the open port of the suction chamber intersect with each other and an outside of the main body of suction nozzle;

a concave part is formed from one end side of an edge in which the continuous surface and the open port intersect with each other and in a whole region of an lower face of the main body of suction nozzle in a direction crossing over the edge;

a rubber-made skirt for shielding a gap between the lower face of the main body of suction nozzle and the surface to be cleaned, being formed so as to cover the open port from one step part to another step part defined by the concave part;

a roller for make smooth a movement of the main body of suction nozzle is formed is installed in a lower face in a opposite position to the open port of the concave part formed in the lower face of the main body of suction nozzle;

the suction means is composed of an extension tube connected to the fluid path and a blower; and

a symmetrical and continuous spiral air flow developed from an end side in a direction in which the continuous surface and the open port of the suction chamber intersect with each other toward the fluid path is made to be generated by evacuating an air inside the suction chamber by the blower.

13. A vacuum cleaner comprising

a main body of suction nozzle having a suction chamber with an open port facing to a surface to be cleaned; and

a suction means for sucking an air inside the suction chamber,

wherein

a spiral air flow is generated in the suction chamber including an edge of the open port along a longitudinal direction of the suction chamber, the air flow developed in the longitudinal direction;

the spiral air flow is made to be collided directly with the surface to be cleaned; and

a reflected air flow after collision is evacuated thereby.

FIG.1

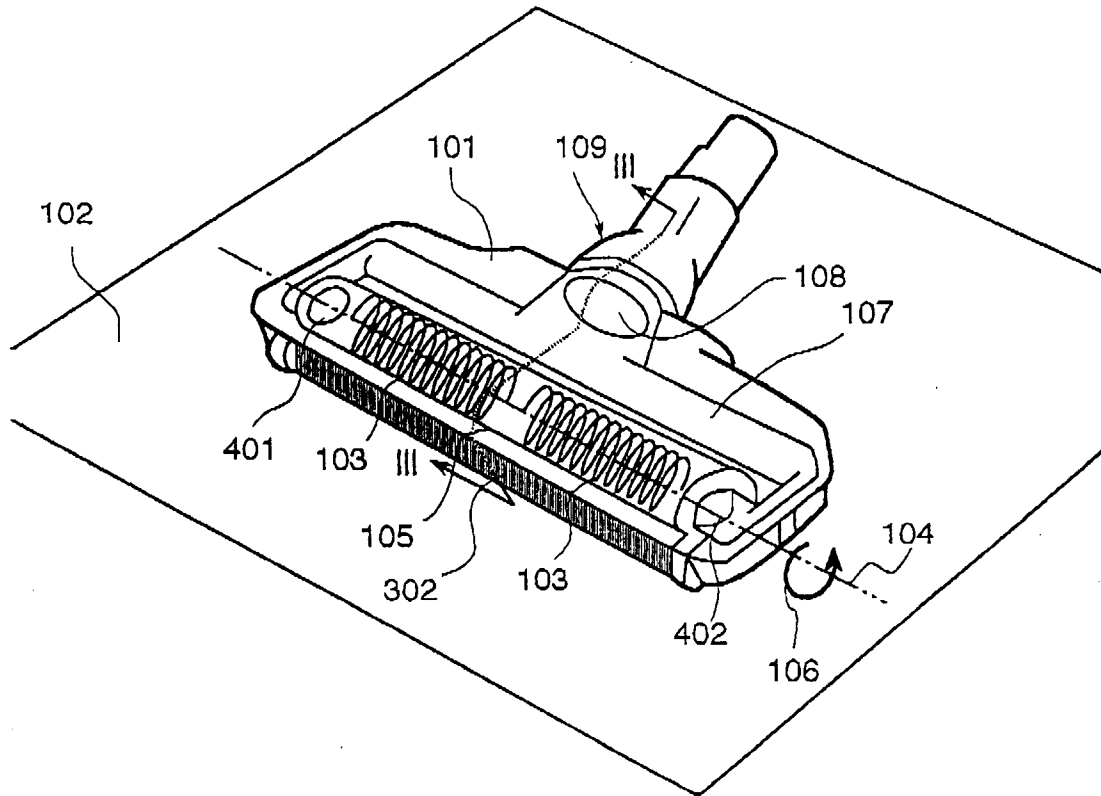


FIG.2

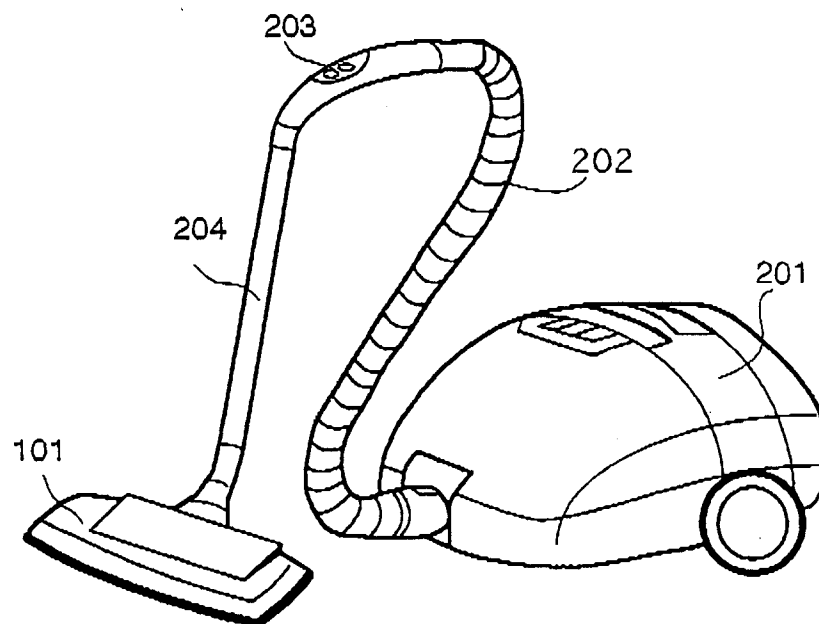


FIG.3

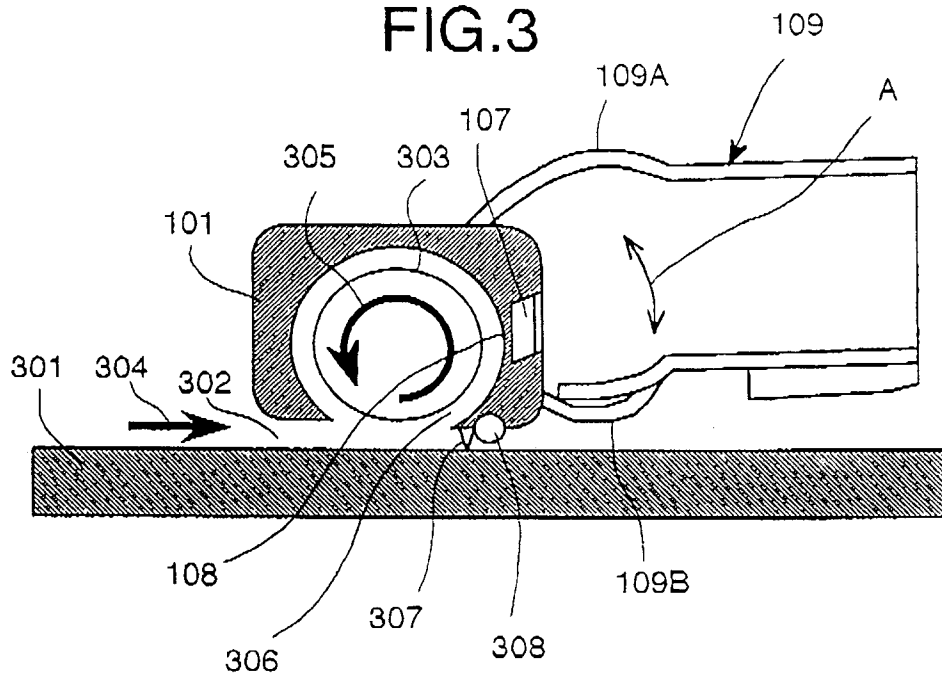


FIG.4

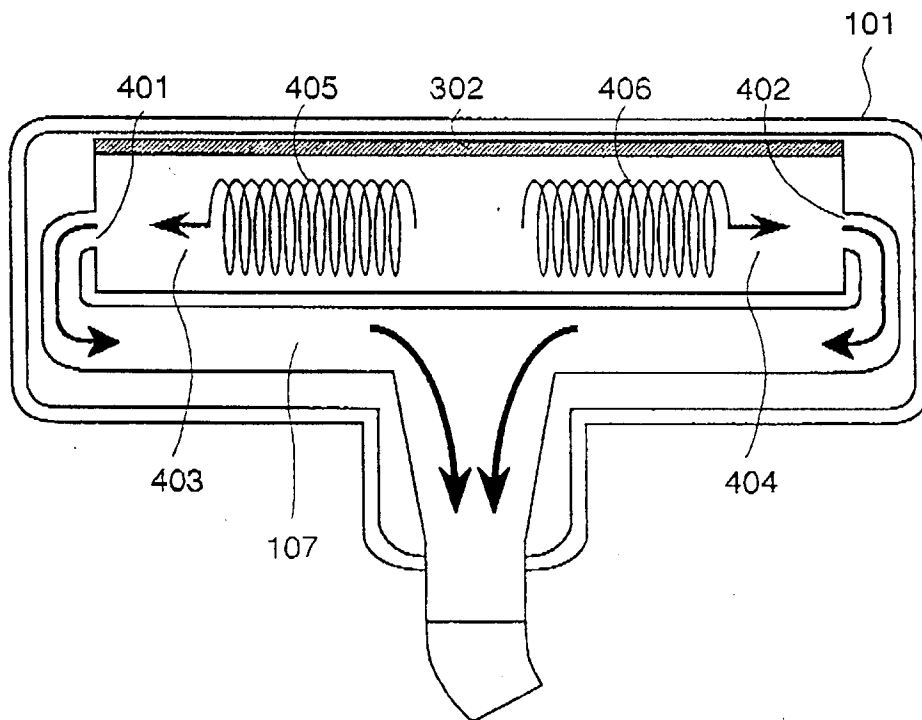


FIG.5

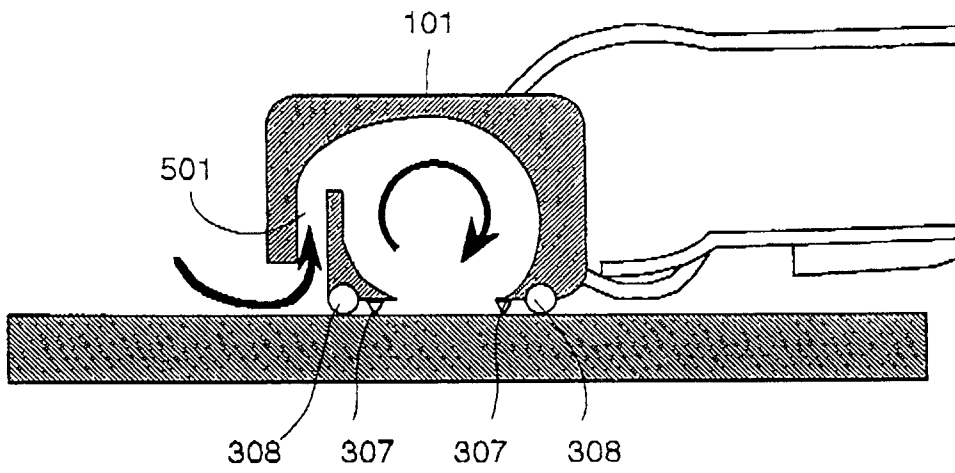


FIG.6

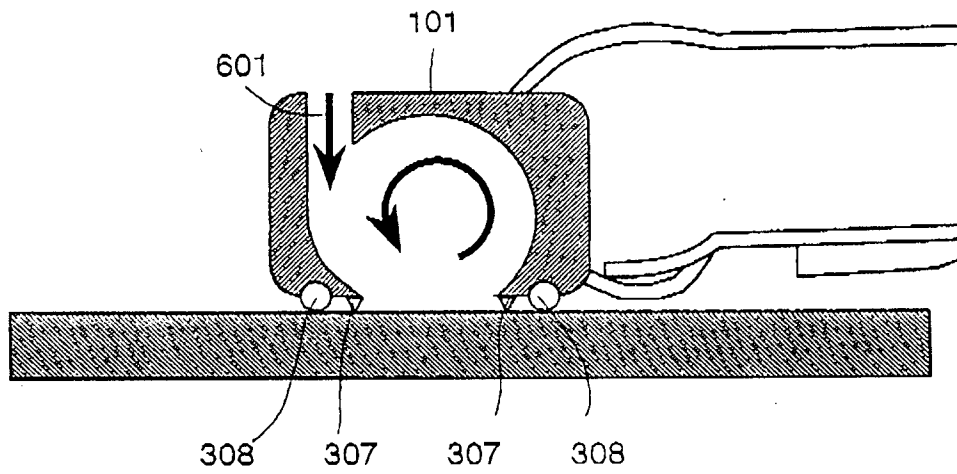


FIG.7

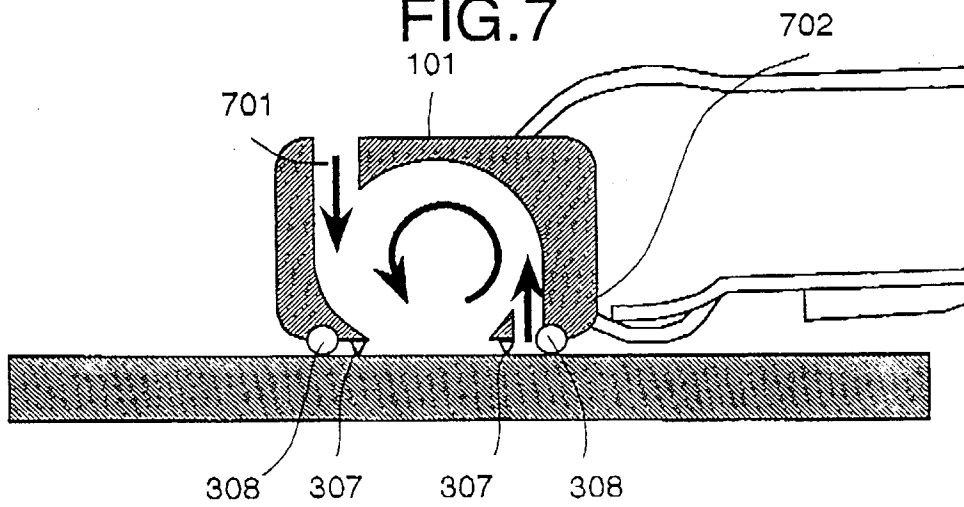


FIG.8

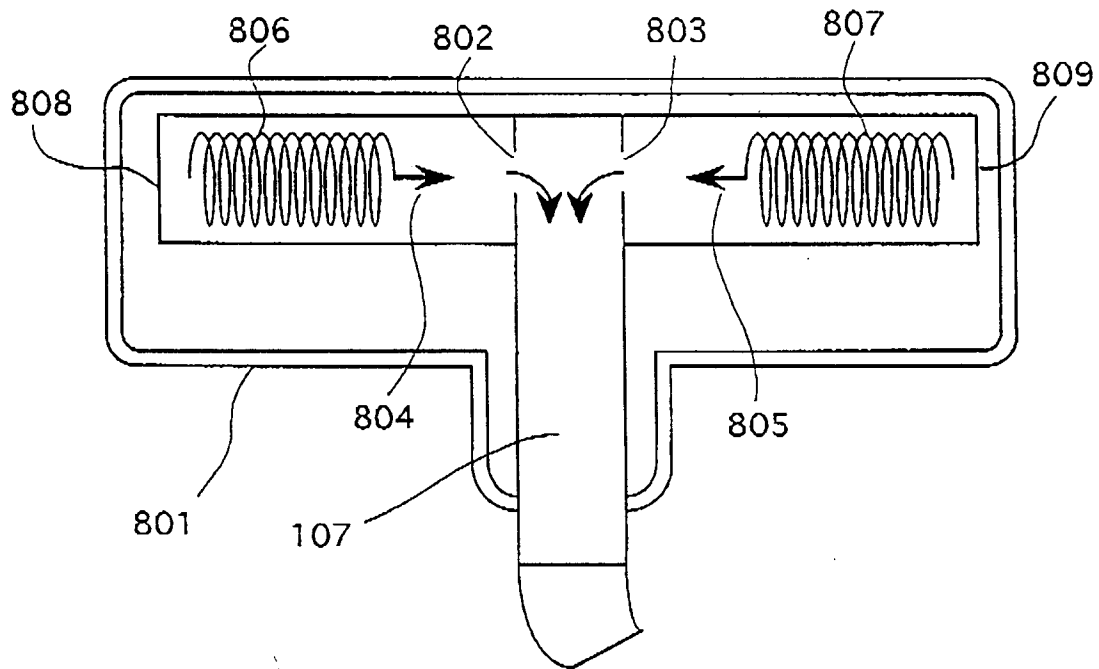


FIG.9

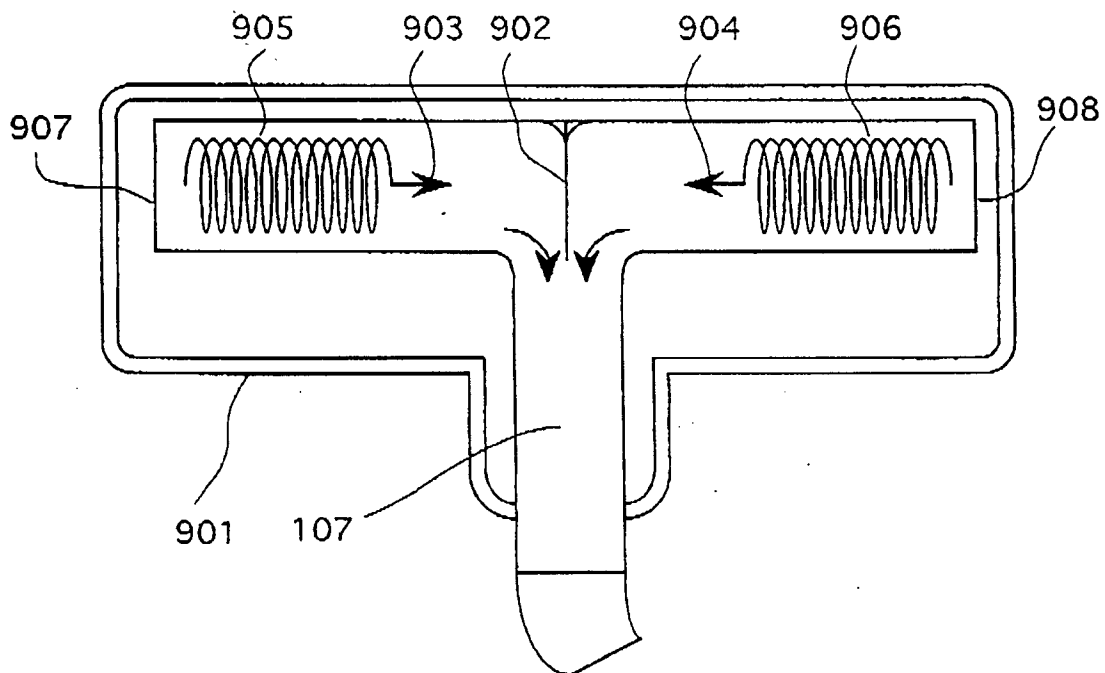
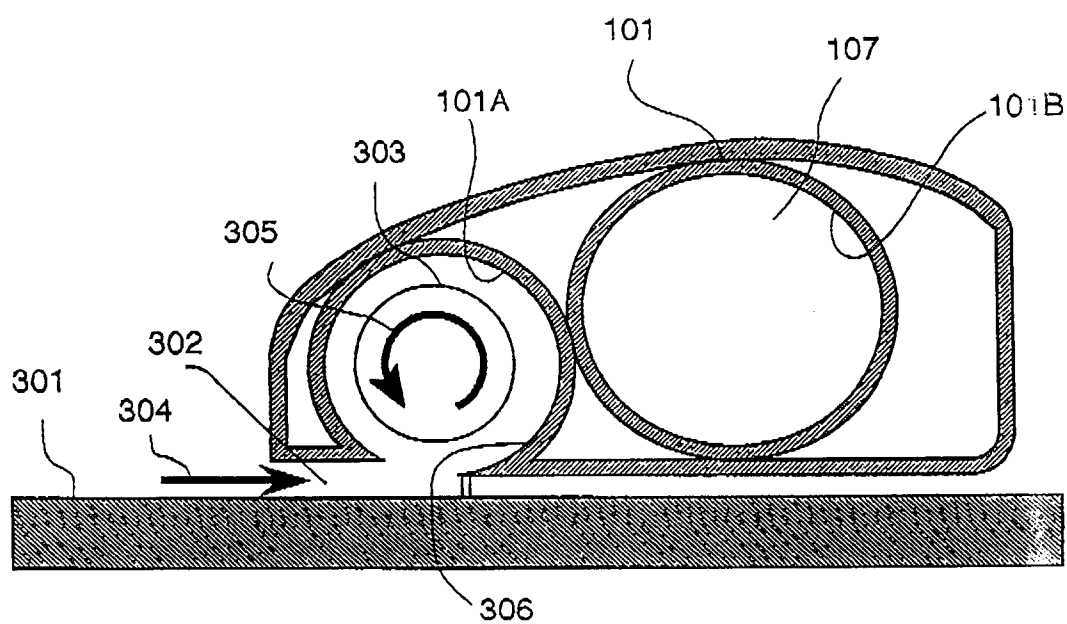


FIG.10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP94/01518

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl⁶ A47L9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl⁵ A47L9/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1994

Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, A, 3-111016 (Takeshi Kadowaki), May 10, 1991 (10. 05. 91), (Family: none)	1-13
A	JP, A, 62-201126 (Arstor Felbraozhosgutter GmbH & Co. KG.), September 4, 1987 (04. 09. 87), (Family: none)	1-13
A	JP, U, 56-148349 (Takao Muto), November 7, 1981 (07. 11. 81), (Family: none)	1-13

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

November 15, 1994 (15. 11. 94)

Date of mailing of the international search report

December 6, 1994 (06. 12. 94)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.