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(54) **HANDHELD VACUUM CLEANER, AND VACUUM CLEANER COMPRISING A HANDHELD VACUUM CLEANER**

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(56) References cited:
**WO-A1-2014/056686 WO-A1-2017/092832
WO-A1-2018/065069 CN-A- 108 903 792
GB-A- 2 468 299 KR-A- 20070 032 443**

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a handheld vacuum cleaner. The present disclosure further relates to a vacuum cleaner comprising a holder for a handheld vacuum cleaner.

BACKGROUND

[0002] A vacuum cleaner is a device that uses an air pump, most often a centrifugal fan, to create a partial vacuum in order to suck up dust and dirt from surfaces, such as floors, carpets, and the like. Different kinds of vacuum cleaners are known. Among them, upright/stick type vacuum cleaners and handheld vacuum cleaners. These types of vacuum cleaner generally have an elongated body with a nozzle in one end and a handle in the other end. A housing with a fan and filter may be attached to the elongated body and may extend substantially in parallel thereto. Such a housing may comprise a fan and motor, a dust collector, a filter, and other necessary parts.

[0003] Handheld vacuum cleaners and upright/stick type vacuum cleaners allow a user to remove dust and debris in a relatively easy and efficient manner and may be operated with a single hand grip. Handheld vacuum cleaners have become increasingly popular. Reasons for this might be that they are simple to use and require little space when not in use.

[0004] In general, some problems and requirements exist when designing vacuum cleaners. One example is the cleaning efficiency. Users of vacuum cleaners expect a high cleaning efficiency in order to achieve a good cleaning result with little effort. Another problem is noise level during operation. Noise generated by a vacuum cleaner is usually annoying for the user and for persons in the vicinity of the vacuum cleaner. Still another problem is to provide a user-friendly vacuum cleaner which can be used in a simple and intuitive manner. A further problem is energy consumption of the vacuum cleaner. These problems and requirements are usually conflicting problems and requirements. That is, an easy way to increase the cleaning efficiency of a vacuum cleaner is to increase the power of the fan. However, as a result thereof, the noise generated by the vacuum cleaner as well as the energy consumption of the vacuum cleaner will increase.

[0005] Moreover, generally, on today's consumer market, it is an advantage if products, such as vacuum cleaners and vacuum cleaner components, have conditions and/or characteristics suitable for being manufactured and assembled in a cost-efficient manner. To be inserted on page 1, line 34 of original description.

[0006] Document WO2014/056686 A1 discloses an exhaust grille comprising an array of spaced vanes. The grill is configured so as to deflect sound waves incident upon the grille to prevent them from passing through the exhaust grille.

[0007] Document WO2018/065069 A1 discloses a stick vacuum cleaner having a handheld vacuum cleaner adapted to be docked to a stick. When the handheld vacuum cleaner is docked to the stick an air path is formed connecting an air outlet of the handheld vacuum cleaner with an air outlet provided in the stick. A noise absorption unit is provided in the air path or outside the air outlet from the stick.

[0008] Document GB2468299 A discloses A cleaning appliance having an exhaust vent and an exhaust baffle, the exhaust baffle includes a body having an upstream face and a downstream face.

[0009] Document CN108903792 A discloses dust collector and a noise reduction structure. A noise reduction sleeve is installed at a tail of the motor cover, and a mazy air-out structure is formed between the noise reduction sleeve and the motor cover to reduce the noise.

[0010] Document KR20070032443 A discloses a suction nozzle of a vacuum having a noise reducing rib at the suction port.

[0011] Document WO2017/092832 A1 discloses a vacuum cleaner comprising a motor housing providing a wall structure having a plurality of walls and defining an air flow channel with a plurality of turns.

SUMMARY

[0012] It is an object of the present invention to overcome, or at least alleviate, at least some of the above-mentioned problems and drawbacks.

[0013] According to a first aspect of the invention, the object is achieved by a handheld vacuum cleaner according to the independent claim 1.

[0014] Since the vacuum cleaner comprises a sound reducing section extending from the fan in the extension direction, and since the angle between the extension direction and the fan axis is less than 45 degrees, the noise generated by the fan is attenuated in an efficient manner. Thereby, a vacuum cleaner is provided having conditions for generating less noise during operation, and conditions for increased power levels of the fan while generating less noise.

[0015] Furthermore, since the angle between the extension direction of the sound reducing section and the fan axis is less than 45 degrees, a low flow resistance of air flowing through the sound reducing section can be provided while obtaining an efficient attenuation of the noise generated by the fan. Moreover, since the angle between the extension direction of the sound reducing section and the fan axis is less than 45 degrees, conditions are provided for a vacuum cleaner having a well-balanced weight distribution, which facilitates use of the vacuum cleaner, as is further explained herein.

[0016] Accordingly, a handheld vacuum cleaner is provided overcoming, or at least alleviating, at least some of the above-mentioned problems and drawbacks. As a result, the above-mentioned object is achieved.

[0017] Optionally, the length of the sound reducing

section is greater than 5 cm. Thereby, a vacuum cleaner is provided having conditions for generating less noise during operation, and conditions for increased power levels of the fan while generating less noise. Furthermore, a low flow resistance of air flowing through the sound reducing section can be provided while obtaining an efficient attenuation of the noise generated by the vacuum cleaner. Moreover, conditions are provided for a well-balanced vacuum cleaner.

[0018] Optionally, the length of the sound reducing section is at least 20%, or at least 30%, of the distance between the air inlet and the air outlet of the vacuum cleaner. Thereby, a vacuum cleaner is provided having conditions for generating less noise during operation, and conditions for increased power levels of the fan while generating less noise. Furthermore, a low flow resistance of air flowing through the sound reducing section can be provided while obtaining an efficient attenuation of the noise generated by the vacuum cleaner. Moreover, conditions are provided for a well-balanced vacuum cleaner.

[0019] Optionally, the sound reducing section comprises one or more blades protruding into the sound reducing section so as to counteract vortex flow of air in the sound reducing section. Thereby, the flow resistance of air flowing through the sound reducing section is significantly reduced. As a result, the energy consumption of the vacuum cleaner can be lowered while allowing higher power levels of the fan. Moreover, due to the one or more blades protruding into the sound reducing section, the sound generated by the vacuum cleaner can be further lowered. This because turbulent flow of air in the sound reducing section is significantly lowered.

[0020] Optionally, each blade of the one or more blades protrudes in a direction parallel to the fan axis. Thereby, vortex flow of air in the sound reducing section is counteracted in an efficient manner. Moreover, the one or more blades have conditions and characteristics suitable for being manufactured in a cost-efficient manner.

[0021] In the invention the sound reducing section comprises a first portion and a second portion downstream of the first portion, and wherein a cross sectional area of the second portion is smaller than the cross sectional area of the first portion. Thereby, the noise generated by the vacuum cleaner is attenuated in a further efficient manner.

[0022] Optionally, the cross sectional area of the second portion is at least 30% smaller than the cross sectional area of the first portion. Thereby, it is ensured that the noise generated by the vacuum cleaner is attenuated in a further efficient manner.

[0023] Optionally, the one or more blades is/are arranged upstream of the second portion. Thereby, vortex flow of air in the second portion of the sound reducing section is counteracted in an efficient manner. As a result thereof, the flow resistance of air flowing through the second portion of the sound reducing section is significantly reduced. As a result, the energy consumption of the vacuum cleaner can be lowered while allowing higher power

levels of the fan. As a further result of these features, the sound generated by the vacuum cleaner is further lowered.

[0024] Optionally, the sound reducing section comprises a narrowing portion between the first and second portions. Thereby, the noise generated by the fan is attenuated in a further efficient manner.

[0025] Optionally, the one or more blades is/are arranged in, or upstream of, the narrowing portion. Thereby, vortex flow of air in the narrowing portion, and in the second portion downstream of the narrowing portion of the sound reducing section, is counteracted in an efficient manner. As a result thereof, the flow resistance of air flowing through the narrowing portion, and through the second portion downstream of the narrowing portion of the sound reducing section, is significantly reduced. As a result, the energy consumption of the vacuum cleaner can be lowered while allowing higher power levels of the fan. As a further result of these features, the sound generated by the vacuum cleaner is further lowered.

[0026] Optionally, the sound reducing section comprises a third portion downstream of the second portion, and wherein the cross sectional area of the third portion is greater than the cross sectional area of the second portion. Thereby, the noise generated by the fan is attenuated in a further efficient manner, while allowing a low flow resistance of air flowing through the sound reducing section. Moreover, conditions are provided for a well-balanced vacuum cleaner.

[0027] Optionally, the cross sectional area of the third portion is at least 30% greater than the cross sectional area of the second portion. Thereby, it is ensured that the noise generated by the fan is attenuated in a further efficient manner, while allowing a low flow resistance of air flowing through the sound reducing section. Moreover, conditions are provided for a well-balanced vacuum cleaner, as is further explained herein.

[0028] Optionally, the length of the second portion, measured in a direction coinciding with the fan axis, is more than 3 cm, or more than 5 cm. Thereby, it is ensured that the noise generated by the fan is attenuated in an efficient manner while allowing a low flow resistance of air flowing through the sound reducing section. Moreover, conditions are provided for a well-balanced vacuum cleaner, as is further explained herein.

[0029] Optionally, outer surfaces of the second portion form a handle for a user of the handheld vacuum cleaner. Thereby, a vacuum cleaner is provided in which a portion of the sound reducing section forms a handle for a user of the handheld vacuum cleaner. As a result thereof, a vacuum cleaner is provided having conditions for generating less noise during operation while having conditions and characteristics suitable for being manufactured and assembled in a cost-efficient manner. Moreover, a vacuum cleaner is provided having conditions for a compact and well-balanced design, as is further explained herein.

[0030] Optionally, the vacuum cleaner comprises a motor configured to rotate the fan around the fan axis,

and wherein the motor is arranged in the first portion of the sound reducing section. Thereby, the motor is cooled in an efficient manner by the air flowing through the sound reducing section during operation of the vacuum cleaner. Accordingly, a vacuum cleaner is provided having conditions for generating less noise during operation while having conditions and characteristics suitable for being manufactured and assembled in a cost-efficient manner. Moreover, a vacuum cleaner is provided having conditions for a compact and well-balanced design.

[0031] Optionally, the vacuum cleaner comprises a battery configured to provide electricity to the motor, and wherein the battery is arranged in the third portion of the sound reducing section. Thereby, the battery is cooled in an efficient manner by the air flowing through the sound reducing section during operation of the vacuum cleaner. Accordingly, a user-friendly vacuum cleaner is provided having conditions for generating less noise during operation while having conditions and characteristics suitable for being manufactured and assembled in a cost-efficient manner. Moreover, a vacuum cleaner is provided having conditions for a compact and well-balanced design.

[0032] Optionally, the third portion comprises the air outlet. Thereby, a vacuum cleaner is provided having conditions for generating less noise during operation.

[0033] Optionally, the air outlet comprises a shield. Thereby, the noise generated by the vacuum cleaner is attenuated in a further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section.

[0034] Optionally, the shield is configured to direct the air to directions being angled relative to the fan axis. Thereby, the noise generated by the vacuum cleaner is attenuated in a further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section. Moreover, conditions are provided for directing the air flowing through the air outlet in directions causing less disturbance to a user of the vacuum cleaner.

[0035] Optionally, the shield is configured to direct the air to substantially radial directions relative to the fan axis. Thereby, the noise generated by the vacuum cleaner is attenuated in a further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section. Moreover, conditions are provided for directing the air flowing through the air outlet in directions causing less disturbance to a user of the vacuum cleaner.

[0036] Optionally, the vacuum cleaner comprises at least one sound absorbing unit provided in a sound absorbing material arranged in the sound reducing section, preferably an air permeable sound absorbing material or a sound absorbing surface coating. Thereby, the noise generated by the vacuum cleaner is attenuated in a further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section.

[0037] Optionally, the vacuum cleaner comprises at least one sound absorbing unit provided in a sound absorbing material arranged in the second portion of the sound reducing section, preferably an air permeable

sound absorbing material or a sound absorbing surface coating. Thereby, the noise generated by the vacuum cleaner is attenuated in a still further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section.

[0038] Optionally, the vacuum cleaner comprises at least one sound absorbing unit provided in a sound absorbing material arranged in the third portion of the sound reducing section, preferably an air permeable sound absorbing material or a sound absorbing surface coating. Thereby, the noise generated by the vacuum cleaner is attenuated in a still further efficient manner while allowing a low flow resistance of air flowing through the sound reducing section.

[0039] Optionally, the angle between the extension direction of the sound reducing section and the fan axis is less than 25 degrees, or less than 10 degrees, or around 0 degrees.

[0040] Optionally, the vacuum cleaner may comprise a shaft part and a detachable handheld vacuum cleaner according to some embodiments of the present disclosure, wherein the shaft part comprises a handle, two tube parts, a floor nozzle, and a holder for the handheld vacuum cleaner arranged between the two tube parts.

[0041] Since the vacuum cleaner comprises a detachable handheld vacuum cleaner according to some embodiments, a vacuum cleaner is provided having conditions for generating less noise during operation, and conditions for increased power levels of the fan while generating less noise. Furthermore, since the sound reducing section of the handheld vacuum cleaner extends from the fan in an extension direction, and wherein the angle between the extension direction and the fan axis is less than 45 degrees, a low flow resistance of air flowing through the sound reducing section can be provided while obtaining an efficient attenuation of the noise generated by the fan of the handheld vacuum cleaner.

[0042] Accordingly, a vacuum cleaner is provided overcoming, or at least alleviating, at least some of the above-mentioned problems and drawbacks. As a result, the above-mentioned object is achieved.

[0043] Optionally, the air outlet of the handheld vacuum cleaner is positioned between the two tube parts when the handheld vacuum cleaner is attached to the holder. Thereby, conditions are provided for directing the air flowing through the air outlet in directions causing less disturbance to a user of the vacuum cleaner while allowing a low flow resistance of air flowing through the air outlet of the handheld vacuum cleaner.

[0044] Further features of, and advantages with, the present invention will become apparent when studying the appended claims and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] Various aspects of the invention, including its particular features and advantages, will be readily under-

stood from the example embodiments discussed in the following detailed description and the accompanying drawings, in which:

Fig. 1 illustrates a first cross section of a handheld vacuum cleaner according to some embodiments, Fig. 2 illustrates a second cross section of the vacuum cleaner illustrated in Fig. 1 with some components removed,

Fig. 3 illustrates a third cross section of the vacuum cleaner illustrated in Fig. 1 and Fig. 2,

Fig. 4 illustrates a top view of a vacuum cleaner according to the embodiments illustrated in Fig. 1 - Fig. 3, and

Fig. 5 illustrates a vacuum cleaner according to some further embodiments of the present disclosure.

DETAILED DESCRIPTION

[0046] Aspects of the present invention will now be described more fully. Like numbers refer to like elements throughout. Well-known functions or constructions will not necessarily be described in detail for brevity and/or clarity.

[0047] Fig. 1 illustrates a first cross section of a handheld vacuum cleaner 1 according to some embodiments. For the reason of brevity and clarity, the handheld vacuum cleaner 1 is in some places herein referred to as "the vacuum cleaner". The vacuum cleaner 1 comprises an air inlet 3, an air outlet 5, and a fan 7. The fan 7 is powered by an electric motor 27. The electric motor 27 is configured to rotate the fan 7 around a fan axis ax. The cross section of Fig. 1 is made through a plane comprising the fan axis ax. The fan 7 is configured to rotate around the fan axis ax to create an air flow through an air flow path 9. The air flow path 9 extends from the air inlet 3 to the air outlet 5. The electric motor 27 may comprise ball bearings and may be rubber suspended relative to a housing 6 of the vacuum cleaner 1. In this manner, less noise is generated during operation of the vacuum cleaner 1.

[0048] The vacuum cleaner 1 further comprises a separation device 11 arranged in the air flow path 9. The separation device 11 is configured to separate dust from air flowing through the air flow path 9. The separation device 11 may comprise a dust bag, a filter, a cyclone separator, or the like.

[0049] The air flow path 9 comprises a sound reducing section 13 arranged downstream of the fan 7. As can be seen in Fig. 1, the sound reducing section 13 extends from the fan 7 in an extension direction d. According to the illustrated embodiments, the sound reducing section 13 is substantially concentric to the fan axis ax. According to further embodiments, the angle α_1 between the extension direction d of the sound reducing section 13 and the fan axis ax may be less than 45 degrees, or less than 25 degrees, or less than 10 degrees, or around 0 degrees. Due to these features, as is further explained herein, the

noise generated by the fan 7 and the electric motor 27 is attenuated in an efficient manner. Moreover, as is further explained herein, conditions are provided for a user-friendly vacuum cleaner 1 having a balanced weight distribution. The feature that the sound reducing section 13 is substantially concentric to the fan axis ax, as mentioned herein, may encompass that a distance between the fan axis ax and the sound reducing section 13 is less than 5 cm along the extent of the sound reducing section 13. Moreover, the feature that the sound reducing section 13 is substantially concentric to the fan axis ax may encompass that the angle between the fan axis ax and the extent of the sound reducing section 13 is less than 10 degrees.

[0050] According to the illustrated embodiments, the length L1 of the sound reducing section 13 is approximately 53.5% of the distance L2 between the air inlet 3 and the air outlet 5 of the vacuum cleaner 1. According to further embodiments, the length L1 of the sound reducing section 13 may be at least 10%, at least 20%, or at least 30%, of the distance L2 between the air inlet 3 and the air outlet 5 of the vacuum cleaner 1. According to some embodiments, the length L1 of the sound reducing section 13 is greater than 5 cm, or greater than 7 cm.

Thereby, the noise generated by the fan 7 and the electric motor 27 can be attenuated in an efficient manner while allowing a low flow resistance of air flowing through the sound reducing section 13. Moreover, as is further explained herein, conditions are provided for a user-friendly vacuum cleaner 1 having a balanced weight distribution.

[0051] The sound reducing section 13 comprises a first portion 21 and a second portion 22 downstream of the first portion 21. Moreover, the sound reducing section 13 comprises a narrowing portion 21' between the first and second portions 21, 22. Furthermore, the sound reducing section 13 comprises a third portion 23 downstream of the second portion 22. According to the illustrated embodiments, the sound reducing section 13, and the portions 21, 21', 22, 23 thereof is formed by inner surfaces of the housing 6 of the vacuum cleaner 1. The housing 6 may be provided in a polymeric material.

[0052] As can be seen in Fig. 1, the cross sectional area A2 of the second portion 22 is smaller than the cross sectional area A1 of the first portion 21. According to the illustrated embodiments, the cross sectional area A1 of the first portion 21 is approximately 9 045 mm² and the cross sectional area A2 of the second portion 22 is approximately 910 mm². According to further embodiments, the cross sectional area A1 of the first portion 21 may be within the range of 8 000 - 12 000 mm², and the cross sectional area A2 of the second portion 22 may be within the range of 700 - 1500 mm². According to some embodiments, the cross sectional area A2 of the second portion 22 may be at least 30% smaller than the cross sectional area A1 of the first portion 21.

[0053] Moreover, as can be seen in Fig. 1, the cross sectional area A3 of the third portion 23 is greater than the cross sectional area A2 of the second portion 22.

According to the illustrated embodiments, the cross sectional area A3 of the third portion 23 is approximately 6 901 mm². According to further embodiments, the cross sectional area A3 of the third portion 23 may be within the range of 4 500 - 9 000 mm². According to some embodiments, the cross sectional area A3 of the third portion 23 may be at least 30 % greater than the cross sectional area A2 of the second portion 22.

[0054] According to the illustrated embodiments, the motor 27 is arranged in the first portion 21 of the sound reducing section 13. Moreover, the vacuum cleaner 1 comprises a battery 29 configured to provide electricity to the motor 27. As can be seen in Fig. 1, the battery 29 is arranged in the third portion 23 of the sound reducing section 13. The vacuum cleaner 1 comprises electrical wires 28 for transferring electricity between the battery 29 and the motor 27. The electrical wires 28 extends through the second portion 22 of the sound reducing section 13.

[0055] Fig. 2 illustrates a second cross section of the vacuum cleaner 1 illustrated in Fig. 1 with some components removed to provide a better view of the sound reducing section 13 and the features thereof. As indicated in Fig. 2, the sound reducing section 13 comprises a set of blades 15 protruding into the sound reducing section 13. The blades 15 are configured to counteract vortex flow of air in the sound reducing section 13. According to the illustrated embodiments, the blades 15 of the set of blades 15 are arranged upstream of the second portion 22 and upstream of the narrowing portion 21'. According to further embodiments, the blades 15 of the set of blades 15 may be arranged in, or upstream of, the narrowing portion 21'. In this manner, vortex flow of air in the second portion 22 of the sound reducing section 13 is counteracted in an efficient manner.

[0056] Fig. 3 illustrates a third cross section of the vacuum cleaner 1 illustrated in Fig. 1 and Fig. 2. The third cross section of Fig. 3 is made in a plane perpendicular to the fan axis ax at the first portion 21 of the sound reducing section 13. As best seen in Fig. 3, each blade 15 of the set of blades 15 protrudes into the sound reducing section 13 in a direction parallel to the fan axis ax. In this manner, vortex flow of air is efficiently counteracted when the air is flowing from the first portion 21 into the second portion 22 via the narrowing portion 21'. Moreover, since each blade 15 of the set of blades 15 protrudes into the sound reducing section 13 in a direction parallel to the fan axis ax, a vacuum cleaner 1 is provided having conditions and characteristics suitable for being manufactured in a cost-efficient manner.

[0057] Fig. 4 illustrates a top view of a vacuum cleaner 1 according to the embodiments illustrated in Fig. 1 - Fig. 3. As seen in Fig. 4, the vacuum cleaner 1 comprises an activation button 32 and a battery level indicator 34. Below, simultaneous reference is made to Fig. 1 - Fig. 4. As is indicated in Fig. 4, as well as in Fig. 1 and Fig. 2, outer surfaces 25 of the second portion 22 of the sound reducing section 13 form a handle for a user of the hand-

held vacuum cleaner 1. According to the illustrated embodiments, the length L3 of the second portion 22, measured in a direction d coinciding with the fan axis ax, is sufficient for accommodating at least four fingers of a hand of a user. According to some embodiments, the length L3 of the second portion 22, measured in a direction d coinciding with the fan axis ax, is more than 3 cm, or more than 5 cm.

[0058] Since the outer surfaces 25 of the second portion 22 form a handle for a user of the handheld vacuum cleaner 1, and since the battery 29 is arranged in the third portion 23 of the sound reducing section 13 and the motor 27 is arranged in the first portion 21 of the sound reducing section 13, a vacuum cleaner 1 is provided having a well-balanced weight distribution, which facilitates use of the vacuum cleaner 1.

[0059] As indicated in Fig. 1, Fig. 2, and Fig. 3, the third portion 23 comprises the air outlet 5. Moreover, according to the illustrated embodiments, the air outlet 5 comprises a shield 31. The shield 31 is configured to direct the air flowing through the air outlet 5 to directions d2 being angled relative to the fan axis ax, as indicated in Fig. 1 and Fig. 2. According to the illustrated embodiments, the shield 31 is configured to direct the air to substantially radial directions d2 relative to the fan axis ax. Due to these features, the noise generated by the vacuum cleaner 1 is further attenuated and the air flowing through the air outlet 5 will cause less disturbance to a user of the vacuum cleaner 1. Furthermore, as indicated in Fig. 4, according to the illustrated embodiments, the vacuum cleaner 1 comprises a section 36 blocking air from flowing towards the top side of the vacuum cleaner 1, wherein the top side of the vacuum cleaner 1 is the side that faces the forearm of the user when the user grips the handle of the vacuum cleaner 1 in an intended grip direction. Moreover, the top side of the vacuum cleaner 1 comprises the activation button 32 and the battery level indicator 34. Due to the section 36 blocking air from flowing towards the top side of the vacuum cleaner 1, the air flowing through the air outlet 5 will cause even less disturbance to a user of the vacuum cleaner 1.

[0060] As indicated in Fig. 2, the vacuum cleaner 1 may comprise at least one sound absorbing unit 33, 35 provided in a sound absorbing material arranged in the sound reducing section 13. According to the illustrated embodiments, the vacuum cleaner 1 comprises a sound absorbing unit 33 provided in a sound absorbing material arranged in the second portion 22 of the sound reducing section 13, and a sound absorbing unit 35 provided in a sound absorbing material arranged in the third portion 23 of the sound reducing section 13. The sound absorbing units 33, 35 may each be provided in an air permeable material, such as a foam material. The sound absorbing units 33, 35 may also be a surface coating on the inside of any of the first to third portions 21, 22, 23 of the sound reduction section 13. Due to the sound absorbing units 33, 35, the noise generated by the vacuum cleaner 1 is attenuated in a further efficient manner.

[0061] Fig. 5 illustrates a vacuum cleaner 2 according to some embodiments of the present disclosure. The vacuum cleaner 2 illustrated in Fig. 5 is a stick-type vacuum cleaner 2. The vacuum cleaner 2 comprises a shaft part 41 and a detachable handheld vacuum cleaner 1 according to the embodiments illustrated in Fig. 1 - Fig. 4. The shaft part 41 comprises a handle 43, two tube parts 45, a floor nozzle 47, and a holder 49 for the handheld vacuum cleaner 1 arranged between the two tube parts 45. In Fig. 5, the handheld vacuum cleaner 1 is attached to the holder 49 of the vacuum cleaner 2. When in this position, the air inlet of the handheld vacuum cleaner 1 is fluidly connected to the floor nozzle 47.

[0062] As seen in Fig. 5, the air outlet 5 of the handheld vacuum cleaner 1 is positioned between the two tube parts 45 when the handheld vacuum cleaner 1 is attached to the holder 49. In this manner, the air flowing through the air outlet 5 will cause less disturbance to a user of the vacuum cleaner 2 while allowing a low flow resistance of air flowing through the air outlet 5 of the handheld vacuum cleaner 1.

[0063] It is to be understood that the foregoing is illustrative of various example embodiments and that the invention is defined only by the appended claims. A person skilled in the art will realize that the example embodiments may be modified, and that different features of the example embodiments may be combined to create embodiments other than those described herein, without departing from the scope of the present invention, as defined by the appended claims.

[0064] As used herein, the term "comprising" or "comprises" is open-ended, and includes one or more stated features, elements, steps, components, or functions but does not preclude the presence or addition of one or more other features, elements, steps, components, functions, or groups thereof.

Claims

1. A handheld vacuum cleaner (1) comprising:

- an air inlet (3),
- an air outlet (5),
- a fan (7) configured to rotate around a fan axis (ax) to create an air flow through an air flow path (9) extending from the air inlet (3) to the air outlet (5), and
- a separation device (11) arranged in the air flow path (9), the separation device (11) being configured to separate dust from air flowing through the air flow path (9), wherein the air flow path (9) comprises a sound reducing section (13) extending from the fan (7) in an extension direction (d), and wherein the angle (α_1) between the extension direction (d) and the fan axis (ax) is less than 45 degrees characterized in that

the sound reducing section (13) comprises a first portion (21) and a second portion (22) downstream of the first portion (21), and wherein a cross sectional area (A_2) of the second portion (22) is smaller than the cross sectional area (A_1) of the first portion (21).

2. The vacuum cleaner (1) according to claim 1, wherein the length (L_1) of the sound reducing section (13) is greater than 5 cm.
3. The vacuum cleaner (1) according to claim 1 or 2, wherein the length (L_1) of the sound reducing section (13) is at least 20%, or at least 30%, of the distance (L_2) between the air inlet (3) and the air outlet (5) of the vacuum cleaner (1).
4. The vacuum cleaner (1) according to any one of the preceding claims, wherein the sound reducing section (13) comprises one or more blades (15) protruding into the sound reducing section (13) so as to counteract vortex flow of air in the sound reducing section (13).
5. The vacuum cleaner (1) according to claim 4, wherein each blade (15) of the one or more blades (15) protrudes in a direction parallel to the fan axis (ax).
6. The vacuum cleaner (1) according to claim 1, wherein the cross sectional area (A_2) of the second portion (22) is at least 30% smaller than the cross sectional area (A_1) of the first portion (21).
7. The vacuum cleaner (1) according to claim 4 or 5 and any one of the claims 1 and 6, wherein the one or more blades (15) is/are arranged upstream of the second portion (22).
8. The vacuum cleaner (1) according to any one of the claims 1 or 6 - 7, wherein the sound reducing section (13) comprises a narrowing portion (21') between the first and second portions (21, 22).
9. The vacuum cleaner (1) according to claim 8 and any one of the claims 4 and 5, wherein the one or more blades (15) is/are arranged in, or upstream of, the narrowing portion (21').
10. The vacuum cleaner (1) according to any one of the claims 1 or 6 - 9, wherein the sound reducing section (13) comprises a third portion (23) downstream of the second portion (22), and wherein the cross sectional area (A_3) of the third portion (23) is greater than the cross sectional area (A_2) of the second portion (22).
11. The vacuum cleaner (1) according to claim 10, wherein the cross sectional area (A_3) of the third

portion (23) is at least 30 % greater than the cross sectional area (A2) of the second portion (22).

12. The vacuum cleaner (1) according to any one of the claims 1 or 6 - 11, wherein the length (L3) of the second portion (22), measured in a direction (d) coinciding with the fan axis (ax), is more than 3 cm, or more than 5 cm. 5
13. The vacuum cleaner (1) according to any one of the claims 1 or 6 - 12, wherein outer surfaces (25) of the second portion (22) form a handle for a user of the handheld vacuum cleaner (1). 10
14. The vacuum cleaner (1) according to any one of the claims 1 or 6 - 13, wherein the vacuum cleaner (1) comprises a motor (27) configured to rotate the fan (7) around the fan axis (ax), and wherein the motor (27) is arranged in the first portion (21). 15
15. The vacuum cleaner (1) according to claim 14 and any one of the claims 10 and 11, wherein the vacuum cleaner (1) comprises a battery (29) configured to provide electricity to the motor (27), and wherein the battery (29) is arranged in the third portion (23). 20
16. The vacuum cleaner (1) according to claim 10, 11 or 15, wherein the third portion (23) comprises the air outlet (5). 25
17. The vacuum cleaner (1) according to any one of the preceding claims, wherein the vacuum cleaner (1) comprises at least one sound absorbing unit (33, 35) provided in a sound absorbing material arranged in the sound reducing section (13), preferably an air permeable sound absorbing material or a sound absorbing surface coating. 30
18. A vacuum cleaner (2) comprising a shaft part (41) and a detachable handheld vacuum cleaner (1) according to any of preceding claims, wherein the shaft part (41) comprises a handle (43), two tube parts (45), a floor nozzle (47), and a holder (49) for the handheld vacuum cleaner (1) arranged between the two tube parts (45). 35

Patentansprüche

1. Tragbarer Staubsauger (1), umfassend: 40
 - einen Lufteinlass (3),
 - einen Luftauslass (5),
 - ein Gebläse (7), das dazu ausgelegt ist, sich um eine Gebläseachse (ax) zu drehen, um einen Luftstrom durch einen Luftströmungsweg (9) zu erzeugen, der sich vom Lufteinlass (3) zum Luftauslass (5) erstreckt, und 45

- eine Trennvorrichtung (11), die im Luftströmungsweg (9) angeordnet ist, wobei die Trennvorrichtung (11) dazu ausgelegt ist, Staub von der durch den Luftströmungsweg (9) strömenden Luft zu trennen, wobei der Luftströmungsweg (9) einen schallreduzierenden Abschnitt (13) umfasst, der sich vom Gebläse (7) in einer Erstreckungsrichtung (d) erstreckt, und wobei der Winkel (a1) zwischen der Erstreckungsrichtung (d) und der Gebläseachse (ax) weniger als 45 Grad beträgt, **dadurch gekennzeichnet, dass** der schallreduzierende Abschnitt (13) einen ersten Teilbereich (21) und einen zweiten Teilbereich (22) stromabwärts des ersten Teilbereichs (21) umfasst, und wobei eine Querschnittsfläche (A2) des zweiten Teilbereichs (22) kleiner als die Querschnittsfläche (A1) des ersten Teilbereichs (21) ist.

2. Staubsauger (1) nach Anspruch 1, wobei die Länge (L1) des schallreduzierenden Abschnitts (13) größer als 5 cm ist. 20
3. Staubsauger (1) nach Anspruch 1 oder 2, wobei die Länge (L1) des schallreduzierenden Abschnitts (13) mindestens 20 % oder mindestens 30 % des Abstands (L2) zwischen dem Lufteinlass (3) und dem Luftauslass (5) des Staubsaugers (1) beträgt. 25
4. Staubsauger (1) nach einem der vorhergehenden Ansprüche, wobei der schallreduzierende Abschnitt (13) eine oder mehrere Leitschaufeln (15) umfasst, die in den schallreduzierenden Abschnitt (13) hineinragen, um einer Wirbelströmung der Luft im schallreduzierenden Abschnitt (13) entgegenzuwirken. 30
5. Staubsauger (1) nach Anspruch 4, wobei jede Leitschaufel (15) der einen oder der mehreren Leitschaufeln (15) in einer Richtung parallel zur Gebläseachse (ax) hervorsteht. 35
6. Staubsauger (1) nach Anspruch 1, wobei die Querschnittsfläche (A2) des zweiten Teilbereichs (22) mindestens 30 % kleiner als die Querschnittsfläche (A1) des ersten Teilbereichs (21) ist. 40
7. Staubsauger (1) nach Anspruch 4 oder 5 und einem der Ansprüche 1 und 6, wobei die eine oder die mehreren Leitschaufeln (15) stromaufwärts des zweiten Teilbereichs (22) angeordnet ist/sind. 45
8. Staubsauger (1) nach einem der Ansprüche 1 oder 6 - 7, wobei der schallreduzierende Abschnitt (13) einen sich verengenden Teilbereich (21') zwischen dem ersten und dem zweiten Teilbereich (21, 22) umfasst. 50

9. Staubsauger (1) nach Anspruch 8 und einem der Ansprüche 4 und 5, wobei die eine oder die mehreren Leitschaukeln (15) in dem sich verengenden Teilbereich (21') oder stromaufwärts davon angeordnet ist/sind. 5
10. Staubsauger (1) nach einem der Ansprüche 1 oder 6 - 9, wobei der schallreduzierende Abschnitt (13) einen dritten Teilbereich (23) stromabwärts des zweiten Teilbereichs (22) umfasst und wobei die Querschnittsfläche (A3) des dritten Teilbereichs (23) größer als die Querschnittsfläche (A2) des zweiten Teilbereichs (22) ist.
11. Staubsauger (1) nach Anspruch 10, wobei die Querschnittsfläche (A3) des dritten Teilbereichs (23) mindestens 30 % größer als die Querschnittsfläche (A2) des zweiten Teilbereichs (22) ist. 15
12. Staubsauger (1) nach einem der Ansprüche 1 oder 6 - 11, wobei die Länge (L3) des zweiten Teilbereichs (22), gemessen in einer Richtung (d), die mit der Gebläseachse (ax) zusammenfällt, mehr als 3 cm oder mehr als 5 cm beträgt. 20
13. Staubsauger (1) nach einem der Ansprüche 1 oder 6 - 12, wobei Außenflächen (25) des zweiten Teilbereichs (22) einen Griff für einen Benutzer des tragbaren Staubsaugers (1) bilden. 25
14. Staubsauger (1) nach einem der Ansprüche 1 oder 6 - 13, wobei der Staubsauger (1) einen Motor (27) umfasst, der dazu ausgelegt ist, das Gebläse (7) um die Gebläseachse (ax) zu drehen, und wobei der Motor (27) im ersten Teilbereich (21) angeordnet ist. 30
15. Staubsauger (1) nach Anspruch 14 und einem der Ansprüche 10 und 11, wobei der Staubsauger (1) eine Batterie (29) umfasst, die dazu ausgelegt ist, den Motor (27) mit Strom zu versorgen, und wobei die Batterie (29) im dritten Teilbereich (23) angeordnet ist. 35
16. Staubsauger (1) nach Anspruch 10, 11 oder 15, wobei der dritte Teilbereich (23) den Luftauslass (5) umfasst. 40
17. Staubsauger (1) nach einem der vorhergehenden Ansprüche, wobei der Staubsauger (1) mindestens eine Schallabsorptionseinheit (33, 35) umfasst, die aus einem schallabsorbierenden Material, vorzugsweise einem luftdurchlässigen schallabsorbierenden Material oder einer schallabsorbierenden Oberflächenbeschichtung, besteht und im schallreduzierenden Abschnitt (13) angeordnet ist. 50
18. Staubsauger (2), umfassend einen Schaftteil (41) und einen abnehmbaren tragbaren Staubsauger (1) 55

nach einem der vorhergehenden Ansprüche, wobei der Schaftteil (41) einen Griff (43), zwei Rohrteile (45), eine Fußbodendüse (47) und eine Halterung (49) für den tragbaren Staubsauger (1) umfasst, die zwischen den zwei Rohrteilen (45) angeordnet ist.

Revendications

1. Aspirateur à main (1), comprenant : 10
- une entrée d'air (3),
 - une sortie d'air (5),
 - un ventilateur (7) configuré pour entrer en rotation autour d'un axe de ventilateur (ax) pour créer un écoulement d'air à travers un chemin d'écoulement d'air (9) s'étendant depuis l'entrée d'air (3) jusqu'à la sortie d'air (5), et
 - un dispositif de séparation (11) agencé dans le chemin d'écoulement d'air (9), le dispositif de séparation (11) étant configuré pour séparer de la poussière de l'air s'écoulant à travers le chemin d'écoulement d'air (9), 20
- dans lequel le chemin d'écoulement d'air (9) comprend un section d'atténuation acoustique (13) s'étendant depuis le ventilateur (7) dans une direction d'extension (d), et dans lequel l'angle (a1) entre la direction d'extension (d) et l'axe de ventilateur (ax) est inférieur à 45 degrés, 25
- caractérisé en ce que**
- la section d'atténuation acoustique (13) comprend une première portion (21) et une deuxième portion (22) en aval de la première portion (21), et dans lequel une superficie de section transversale (A2) de la deuxième portion (22) est inférieur à la superficie de section transversale (A1) de la première portion (21). 30
2. Aspirateur (1) selon la revendication 1, dans lequel la longueur (L1) de la section d'atténuation acoustique (13) est supérieure à 5 cm. 35
3. Aspirateur (1) selon la revendication 1 ou 2, dans lequel la longueur (L1) de la section d'atténuation acoustique (13) est au moins 20 %, ou au moins 30 %, de la distance (L2) entre l'entrée d'air (3) et la sortie d'air (5) de l'aspirateur (1). 40
4. Aspirateur (1) selon l'une quelconque des revendications précédentes, dans lequel la section d'atténuation acoustique (13) comprend une ou plusieurs lames (15) faisant saillie dans la section d'atténuation acoustique (13) afin de contrer un écoulement en tourbillon d'air dans la section d'atténuation acoustique (13). 50
5. Aspirateur (1) selon la revendication 4, dans lequel chaque lame (15) de l'une ou des plusieurs lames 55

- (15) fait saillie dans une direction parallèle à l'axe de ventilateur (ax).
6. Aspirateur (1) selon la revendication 1, dans lequel la superficie de section transversale (A2) de la deuxième portion (22) est inférieure d'au moins 30 % à la superficie de section transversale (A1) de la première portion (21). 5
 7. Aspirateur (1) selon la revendication 4 ou 5 et l'une quelconque des revendications 1 et 6, dans lequel l'une ou les plusieurs lames (15) est/sont agencée(s) en amont de la deuxième portion (22). 10
 8. Aspirateur (1) selon l'une quelconque des revendications 1 ou 6 à 7, dans lequel la section d'atténuation acoustique (13) comprend une portion de rétrécissement (21') entre les première et deuxième portions (21, 22). 15
20
 9. Aspirateur (1) selon la revendication 8 et l'une quelconque des revendications 4 et 5, dans lequel l'une ou les plusieurs lames (15) est/sont agencée(s) dans la portion de rétrécissement (21'), ou en amont de celle-ci. 25
 10. Aspirateur (1) selon l'une quelconque des revendications 1 ou 6 à 9, dans lequel la section d'atténuation acoustique (13) comprend une troisième portion (23) en aval de la deuxième portion (22), et dans lequel la superficie de section transversale (A3) de la troisième portion (23) est supérieure à la superficie de section transversale (A2) de la deuxième portion (22). 30
35
 11. Aspirateur (1) selon la revendication 10, dans lequel la superficie de section transversale (A3) de la troisième portion (23) est supérieure d'au moins 30 % à la superficie de section transversale (A2) de la deuxième portion (22). 40
 12. Aspirateur (1) selon l'une quelconque des revendications 1 ou 6 à 11, dans lequel la longueur (L3) de la deuxième portion (22), mesurée dans une direction (d) coïncidant avec l'axe de ventilateur (ax), est supérieure à 3 cm, ou supérieure à 5 cm. 45
 13. Aspirateur (1) selon l'une quelconque des revendications 1 ou 6 à 12, dans lequel des surfaces extérieures (25) de la deuxième portion (22) forment une poignée pour un utilisateur de l'aspirateur à main (1). 50
 14. Aspirateur (1) selon l'une quelconque des revendications 1 ou 6 à 13, dans lequel l'aspirateur (1) comprend un moteur (27) configuré pour mettre en rotation le ventilateur (7) autour de l'axe de ventilateur (ax), et dans lequel le moteur (27) est agencé dans la première portion (21). 55
 15. Aspirateur (1) selon la revendication 14 et l'une quelconque des revendications 10 et 11, dans lequel l'aspirateur (1) comprend une batterie (29) configurée pour fournir de l'électricité au moteur (27), et dans lequel la batterie (29) est agencée dans la troisième portion (23).
 16. Aspirateur (1) selon la revendication 10, 11 ou 15, dans lequel la troisième portion (23) comprend la sortie d'air (5).
 17. Aspirateur (1) selon l'une quelconque des revendications précédentes, dans lequel l'aspirateur (1) comprend au moins une unité absorbante acoustique (33, 35) prévue en un matériau absorbant acoustique agencé dans la section d'atténuation acoustique (13), de préférence un matériau absorbant acoustique perméable à l'air ou un revêtement de surface absorbant acoustique.
 18. Aspirateur (2) comprenant une partie manche (41) et un aspirateur détachable à main (1) selon de quelques revendications précédentes, dans lequel la partie manche (41) comprend une poignée (43), deux parties tubulaires (45), un suceur de sol (47), et un organe de retenue (49) pour l'aspirateur à main (1) agencé entre les deux parties tubulaires (45).

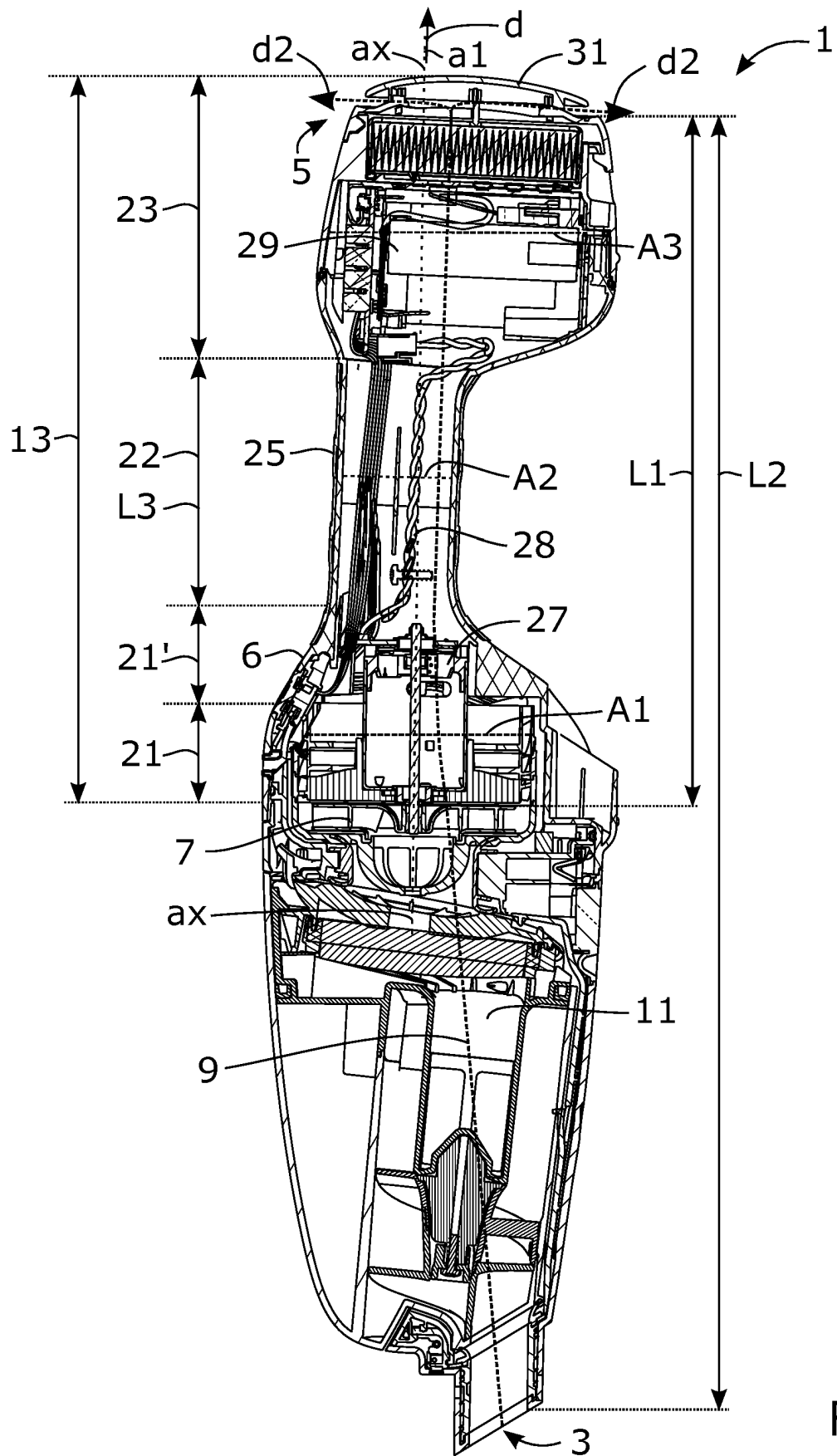
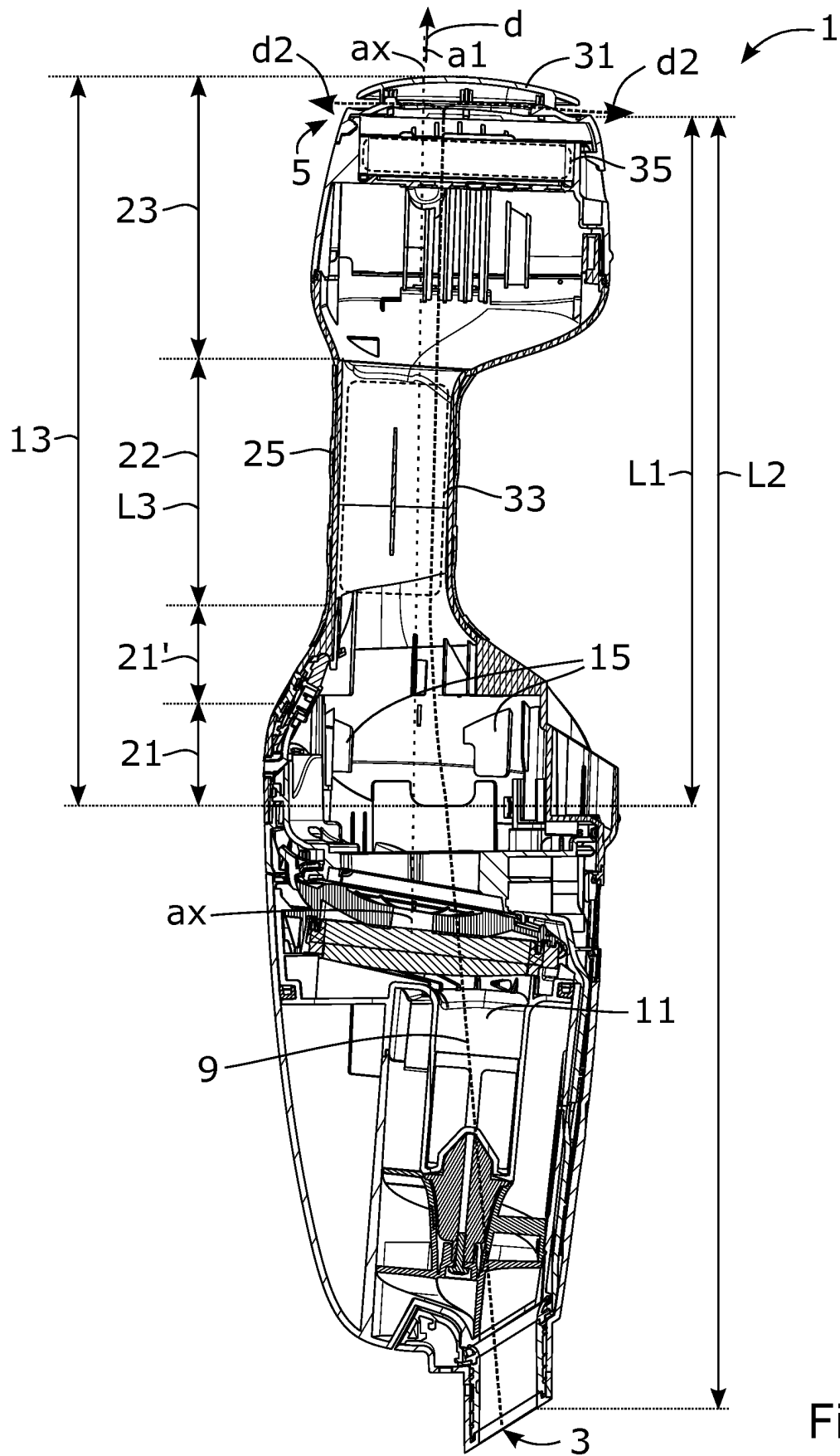
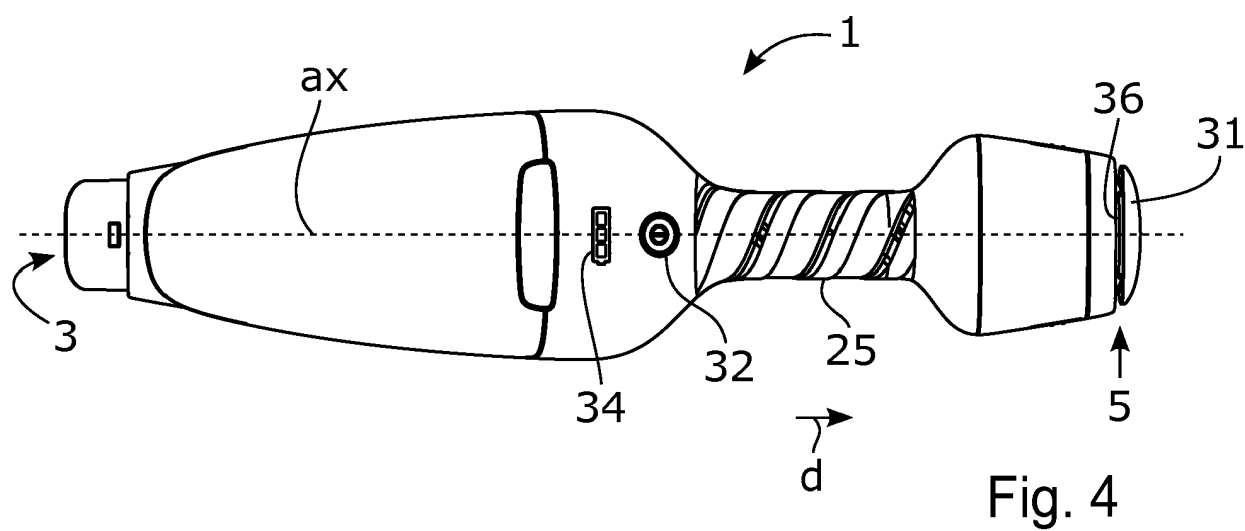
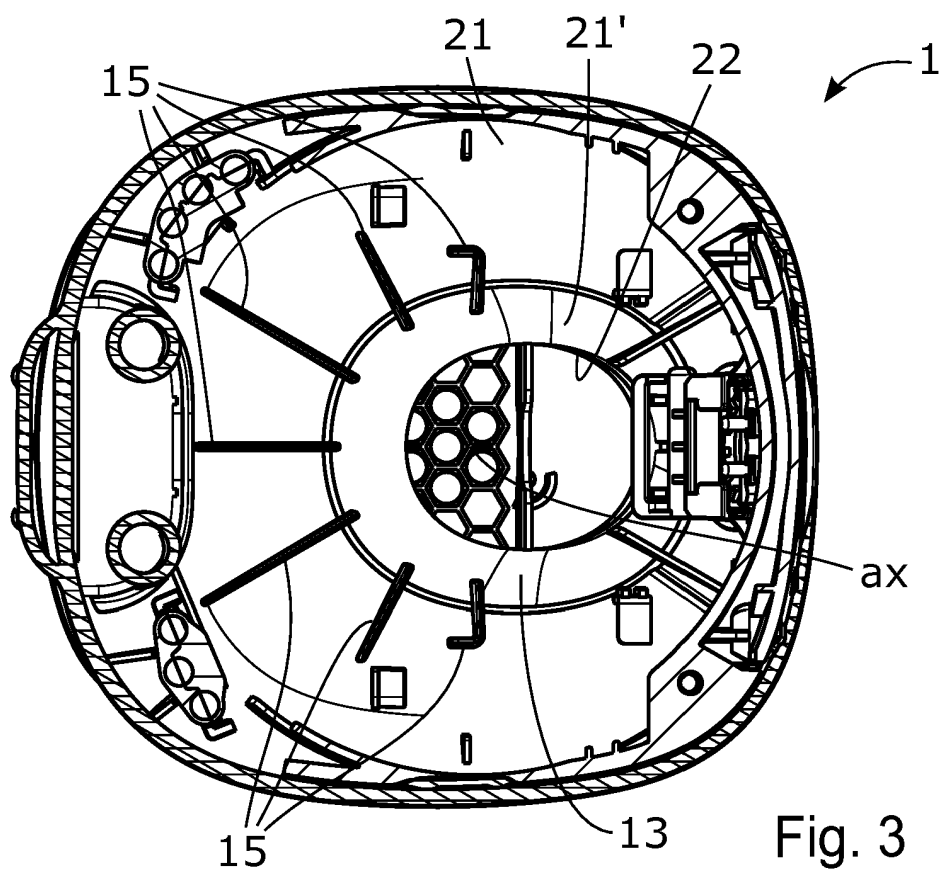


Fig. 1





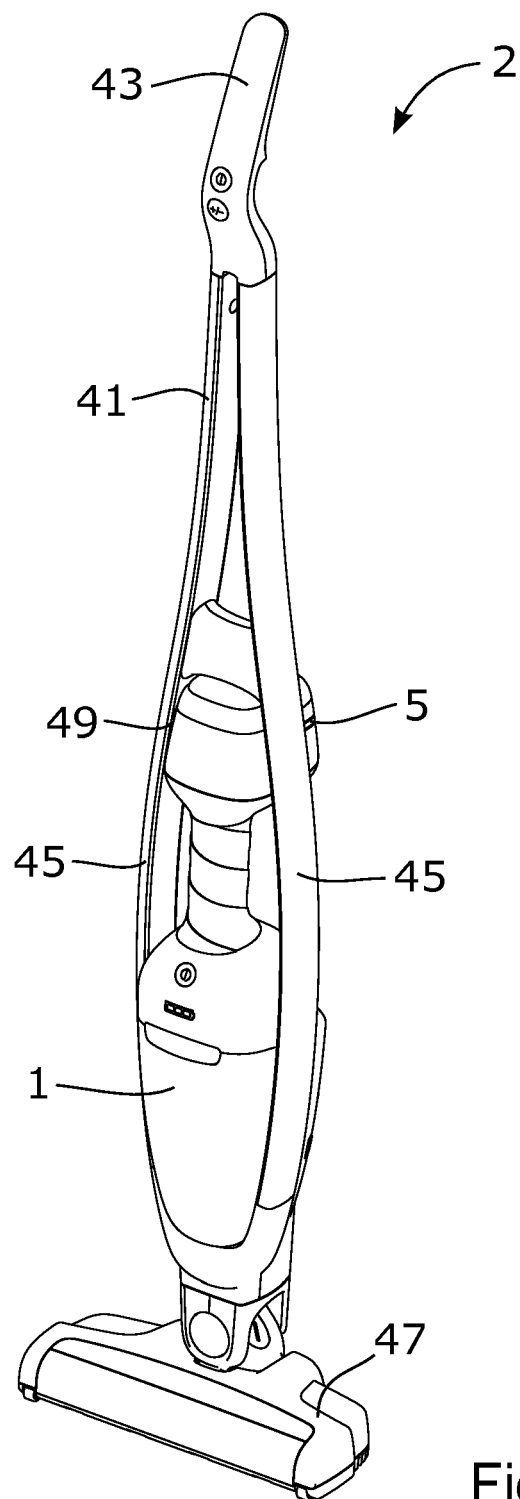


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2014056686 A1 **[0006]**
- WO 2018065069 A1 **[0007]**
- GB 2468299 A **[0008]**
- CN 108903792 A **[0009]**
- KR 20070032443 A **[0010]**
- WO 2017092832 A1 **[0011]**