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KG, Winnenden (DE)(21) Appl. No.: **12/322,067**(22) Filed: **Jan. 27, 2009****Related U.S. Application Data**(63) Continuation of application No. PCT/EP2006/
007543, filed on Jul. 29, 2006.(57) **ABSTRACT**

The invention relates to a vacuum cleaner with an electronic control unit and a dirt collecting container, which has a suction inlet and is in flow connection with a suction unit via a suction extraction line, the suction unit being connected to at least one air outlet via at least one air duct. To develop the vacuum cleaner in such a way that, in a structurally simple manner, the production of noise can be kept low and heat-sensitive components can be protected from being damaged, it is proposed according to the invention that at least one air duct is sealed off by means of a sound-insulating sealing mat which is produced from a flame-retardant material and covers the electrical control unit.

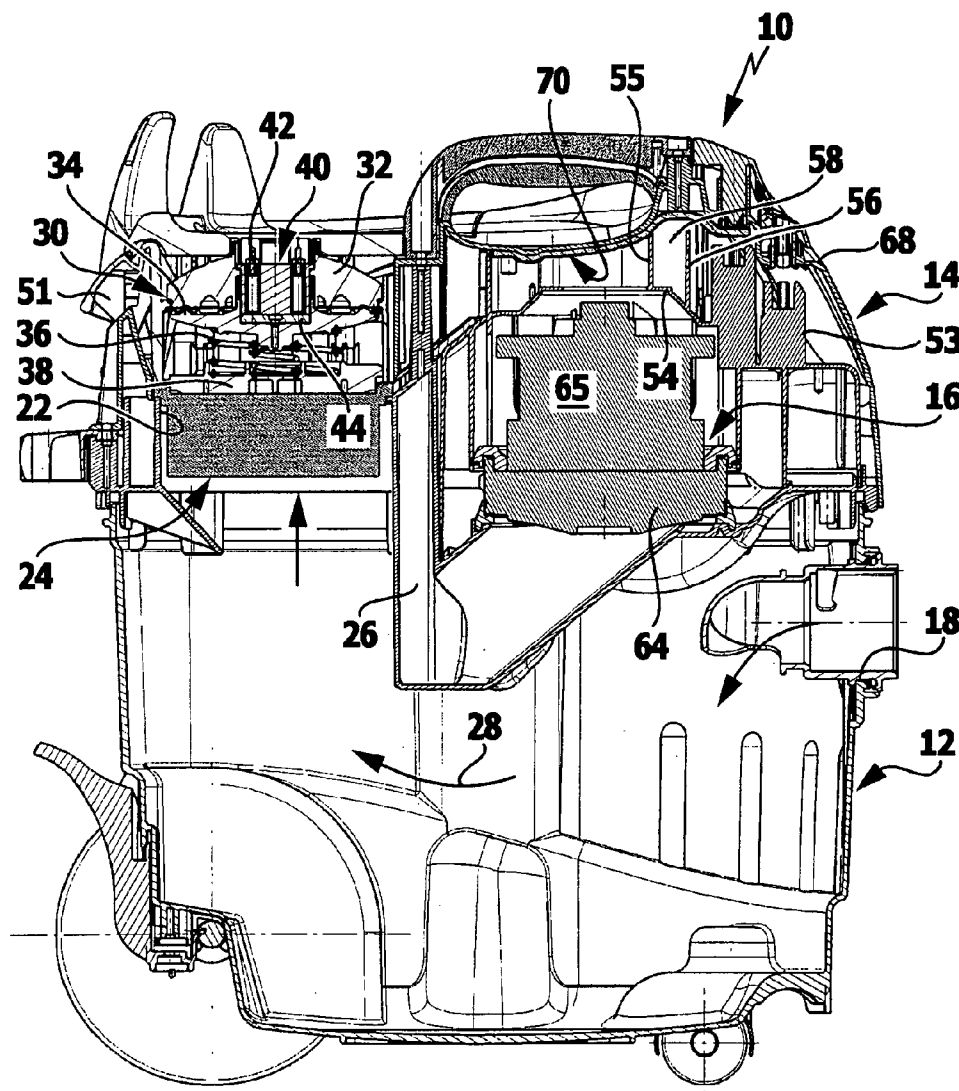


FIG.1

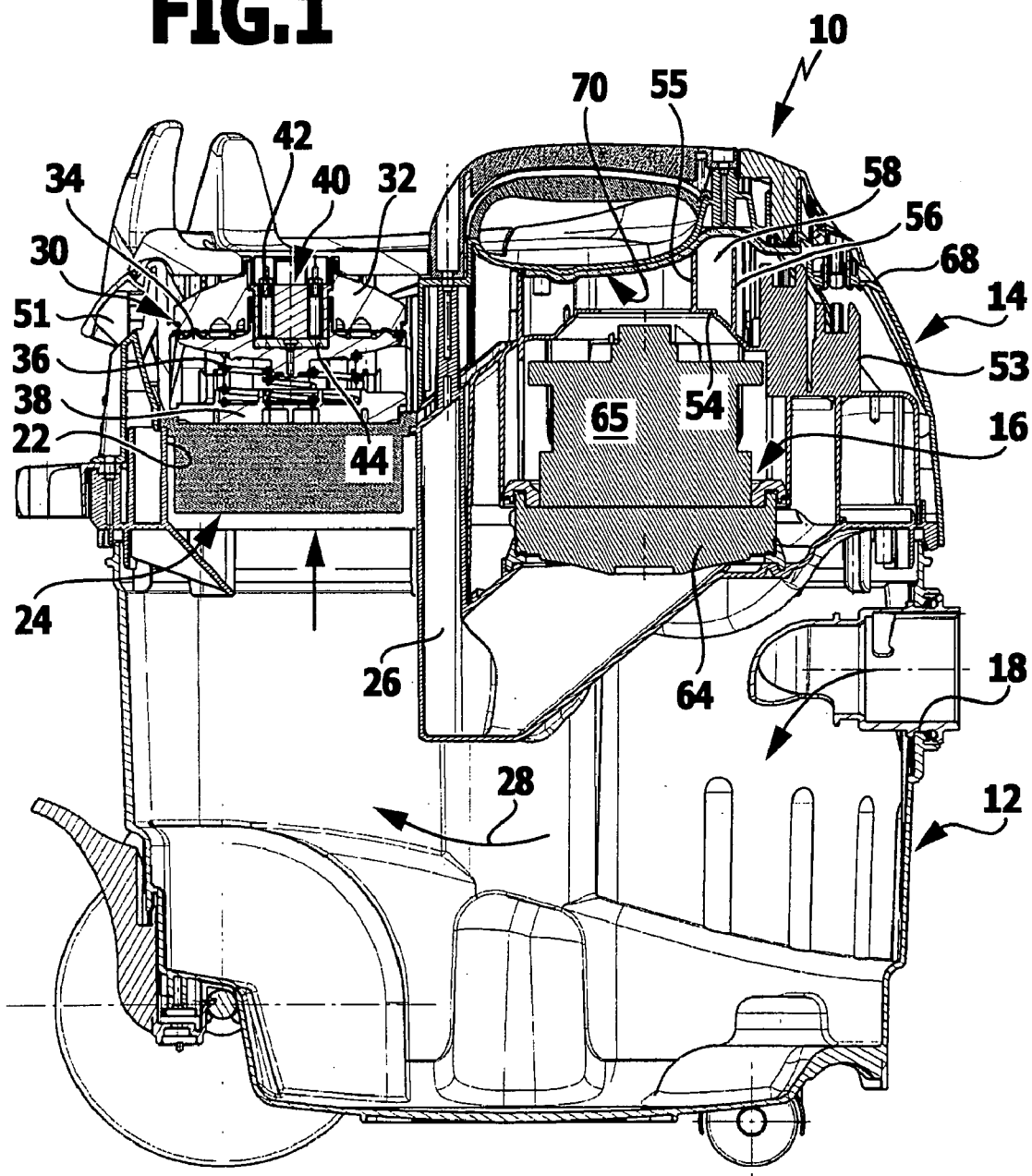


FIG. 2

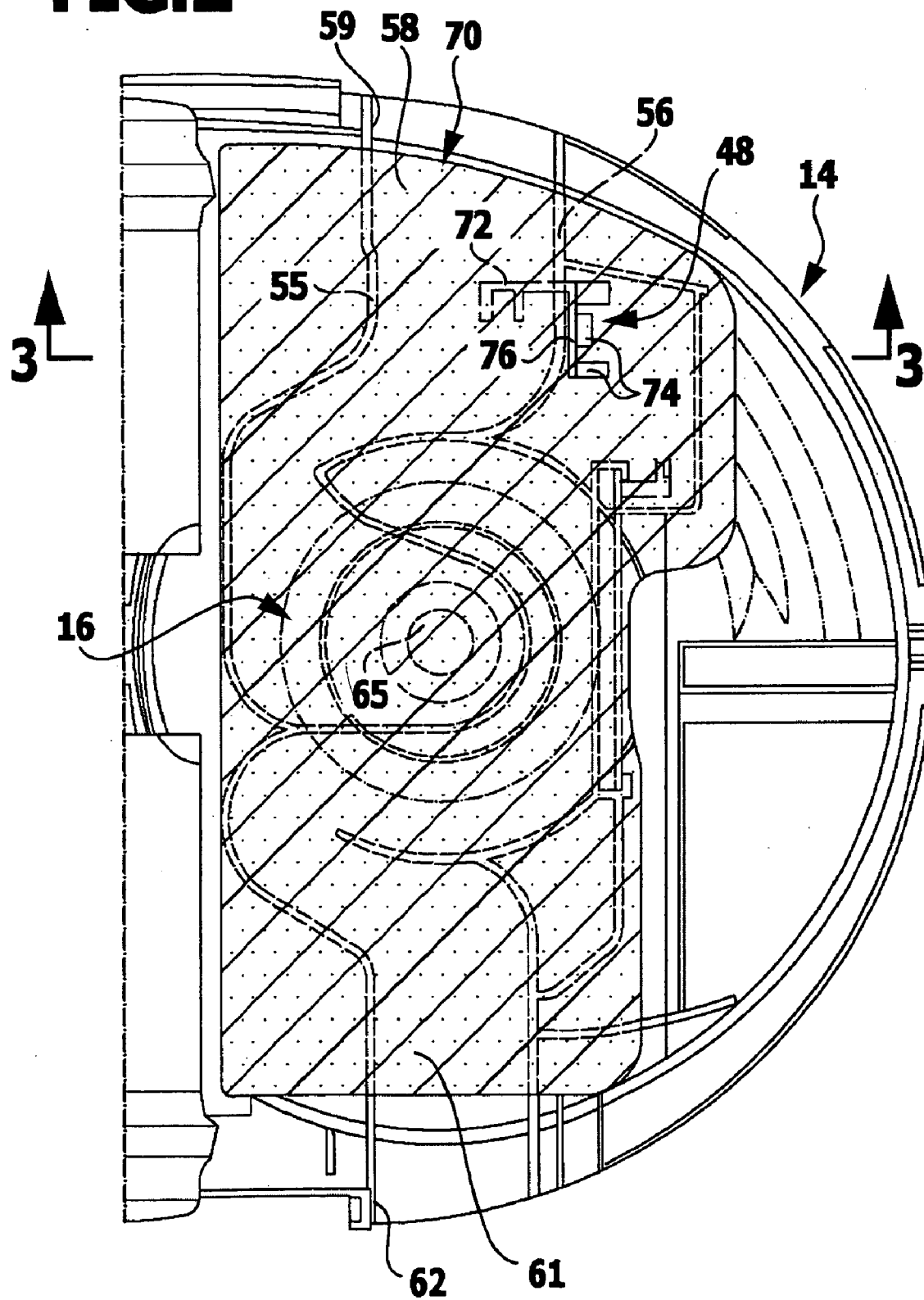
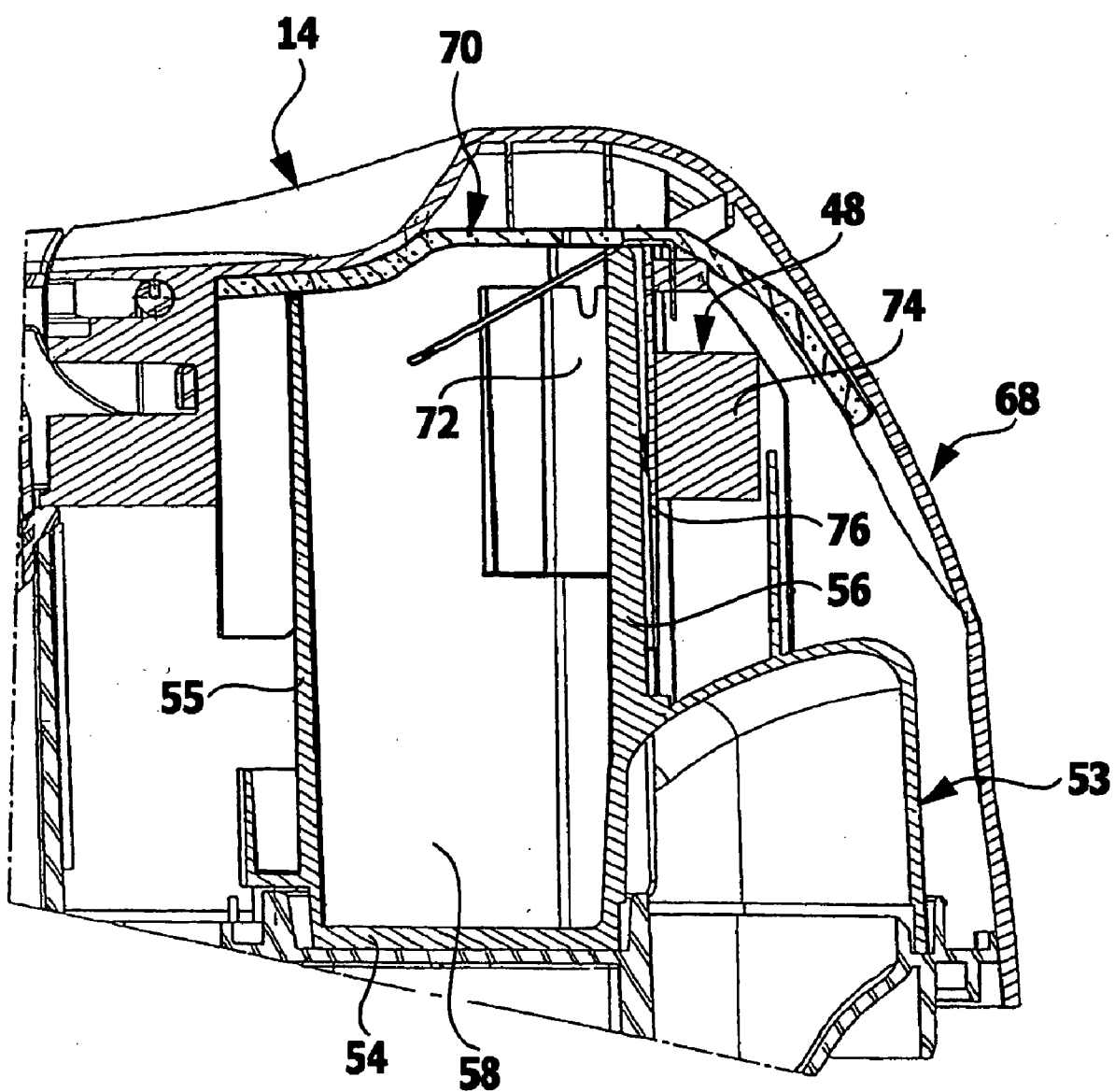


FIG.3



VACUUM CLEANER

[0001] This application is a continuation of international application number PCT/EP2006/007543 filed on Jul. 29, 2006.

[0002] The present disclosure relates to the subject matter disclosed in international application number PCT/EP2006/007543 of Jul. 29, 2006, which is incorporated herein by reference in its entirety and for all purposes.

BACKGROUND OF THE INVENTION

[0003] The invention relates to a vacuum cleaner with a control unit and a dirt collecting container, which has a suction inlet and is in flow connection with a suction unit via a suction extraction line, the suction unit being connected to at least one air outlet via at least one air duct.

[0004] By means of such vacuum cleaners, dirt and preferably also liquid can be sucked up using the suction unit to apply negative pressure to the dirt collecting container, so that a suction flow forms from the suction inlet through the dirt collecting container via the suction extraction line to the suction unit. The air sucked in can be conducted from the suction unit via an air duct to an air outlet of the vacuum cleaner.

[0005] An electronic control unit is used to control the vacuum cleaner and in many cases has heat-emitting power semiconductors and/or electromechanical relays.

[0006] Operation of the suction unit involves the production of a certain amount of noise, which is to be kept as low as possible, and use of the electronic control unit involves the production of a certain amount of heat, which is likewise to be kept low, and in the event of excessive heat being produced it is to be ensured that heat-sensitive components of the vacuum cleaner are not damaged.

[0007] It is an object of the present invention to develop a vacuum cleaner of the generic type in such a way that, in a structurally simple manner, the production of noise can be kept low and heat-sensitive components can be protected from being damaged.

SUMMARY OF THE INVENTION

[0008] This object is achieved according to the invention in the case of a vacuum cleaner of the type mentioned at the beginning by at least one air duct being sealed off by means of a sound-insulating sealing mat which is produced from a flame-retardant material and covers the electrical control unit.

[0009] The invention includes the idea that the production of noise by the vacuum cleaner can be kept low by using a sound-insulating sealing mat to seal off at least one air duct leading from the suction unit. The sealing mat not only makes it possible to make the air duct flow-tight, and for example to compensate for tolerances in the production of the air duct, but it also provides protection against fire in the event that the electronic control unit heats up to a high temperature. For this purpose, the sealing mat covers the electronic control unit and is produced from a flame-retardant material.

[0010] The sealing mat consequently assumes a number of functions. It forms sound insulation, so that the production of noise by the vacuum cleaner is reduced. It also makes it possible for the air duct to be provided with a flow-tight seal while allowing compensation for production tolerances of the air duct. In addition, the sealing mat provides protection

against fire, ensuring that the vacuum cleaner does not easily catch fire if the electronic control unit heats up to a high temperature. The sealing mat can be fitted in a simple manner, so that the vacuum cleaner according to the invention can be configured in a structurally simple manner in such a way that it produces relatively little noise and has reliable fire protection.

[0011] The sealing mat is preferably elastically deformable. This provides the possibility of compressing the sealing mat while it is being fitted, after which it tries to resume its original shape, and thereby comes to lie against mutually adjacent walls and edges of the vacuum cleaner with a flow-tight effect.

[0012] It is advantageous if the sealing mat is produced from a foamed thermosetting material. Thermosets are crosslinked plastics that do not melt even at relatively high temperature. According to the invention, the sealing mat covers the electronic control unit, so that, on account of the flame-retardant property of the sealing mat, reliable fire protection is ensured in the event of the electronic control unit heating up to a high temperature.

[0013] In the case of a preferred embodiment, the sealing mat is produced from a foamed thermosetting material from the group of aminoplastics. Alternatively, foamed thermosets based on PU material (polyurethane material) could also be used.

[0014] To achieve particularly effective fire protection, it is advantageous if the sealing mat has a thermal conductivity of less than 0.04 W/mK, in particular less than 0.035 W/mK. The thermal conductivity is measured at a temperature of 10° C. and is determined in accordance with DIN standard 52612. It has been found that in the event of the electronic control unit heating up to a high temperature, a sealing mat with such a thermal conductivity value is particularly suitable for protecting the other components of the vacuum cleaner from being damaged.

[0015] In the case of a preferred configuration, the vacuum cleaner has a housing part with a hood which covers a separating wall part, the separating wall part having a base from which two separating walls protrude with a spacing in between, defining an air duct between them, and the sealing mat being disposed between the hood and the separating walls. In the region of the air duct, the separating wall part may have a U-shaped profile, which is formed by the base and the two separating walls and is covered by the hood with the sealing mat lying in between. During the assembly of the vacuum cleaner, the hood can be clipped onto the separating wall part or screwed to it. The sealing mat disposed between the hood and the separating wall part can compensate for production tolerances that occur. The sealing mat forms a flow-tight seal for the air duct, extending not only over the air duct but also additionally over the electronic control unit of the vacuum cleaner.

[0016] The electronic control unit is preferably disposed laterally alongside one of the separating walls, outside the air duct. It may comprise at least one printed circuit board, on which electrical components are disposed. The printed circuit board may be fixed to the separating wall.

[0017] It is of particular advantage if the electronic control unit is connected to at least one cooling element, for example a cooling plate, which protrudes into the air duct. For this purpose, the separating wall on the outer side of which the electronic control unit is disposed may have an opening, through which the cooling element reaches.

[0018] It is particularly advantageous if the suction unit is covered by the sealing mat. In the case of such an embodiment, the sealing mat extends not only over the air duct and the electronic control unit but also covers the suction unit. This makes it possible to keep the production of noise by the vacuum cleaner particularly low. It is advantageous if the suction unit is disposed in an upper part of the vacuum cleaner that can be mounted on the dirt collecting container.

[0019] The suction unit advantageously comprises an electric motor, which is cooled by external air and is connected via a first air duct to a cooling air outlet, and comprises a suction turbine, which is driven by the electric motor and is connected via a second air duct to a suction air outlet, the sealing mat sealing off the first and second air ducts. The suction turbine, made to rotate by the electric motor, can be used to achieve a suction flow from the suction inlet through the dirt collecting container and the suction extraction line to the suction unit. The air sucked in can be discharged to the suction air outlet of the vacuum cleaner via the second air duct. To cool the electric motor, cooling air is fed to it independently of the suction air, and this cooling air can be discharged to the surroundings via the first air duct and the cooling air outlet. As a result, the suction unit can have a considerable suction capacity. Since the sound-insulating sealing mat seals the first and second air ducts and covers the air ducts, preferably completely, the flow of the cooling air and the suction air can be optimized with regard to lowest possible production of noise by the vacuum cleaner.

[0020] It is advantageous if the electronic control unit is electrically connected to at least one electromagnetic closing valve, which closes an external air inlet, it being possible for the side of a filter disposed in the flow path between the dirt collecting container and the suction unit that is oriented away from the dirt collecting container to be impinged upon by external air via the external air inlet in an impulsive manner for cleaning purposes. Such a configuration makes filter back-flushing possible, in order to dislodge dirt particles deposited on the side of the at least one filter that is oriented toward the dirt collecting container during suction operation.

[0021] For cleaning, the side of the filter that is oriented away from the dirt collecting container can be impinged upon by external air by the electromagnetic closing valve being opened, so that external air can flow into the suction extraction line via the external air inlet. The filter cleaning is controlled by the electronic control unit, which therefore produces a not inconsiderable amount of heat. The risk of components of the vacuum cleaner being damaged during inadmissible overheating of the electronic control unit is kept low by the sealing mat that is used according to the invention.

[0022] In the case of a preferred embodiment, current can be applied by means of the control unit to an electromagnet for closing the closing valve, it being possible for the current supply to be interrupted in a time-controlled manner. During normal suction operation, an excitation current is applied to the electromagnet of the closing valve by the control unit, so that a magnetic field which keeps the closing valve in its closed position is formed. If filter cleaning is to be performed, the excitation current is interrupted by the control unit for a short time. This has the consequence that the magnetic field of the electromagnet breaks down and, as a result, the closing valve opens. External air can then abruptly impinge upon the side of the filter that is oriented away from the dirt collecting container and, as a result, the filter can be mechanically shaken. Furthermore, it can be flowed through by external air

in the direction of counterflow, that is to say counter to the suction flow prevailing during normal suction operation, in order to be effectively cleaned in this way. During normal suction operation, an excitation current is therefore permanently provided by the control unit. This may have the consequence that the control unit heats up considerably. Since, however, according to the invention the control unit is covered by the flame-retardant sealing mat of low thermal conductivity, there is virtually no risk of the production of heat by the control unit leading to any impairment of other parts of the vacuum cleaner.

[0023] The following description of a preferred embodiment of the invention serves for further explanation in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 shows a schematic sectional view of a vacuum cleaner according to the invention;

[0025] FIG. 2 shows a plan view of a detail of the vacuum cleaner with the hood removed; and

[0026] FIG. 3 shows a sectional view along the line 3-3 in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Schematically represented in the drawing is a vacuum cleaner 10, with a dirt collecting container 12, mounted on which is an upper part 14, which accommodates a suction unit 16. The dirt collecting container 12 has a suction inlet 18, to which a suction hose (not represented in the drawing) can be connected. At the free end of the suction hose, a suction nozzle may be connected. Alternatively, it may be provided that the suction hose is connected to a working tool, for example a drilling unit or a milling unit, so that dust produced during the operation of the working tool can be sucked away.

[0028] The upper part 14 forms a suction outlet 22 for the dirt collecting container 12. Held on the suction outlet 22 is a folded filter 24, which is followed by a suction extraction line in the form of a suction channel 26. By way of the suction channel 26, the folded filter 24 is flow-connected to the suction unit 16. The dirt collecting container 12 can be acted upon by negative pressure from the suction unit 16 via the suction channel 26 and the folded filter 24, so that there forms a suction flow, symbolized in FIG. 1 by the arrows 28, under the action of which dirt can be sucked into the dirt collecting container 12. By means of the folded filter 24, the dirt particles can be separated from the suction flow 28.

[0029] Disposed above the folded filter 24 in the upper part 14 is a closing valve 30, which comprises a valve holder 32, which is fixedly positioned in the upper part 14, forms a valve seat and interacts with a movable valve body in the form of a circular valve disk 34. The valve disk 34 is acted upon by a closing force in the direction of the valve holder 32 by means of a closing spring 36. The closing spring 36 is restrained between a plate-like filter holder 38, having a multiplicity of flow passages and fixedly disposed in the upper part 14, and the valve disk 34.

[0030] In a central region, the valve holder 32 carries an electromagnet 40 with a magnetic coil 42. Disposed on the valve disk 34 is a magnetizable element associated with the electromagnet 40 in the form of an iron plate 44, which in the closed position of the closing valve 30 lies against the end face of the electromagnet 40. For this purpose, an excitation

current is applied to the electromagnet 40 from an electronic control unit 48, illustrated in FIGS. 2 and 3, via connecting lines not represented in the drawing, so that a magnetic field forms and the iron plate 44 is acted on by a magnetic holding force. If the filter 24 is to be cleaned, the current supply to the electromagnet 40 is interrupted. This has the consequence that the valve disk 34 lifts off from the associated valve seat on account of the pressure difference acting on it, which is produced by the pressure of the external air fed to the closing valve 30 via a lateral opening 51 and the negative pressure prevailing in the suction channel 26. External air can consequently flow from the lateral opening 51 to the side of the filter 34 that is oriented away from the dirt collecting container 12 and impinge upon said side of the filter with a pressure surge. The valve disk 34 is returned to the associated valve seat again by the closing spring 36 after only a very short time, preferably after a time of less than 0.5 s, so that the further feeding of external air can be prevented and normal suction operation resumed.

[0031] Like the suction unit 16, the electronic control unit 48 is disposed in the upper part 14 of the vacuum cleaner 10. As FIG. 3 reveals particularly clearly, the upper part 14 comprises a separating wall part 53, which is formed in one piece as a plastics molding and forms a base 54, from which an inner separating wall 55 and an outer separating wall 56 protrude upward with a spacing in between. The separating walls 55, 56 follow a labyrinthine path and on one side of the vacuum cleaner 10 form a first air duct in the form of a cooling air duct 58, which opens out into a cooling air outlet 59; on the other side of the vacuum cleaner 10, the two separating walls 55 and 56 define between them a second air duct in the form of a suction air duct 61, which opens out into a suction air outlet 62. The suction air outlet 62 is disposed on the side of the vacuum cleaner 10 that is opposite from the cooling air outlet 59.

[0032] The suction unit 16 comprises a suction turbine 64, which is set in rotation by an electric motor 65 cooled by external air.

[0033] The cooling air of the electric motor 65 can be discharged to the surroundings via the cooling air duct 58 and the cooling air outlet 59, and the suction air sucked in by the suction turbine 64 through the suction inlet 18 and the dirt collecting container 12 as well as the suction channel 26 can be discharged to the surroundings via the suction air duct 61 and the suction air outlet 62.

[0034] The electronic control unit 48 comprises a number of electronic components 74, which are disposed on a printed circuit board 76. The printed circuit board 76 is positioned on the outer side of the outer separating wall 56. A cooling element in the form of a cooling plate 72 protrudes into the cooling air duct 58 through an opening (not represented in the drawing) in the outer separating wall 56. The cooling plate 72 is connected in a heat-conducting manner to components 74 of the electronic control unit 48 and makes effective cooling of the components 74 possible.

[0035] The separating wall part 53 of the upper part 14 is covered by a hood 68. This is revealed particularly clearly by FIG. 3. Disposed between the separating wall part 53 and the hood 68 is a sound-insulating sealing mat 70, which is produced from a flame-retardant material, to be specific from a foamed thermosetting material from the group of aminoplastics. The sealing mat 70 extends over the suction unit 16, the cooling air duct 58 and the suction air duct 61, and additionally extends over the electronic control unit 48 disposed on

the outer side of the outer separating wall 56. It is elastically deformable and makes it possible in a structurally simple manner to compensate for production tolerances between the separating wall part 53 and the hood 68. In addition, it reduces the production of noise by the vacuum cleaner 10 and ensures that, if the electronic control unit 48 heats up to a high temperature, there is no risk of other components of the vacuum cleaner 10 being affected. The extent of the sealing mat 70 is revealed particularly clearly by FIG. 2, in which the sealing mat 70 is represented in a hatched manner. FIG. 2 represents a plan view of the vacuum cleaner 10 in the region of the suction unit 16, the hood 68 having been removed so that the position of the sealing mat 70 can be seen.

1. Vacuum cleaner with an electronic control unit and a dirt collecting container, which has a suction inlet and is in flow connection with a suction unit via a suction extraction line, the suction unit being connected to at least one air outlet via at least one air duct, wherein at least one air duct is sealed off by means of a sound-insulating sealing mat which is produced from a flame-retardant material and covers the electrical control unit.

2. Vacuum cleaner according to claim 1, wherein the sealing mat is elastically deformable.

3. Vacuum cleaner according to claim 1, wherein the sealing mat is produced from a foamed thermosetting material.

4. Vacuum cleaner according to claim 1, wherein the sealing mat is produced from a foamed thermosetting material from the group of aminoplastics.

5. Vacuum cleaner according to claim 1, wherein the sealing mat has a thermal conductivity of less than 0.04 W/mK.

6. Vacuum cleaner according to claim 1, wherein the vacuum cleaner has a housing part with a hood which covers a separating wall part, the separating wall part having a base from which two separating walls protrude with a spacing in between, defining an air duct between them, and the sealing mat being disposed between the hood and the separating walls.

7. Vacuum cleaner according to claim 6, wherein the electronic control unit is disposed laterally alongside a separating wall, outside the air duct.

8. Vacuum cleaner according to claim 7, wherein the electronic control unit is connected to at least one cooling element, which protrudes into the air duct.

9. Vacuum cleaner according to claim 1, wherein the suction unit is covered by the sealing mat.

10. Vacuum cleaner according to claim 1, wherein the suction unit has an electric motor, which is cooled by external air and is connected via a first air duct to a cooling air outlet, and wherein the suction unit has a suction turbine, which is driven by the electric motor and is connected via a second air duct to a suction air outlet, the sealing mat sealing off the first and second air ducts.

11. Vacuum cleaner according to claim 1, wherein the electronic control unit is electrically connected to at least one electromagnetic closing valve, which closes an external air inlet, it being possible for the side of a filter disposed in the flow path between the dirt collecting container and the suction unit that is oriented away from the dirt collecting container to be impinged upon by external air via the external air inlet in an impulsive manner for cleaning purposes.

12. Vacuum cleaner according to claim 11, wherein current can be applied by means of the electronic control unit to an electromagnet for closing the closing valve, it being possible for the current supply to be interrupted in a time-controlled manner.