



## DEVICE FOR SEPARATING PARTICLES FROM AIR, COMPRISING A VORTEX CHAMBER

### FIELD OF THE INVENTION

The present invention relates to a device for separating particles from air, comprising a vortex chamber having an inlet for letting in a mixture of air and particles to the vortex chamber, an air outlet for letting out air from the vortex chamber, a curved interior surface for creating and guiding a vortex movement in air supplied to the vortex chamber through the air inlet during operation of the device, and a particle outlet for letting out particles from the vortex chamber, which comprises a particle discharge opening in a wall of the vortex chamber having the curved interior surface.

The present invention further relates to a vacuum cleaner, comprising a device as mentioned, means for supplying a mixture of air and particles to the vortex chamber of the device, through the inlet, and means such as a motor for realizing an airflow in the vortex chamber.

### BACKGROUND OF THE INVENTION

US 6,432,154 discloses a cyclone dust collecting apparatus for a vacuum cleaner, which includes a hollow cylindrical cyclone body having an open upper end through which air and contaminants are drawn in, and a dust discharge port located proximate a lower end of the cyclone body. The dust discharge port receives contaminants that have been separated from the air by centrifugal force and discharged from the cyclone body. The apparatus further includes a dust receptacle connected to the cyclone body for collecting the contaminants discharged from the cyclone body through the dust discharge port, and a backflow prevention means for guiding contaminants that have been discharged from the cyclone body into the dust receptacle and preventing a backflow of the contaminants collected in the dust receptacle from returning to the cyclone body.

In general, a vacuum cleaner comprises a suction nozzle to be moved along a surface to be cleaned, and a motor for generating a suction force which is used for removing particles, typically dust and dirt particles, from the surface and displacing these particles to the inside of the vacuum cleaner. A device is arranged inside the vacuum cleaner for separating the particles from the air. As a result of a separation process, the dust can be collected in a suitable space, and clean air can be blown out. One possibility is using filters

for performing the separating process. Another possibility is using suitable means for creating a vortex movement (also commonly known as cyclone movement) in the sucked-in mixture of air and particles, wherein the particles are displaced towards an outside circumference of the vortex flow under the influence of centrifugal forces, where the particles can be collected. In practical situations, the vortex flow is created in a vortex chamber which is shaped like a hollow cylinder having a circular interior circumference, wherein the particles are discharged from the chamber through an opening in the side wall of the cylinder, i.e. the wall having a curved interior surface.

For the purpose of storing the particles which are collected at the outside boundary of the vortex flow, another chamber is provided, wherein the vortex chamber is connected to this other chamber through the particle discharge opening. In the following, for sake of clarity, the other chamber will be referred to as particle collecting chamber. A commonly known problem in the field of collecting and storing particles which are separated from air in a vortex flow is that there is a risk that the particles flow back to the vortex flow from the particle discharge opening providing access to the particle collecting chamber. The reason is that the air which is allowed to flow to the particle collecting chamber enters this chamber while still performing the vortex movement, as a result of which another vortex flow is generated. The presence of a vortex flow inside the particle collecting chamber may cause the particles to stay out of the particle collecting chamber, may cause the particles to be more or less stuck in the particle discharge opening, and may even cause the particles to be taken along with the vortex flow inside the vortex chamber again.

US 6,432,154 teaches the use of a backflow prevention means as a solution to the problem as explained in the foregoing, which is a problem of lack of effectiveness in the process of separating particles from air. In particular, the backflow prevention means includes a guide member that extends from an outline of the particle discharge opening (i.e. the dust discharge port located proximate a lower end of the cyclone body) inward to the particle collecting chamber (i.e. the dust receptacle). The guide member is disposed at an acute angle with respect to the outer circumference of the vortex chamber. In addition, the guide member is disposed adjacent to the bent outline, which is located in the downstream region of the vortex flow. The guide member extends along the entire length of the particle collecting chamber, in order to completely prevent backflow. Furthermore, the guide member is preferably made of an elastic material, such as a film that is flexible under a discharge pressure from the particle discharge opening. The guide member has a certain radius of curvature that corresponds to the outer circumference of the vortex chamber. Consequently,

the radius of curvature of the guide member enables effective guiding of the particles into the particle collecting chamber, and prevents the backflow of the collected particles into the vortex chamber by preventing reverse deformation of the guide member.

During operation, particles are collected in the particle collecting chamber, wherein they pile up behind the guide member. The collected particles in the particle collecting chamber move within the chamber in a turbulent manner due to the discharge pressure, however, the guide member blocks the path to prevent the particles from returning to the vortex chamber through the particle discharge opening.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a device for separating particles from air, in which the separation process can be very effective, without the need to use the guide member known from US 6,432,154, thereby avoiding a rather complex manufacturing process which needs to comprise a step of providing the guide member and attaching the guide member to the outside of the vortex chamber. The object is achieved by a device in which, at least along a portion of the circumference of the particle discharge opening, a baffle surface is provided which is protruding from the wall of the vortex chamber, at the outside of the vortex chamber, and wherein at least a portion of the baffle surface is positioned for constituting an obstacle to an airflow moving through the particle discharge opening during operation of the device while performing the vortex movement.

The device according to the present invention is very effective in separating particles from air, including elongated particles like fibers and hairs. In conventional vortex chambers, in which there is simply a particle discharge opening without any protrusions extending from the circumference of the opening, there are relatively sharp edges where fibers may get stuck. In such a case, a part of a fiber may be captured, but another part may be still in the vortex flow and may be pulled back as a result thereof. Also, it may occur that dust and fibers accumulate at the edges, resulting in a relatively large cluster of particles that may get detached at a certain point, and may contaminate the air outlet, for example. The disadvantageous possible effects are prevented or at least reduced by having the baffle surface as mentioned, because there is no longer a rather sharp edge at the position where the baffle surface is present, but a smooth transition. It is noted that a smooth transition is also present in the apparatus known from US 6,432,154 on the basis of the application of the guide member. However, there is a significant difference between the device according to the present invention and the apparatus known from US 6,432,154 when the way of preventing

backflow is considered. As explained in the foregoing, US 6,432,154 teaches the application of a guide member, wherein the collected particles pile up behind this member. According to the present invention, a baffle surface is applied, wherein at least a portion of the baffle surface is positioned for constituting an obstacle to an airflow moving through the particle discharge opening during operation of the device, while performing a vortex movement. This is different from the known possibility, as the guide member is not in the way of any incoming airflow. On the contrary, the guide member is suitable for guiding the airflow in a direction following the outer circumference of the vortex chamber, and may even be flexible.

By using the baffle surface as defined, the formation of a vortex flow in a particle collecting chamber, which may also be part of the device, and which is then positioned for receiving particles from the vortex chamber, wherein the particle outlet of the vortex chamber provides access from the vortex chamber to the particle collecting chamber, can be prevented. The baffle surface can function as an obstacle between air swirling with high velocity in the vortex chamber, and air that is hardly moving or not moving at all in the particle collecting chamber. In other words, on the basis of the presence of the baffle surface, the formation of a second vortex flow in the particle collecting chamber is prevented, or, if this is not exactly the case, the second vortex flow is only present at a very low energy level, i.e. with very low velocities. Hence, on the basis of reduced air movement or lack of air movement inside the particle collecting chamber, a backflow of particles to the vortex chamber does not occur.

When the present invention is applied, there is no need for a guide member extending along the entire length of the particle collecting chamber. It is sufficient to have a member extending only along the length of the particle discharge opening. Furthermore, a member having the baffle surface can be integrated with the other components of the vortex chamber, so that it is possible to have a relatively simple manufacturing process of the device according to the present invention. For example, the vortex chamber can be made of transparent plastic, and the manufacturing process can be performed by applying injection molding techniques, wherein it is not necessary to attach a separate member in an additional step.

In a practical embodiment of the device according to the present invention, the vortex chamber is shaped like a hollow cylinder having a circular interior circumference. In that case, an airflow moving through the particle discharge opening during operation of the device while performing the vortex movement can also be denoted as an airflow moving in a tangential direction with respect to the cylinder shape of the vortex chamber. Furthermore, in

that case, the portion of the baffle surface which is positioned for constituting an obstacle to an airflow moving through the particle discharge opening during operation of the device while performing the vortex movement may be orientated in a substantially radial direction with respect to the cylinder shape of the vortex chamber, parallel to a longitudinal axis of the cylinder shape.

For sake of completeness, it is noted that in general, a longitudinal direction, a radial direction and a tangential direction are defined in the case of a cylinder, especially a cylinder having a circular circumference. The longitudinal direction is a direction which coincides with an axis of rotational symmetry of the cylinder. The radial direction is a direction in which a radius of the circular circumference is determined, wherein the radius intersects the axis of rotational symmetry in a plane extending perpendicular to said axis. The tangential direction is a direction which is perpendicular to both the longitudinal direction and the radial direction.

The particle discharge opening may have a rectangular circumference, as seen in a radial direction with respect to the cylinder shape of the vortex chamber. In any case, it is advantageous if the opening has a relatively large dimension at the side which is the most remote from the inlet of the vortex chamber, as at that side, the major part of the particles can be caught. In a practical embodiment, the baffle surface may be a surface of at least two strips extending at the outside of the vortex chamber, at opposite sides of the circumference of the particle discharge opening, in a direction substantially parallel to a longitudinal axis of the cylinder shape of the vortex chamber. For sake of completeness, it is noted that an embodiment comprising only one of the strips is also covered by the present invention, as long as the strip is positioned such as to be encountered by air moving through the particle discharge opening.

In many cases, the vortex movement of the air in the vortex chamber can be expected to always be in the same direction, which can be determined by the positioning of the inlet. Hence, in those cases, it is possible to predict a general direction of the flow of air through the particle discharge opening. Still, it is possible to have a reverse direction of the vortex movement. In view thereof, in general, it may be advantageous if the portion of the baffle surface which is positioned for constituting an obstacle to an airflow moving through the particle discharge opening during operation of the device while performing the vortex movement comprises two parts which are arranged at opposite sides of the particle discharge opening. With the two parts as mentioned being present, an airflow moving through the

particle discharge opening will always encounter an obstacle, irrespective of the direction of the vortex movement of the air in the vortex chamber.

In order to have the desired effect of avoiding a vortex movement of air inside the particle collecting chamber, while still allowing particles to be drawn into the particle collecting chamber, it is advantageous if a dimension of the baffle surface as seen in a radial direction with respect to the cylinder shape of the vortex chamber, perpendicular to a longitudinal axis of the cylinder shape, is in a certain range. For example, in a situation in which an inner diameter of the vortex chamber is smaller than 110 mm, the dimension as mentioned can be between 3 mm and 40 mm, preferably between 10 mm and 30 mm. The values as mentioned were found during experiments during which the extent of separation of particles from air swirling inside the vortex chamber was checked.

As explained in the foregoing, it is possible that two strips are provided, wherein the baffle surface is a surface of the strips. Another option is that a tube-shaped element is provided, which is connected to the wall of the vortex chamber having the curved interior surface, wherein the baffle surface is an interior surface of the tube-shaped element. The tube-shaped element can have a radial orientation with respect to the cylinder shape of the vortex chamber.

In the device according to the present invention, it may be so that a tube-shaped element is arranged in the vortex chamber, which element extends at a central position in the vortex chamber, and which is provided with at least one hole for letting out air from the vortex chamber. Hence, the tube-shaped element is suitable to be used as the air outlet of the vortex chamber. On the basis of the central arrangement of the tube-shaped element, it is ensured that the element is present in a zone of the vortex chamber where there is only clean air, and where there are no particles due to the centrifugal forces of the vortex flow, which cause the particles (having a larger mass density than the air) to move to the outer circumference of the vortex chamber. It is noted that the tube-shaped element is known per se, and is often denoted as vortex finder.

It is a practical possibility for the vortex chamber to comprise at least two pieces, which are adapted to be joined such as to build the vortex chamber. According to that possibility, one of the pieces can be a kind of lid which can be easily removed by a user for cleaning purposes, for example. Also, having the vortex chamber divided into at least two pieces may facilitate the manufacturing process of the vortex chamber.

In respect of the mutual positioning of the vortex chamber and the particle collecting chamber, it is noted that the vortex chamber may be positioned inside the particle

collecting chamber, for example. It is also very well possible for the chambers to be positioned alongside each other.

All in all, the present invention provides a constructional possibility for effectively separating particles from air performing a vortex movement, wherein a backflow of particles, including fibers and hairs, is prevented by having a baffle surface which is arranged such as to impede air moving through an opening at an outside circumference of the vortex flow. In the first place, the baffle surface has a function in preventing a construction with relatively sharp edges at the circumference of the opening, which might otherwise constitute places where particles are accumulated. In the second place, the baffle surface has a function in avoiding the creation of another vortex flow in a space where the particles are collected.

The above-described and other aspects of the present invention will be apparent from and elucidated with reference to the following detailed description of a device for separating particles from air, which is intended to be used in a vacuum cleaner.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be explained in greater detail with reference to the figures, in which equal or similar parts are indicated by the same reference signs, and in which:

Figures 1 and 2 diagrammatically show two different views of a vortex chamber of a first preferred embodiment of a device according to the present invention;

Figure 3 diagrammatically shows a perspective view of a portion of the vortex chamber shown in figures 1 and 2, including a particle discharge opening and a baffle arrangement;

Figure 4 illustrates how a vortex chamber can be combined with a particle collecting chamber; and

Figure 5 diagrammatically shows a perspective view of a portion of a vortex chamber of a second preferred embodiment of a device according to the present invention.

#### DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1 and 2 show a vortex chamber 10 of a first preferred embodiment of a device according to the present invention, and figure 3 shows a portion of the vortex chamber 10. The device serves for separating particles from air, and is intended to be used in a vacuum cleaner, particularly a so-called bagless vacuum cleaner, in which the separation



process takes place by letting a sucked-in mixture of air and particles perform a vortex movement, wherein the particles can be collected at the outside of the vortex due to the fact that their mass density is considerably larger than the mass density of air. Such a vacuum cleaner is a well-known device, and will therefore not be further elucidated here.

In general, the vortex chamber 10 is shaped like a hollow cylinder having a circular interior circumference. Hence, a wall 11 of the vortex chamber 10 has a curved interior surface 12. In figures 1 and 2, a longitudinal axis of the cylinder shape is indicated by means of a dash and dot line 13. In figure 3, a longitudinal direction, a radial direction and a tangential direction of the cylinder shape are indicated by means of double-headed arrows and letters  $l$ ,  $r$ , and  $t$ , respectively.

The vortex chamber 10 has an inlet 14 for letting in a mixture of air and particles, which has a tangential arrangement with respect to the cylinder shape, so that a vortex movement can be created in the mixture on its way further downstream in the vortex chamber 10. Furthermore, the vortex chamber 10 has an air outlet 15 for letting out clean air. In the shown example, the air outlet is realized in the form of a so-called vortex finder 15, i.e. a tube-shaped element extending at a central position in the vortex chamber 10, such that a longitudinal axis of the element substantially coincides with the longitudinal axis 13 of the vortex chamber 10. In figures 1 and 2, the vortex finder 15 is indicated by means of dashed lines. Naturally, the vortex finder 15 has at least one hole (not shown) for discharging the air from the vortex chamber 10.

During operation of the device of which the vortex chamber 10 is part, under the influence of a pressure which can be applied in a manner known per se, for example, by operating a motor (not shown) such as to generate a suction force, a mixture of air and particles is drawn into the vortex chamber 10, through the inlet 14. The mixture flows along the curved interior surface 12 of the wall 11 of the vortex chamber 10, and is made to perform a vortex movement as the mixture moves further downstream under the influence of the pressure, wherein a longitudinal axis of the vortex movement coincides with the longitudinal axis 13 of the vortex chamber 10. On the basis of the fact that there is a vortex flow, the particles are separated from the air, since the particles have a larger mass density than the air. In particular, the particles are forced to move away from the longitudinal axis 13 of the vortex chamber 10, until they reach the interior surface 12 of the wall 11 of the vortex chamber 10.

For the purpose of letting out the particles from the vortex chamber 10, a particle discharge opening 16 is arranged in the wall 11 of the vortex chamber 10 having the

curved interior surface 12. In the shown example, the particle discharge opening 16 is arranged at a position which is relatively far from the inlet 14, such as to ensure that there is sufficient length for the separation process to take place in a proper and complete manner. Furthermore, in the shown example, the particle discharge opening 16 has a rectangular circumference, as seen in a radial direction with respect to the cylinder shape of the vortex chamber 10. An advantage of the rectangular shape of the discharge opening 16 as mentioned, in comparison to a circular shape, for example, is that at the side which is the most remote from the inlet 14, which is the side where most of the particles are present at the outside of the vortex flow, the dimension of the particle discharge opening 16 is sufficiently large for discharging all the particles.

Advantageously, the vortex chamber 10 comprises two pieces 20, 30, as is the case in the shown example, namely a basic piece 20 and a lid 30, wherein the lid 30 serves for closing the basic piece 20 at the side where the particle discharge opening 16 is located. The lid 30 has an insert portion 31 which is intended to be positioned inside the basic piece 20, which insert portion 31 has a circular circumference, and a diameter which is such that the insert portion 31 snugly fits into the basic portion 20. It is possible to use suitable means such as a sealing ring (not shown) between the lid 30 and the basic portion 20 for ensuring that air cannot escape from the vortex chamber 10 at the side of the lid 30. The lid 30 is only shown in figures 1 and 2, wherein the insert portion 31 is indicated by means of dashed lines.

It follows from the foregoing that during operation, air and particles are made to swirl inside the vortex chamber 10, wherein the particles are forced to move outwardly, and wherein clean air is obtained at a more central position. The particles are discharged from the vortex chamber 10 through the particle discharge opening 16, while the clean air is discharged through the vortex finder 15. In order to ensure a complete discharge of particles, with no chance of particles re-entering the vortex chamber 10, a baffle arrangement 40 having a baffle surface 41 is positioned such as to at least partially surround the particle discharge opening 16 at the outside of the vortex chamber 10. According to the present invention, at least a portion of the baffle surface 41 is positioned such that air flowing through the particle discharge opening 16 with the swirling movement directly encounters the baffle surface 41. Hence, at least a portion of the baffle surface 41 has another orientation than a tangential orientation with respect to the cylinder shape of the vortex chamber 10.

The baffle construction 40 has two main functions. A first function is avoiding that the particle discharge opening 16 is delimited by sharp edges, which would be the case if the baffle construction 40 would be omitted, and which would lead to a situation in which

there is considerable chance that particles, especially fibers and hairs, get stuck on the edges and are pulled back into the air flow in the vortex chamber 10 from that position. A second function is avoiding as much as possible that another vortex flow is generated outside of the vortex chamber 10, in another chamber for receiving the particles, on the basis of the fact that air flowing from the vortex chamber 10 encounters the baffle surface 41, so that the movement of the air cannot be continued. Both functions contribute to the effectiveness of the separation process, as a backflow of particles is prevented, or at least significantly reduced with respect to known situations.

Figure 4 illustrates the application of another chamber 50 besides the vortex chamber 10, namely a chamber 50 for receiving the particles from the vortex chamber 10 and collecting the particles. In the shown example, the vortex chamber 10 is positioned inside this particle collecting chamber 50, but that does not alter the fact that another mutual positioning of the chambers 10, 50 is possible, as long as there can be a transfer of particles from the vortex chamber 10 to the particle collecting chamber 50 through the particle discharge opening 16. In figure 4, a top view of the particle collecting chamber 50 is shown, wherein the vortex chamber 10 is indicated by means of dashed lines.

In the example shown in figures 1-3, the baffle arrangement 40 comprises three interconnected strips 42, 43, 44, wherein one strip 42 is positioned at the side of the particle discharge opening 16 which is closest to the inlet 14, and wherein two strips 43, 44 are positioned at opposite sides of the particle discharge opening 16, having a surface 41 extending in a direction which is substantially radial with respect to the cylinder shape of the vortex chamber 10, and which is substantially parallel to the longitudinal axis 13 of the vortex chamber 10.

Figure 5 shows an alternative design of the baffle arrangement 40. In this design, the baffle arrangement 40 is shaped like a tube-shaped element which completely surrounds the particle discharge opening 16, wherein the baffle surface 41 is the interior surface of the element. As the particle discharge opening 16 has a rectangular shape, a cross-section of the tube-shaped element has a rectangular shape as well. The edges may be round such as to avoid that particles can get stuck there.

In a practical situation, the vortex chamber 10 can have an inner diameter which is smaller than 110 mm. In fact, it is preferred to have a diameter which is as small as possible, but the value of the diameter has a practical minimum on the basis of the fact that it is desirable to have an option of removal by hand of items which are so large that stoppage occurs. Experiments have shown that with the inner diameter as mentioned, i.e. the inner

diameter which is smaller than 110 mm, but larger than a minimum, for example, 90 mm, it is preferred to have a dimension of the baffle surface 41 in the radial direction with respect to the cylinder shape of the vortex chamber 10 which is in a range of 3 mm to 40 mm, preferably a range of 10 mm to 30 mm. In case the baffle arrangement 40 comprises a tube-shaped element as shown in figure 5, the dimension of the baffle surface 41 as mentioned is the dimension of the tube-shaped element in the longitudinal direction of the tube shape. For sake of clarity, in figures 2, 3, and 5, the dimension of the baffle surface 41 as mentioned is indicated by means of a double-headed arrow x.

Within the scope of the present invention, the baffle surface 41 may be shaped differently than is the case with the two examples as shown and described, as long as at least a portion of the baffle surface 41 is in the way of air coming from the vortex flow inside the vortex chamber 10 and moving through the particle discharge opening 16.

It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the present invention as defined in the attached claims. While the present invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The present invention is not limited to the disclosed embodiments.

Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope of the present invention.

For sake of completeness, it is noted that where the term "particles" is used in this text, this term should be understood such as to cover all possible items which can be sucked in with an airflow during a vacuum cleaning action, such as dust particles, dirt particles, fibers, hairs, droplets of liquid, etc.

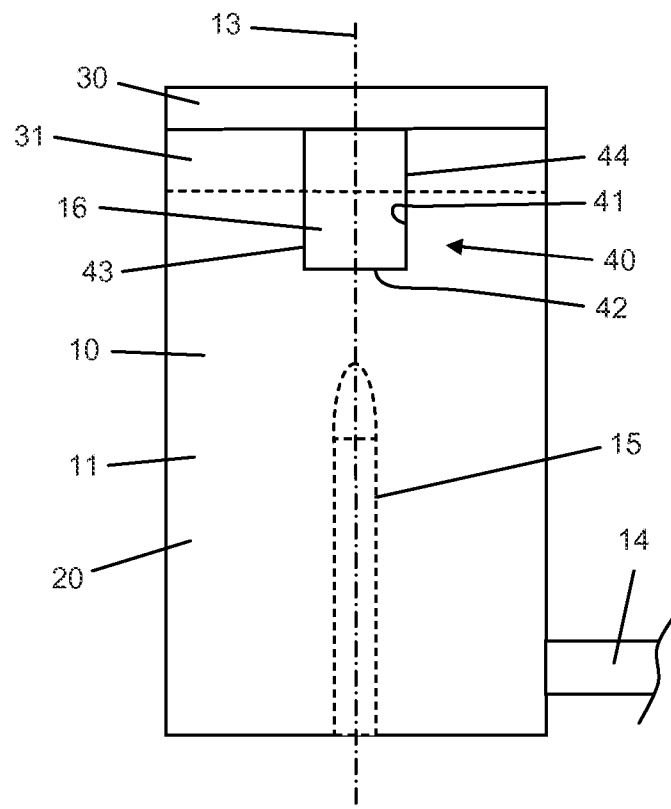
## CLAIMS:

1. Device for separating particles from air, comprising a vortex chamber (10) having an inlet (14) for letting in a mixture of air and particles to the vortex chamber (10), an air outlet (15) for letting out air from the vortex chamber (10), a curved interior surface (12) for creating and guiding a vortex movement in air supplied to the vortex chamber (10) through the air inlet (14) during operation of the device, and a particle outlet for letting out particles from the vortex chamber (10), which comprises a particle discharge opening (16) in a wall (11) of the vortex chamber (10) having the curved interior surface (12), wherein, at least along a portion of the circumference of the particle discharge opening (16), a baffle surface (41) is provided which is protruding from the wall (11) of the vortex chamber (10), at the outside of the vortex chamber (10), and wherein at least a portion of the baffle surface (41) is positioned for constituting an obstacle to an airflow moving through the particle discharge opening (16) during operation of the device while performing the vortex movement.
2. Device according to claim 1, wherein the portion of the baffle surface (41) which is positioned for constituting an obstacle to an airflow moving through the particle discharge opening (16) during operation of the device while performing the vortex movement comprises two parts (43, 44) which are arranged at opposite sides of the particle discharge opening (16).
3. Device according to claim 1, wherein the vortex chamber (10) is shaped like a hollow cylinder having a circular interior circumference.
4. Device according to claim 3, wherein the portion of the baffle surface (41) which is positioned for constituting an obstacle to an airflow moving through the particle discharge opening (16) during operation of the device while performing the vortex movement is orientated in a substantially radial direction with respect to the cylinder shape of the vortex chamber (10), parallel to a longitudinal axis (13) of the cylinder shape.

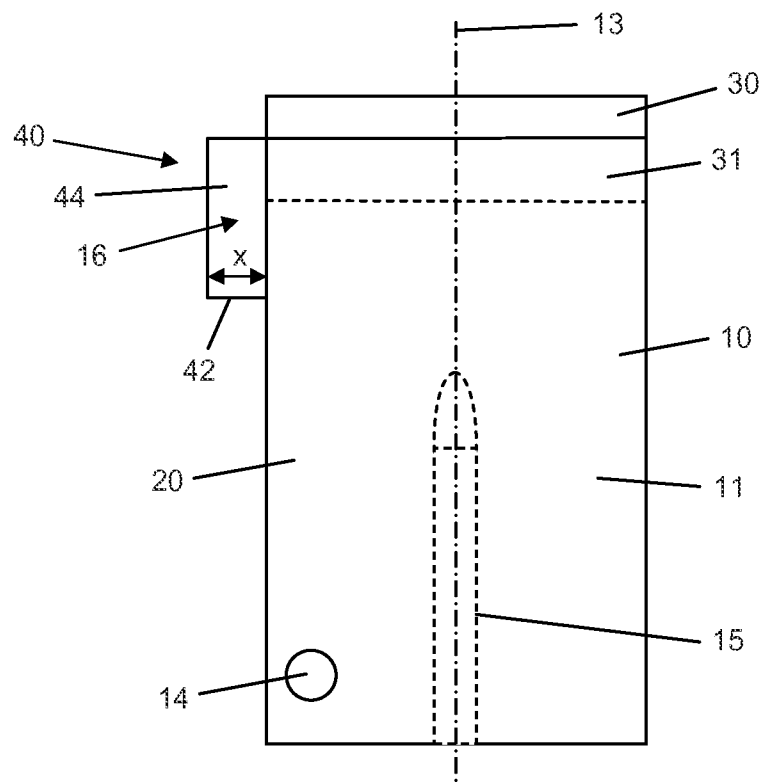
5. Device according to claim 3, wherein the particle discharge opening (16) has a rectangular circumference, as seen in a radial direction with respect to the cylinder shape of the vortex chamber (10).
6. Device according to claim 5, wherein the baffle surface (41) is a surface of at least two strips (43, 44) extending at the outside of the vortex chamber (10), at opposite sides of the circumference of the particle discharge opening (16), in a direction substantially parallel to a longitudinal axis (13) of the cylinder shape of the vortex chamber (10).
7. Device according to claim 3, wherein a dimension (x) of the baffle surface (41) as seen in a radial direction with respect to the cylinder shape of the vortex chamber (10), perpendicular to a longitudinal axis (13) of the cylinder shape, is between 3 mm and 40 mm, in a situation in which an inner diameter of the vortex chamber (10) is smaller than 110 mm.
8. Device according to claim 3, wherein a dimension (x) of the baffle surface (41) as seen in a radial direction with respect to the cylinder shape of the vortex chamber (10), perpendicular to a longitudinal axis (13) of the cylinder shape, is between 10 mm and 30 mm, in a situation in which an inner diameter of the vortex chamber (10) is smaller than 110 mm.
9. Device according to claim 1, wherein the baffle surface (41) is an interior surface of a tube-shaped element which is connected to the wall (11) of the vortex chamber (10) having the curved interior surface (12).
10. Device according to claim 3, wherein the baffle surface (41) is an interior surface of a tube-shaped element which is connected to the wall (11) of the vortex chamber (10) having the curved interior surface (12), and wherein the tube-shaped element has a radial orientation with respect to the cylinder shape of the vortex chamber (10).
11. Device according to claim 1, wherein a tube-shaped element (15) is arranged in the vortex chamber (10), which element (15) extends at a central position in the vortex chamber (10), and which is provided with at least one hole for letting out air from the vortex chamber (10).

12. Device according to claim 1, wherein the vortex chamber (10) comprises at least two pieces (20, 30), which are adapted to be joined such as to build the vortex chamber (10).
13. Device according to claim 1, further comprising another chamber (50), which is a particle collecting chamber (50) which is positioned for receiving particles from the vortex chamber (10), wherein the particle outlet of the vortex chamber (10) provides access from the vortex chamber (10) to the particle collecting chamber (50).
14. Device according to claim 13, wherein the vortex chamber (10) is positioned inside the particle collecting chamber (50).
15. Vacuum cleaner, comprising a device according to claim 1, means for supplying a mixture of air and particles to the vortex chamber (10) of the device, through the inlet (14), and means such as a motor for realizing an airflow in the vortex chamber (10).

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**Fig. 1**



**Fig. 2**



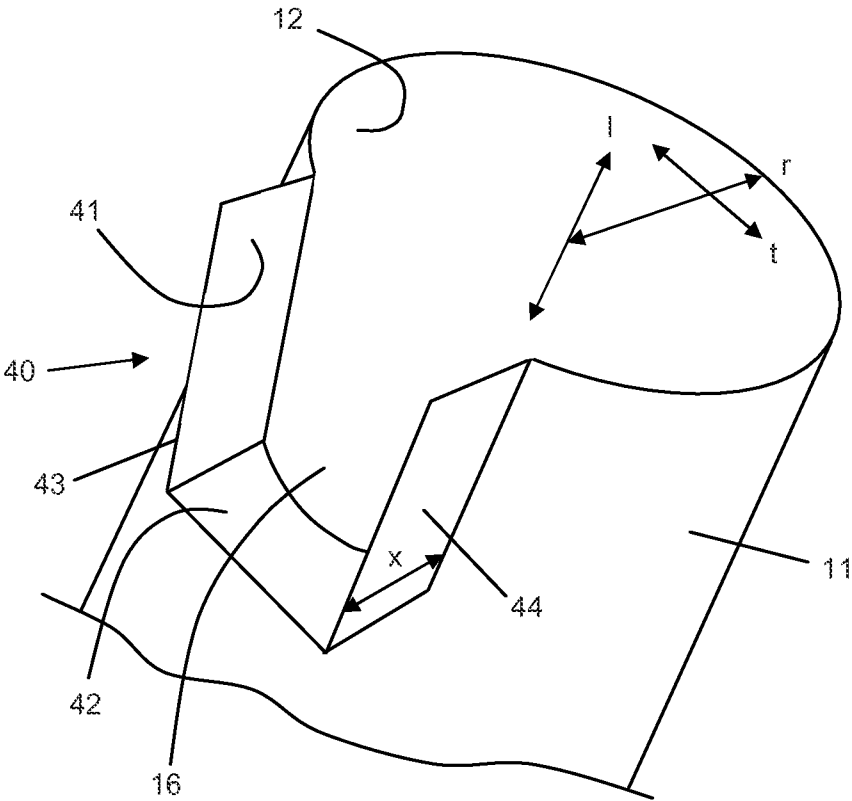


Fig. 3

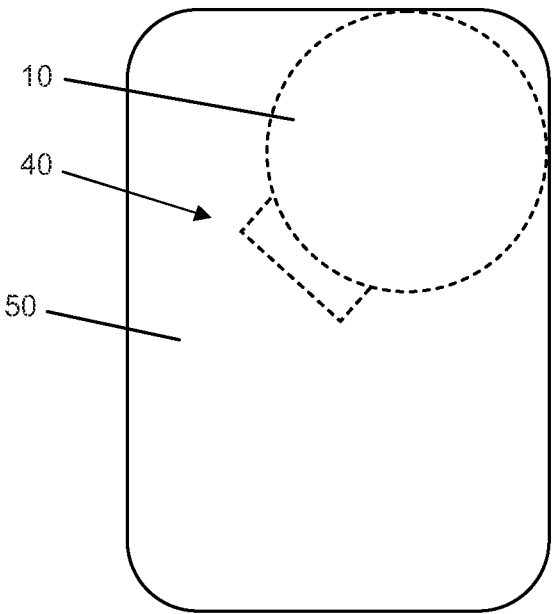


Fig. 4

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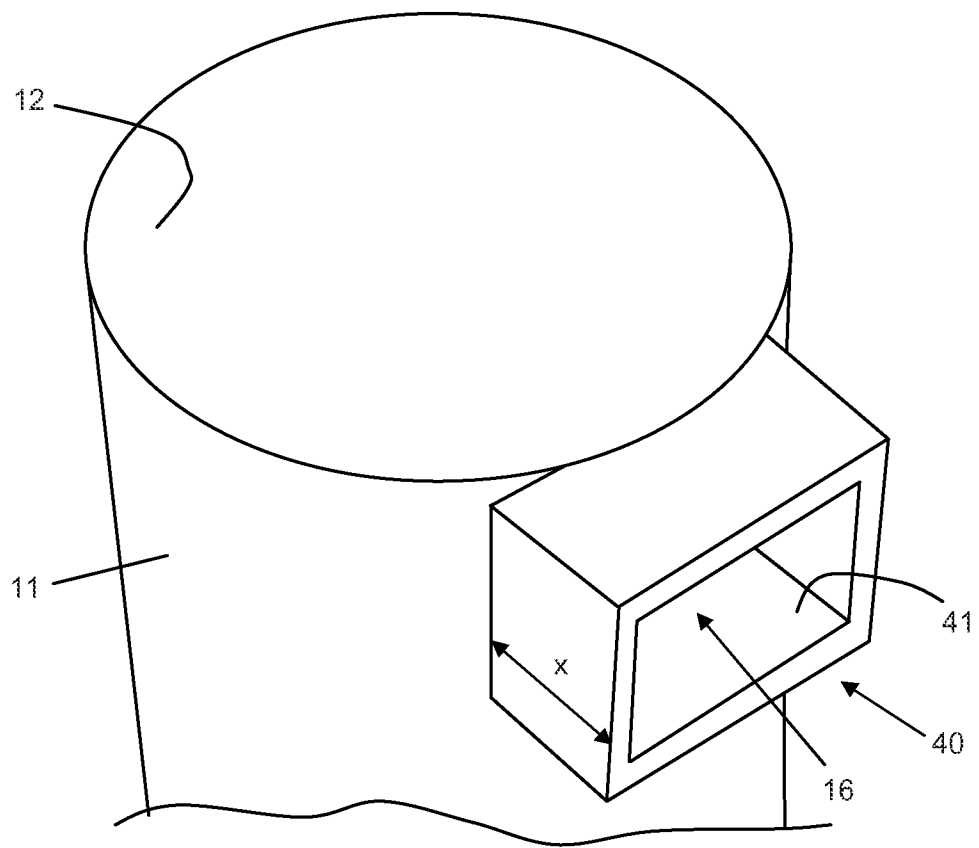


Fig. 5

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/IB2012/050359

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| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. A47L9/16<br>ADD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                |                                                                                                                               |
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| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>A47L B01D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                |                                                                                                                               |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                |                                                                                                                               |
| Electronic data base consulted during the international search (name of data base and, where practical, search terms used)<br>EP0-Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                |                                                                                                                               |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                |                                                                                                                               |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Citation of document, with indication, where appropriate, of the relevant passages                             | Relevant to claim No.                                                                                                         |
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| <div style="display: flex; justify-content: space-between;"> <span><input type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                |                                                                                                                               |
| <div style="display: flex;"> <div style="flex: 1;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>"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</p> <p>"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</p> <p>"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.</p> <p>"&amp;" document member of the same patent family</p> </div> </div> |                                                                                                                |                                                                                                                               |
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International application No

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