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(54) Ventilation apparatus

(57) A ventilation apparatus comprises a cushion part comprising a pad permeable to air; and a ventilation unit comprising a housing, a fan disposed within the housing, and an inlet and an outlet in fluid communication with the fan; wherein the pad comprises a recess or opening for receiving said ventilation unit, such that said inlet is arranged to receive air from outside the ventilation apparatus and said outlet is arranged to direct air from the

fan into the pad. Air driven by a fan is heated by a heating element having a positive temperature coefficient of resistance (PTC), which is connected in series with a resistive element having a negative temperature coefficient of resistance (NTC) for limiting current through the heating element at low temperatures. A cable is connected or connectable at one end to the ventilation unit, and comprises an in-line connector at its other end for connection via a further cable to a power supply.

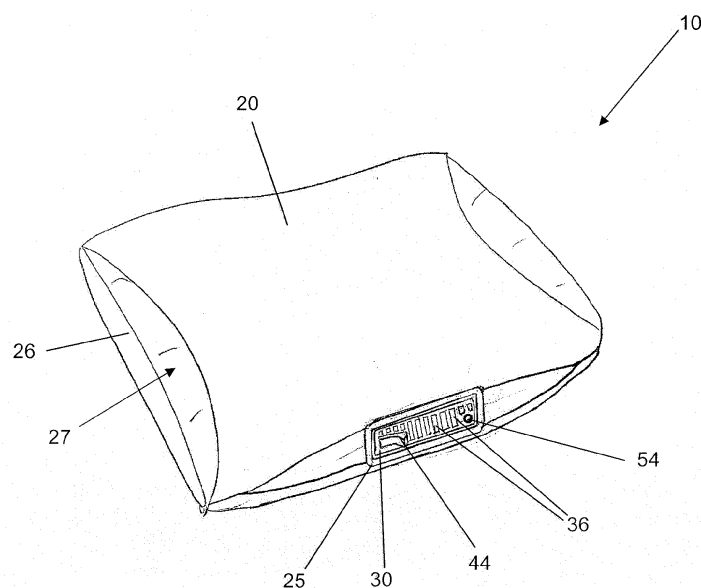


Figure 1

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Description

[0001] The present invention relates to a ventilation apparatus, in particular, but not exclusively, a personal heating apparatus.

[0002] Known personal heating devices include hot-water bottles, microwaveable heat pads and heated cushions. Heated cushions typically incorporate resistive electrical heating wires in their surface fabric. However, there are several disadvantages associated with these known devices.

[0003] Hot water bottles and microwaveable heat pads lose heat quickly and need to be regularly re-filled or re-heated if used for a long period of time. They can also be too hot to touch when initially heated, and may need to be wrapped in a cover to protect the user. Hot water bottles can also be dangerous, with a risk of scalding when filling with hot water, and significant risks of bursts or leaks in use.

[0004] Personal heating devices providing heat through conduction, such as those described above, only provide localised warmth to the part of the user which is physically touching the heater, while other parts remain cold.

[0005] US 2009/0126110 A1 discloses a further type of heated cushion, which includes a warm air blower connected to a cushion via a hose for warming the cushion convectively. However, the hose connection can be uncomfortable for the user and is aesthetically unattractive.

[0006] Warm air blowers usually use a resistive wire heating element for heating the air. This type of heater element can overheat if the airflow is restricted, causing a risk of fire or electric shock. To ensure safe operation, protection against overheating must be provided, for example a bimetallic strip, thermostat or thermal fuse. Instead, some warm air blowers use a Positive Temperature Coefficient (PTC) heating element for heating the air. The resistance of a PTC heating element increases rapidly with temperature due to its chemical composition, thereby providing automatic temperature limitation. However, a drawback of PTC heating elements is their low electrical resistance at low or ambient temperatures, which causes them to draw a high current when initially switched on. Heating devices based on PTC heating elements therefore require some means for limiting the initial current, typically by the use of a microcontroller which rapidly pulses the power to the heating element, allowing it to warm up gradually and maintaining the average current at a lower level. This increases the complexity and therefore the cost of the system.

[0007] Preferred embodiments of the present invention seek to overcome one or more of the above disadvantages of the prior art.

[0008] According to a first aspect of the invention, there is provided a ventilation apparatus, comprising:

a cushion part comprising a pad permeable to air; and

a ventilation unit comprising a housing, a fan disposed within the housing, and an inlet and an outlet in fluid communication with the fan;

wherein the pad comprises a recess or opening for receiving said ventilation unit, such that said inlet is arranged to receive air from outside the ventilation apparatus and said outlet is arranged to direct air from the fan into the pad.

[0009] By integrating the ventilation unit into the cushion part, user comfort is improved. In particular, by eliminating the need for a hose between the fan and cushion part, a smaller fan operating at safe, low voltage can be used. This reduces the size and weight of the ventilation unit, making the apparatus easier to carry. Without a trailing hose, there is less danger of a user tripping over or obstructing the hose, or snagging it on other objects.

[0010] The ventilation unit may further comprise a heating element in fluid communication with the fan.

[0011] When used as a heating apparatus, further advantages of integrating the ventilation unit into the cushion part become apparent. In the apparatus disclosed in US 2009/0126110 A1, heat is lost through the hose unless it is well insulated. By contrast, the apparatus of the present invention is able to heat the cushion part more efficiently, enabling a small heating unit operating at a safe, low voltage (e.g. 12V DC) to be used. Compared with hot water bottles, microwaveable heat pads and resistively heated cushions, the ventilation of the present invention provides more widespread warmth at a comfortable temperature, heating parts of the body not necessarily in direct contact with the cushion part.

[0012] Preferably, the heating element has a positive temperature coefficient of resistance.

[0013] Advantageously, this type of heating element may self-regulate at a predetermined temperature. This is because the resistance of the heating element increases rapidly as its temperature increases, reducing the current through the element and preventing further heating.

[0014] Preferably, the heating element is connected in series with at least one resistive element having a negative temperature coefficient of resistance for limiting current through said heating element.

[0015] Advantageously, a negative temperature coefficient (NTC) resistive element, such as an NTC thermistor, has a high resistance at low temperatures, and thereby limits the current through the positive temperature coefficient heating element at low temperature, for example when the ventilation apparatus is initially switched on, thereby preventing the positive temperature coefficient heating element from drawing high currents when its temperature and resistance are low. As the temperature rises, the resistance of the negative temperature coefficient resistive element decreases, while the resistance of the positive temperature coefficient heating element increases. The negative temperature coefficient resistive element may be selected to have a negligible resistance at operating temperatures, thereby reducing power con-

sumption. Reducing the maximum current in this way enables the ventilation apparatus to be powered using a relatively small and inexpensive power supply, and avoids the need for complex current limiting circuitry.

[0016] Preferably, said heating element and said resistive element are in thermal contact.

[0017] Advantageously, this ensures that the resistance of the resistive element drops rapidly as the heating element increases towards operating temperature.

[0018] Preferably, a surface of said housing is exposed when said ventilation unit is received in said recess.

[0019] Advantageously, this allows easy access to the ventilation unit.

[0020] In one embodiment, at least one of: a connector for connecting said ventilation unit to a power supply, a switch for controlling said ventilation unit, and/or said inlet, is disposed on said surface.

[0021] By providing a direct inlet on an exposed surface of the housing, air resistance to the fan is reduced, and a user can easily see if the inlet is blocked. By providing a switch on the exposed surface, the ventilation unit is easily controlled by a person holding said cushion, without needing to get up and walk to power supply or mains switch. By providing a connector on the surface of the housing, the power connection may be easily removed for use of the apparatus unpowered, as a conventional cushion, with no trailing cable.

[0022] The ventilation apparatus may further comprise a support disposed in said recess and attached to said cushion part, for removably receiving said ventilation unit.

[0023] This enables the ventilation to be easily removed for cleaning the cushion part or for stand alone use of the ventilation apparatus, for example to warm a user's fingers when using a keyboard.

[0024] The support and/or the ventilation unit may comprise latching means for releasably securing said ventilation unit to said support.

[0025] This enables the ventilation unit to be removed from and reinstalled in the cushion part without the use of tools, improving ease of use.

[0026] The cushion part may comprise a pouch for warming a user's hands.

[0027] The ventilation apparatus may further comprise a cable connected or connectable to said ventilation unit, said cable comprising an in-line connector for connection, via a further cable, to a power supply.

[0028] Advantageously, this improves a user's safety. If a user moves while holding on to apparatus, the cable will be pulled taut such that the force on the in-line connector will be along the direction of the cable. This is the direction of force required for disconnecting the in-line connector, so it will disconnect, preventing the cable from pulling on any entangled objects. In contrast, the force on a panel mount connector may be transverse to direction of connection, in which case a panel mount connector would not be disconnected.

[0029] According to a second aspect of the invention, there is provided a ventilation unit for producing a flow

of warm air, the ventilation unit comprising: a fan; a heating element for warming air from the fan, the heating element having a positive temperature coefficient of resistance; and at least one resistive element having a negative temperature coefficient of resistance, connected in series with said heating element for limiting current through said heating element.

[0030] Preferably, the heating element and the resistive element are in thermal contact.

[0031] The ventilation unit may further comprise an outlet, in fluid communication with the fan and arranged to direct said warm air through a cushion to heat said cushion.

[0032] According to a third aspect of the invention, there is provided a heating or ventilation apparatus, comprising: a heating or ventilation device for generating heat and/or a flow of air; and a cable connected or connectable at one end to said heating or ventilation unit, said cable comprising an in-line connector at its other end for connection via a further cable to a power supply.

[0033] The heating or ventilation apparatus may further comprise a cushion, said heating or ventilation device operable to heat and/or cause air to flow through the cushion.

[0034] A preferred embodiment of the present invention will now be described, by way of example only and not in any limitative sense, with reference to the accompanying drawings, in which:

Figure 1 shows a ventilation apparatus according to an embodiment of the present invention;

Figure 2A shows the ventilation apparatus of Figure 1 with a ventilation unit fully separated from a cushion part; Figure 2B shows the ventilation apparatus of Figure 1 with the ventilation unit partially separated from the cushion part;

Figures 3A and 3B illustrate a means of attachment between a cover and a support of the cushion part;

Figure 4 shows a circuit diagram for the ventilation unit; and

Figure 5 illustrates the interior of the ventilation unit.

[0035] With reference to Figures 1, 2 and 5, a ventilation apparatus 10 according to a first embodiment of the invention comprises a cushion part 20 and a ventilation unit 30. The ventilation unit 30 comprises a housing 32, a fan 34 disposed within the housing 32, and an inlet 36 and an outlet 38 in fluid communication with the fan 32. The cushion part 20 comprises a pad 22 permeable to air, which has an opening or recess 24 for receiving the ventilation unit 30, such that said inlet 36 is arranged to receive air from outside the ventilation apparatus 10 and said outlet 38 is arranged to direct air from the fan 34 into the pad 22. The ventilation unit 30 also comprises a heat-

ing element 40 for heating air driven by the fan 34.

[0036] The ventilation apparatus 10 is adapted to be held by a user to provide warmth. Unlike heating devices which operate principally by conduction, the ventilation apparatus 10 combines the advantages of a warm cushion and a gentle stream of warm air which envelopes the user to create a warm local environment. Although the cushion part 20 of the present embodiment is a small scatter cushion, in other embodiments of the invention the cushion part may be a mattress, seat cushion, seat back or other type of cushion. The cushion part 20, in particular the pad 22, may have various different shapes depending on the application. For example it may be shaped for use as a foot muff or neck warmer.

[0037] The pad 22 of the cushion part 20 is an air-permeable mass of soft cushioning material, such as wadding, foam or other filling material, so that the ventilation apparatus 10 is comfortable to use. In one embodiment, the pad 22 is formed of non-woven synthetic fibre such as polyester. The cushion part 20 includes an air-permeable fabric cover 26. The fabric cover 26 may be less permeable than the pad 22 in order to improve the distribution of air over the surface of the cushion part 20 by increasing the pressure within. The fabric cover 26 includes a pocket 27, preferably fleece-lined, in which a user can warm their hands. The cover 26 is not essential to the invention, especially if the pad 22 is in the form of a single piece of material such as foam.

[0038] With reference to Figures 2 and 3, the recess 24 of the cushion part 20 includes a support 25 into which the ventilation unit 30 can be inserted and removed. The ventilation unit 30 is secured in the support 25 by means of a push-in latch mechanism. The support 25 and ventilation unit housing 32 are moulded from plastic, with the latch mechanism being integrally formed by the shape of the plastic mouldings. No tools are required to remove or replace the ventilation unit 30 in the cushion part 20, making it simple to use. This enables a user to remove the ventilation unit 30 from the cushion part 20 for cleaning the cushion part 20 or for using the ventilation unit 30 as a stand-alone heating or ventilating device, for example for warming a user's fingers when typing at a keyboard.

[0039] Figure 3 shows how the support 25 is attached to the cover 26 of the cushion part 20. The cover 26 includes a tubular neck part 28, which is folded back inside the recess 24 when assembled to form the cushion part 20. The support 25 is inserted into the tubular neck part 28, which is secured around the support 25 from the inside using cable ties 29.

[0040] When the ventilation unit 30 is received in the support 25, it does not significantly project from the cushion part 20. The ventilation unit 30 is substantially embedded within the cushion part 20 so that a user is cushioned from the both the support 25 and the ventilation unit housing 32 by the soft pad 22 of the cushion part 20.

[0041] With reference to Figures 4 and 5, the ventilation unit 30 comprises housing 32, fan 34, inlet 36, outlet

38, heater element 40, a thermistor 42, and a control switch 44.

[0042] The housing 32 is formed in two halves from injection moulded plastic. Inlet 34 and outlet 36 are provided on opposite ends of the housing 32 in the form of vents. The inlet 34 is further provided with a removable filter (not shown). The removable filter may comprise, for example, a monofilament nylon mesh of 40 holes per inch, secured to a plastic frame to provide rigidity and allow it to be easily removed.

[0043] The fan 34 is a 12V DC centrifugal fan. The heating element 40 is a dual-element positive temperature coefficient (PTC) ceramic heater element which self-regulates its temperature to 70°C. PTC heating elements are preferred because they self-regulate at a predetermined temperature without requiring further control circuitry. This is because the resistance of the heating element 40 increases rapidly as its temperature increases, reducing the current through the element and preventing further heating.

[0044] The thermistor 42 is a negative temperature coefficient (NTC) thermistor, and therefore has a resistance which decreases as its temperature increases. The skilled person will appreciate that it is straightforward to select a thermistor having a suitable resistance profile. The heating element 40 and thermistor 42 are arranged in physical contact to allow heat to be conducted between them. Preferably, a heat sink compound is used between the heater elements 40 and thermistor 42 to improve thermal contact. The NTC thermistor 42 provides a convenient means for preventing a high inrush current to the heating element 40 when the ventilation unit 30 is initially switched on. At low temperatures, for example at room temperature, the PTC heating element 40 may have a low resistance and would otherwise draw a high current. Once the PTC heating element 40 reaches its operating temperature, i.e. the temperature at which it self regulates, its resistance is much higher. In contrast, the NTC thermistor 42 has a high resistance at low temperatures, and thereby limits the current through the PTC heating element 40 when it is initially switched on. As the temperature of the heating element 40 rises towards the operating temperature, the resistance of the NTC thermistor 42 decreases, so that at operating temperature, the current is regulated almost entirely by the PTC heating element 40. Good thermal contact between the heating element 40 and thermistor 42 ensures that the temperature of the thermistor 42 follows that of the heating element 40 to produce a corresponding drop in resistance.

[0045] The control switch 44 connects power to the fan 34 and heating element 40. In other embodiments, two switches may be provided to allow operation of the fan 34 independently of the heating element 40 to provide a stream of air at ambient temperature for cooling a user. An indicator lamp 46 shows whether the ventilation apparatus 10 is switched on. In this embodiment, the control switch 44 is an illuminated rocker switch and incorporates the indicator lamp 46. A 10A in-line fuse 48 is also pro-

vided.

[0046] The ventilation unit 30 is connected to a DC power supply by a cable 50. The cable 50 may be permanently connected to the ventilation unit 30, with a strain relief grommet 52 to prevent it from being pulled away from the housing 32, as shown in Figures 5 and 6. Alternatively, a panel mount connector 54 may be provided on the housing 32 as shown in Figure 1. The advantage of the latter is that the cable 50 may be removed so that the apparatus 10 can be used as a conventional cushion, with no trailing cables.

[0047] The cable 50 terminates at an in-line connector (not shown), for example a 5.5x2.5mm female DC socket (centre positive), which is connected to the power supply via a further cable. This is an important safety feature, as it disconnects the power supply when a force is applied to the cable 50. If a person is holding the ventilation apparatus 10 while seated, and then stands up to walk around while still holding the apparatus 10, the cable 50 may become tangled around other objects or people, or the power supply may be dragged along, risking an accident. However, this will cause a force to be exerted on the cable 50, disconnecting the in-line connector. Because the force will always be along the direction of the cable 50, the in-line connector should disconnect in a reliable manner. In contrast, the force between the cable 50 and the panel mount connector 54 on the ventilation unit housing 32 may be transverse to the cable 50, so will not always act to disconnect the cable 50 from the connector 54.

[0048] When the ventilation unit 30 is received in the support of the cushion part 20, only one wall of the ventilation unit housing 32 is exposed at the periphery of the cushion part 20. The inlet 34, control switch and connector 54 are all provided on this surface to be easily accessible to a user.

[0049] Although the ventilation apparatus 10 described above includes a heating element 40 for warming the air which passes through the cushion pad 22, the apparatus may also be operated without the heating element, to provide ventilation at ambient air temperature. Other embodiments may include cooling elements, such as a Peltier, instead of or in addition to the heating element 40.

[0050] The skilled person will appreciate that a ventilation unit comprising fan 34, PTC heating element 40 and NTC thermistor 42 may be used in other heating devices, not only the ventilated cushion apparatus of the embodiment described herein, for example a ventilation unit for heating a cushion via a hose, or a fan heater.

[0051] The skilled person will also appreciate that other electrically-powered portable ventilation or heating apparatuses, for example resistively heated cushions, may benefit from including a cable provided with an in-line connector as described above, for connecting the apparatus to a power supply.

[0052] It will be appreciated by persons skilled in the art that the above embodiments have been described by way of example only, and not in any limitative sense, and

that various alterations and modifications are possible without departure from the scope of the invention as defined by the appended claims.

Claims

1. A ventilation apparatus, comprising:

a cushion part comprising a pad permeable to air; and
a ventilation unit comprising a housing, a fan disposed within the housing, and an inlet and an outlet in fluid communication with the fan;
wherein the pad comprises a recess or opening for receiving said ventilation unit, such that said inlet is arranged to receive air from outside the ventilation apparatus and said outlet is arranged to direct air from the fan into the pad.

2. A ventilation apparatus according to claim 1, wherein said ventilation unit further comprises a heating element in fluid communication with said fan.

3. A ventilation apparatus according to claim 2, wherein said heating element has a positive temperature coefficient of resistance.

4. A ventilation apparatus according to claim 3, wherein said heating element is connected in series with at least one resistive element having a negative temperature coefficient of resistance for limiting current through said heating element.

5. A ventilation apparatus according to claim 4, wherein said heating element and said resistive element are in thermal contact.

6. A ventilation apparatus according to any of the preceding claims, wherein a surface of said housing is exposed when said ventilation unit is received in said recess.

7. A ventilation apparatus according to claim 6, wherein at least one of:

a connector for connecting said ventilation unit to a power supply,
a switch for controlling said ventilation unit, and/or
said inlet,

is disposed on said surface.

8. A ventilation apparatus according to any of the preceding claims, further comprising a support disposed in said recess and attached to said cushion part, for removably receiving said ventilation unit.

9. A ventilation apparatus according to claim 8, wherein said support and/or said ventilation unit comprises latching means for releasably securing said ventilation unit to said support. 5
10. A ventilation apparatus according to any of the preceding claims, wherein said cushion part comprises a pouch for warming a user's hands.
11. A ventilation apparatus according to any of the preceding claims, further comprising a cable connected or connectable to said ventilation unit, said cable comprising an in-line connector for connection via a further cable to a power supply. 10
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12. A ventilation unit for producing a flow of warm air, the ventilation unit comprising:
- a fan;
 - a heating element for warming air from the fan, 20
 - the heating element having a positive temperature coefficient of resistance; and
 - at least one resistive element having a negative temperature coefficient of resistance, connected 25
 - in series with said heating element for limiting current through said heating element at low temperatures.
13. A ventilation unit according to claim 12, including one or more of the following features: 30
- (i) wherein said heating element and said resistive element are in thermal contact; or
 - (ii) further comprising an outlet, in fluid communication with the fan and arranged to direct said 35
 - warm air through a cushion to heat said cushion.
14. A heating or ventilation apparatus, comprising:
- a heating or ventilation device for generating 40
 - heat and/or a flow of air; and
 - a cable connected or connectable at one end to said heating or ventilation unit, said cable comprising an in-line connector at its other end for 45
 - connection via a further cable to a power supply.
15. A heating or ventilation apparatus according to claim 14, wherein said heating or ventilation apparatus further comprises a cushion, said heating or ventilation device operable to heat and/or cause air to flow 50
- through the cushion. 55

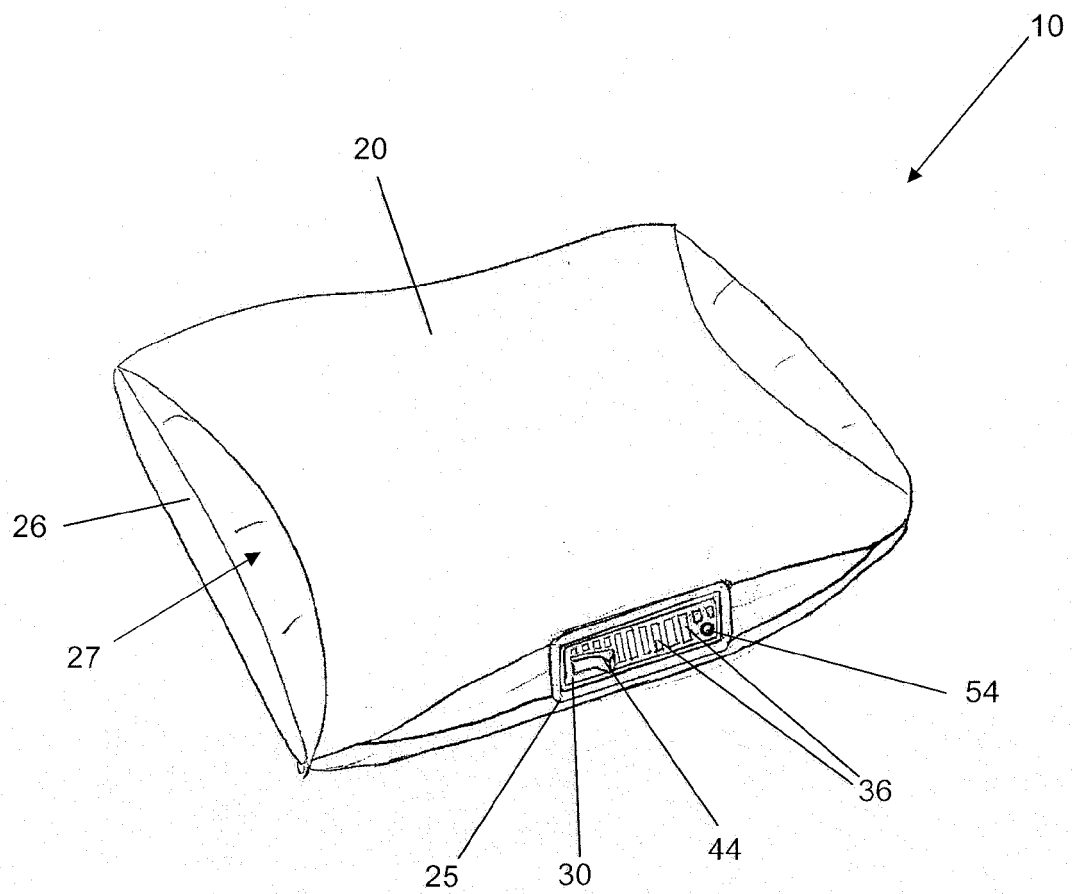


Figure 1

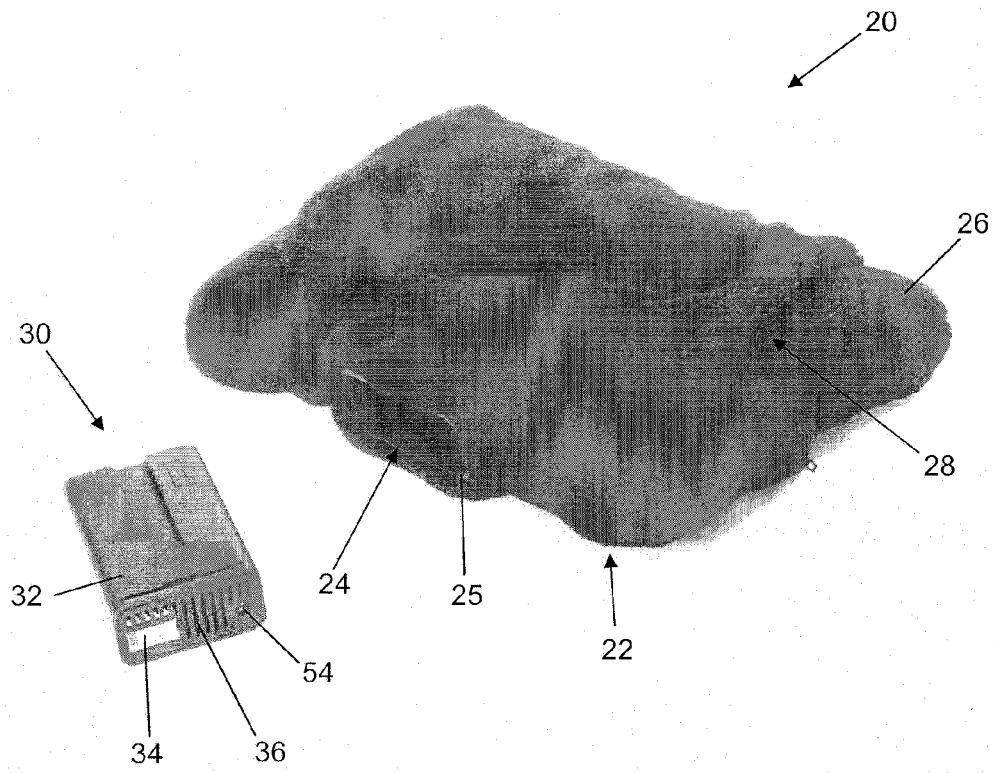


Figure 2A

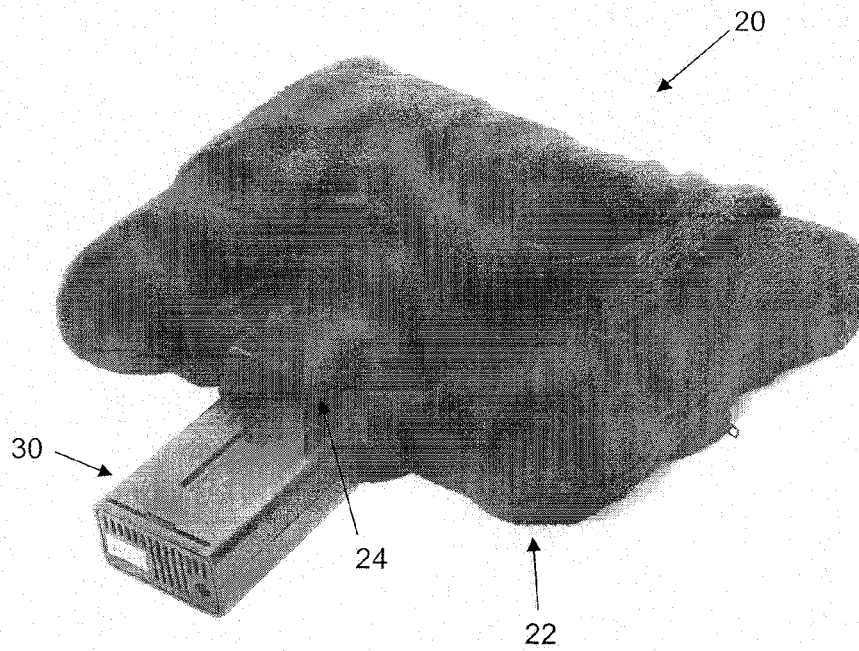


Figure 2B

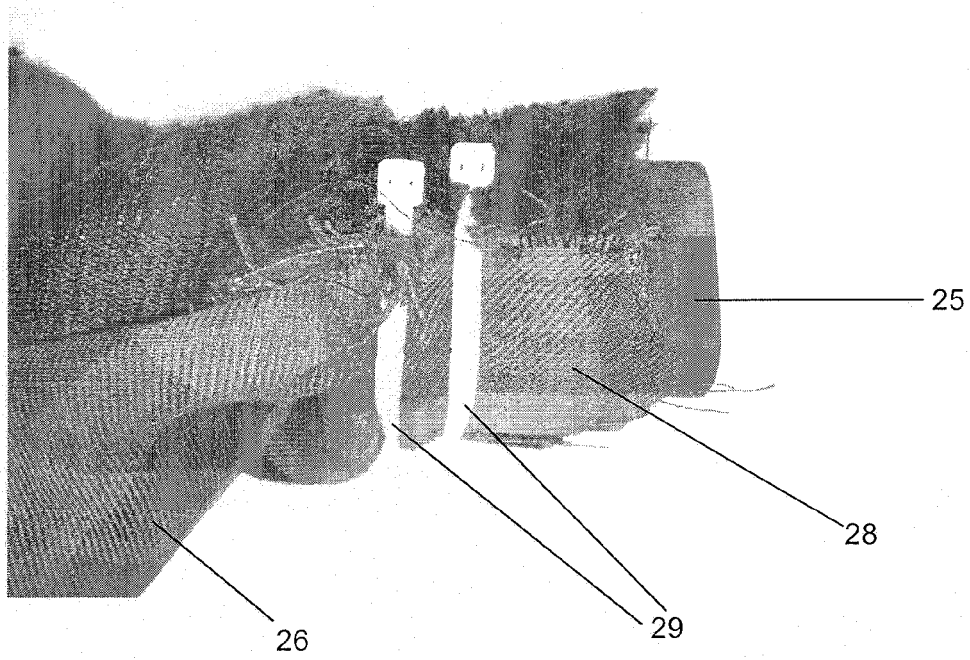


Figure 3A

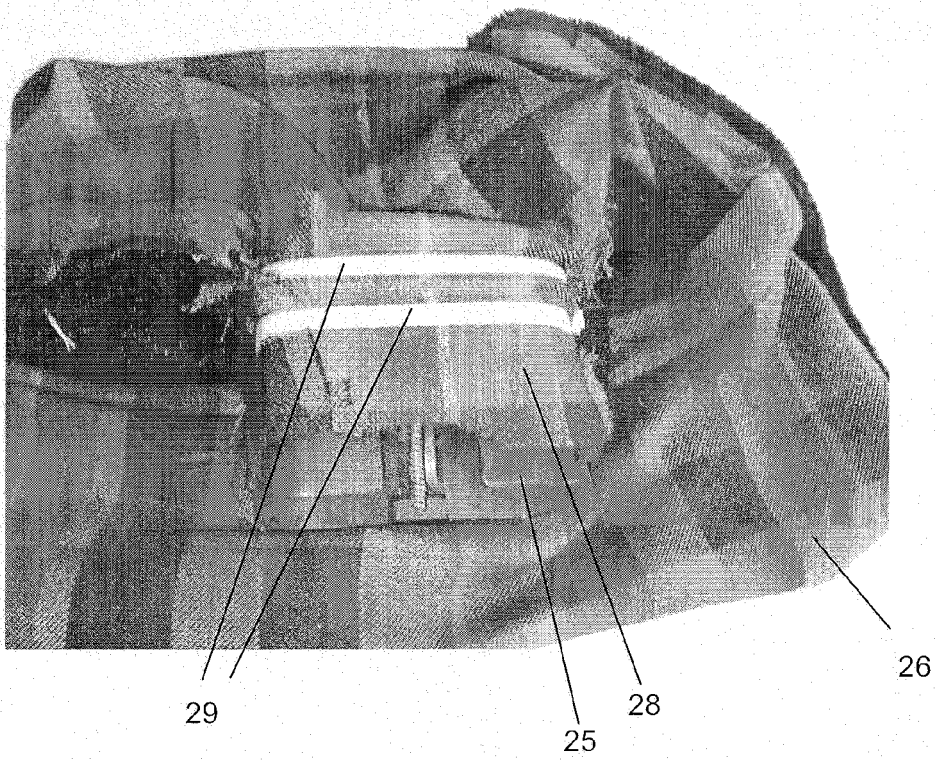


Figure 3B

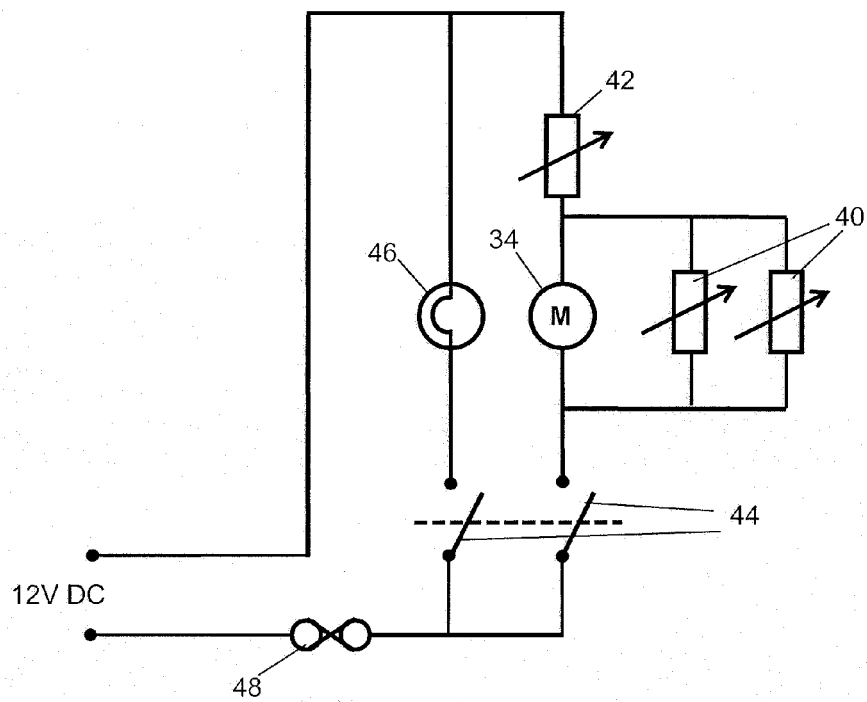


Figure 4

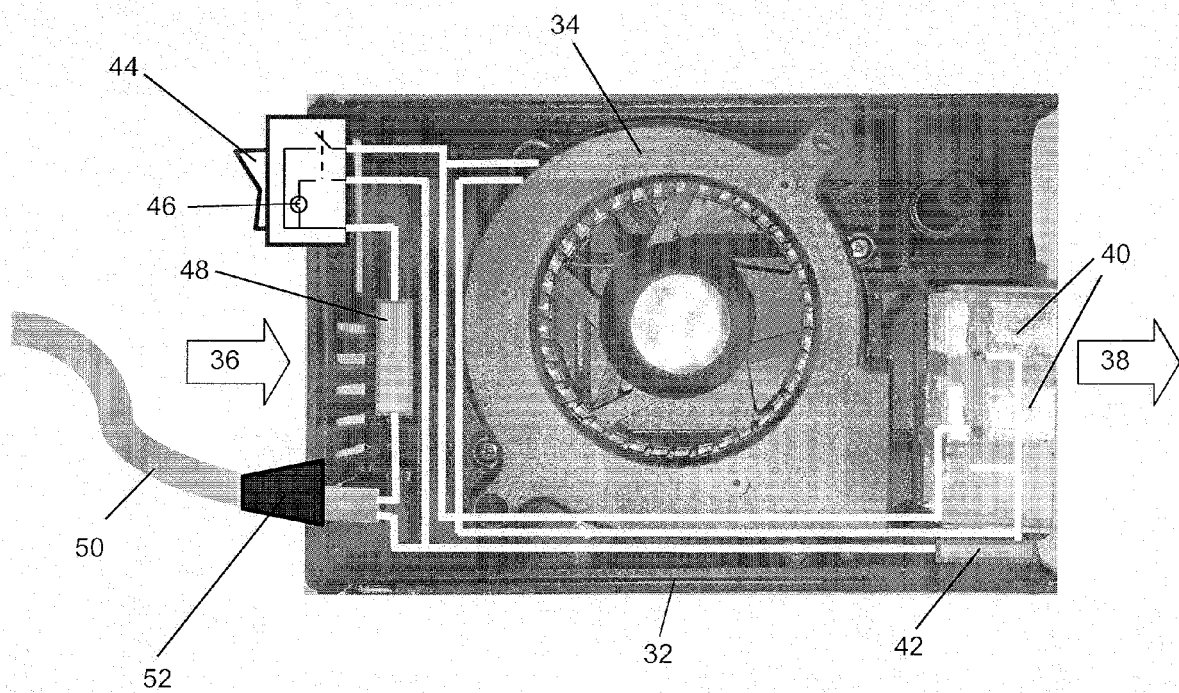


Figure 5



EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 17 January 2013	Examiner MacCormick, Duncan
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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