



(11)

EP 4 088 636 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.11.2022 Bulletin 2022/46

(51) International Patent Classification (IPC):
A47L 9/00 (2006.01) **A47L 9/22** (2006.01)

(21) Application number: **22173809.9**

(52) Cooperative Patent Classification (CPC):
A47L 9/0081; A47L 9/22

(22) Date of filing: **04.12.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(72) Inventor: **ERIKSSON, Henrik**
105 45 Stockholm (SE)

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
15804551.8 / 3 383 241

(74) Representative: **Electrolux Group Patents**
AB Electrolux
Group Patents
S:t Göransgatan 143
105 45 Stockholm (SE)

(71) Applicant: **AKTIEBOLAGET ELECTROLUX**
105 45 Stockholm (SE)

Remarks:

This application was filed on 17.05.2022 as a divisional application to the application mentioned under INID code 62.

(54) **A VACUUM CLEANER**

(57) A vacuum cleaner (1) comprising: a motor assembly (16) for generating an air flow for drawing air carrying dust into a dust collector compartment (11); a cover (17) for the motor assembly; and an air flow channel (31), from the motor assembly to an air outlet (27) in the housing. The cover comprises an inner and an outer motor assembly cover member (32, 33), each extending over an end of the motor assembly (16b) near the air outlet (27) and along the side of the motor assembly to form a double wall (32b, 33b) of the wall structure between the

motor assembly and the air outlet in a region where the air exits the motor assembly and each having an edge (32c, 33c) located with respect to other walls of the wall structure such that air flows around the edge to reach the outlet and thereby forms one or more turns of the air flow channel. At least one of said edges (32c, 33c, 34c) has an undulating shape with a plurality of peaks and troughs and/or at least one of said edges (32c, 33c, 34c) are wave-shaped, preferably at least one of said edges (32c, 33c, 34c) are in the shape of a sinusoid curve.

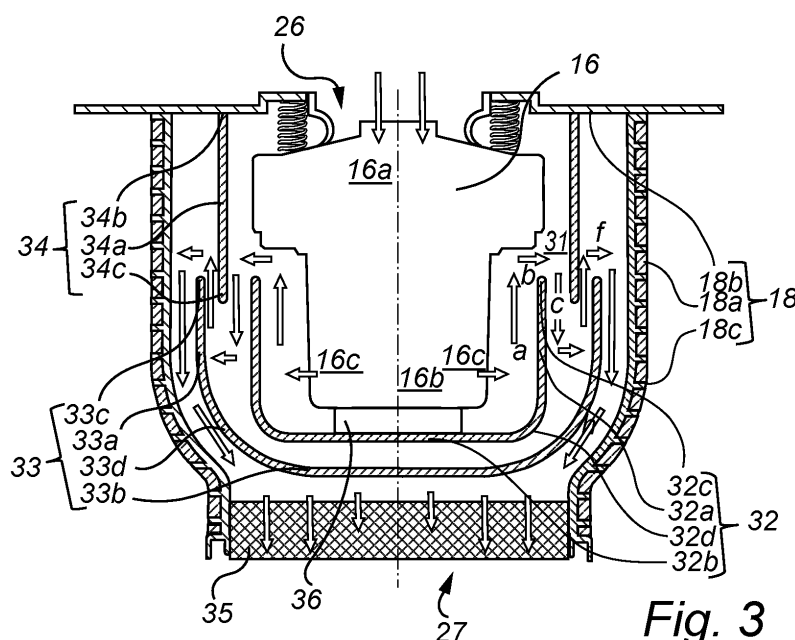


Fig. 3

Description

FIELD

[0001] The specification relates to vacuum cleaners. In particular, it relates to a vacuum cleaner having a motor assembly and a motor assembly cover within a housing wherein the motor assembly cover and housing provide a flow channel for air from the motor assembly to an air outlet of the housing.

BACKGROUND

[0002] Vacuum cleaners are popular for removing dust from surfaces. Vacuum cleaners are typically equipped with an electric motor and fan assembly that draws air carrying dust into a dust collector arrangement. A problem with vacuum cleaners on the market is that they generate disturbing noise when operated. Noise sources in a vacuum cleaner include for example the electric motor assembly, the air flow itself and vibrations transferred from the electric motor assembly to a motor housing, a dust collector arrangement housing and a vacuum cleaner casing.

[0003] In many vacuum cleaners the motor assembly is provided within a housing and the air flows from the motor assembly to an air outlet in the housing. In some vacuum cleaners, a one walled motor cover is provided around the motor assembly within the housing and sound absorbing materials may be provided within the air channels around the motor assembly and the cover in an attempt to absorb acoustic energy from the motor assembly and to diffuse the velocity of the air for decreasing flow induced noise. The air flow from the motor assembly to the outlet is often hard to control and significant flow induced noise may still be generated by the air flow within the housing. Moreover, significant acoustic energy from the motor assembly may still be transmitted to the outside of the housing.

SUMMARY OF THE INVENTION

[0004] According to an aspect of the invention, there is provided a vacuum cleaner comprising: a motor assembly, comprising a motor and fan, for generating an air flow for drawing air carrying dust into a dust collector compartment; a cover for the motor assembly; and a housing around the motor assembly and the cover, the cover and housing providing a wall structure comprising a plurality of walls and defining an air flow channel, from the motor assembly to an air outlet in the housing, with a plurality of turns, wherein the cover comprises an inner and an outer motor assembly cover member, each extending over an end of the motor assembly near the air outlet and along the side of the motor assembly to form a double wall of the wall structure between the motor assembly and the air outlet in a region where the air exits the motor assembly and each having an edge located

with respect to other walls of the wall structure to allow air to flow around the edge to reach the outlet, thereby forming one of the plurality of turns of the air flow channel.

[0005] By providing a double wall in the region where the air exits the motor assembly, the transmission of acoustic energy from the motor to the air outlet is reduced dramatically. The double wall forms an air cavity between the motor assembly and the air outlet. Moreover, the plurality of turns of the flow channel provided by the wall structure increases the length of the air channel from the motor assembly to the outlet, which allows increased absorption of acoustic energy in the channel.

[0006] The inner cover member is located at least partially within the outer cover member to form the double wall. Each edge of a cover member may be located such that the air has to flow along a wall section of the cover member, around the edge and back on the other side of the wall section.

[0007] The cover may further comprise an intermediate cover member comprising a wall having an edge located between the inner and outer cover members, the wall forming an intermediate wall of the wall structure.

[0008] The flow channel has a plurality of flow ducts connected to bend ducts providing the turns in the flow channel. The edges of the inner, intermediate and outer wall members may be arranged in a staggered manner such that the air flow channel comprises a flow duct in a space between the inner and intermediate cover member, an intermediate bend duct providing one of the turns around the edge of the intermediate member and a flow duct in a space between the intermediate cover member and the outer cover member.

[0009] The flow channel may have a flow duct between the inner cover member and the motor assembly. The flow channel may also have a flow duct between the outer cover member and a wall of the housing.

[0010] The intermediate cover member may comprise a generally cylindrical wall around the motor assembly.

[0011] Each of the inner and outer cover members may curve inwardly. They may for example be bowl-shaped. Alternatively, they may have a U-shaped or rectangular cross-section. The inner and outer cover members may comprise side wall sections which together with the intermediate cover member form generally cylindrical and concentric walls around the motor assembly.

[0012] The inner, outer and intermediate cover members and the housing may be arranged with respect to each other to form a flow channel that has a constant or near constant cross-section. By making the cross-section of the flow channel uniform throughout, efficiency can be improved and noise reduced.

[0013] The plurality of turns may comprise a plurality of 180-degree or substantially 180-degree turns. The flow channel may comprise at least three 180-degree turns. The flow channel may also comprise additional turns.

[0014] The flow channel may be symmetrical on opposite sides of the motor assembly. The motor assembly may comprise rotating parts rotating, in operation, around

an axis and the outlet in the housing may be located on the axis. The air flow channel from the motor assembly to the outlet may be symmetrical or substantially symmetrical 360 degrees around the axis.

[0015] At least one of said edges may have an undulating shape with a plurality of peaks and troughs to increase the length of the edge, eg. the shape of a sinusoid curve. The undulating shape may be provided to increase the surface area where the air makes the turn in order to decrease the local speed of air over the edge. At least one of said edges may be wave-shaped. In some implementations, the edges in each of the turns around the inner, outer and intermediate cover members are wave-shaped edges.

[0016] The flow channel from the motor assembly to the air outlet may comprise, partly or fully, an acoustic absorber. The acoustic absorber may be an air permeable synthetic fibre material. The material may also diffuse the velocity field of the air flow, thereby decreasing turbulence.

[0017] Consequently, embodiments of the vacuum cleaner provide noise reduction for the air flow downstream of the motor assembly. According to some embodiments, a flow channel is provided that can absorb acoustic energy and at the same time minimise flow generated noise downstream of the motor assembly.

[0018] According to another aspect of the invention, there is provided a vacuum cleaner comprising: a motor assembly for generating an air flow for drawing air carrying dust into a dust compartment; a cover for the motor assembly; and a housing for the motor assembly and the cover, the cover and housing providing a wall structure defining an air flow channel, from the motor assembly to an air outlet in the housing, with at least one turn where the air changes directions as it flows over an edge of a wall of the wall structure, the edge being wave-shaped with a plurality of peaks and troughs to increase the length of the edge at the turn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Embodiments will now be described, by way of example, with reference to the accompany drawings in which:

Figure 1 shows a vacuum cleaner in which a noise reducing air flow generator arrangement is used;

Figure 2 is an exploded view of components of the main body of the vacuum cleaner;

Figure 3 is a schematic diagram of components of the air flow generator arrangement of the vacuum cleaner;

Figure 4 is a schematic diagram of components of the air flow generator arrangement in another implementation;

Figure 5a is a cross-sectional view of components of the air flow generator arrangement along a plane indicated in Figure 5b; and

Figure 6a and 6b are schematic diagrams showing parts of some of the components of the air flow generator arrangement in more detail and the air flow direction over the components.

DETAILED DESCRIPTION

[0020] Figure 1 shows a vacuum cleaner 1 comprising a vacuum cleaner main body 2, a hose 3, a tube 4, and a nozzle 5. Air carrying dust particles is drawn into the vacuum cleaner 1 through the nozzle 5, the tube 4 and the hose 3 and collected in the main body. The hose 3, tube 4 and nozzle 5 may be removably connected to the main body 2. The main body comprises a casing 6 enclosing the internal components of the main body. The casing comprises a port 7 for connecting to the hose 3 and for allowing air to be sucked into the main body 2. The casing 6 also comprises an outlet diffuser 8 for allowing cleaned air to be discharged from the vacuum cleaner 1.

[0021] With reference to Figures 1 and 2, the main body 2 comprises a dust collector arrangement 11 and an air flow generator arrangement 12 within the vacuum cleaner casing 6. The air flow generator arrangement 12 creates a vacuum, which in turn creates a suction force. The suction force allows the vacuum cleaner 1 to draw in external air and dust from a cleaning surface, through the nozzle 5, tube 4, hose 3 and inlet port 7. Dust is then separated from the air in the dust collector arrangement 11 before the air flows through the air flow generator arrangement 12 and is discharged to the outside through the outlet diffuser 8.

[0022] The dust collector arrangement 11 may collect dust by filtering, separation or a combination of both. The dust collector arrangement has a housing 13 that forms a dust compartment 14. When the dust collector arrangement collects dust by filtering, for example a dust bag (not shown) for filtering the air and thereby collecting the dust in the bag may be located in the dust compartment 14. Alternatively, the dust collector arrangement may comprise a cyclone arrangement that separates dust particles from the air. The housing 13 may have a section that is pivotally connected to, or removable from, the rest of the housing such that when the dust collector arrangement is arranged to comprise, for example, a dust bag in the compartment 14 the dust compartment 14 can be opened and a dust bag can be inserted or removed.

[0023] The air flow generator arrangement 12 comprises an electric motor assembly 16, a cover for the motor assembly 17 and a motor housing 18 encapsulating the motor assembly and the cover. The electric motor assembly 16 is located within the motor cover 17, which in turn is located within the housing 18. The electric motor assembly comprises a fan 19 and a motor 20 located within a casing 21. The cover 17 and housing 18 form a wall structure that defines a flow channel for the air from the electric motor assembly.

[0024] To allow the air to pass through the vacuum

cleaner and dust to be collected, the dust collector arrangement 11 comprises an air inlet 24, cooperating with the inlet port 7 of the vacuum cleaner, and an air outlet 25 through which cleaned air exits the dust collector arrangement 11. The air flow generator arrangement 12 comprises an air inlet 26 for receiving the air from the dust collector arrangement 11 and an air outlet 27, cooperating with the outlet diffuser 8. The air inlets 24, 26 and outlets 25, 27 of the dust collector arrangement 11 and the air flow generator arrangement 12 may be formed as openings in the walls of the dust collector arrangement and air flow generator arrangement housing 13, 18. The air inlet 26 of the air flow generator arrangement 12 is located adjacent the air outlet 25 of the dust collector arrangement 11 and a seal (not shown) may be provided between the air outlet 25 and the air inlet 26 to ensure that all the air leaving the dust collector arrangement 11 enters the air flow generator arrangement 12. In some implementations, a single wall, providing part of both or one of the dust collector arrangement housing 13 and the air flow generator arrangement housing 18, may be provided between the dust compartment 14 and the electric motor assembly 16. The air inlet 26 of the air flow generator arrangement 12 would then form part of the same opening in the wall as the air outlet 25 of the dust collector arrangement 11. In this case a seal (not shown) may be provided between the air inlet 26 and the fan 19 to ensure that all the air entering the air inlet 26 enters the fan 19.

[0025] When the electric motor assembly 16 is operated, the fan and the motor create the suction force. Air enters the main body of the vacuum cleaner through the port 7, passes through the air inlet 24 in the dust collector arrangement 11, flows through the dust collector arrangement 11 and deposits dust in the dust compartment 14 and exits the dust collector arrangement 11 at outlet 25. The air enters the air flow generator arrangement 12 at air inlet 26, is sucked through the motor assembly 16 and guided to the air outlet 27 of the air flow generator arrangement and then exits through the outlet 27 and the outlet diffuser 8.

[0026] The dust collector arrangement 11 may comprise a filter (not shown) in the air outlet 25 to filter the air. When the dust compartment comprises a dust bag, the filter may also serve as a 'disaster filter' for protecting the motor assembly 16 in case the dust bag breaks. The air flow generator arrangement 12 may also comprise a filter at the outlet 27, which will be described in more detail with respect to Figure 3. Additionally, the vacuum cleaner may comprise a further filter at the outlet diffuser 8.

[0027] Although Figure 1 shows a canister type vacuum cleaner, the disclosure is not limited to canister type vacuum cleaners. The vacuum cleaner can alternatively be an upright vacuum cleaner, a battery handheld vacuum cleaner, a battery stick vacuum cleaner, an automatic vacuum cleaner, a robotic vacuum cleaner or any other suitable type of vacuum cleaner. Any suitable type

of nozzle 5, tube 4 and hose 3 may be used for the vacuum cleaner. Nozzles, tubes and hoses for vacuum cleaners are well known and will not be described in detail herein.

[0028] The air flow generator arrangement 12 will now be described in more detail. As shown in Figure 3, the motor housing delimits a volume V around the electric motor assembly 16. The motor assembly cover is located within the volume V around the electric motor assembly. Figure 3 shows the path of the air leaving the motor assembly 16 in the volume V. With reference to Figure 2 and Figure 3, the flow channel 31 for the air from the motor assembly to the air outlet 27 is defined by the motor assembly cover 17 and the housing 18. The motor assembly cover 17 comprises an inner cover member 32 and an outer cover member 33. The motor assembly also comprises an intermediate cover member 34 partially located between the inner cover member 32 and the outer cover member 33. The inner cover member 32, the intermediate cover member 34, the outer cover member 33 and the housing 18 form the wall structure that defines the flow channel 31. The arrows in Figure 3 show the direction of the air flow in the flow channel 31. As is clear from Figure 3, the flow channel has a plurality of turns where the air flow changes direction.

[0029] As further shown in Figure 3, and as mentioned above, a filter 35 is located at the outlet 27 for providing another stage of filtration. The filter may for example be a micro filter or a high-efficiency particulate arrestance (HEPA) filter but it will be appreciated that it can be any type of suitable filter. The air flow generator arrangement further comprises a suspension element 36 between the inner cover member 32 and the motor assembly 16. The air flow generator arrangement may also comprise attachment elements (not shown) for holding the motor assembly cover 17 in place.

[0030] With reference to Figure 3, the motor assembly 16 has a front end 16a and a rear end 16b. The front end 16a, where the fan is located, faces the air inlet 26 of the air flow generator arrangement 12. The rear end 16b is near the air outlet 27 of the air flow generator arrangement. The air outlet 27 is located at the opposite end of the volume V to the air inlet 26. The motor assembly 16 comprises rotating parts rotating around an axis X. The motor assembly is generally symmetrical around the axis and the front and rear ends 16a, 16b are located on the axis. The air inlet 26, air outlet 27 and filter 35 are also located on the axis X. The fan, when operated by the motor, draws the air into the motor assembly 16 and the air is then guided by motor assembly casing 21 through the motor assembly and leaves the electric motor assembly through outlets 16c in the casing. When the air exists the electric motor assembly it is guided through the flow channel 31 to the air outlet 27 of the air flow generator arrangement 12. The motor housing has a first wall section 18a extending generally parallel with the motor assembly axis X. The housing may also have a second wall section 18b extending generally perpendicular to the axis

X. The air inlet 26 may be formed in the second wall section 18b. In some implementations, the second wall section 18b is a single plate between the dust compartment and the motor assembly. The second wall section 18b may therefore form part of the housing 13 of the dust collector arrangement 11. Alternatively, it can be replaced with a number of components between the motor assembly and the dust collector arrangement or it may be a narrow peripheral wall portion forming an edge of the motor housing 18 for mounting the motor housing 18 to the housing 13 of the dust collector arrangement 11. The motor housing 18 also has a third wall section 18c, continuing from the first wall section 18a, and shaped to taper the width of the housing to form the air outlet 27. The air outlet 27 and the filter 35 in the air outlet extend generally orthogonally to the axis X.

[0031] The cover members 32, 33 and 34 and wall structure providing the flow channel will now be described in detail. With reference to Figure 2 and 3, the inner cover member 32 is located within the outer cover member 33. The inner cover member 32 and the outer cover member 33 each extend over the rear end 16b of the motor assembly and along the side of the motor assembly. The inner cover member 32 and the outer cover member 33 therefore form a double wall between the motor assembly 16 and the air outlet 27 in a region where the air exits the motor assembly 16. The intermediate cover member 34 extends along the side of the motor assembly 16 and forms an intermediate wall in the wall structure.

[0032] The inner cover member 32 has a first wall section 32a along and around the side of the motor assembly connected to a second wall section 32b along the rear of the motor assembly. The first wall section 32a ends in an edge 32c extending around the motor assembly. The first and second wall sections 32a, 32b may be connected by a third connecting wall section 32d, as shown in Figure 3. The outer cover member 33 also has a first wall section 33a along and around the side of the motor assembly connected to a second wall section 33b at the rear of the motor assembly. The first wall section of the outer cover member also ends in an edge 33c extending around the motor assembly. The first and second wall sections 33a, 33b of the outer cover member may be connected by a third connecting wall section 33d, as shown in Figure 3. The second wall section 32b, 33b and the third connecting section 32d, 33d may form a bridging section between opposite sides of the first wall section 32a, 33a in the inner and outer cover member. Two of the turns of the flow channel 31 are formed where the air flow bends around the edges 32c, 33c, of the inner and outer cover members.

[0033] The intermediate member 34 comprises a wall that has at least a section 34a that extends along and around the side of the motor assembly and is located partially between the inner and outer first wall sections. As shown in Figure 3, the intermediate member has a first end 34b located in the direction of the dust collector arrangement 11 and a second end 34c forming an edge

of the wall section 34a. The first end 34b may be positioned near, or abut, the housing wall 18b or components between the motor assembly 16 and the housing 13 of the dust collector arrangement 11. The edge of the wall section 34a extends around the motor assembly. The edges of the inner, intermediate and outer cover members may be arranged in a staggered manner such that the edge of the intermediate wall 34c is located between the first wall sections 32a, 33a of the inner and outer cover members. Another turn in the flow channel is formed where the air bends around the edge 34c of the intermediate member.

[0034] The wall structure provided by the inner and outer first wall sections 32a, 33a, the intermediate member wall 34a and the first wall section 18a of the housing create a folded flow channel 31 for air from the motor assembly. The inner and outer second wall sections 32b, 33b form the double wall at the rear of the motor assembly and provides an air cavity between the rear of the motor assembly 16 and the air outlet 27.

[0035] In more detail, the inner and outer first wall sections 32a, 33a, the intermediate member wall section 34a and the first wall section 18a of the housing extend along the motor assembly in an axial direction of the motor assembly. The wall sections 32a, 33a, 34a, 18a may be parallel or generally parallel. The first wall sections 32a, 33a, the intermediate member 34 and the housing wall section 18a may form cylindrical walls with increasing radii, as will be described in more detail with respect to Figure 5. The inner and outer second wall sections 32b, 33b are generally orthogonal to the inner and outer first wall sections 32a, 33a. Each of the inner and outer cover members 32, 33 may curve inwards to form a concave shape as shown in Figures 2 and 3. The first wall sections 32a, 33a may be straight or generally straight. The second wall sections may be straight or curved. The connecting wall sections 32d, 33d provide a curved connection between the first and second wall sections. As shown in Figures 2 and Figure 3, the inner and outer cover members are bowl-shaped. Alternatively, the inner and outer cover members may have a rectangular or U-shaped cross-section. If the inner and outer cover members have a rectangular cross-sections, the first and second walls may be directly connected to each other and connecting wall sections 32d, 33d may not be required. The inner cover member 32 may be arranged concentrically within the outer cover member 33.

[0036] The motor assembly cover 17 may be mounted within the motor housing 18 and the motor assembly cover 17 and the motor housing 18 may then be attached to the housing 13 of the dust collector arrangement 11. In more detail, the inner cover member 32, the intermediate cover member 34 and the outer cover member 33 are mounted together and then fixed within the housing 18. The inner cover member 32 and the intermediate cover member 34 may be injection moulded as one piece using a plurality of ribs in the channel formed between the walls of the inner and intermediate cover members. Alterna-

tively, the inner cover member may be attached to the intermediate cover member 34 using attachment elements (not shown). For example, the inner cover member may have attachment elements that snap into or onto corresponding attachment elements of the intermediate cover member. The ribs and other attachment elements may be provided in a location where they have limited effect on the air flow.

[0037] The outer cover 33 may be mounted to the inner cover member 32 with further attachment elements (not shown) also provided in a location where they have a limited effect on the air flow. For example, the outer cover member 33 may be mounted to the inner cover member 32 using a number of screws. Alternatively, attachment elements on the second wall section 33b of the outer cover member may snap into or onto attachment elements on the second wall section 32b of the inner cover member. As a specific example, the outer cover member 33 can be attached by a single screw between the second wall sections 32b, 33b of the inner and outer cover members and ribs protruding from the second wall section 32b of the inner cover member, in the direction of the outer cover member, can support the outer cover member and ensure it is positioned in a symmetrical manner with respect to the inner cover member.

[0038] The motor cover 17 may be attached to the motor housing 18 by screws, for example four radial screws near, or in, the second wall section 18b of the motor housing. Alternatively, the motor cover 17 may be attached to the inner part of the first wall section 18a of the motor housing 18 using, for example, a plurality of guides on the inner part of the first wall section 18a of the motor housing and corresponding protrusions on the outer part of the wall section 34a of the intermediate cover member that slide into the guides and thereby fix the motor cover in the housing. The guides may be positioned close to the wall that separates the motor assembly from the dust compartment 14 to minimise interference with the air flow in the flow channel 31. The motor assembly 16 is placed within the motor assembly cover 17 and is held in place by the suspension element 36. The motor housing 18 may then be connected, for example using screws, to the dust collector arrangement housing 13.

[0039] For the air to leave the air flow generator arrangement 12 the air will need to pass through the wall structure formed by the cover members and the housing. The cover members 32, 33, 34 are made of solid material with no holes for allowing air to pass through the walls. Consequently, for the air to reach the outlet 27, the air will need to flow around the walls. When the air flows around edges 32c, 33c, 34c of the walls it is forced to change direction. The direction of the flow channel changes multiple times causing the direction of the exhaust air flow to change multiple times. The air will need to flow over and bend over the edges 32c, 33c, 34c of the inner, intermediate and outer cover members.

[0040] The space between the motor assembly 16 and the first cover member 32 forms a first flow duct 31a con-

nected to a first bend duct 31b where the air flow flows over the edge 32c of the first cover member. The space between the first cover member 32 and the intermediate cover member 34 forms a second flow duct 31c. The flow duct is formed where the first wall section 32a of the first cover member overlaps with the generally parallel wall section 34a of the intermediate cover member. By locating a bowl-shaped first cover member nearest the motor assembly 16, the first duct portion 31a that is formed between the motor assembly and the first cover member forces the air to flow, as it leaves the motor assembly, in a direction generally transverse to the air flow through the motor assembly. The air from the motor assembly may turn as it leaves the air outlets 16c to enter the first flow duct 31a. The air then flows along the first wall section 32a of the inner cover member, over the edge 32c of the inner cover member and back along the other side of the inner cover member.

[0041] A second bend duct 31d is formed by the edge 34c of the intermediate cover member as the air flows around the edge and back along the other side of the intermediate cover member 34. The volume between the intermediate cover member and the outer cover member 33 form a third flow duct 31e. The flow duct is formed in the volume where the intermediate cover member 34 overlaps with the outer cover member 33. A third bend duct 31f is formed around the edge 33c of the outer cover member. The bend duct is connected to a fourth flow duct 31g formed in the space between the second cover member 33 and the first wall section 18a of the housing. The fourth flow duct continues into a fifth flow duct 31h formed in the space between the second cover member and the third wall section 18c of the housing.

[0042] The air flows from the motor along the first flow duct 31a, the first bend duct 31b, the second flow duct 31c, the second bend duct 31d, the third flow duct 31e, the third bend duct 31f, the fourth flow duct 31g and the fifth flow duct 31h to the housing outlet 27 as shown in Figure 3. The flow and bend ducts may extend all around the motor assembly 16. The first, second, third and fourth flow ducts 31a, 31c, 31e, 31g have alternating flow directions. The first, second and third bend ducts 31b, 31d, 31f force the air to make 180 degree turns or approximately 180 degree turns. The air flow is reversed so that the air flows along one side of a wall, turns around the edge of the wall and flows back on the other side. The fifth flow duct 31h also provides a small bend in the flow path. The outlet 27 may have a smaller width than the width of the housing measured at the first wall section 18a of the housing, as shown in Figure 3, and the fifth flow duct 31h may bend to guide the air to the narrower air outlet 27. The flow channel may also comprise additional turns.

[0043] It will be appreciated that additional cover members may be provided to increase the length of the flow channel further and to add additional 180 degree turns.

[0044] By having a double wall all around the region in which the air leaves the motor assembly, the acoustic

energy transmitted to the outside from the motor and fan can be reduced dramatically. The double wall creates an air cavity in the direction of the outlet 27 and cooperates with the motor casing 21, the intermediate cover member 34 and the housing 18 to form a folded flow channel for the air to leave the air flow generator arrangement. The air cavity limits the transmission of acoustic energy through the cover to the housing and air outlet. Moreover, by providing a folded air flow channel including multiple turns, the length of the air flow channel is increased having the result that further acoustic energy can be absorbed within the housing. Moreover, the specific arrangement of the inner, outer and intermediate cover member uses the space efficiently to provide multiple turns in a small space. For example, the inner cover member is located to cooperate with the motor assembly casing to provide the initial part of the flow channel. The arrangement of the inner cover member with respect to the motor assembly forces the air to travel back on itself, along the motor assembly casing and over the edge of the inner cover member, thereby providing another turn in the flow channel, while also providing a wall in the direction of the outlet 27.

[0045] Figure 4 shows another embodiment of the air flow generator arrangement 12 of Figure 2, in which a sound absorbing material 37 is provided in the volume V around the motor assembly 16. The location of the sound absorbing material is indicated with a darker shade in Figure 4. The other components remain the same as in the implementation of Figure 3. In the implementation of Figure 4, the absorbing material is provided throughout a substantial part of the volume V. In other implementations, the sound absorbing material may be provided in the entire volume V or in a smaller part of the volume. It may be provided in the entire flow channel 31 or in a part of the flow channel. For example, it may be provided in the first, second, third, fourth and fifth flow ducts 31a, 31c, 31e, 31g, 31h. The sound absorbing material 37 may for example be open celled foam or a fibrous synthetic material but it will be appreciated that any suitable air permeable sound absorbing material can be used. As a specific example it may comprise Polyethylene Terephthalate (PET) fibres. By increasing the length of the air flow channel 31 using cover members 32, 33 and 34, as has been described with respect to Figures 2 and 3, absorbing material can be provided throughout a longer channel and more acoustic energy can be absorbed. The folded channel 31 functions as a labyrinth for the acoustic waves and increases reflections of the waves into the absorbing material. The material may also help diffuse the velocity field of the air flow, thereby for example decreasing turbulence. This in turn will decrease flow-generated noise.

[0046] The cover members and the housing may be shaped such that the flow path on one side of the motor assembly 16 is symmetrical to the opposite side of the motor assembly. As shown in Figures 2 to 5, the cover members 32, 33 and 34 and the housing 18 are shaped

such that the flow channel from the motor assembly to the outlet 27 in the housing is symmetrical or near symmetrical 360 degrees around the motor assembly. In other words, the flow path is substantially symmetrical 360 degrees around the axis X of the motor assembly shown in Figures 3 and 4. This is beneficial in order to achieve a more even air flow and reduce turbulence. By reducing turbulence, losses and noise can be reduced.

[0047] The inner, outer and intermediate cover members and the housing may be shaped and arranged with respect to each other to form air channels between the walls with a constant or near constant cross-section. The cross section A1, A2, A3 and A4 of these air channels, corresponding to the first, second, third and fourth flow ducts 31a, 31c, 31e, 31g as described with respect to Figure 3, is shown in Figure 5a. The view in Figure 5a is a cross-section along a plane P indicated in Figure 5b, which shows another example of the air flow generator arrangement. Plane P is orthogonal to the motor assembly axis X. The generally parallel wall sections 32a, 33a, 34a, 18a of the inner, intermediate and outer cover members and the housing may be provided by concentric cylindrical wall sections, as indicated in Figure 5a. The casing 21 of the motor assembly 16 may have sections that lie on a cylinder with radius R1, as shown in Figure 5a. The radius R2 of the first wall section 32a of the inner cover member is larger than radius R1 but smaller than the radius R3 of the intermediate member wall section 34a, the radius R3 of the intermediate member wall section is smaller than the radius R4 of the first wall section 33a of the outer cover member, which in turn is smaller than the radius R5 of the first wall section 18a of the housing. The difference between the radii of adjacent cylinders may be the same or almost the same throughout the wall structure to provide a generally constant cross-section. In other words, radius R2 may be a distance D, or approximately distance D, greater than radius R1, radius R3 may be distance D, or approximately D, greater than radius R2 and so on. By having a generally uniform cross section throughout the flow channel efficiency can be improved and noise reduced. When the motor assembly cover and housing are relatively symmetrical around the motor assembly axis X, it becomes easier to design the air channel with a substantially constant cross-section.

[0048] With reference to Figures 2, 6a and 6b, at least some of the edges 32c, 33c, 34c of the inner cover member 32, the outer cover member 33 and the intermediate cover member 34 may be shaped to provide a longer edge length. The longer edge increases the surface area where the air makes a 180-degree turn, as indicated by the arrow in Figure 6b, thereby decreasing the local speed of air over the edge. As a result, turbulence and flow induced noise is decreased. The edges may have an undulating shape with a plurality of peaks and troughs. The edges may have an undulating curved shape. The edge may for example be in the shape of a sinusoid curve. As shown in Figures 6a and 6b, each of the edges 32c,

33c and 34c of the inner cover member 32, outer cover member 33 and the intermediate cover member 34 may be wave-shaped. In other implementations, only some of the edges may be shaped to have a longer edge length. In some implementations, and as shown in Figure 6b, the wave shape or the undulating pattern is provided along the edge and perpendicular to the direction of air flow. In other words, the air flows across, and not along, the waves as it passes the edge.

[0049] The amplitude of each peak or trough may for example be a few millimetres. The wave pattern may repeat with, for example, a 'wavelength' between 8mm and 20mm. As a specific example, the edge may have an undulating shape forming a series of half circles. Each half circle may have a radius of 3mm such that the height from the trough formed by one half circle to the crest formed by the adjacent half circle is 6mm. The curve pattern would then be repeated every 12mm. In other examples the amplitude of the 'wave' or series of half-circles may be between 2mm and 4mm such that the height of the wall from the trough to a crest is between 4mm and 8mm. However, it will be appreciated that other dimensions and wave patterns can be used in other implementations.

[0050] The motor cover and housing may be made from a synthetic resin, including but not limited to plastic. However, it will be realised that the motor cover and housing may be made using any suitable method and material. In some embodiments, they may be injection moulded.

[0051] Whilst specific examples and embodiments of the invention have been described, the scope of the invention is defined by the appended claims and not limited to the examples and embodiments described. The invention could therefore be implemented in other ways and numerous modifications and alternative arrangements can be contemplated, as would be appreciated by those skilled in the art.

[0052] For example, although the cover members have been shown in the drawings with specific shapes, alternative shapes providing the same functions can be used in other implementations. Moreover, although the flow channel has been described to have a substantially uniform cross section, the flow channel may alternatively be designed with a varying cross section. From a noise perspective variations can be beneficial if properly designed. Moreover, the dust collector arrangement and the air flow generator arrangement may comprise additional or alternative components to the ones shown in Figure 2.

[0053] The present disclosure considers the following examples:

1. A vacuum cleaner (1) comprising:

a motor assembly (16) for generating an air flow for drawing air carrying dust into a dust collector compartment (11);
a cover (17) for the motor assembly; and
a housing (18) for the motor assembly and the

cover, the cover and housing providing a wall structure comprising a plurality of walls and defining an air flow channel (31), from the motor assembly to an air outlet (27) in the housing, with a plurality of turns, wherein the cover comprises an inner and an outer motor assembly cover member (32, 33), each extending over an end of the motor assembly (16b) near the air outlet (27) and along the side of the motor assembly to form a double wall (32b, 33b) of the wall structure between the motor assembly and the air outlet in a region where the air exits the motor assembly and each having an edge (32c, 33c) located with respect to other walls of the wall structure such that air flows around the edge to reach the outlet and thereby forms one of the plurality of turns of the air flow channel.

2. A vacuum cleaner according to claim 1, wherein the cover further comprises an intermediate cover member (34) comprising a wall having an edge located between the inner and outer cover members, the wall forming an intermediate wall of the wall structure.

3. A vacuum cleaner according to claim 2, wherein the edges (32c, 33c, 34c) of the inner, intermediate and outer wall members (32, 33, 34) are arranged in a staggered manner such that the air flow channel comprises a flow duct (31c) in a space between the inner and intermediate cover member, an intermediate bend duct (31d) providing one of the turns around the edge (34c) of the intermediate member and a flow duct (31e) in a space between the intermediate cover member (34) and the outer cover member (33).

4. A vacuum cleaner according to claim 2 or 3, wherein the intermediate cover member comprises a generally cylindrical wall around the motor assembly.

5. A vacuum cleaner according to claim 2, 3 or 4, wherein the inner and outer cover members comprise side wall sections (32a, 33a) which together with the intermediate cover member (34) form generally cylindrical and concentric walls around the motor assembly.

6. A vacuum cleaner according to any one of claims 2 to 5, wherein the inner, outer and intermediate cover members (32, 33, 34) and the housing (18) are arranged with respect to each other to form a flow channel (31) that has a generally constant cross-section.

7. A vacuum cleaner according to any one of the preceding claims, wherein each of the inner and outer cover members (32, 33) are bowl-shaped.

8. A vacuum cleaner according to any one of the preceding claims, wherein the flow channel has a flow duct (31g) between the outer cover member (33) and a wall (18a) of the housing.

9. A vacuum cleaner according to any preceding claim, wherein the plurality of turns comprises multiple 180 degree turns.

10. A vacuum cleaner according to any preceding claim, wherein the flow channel (31) has a flow duct (31a) between the inner cover member (32) and the motor assembly (16).

11. A vacuum cleaner according to any preceding claim, wherein the motor assembly (16) comprises rotating parts rotating, in operation, around an axis (X) and wherein the outlet (27) in the housing is located on the axis.

12. A vacuum cleaner according to claim 11, wherein the flow channel from the motor assembly (16) to the outlet (27) is substantially symmetrical 360 degrees around the axis (X).

13. A vacuum cleaner according to any one of the preceding claims wherein at least one of said edges (32c, 33c, 34c) has an undulating shape with a plurality of peaks and troughs.

14. A vacuum cleaner according to any one of the preceding claims wherein at least one of said edges (32c, 33c, 34c) are wave-shaped, preferably at least one of said edges (32c, 33c, 34c) are in the shape of a sinusoid curve.

15. A vacuum cleaner according to any one of the preceding claims, wherein the flow channel (31) from the motor assembly (16) to the air outlet (27), partly or fully, comprises an air permeable synthetic fibre material.

Claims

1. A vacuum cleaner (1) comprising:

a motor assembly (16) for generating an air flow for drawing air carrying dust into a dust collector compartment (11);

a cover (17) for the motor assembly; and an air flow channel (31), from the motor assembly to an air outlet (27) in the housing, wherein the cover comprises an inner and an outer motor assembly cover member (32, 33), each extending over an end of the motor assembly (16b) near the air outlet (27) and along the side of the motor assembly to form a double wall

(32b, 33b) of the wall structure between the motor assembly and the air outlet in a region where the air exits the motor assembly and each having an edge (32c, 33c) located with respect to other walls of the wall structure such that air flows around the edge to reach the outlet and thereby forms one or more turns of the air flow channel, wherein at least one of said edges (32c, 33c, 34c) has an undulating shape with a plurality of peaks and troughs and/or at least one of said edges (32c, 33c, 34c) are wave-shaped, preferably at least one of said edges (32c, 33c, 34c) are in the shape of a sinusoid curve.

2. A vacuum cleaner according to claim 1, wherein the vacuum cleaner comprises a housing (18) for the motor assembly and the cover, the cover and housing providing a wall structure comprising a plurality of walls and defining an air flow channel (31), from the motor assembly to an air outlet (27) in the housing, with a plurality of turns,

3. A vacuum cleaner according to any of claims 1-2, wherein the cover further comprises an intermediate cover member (34) comprising a wall having an edge located between the inner and outer cover members, the wall forming an intermediate wall of the wall structure.

4. A vacuum cleaner according to claim 3, wherein the edges (32c, 33c, 34c) of the inner, intermediate and outer wall members (32, 33, 34) are arranged in a staggered manner such that the air flow channel comprises a flow duct (31c) in a space between the inner and intermediate cover member, an intermediate bend duct (31d) providing one of the turns around the edge (34c) of the intermediate member and a flow duct (31e) in a space between the intermediate cover member (34) and the outer cover member (33).

5. A vacuum cleaner according to claim 3 or 4, wherein the intermediate cover member comprises a generally cylindrical wall around the motor assembly.

6. A vacuum cleaner according to claim 3, 4 or 5, wherein the inner and outer cover members comprise side wall sections (32a, 33a) which together with the intermediate cover member (34) form generally cylindrical and concentric walls around the motor assembly.

7. A vacuum cleaner according to any one of claims 3 to 6, wherein the inner, outer and intermediate cover members (32, 33, 34) and the housing (18) are arranged with respect to each other to form a flow channel (31) that has a generally constant cross-section.

8. A vacuum cleaner according to any one of the preceding claims, wherein each of the inner and outer cover members (32, 33) are bowl-shaped.
9. A vacuum cleaner according to any one of the preceding claims, wherein the flow channel has a flow duct (31g) between the outer cover member (33) and a wall (18a) of the housing. 5
10. A vacuum cleaner according to any preceding claim, wherein the one or more turns comprises a 180 degree turn. 10
11. A vacuum cleaner according to any preceding claim, wherein the flow channel (31) has a flow duct (31a) between the inner cover member (32) and the motor assembly (16). 15
12. A vacuum cleaner according to any preceding claim, wherein the motor assembly (16) comprises rotating parts rotating, in operation, around an axis (X) and wherein the outlet (27) in the housing is located on the axis. 20
13. A vacuum cleaner according to claim 12, wherein the flow channel from the motor assembly (16) to the outlet (27) is substantially symmetrical 360 degrees around the axis (X). 25
14. A vacuum cleaner according to any one of the preceding claims, wherein the flow channel (31) from the motor assembly (16) to the air outlet (27), partly or fully, comprises an air permeable synthetic fibre material. 30

35

40

45

50

55

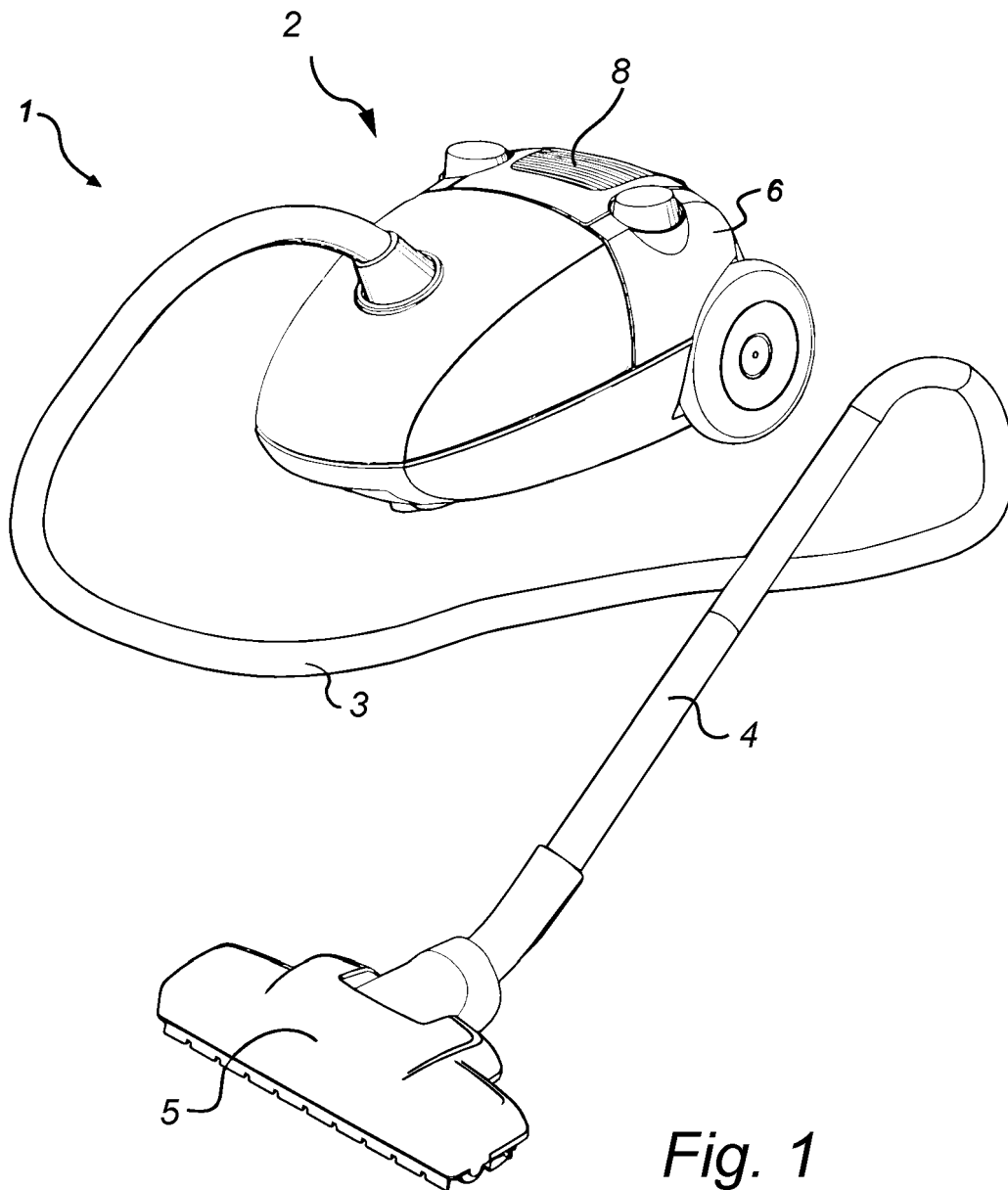
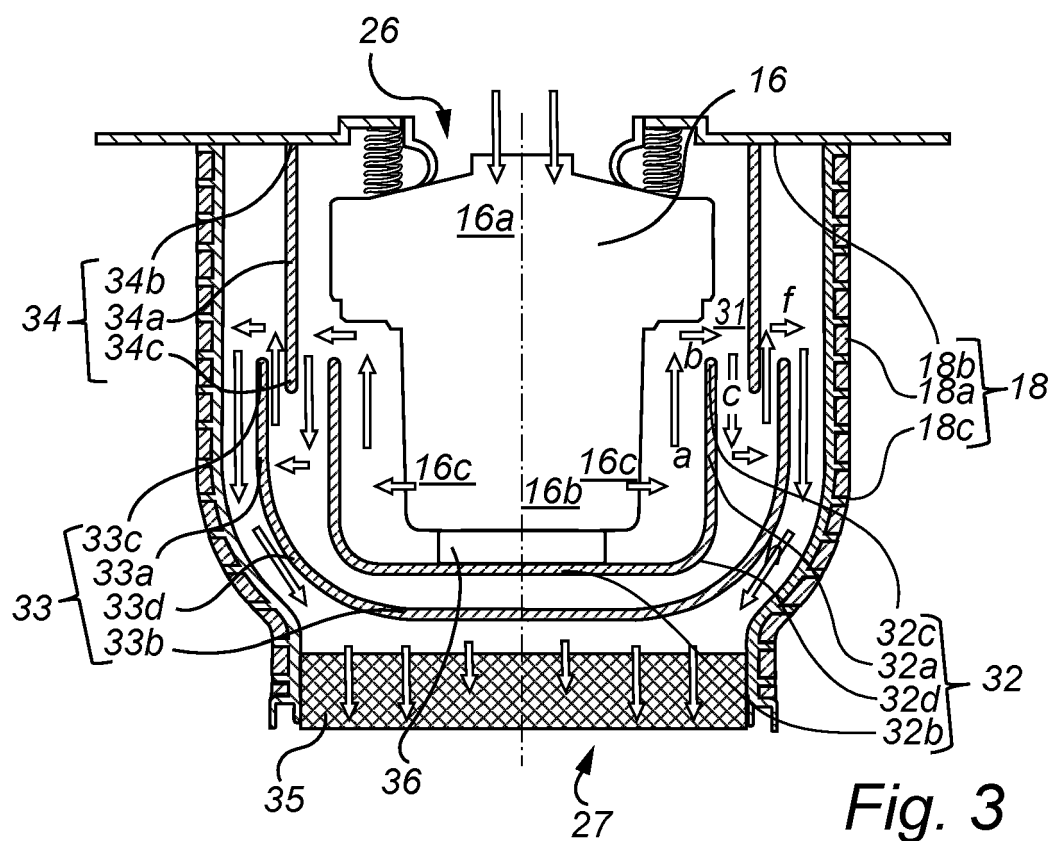
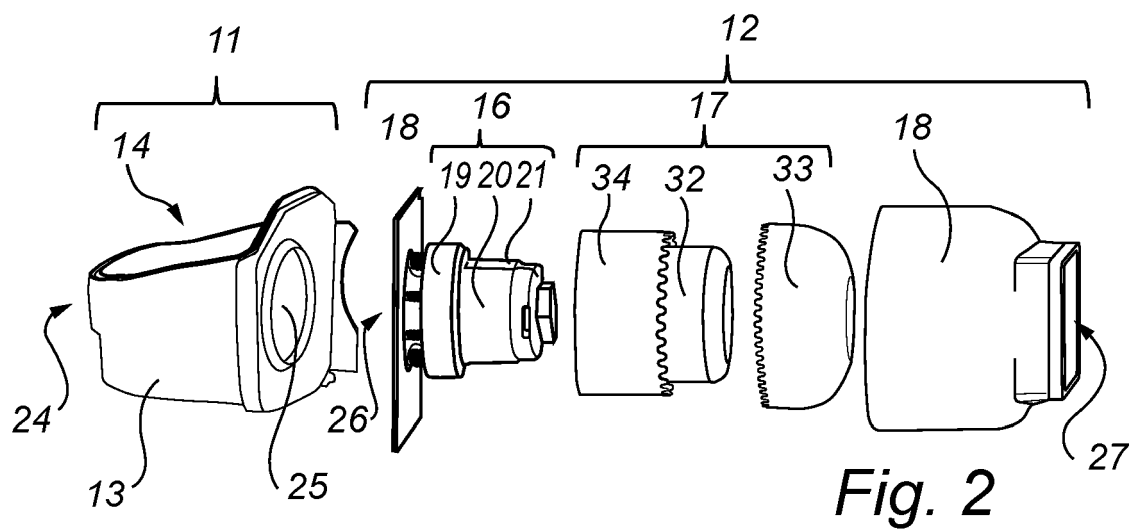


Fig. 1



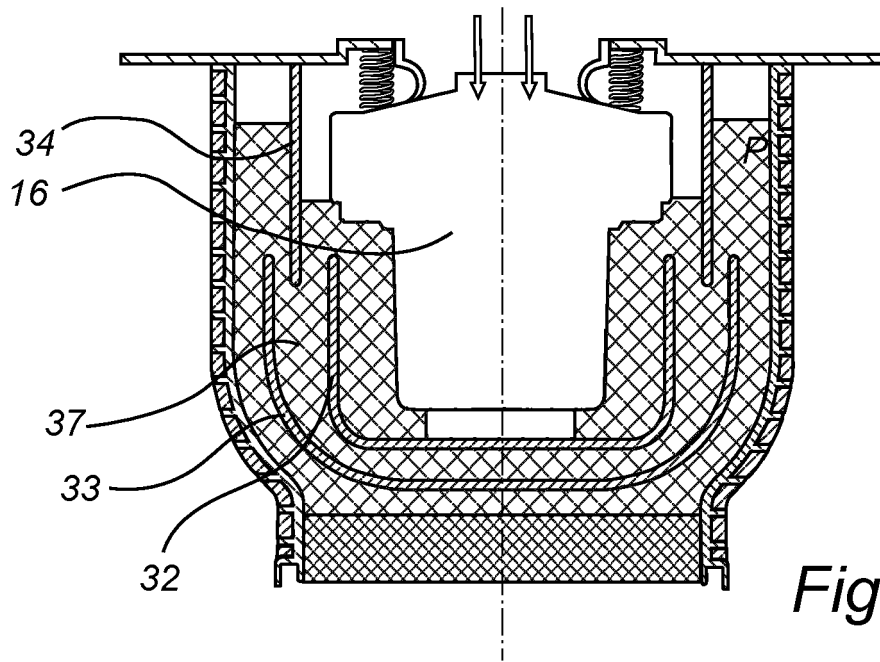


Fig. 4

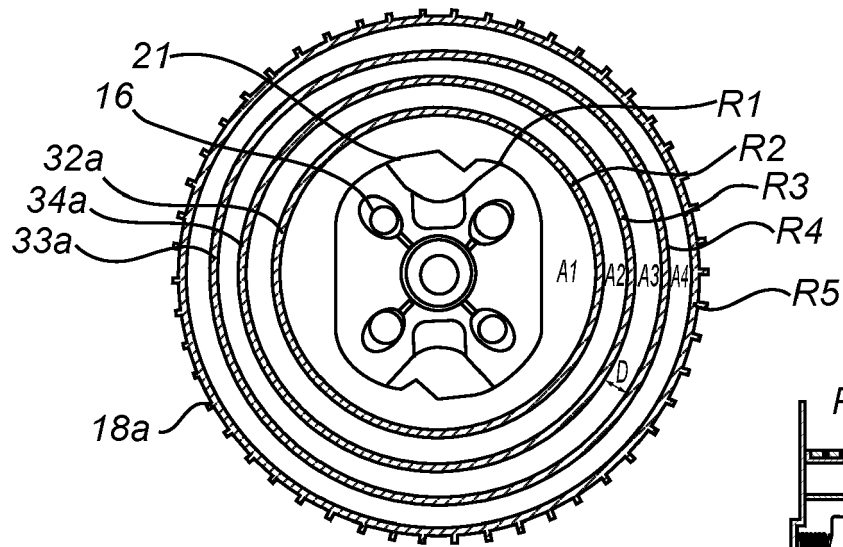
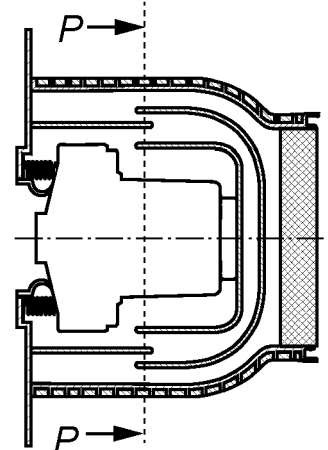


Fig. 5a

Fig. 5b



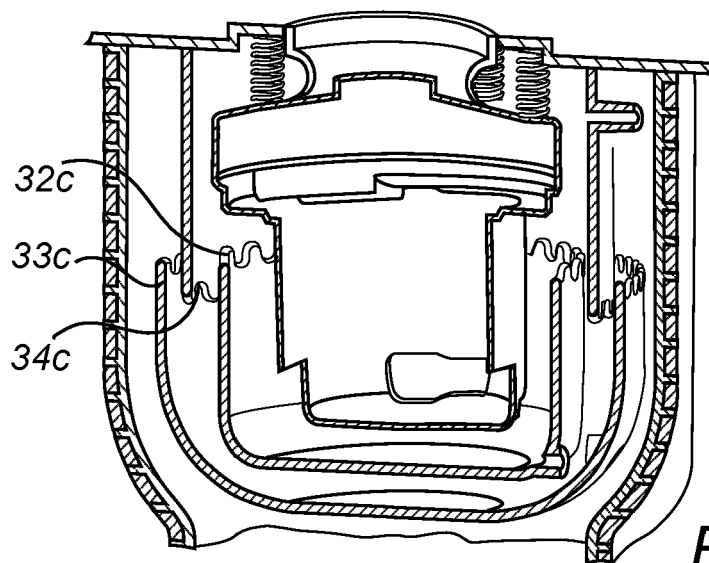


Fig. 6a

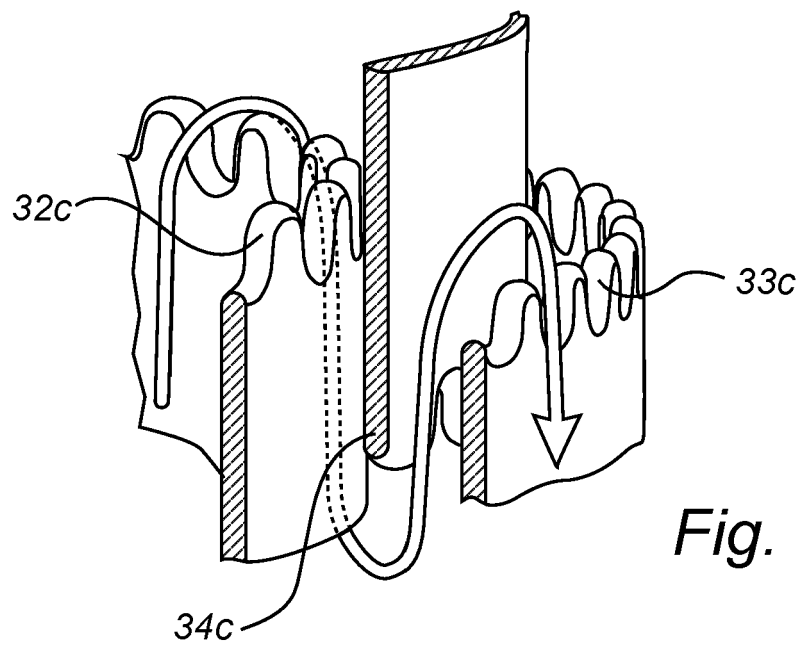


Fig. 6b



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 3809

5

10

15

20

25

30

35

40

45

50

55

2

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 803 382 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 4 July 2007 (2007-07-04) * column 1, paragraph 1 * * column 2, paragraph 6 * * column 5, paragraph 9 * * column 4, paragraph 18 - column 6, paragraph 40 * * figures 3,4 * -----	1-14	INV. A47L9/00 A47L9/22
A	EP 1 266 501 A1 (NILFISK ADVANCE AS [DK]) 18 December 2002 (2002-12-18) * column 1, paragraph 1 * * column 2, paragraph 10 - paragraph 11 * * figure 4 * -----	1-14	
A	US 2006/260091 A1 (SONG HWA-GYU [KR] ET AL) 23 November 2006 (2006-11-23) * abstract * * figure 1 * -----	1	
A	EP 1 929 914 A2 (SAMSUNG KWANGJU ELECTRONICS CO [KR]) 11 June 2008 (2008-06-11) * abstract * * figure 4 * -----	1	TECHNICAL FIELDS SEARCHED (IPC) A47L
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 September 2022	Examiner Redelsperger, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 22 17 3809

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-09-2022

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 1803382	A2	04-07-2007	CN	1989890 A	04-07-2007
			EP	1803382 A2	04-07-2007
			KR	20070068941 A	02-07-2007
			RU	2323674 C1	10-05-2008
			US	2007143952 A1	28-06-2007

EP 1266501	A1	18-12-2002	AT	275311 T	15-09-2004
			AU	4231701 A	08-10-2001
			AU	2001242317 B2	11-11-2004
			DE	60105272 T2	15-09-2005
			DK	1266501 T3	20-09-2004
			EP	1266501 A1	18-12-2002
			ES	2227159 T3	01-04-2005
			WO	0174025 A1	04-10-2001

US 2006260091	A1	23-11-2006	AU	2006201707 A1	07-12-2006
			CN	1864613 A	22-11-2006
			EP	1741374 A2	10-01-2007
			KR	20060118973 A	24-11-2006
			RU	2328202 C2	10-07-2008
			US	2006260091 A1	23-11-2006

EP 1929914	A2	11-06-2008	CN	101196195 A	11-06-2008
			EP	1929914 A2	11-06-2008
			KR	20080051636 A	11-06-2008
			RU	2344322 C1	20-01-2009
