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INT CL **A47L**
Other: **EPODOC & WPI**

(54) Title of the Invention: **Vacuum cleaner**
Abstract Title: **Vacuum cleaner with airflow duct sound deadening characteristics**

(57) A source of suction for a vacuum cleaner comprises an electric motor 42 in driving connection with an airflow-creating fan 44, the motor 42 and fan 44 being disposed within a housing part 50, wherein the motor 42 is supported in the housing part 50 by a flexible mounting means (82, fig 7). The flexible mounting means (82, fig 7) are preferably support elements made of rubber which are equally spaced circumferentially about the motor 42. The support element (82, fig 7) preferably has shape that engages with complementary formations (86, fig 7) associated with the housing part 50 and the motor 42. The housing part 50 may comprise an inner housing disposed within an outer housing part 52, with the inner housing 50 being flexibly mounted with respect to the outer housing 50. The invention in hand is characterized by the inclusion of an air flow passage or the like with sound deadening material on at least one internal and/or external surface.

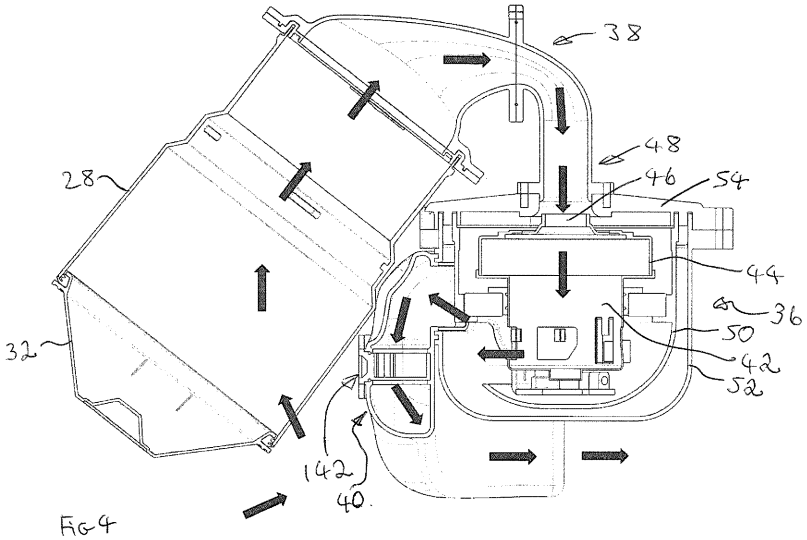

FIG 4

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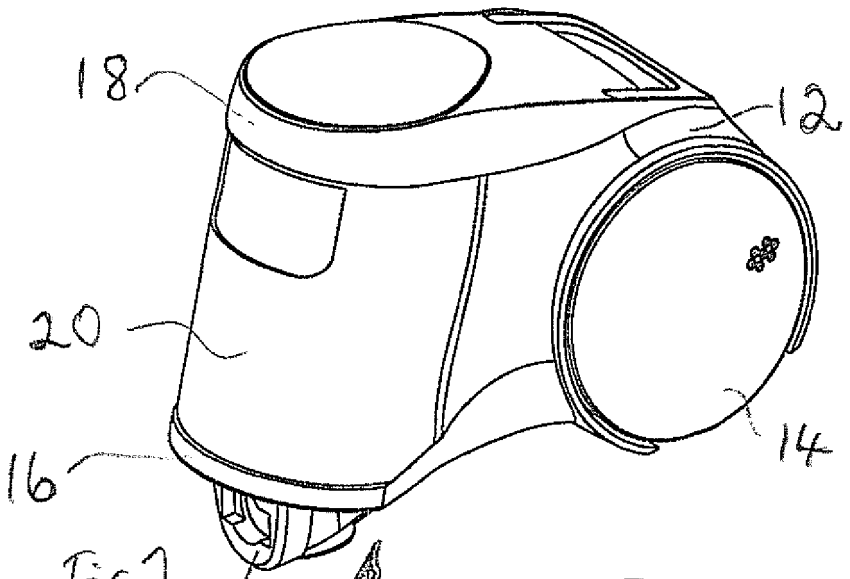

Fig 1

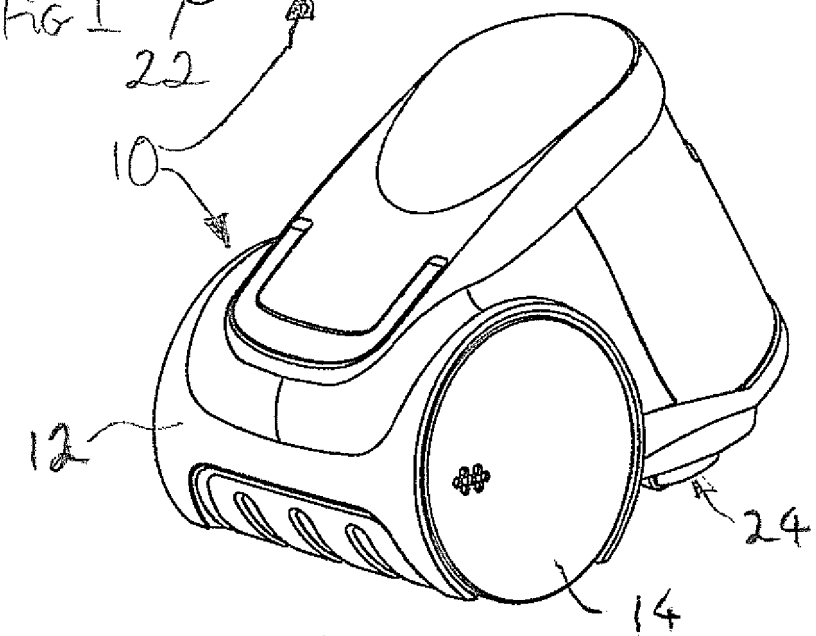

Fig 2

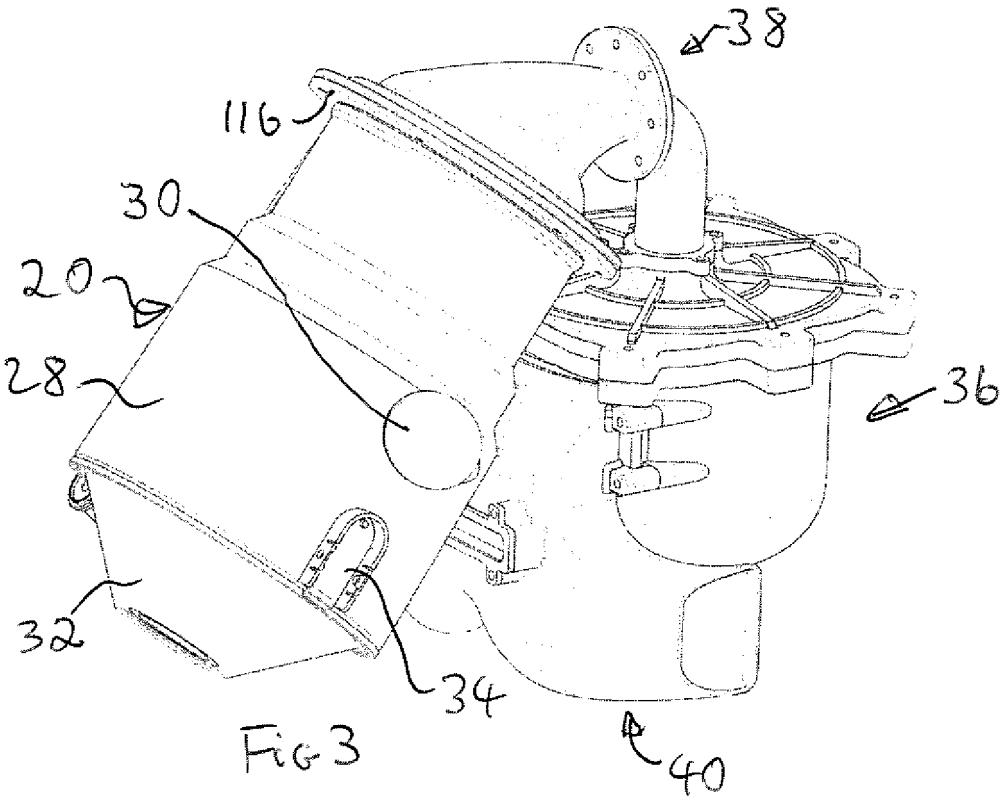

Fig 3

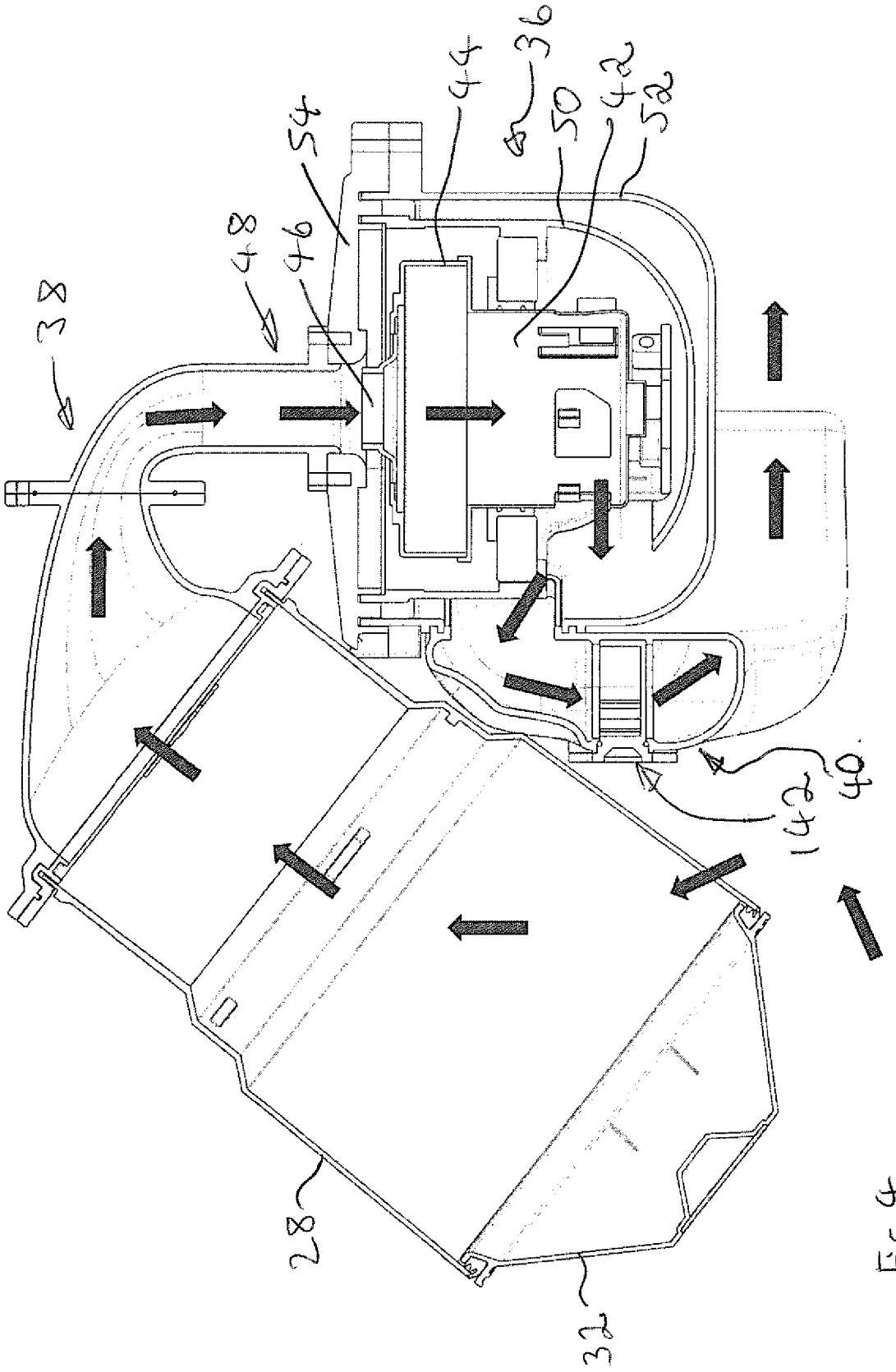

Fig 4

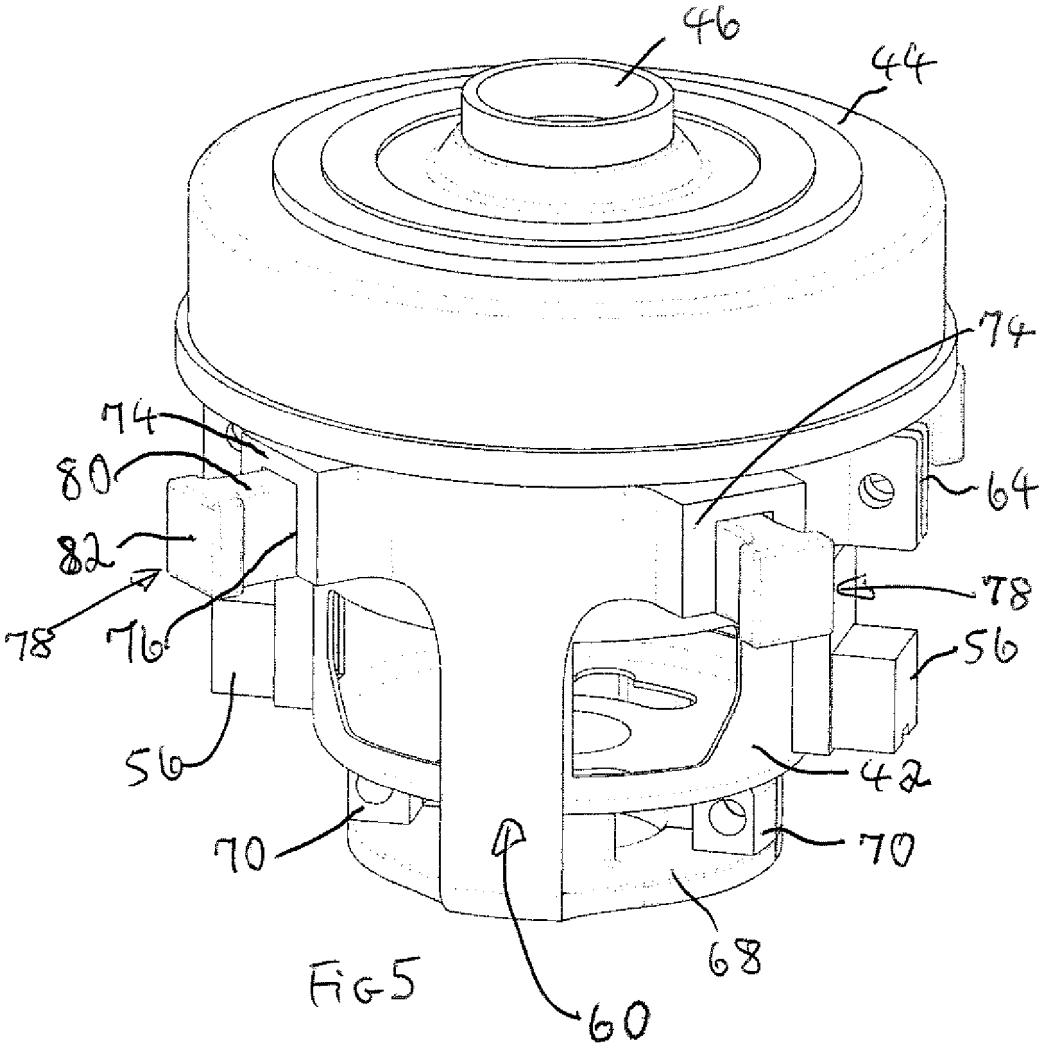
46
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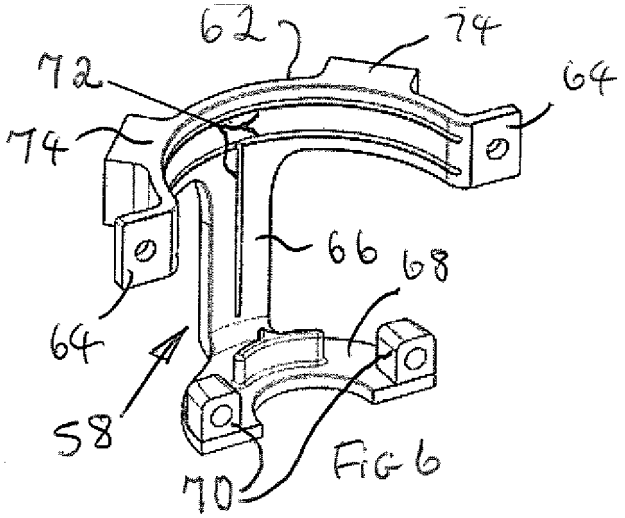
Fig 5


62
74
72
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74
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64
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70

Fig 6

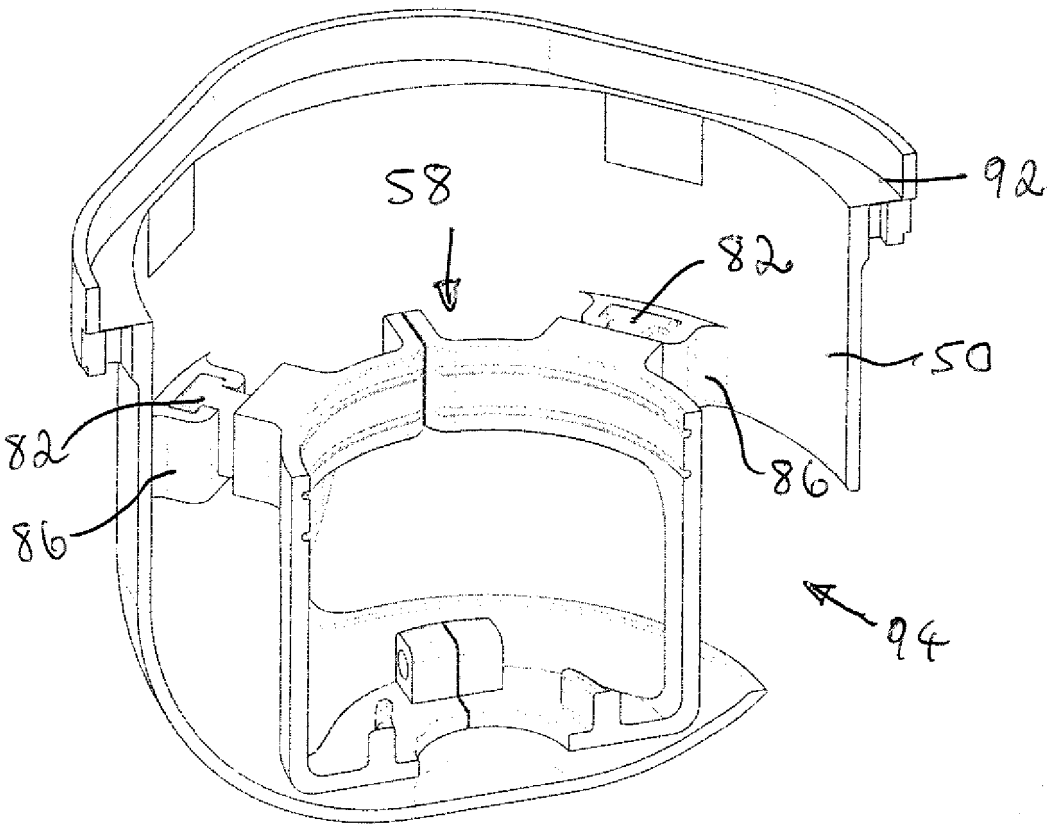


Fig 7

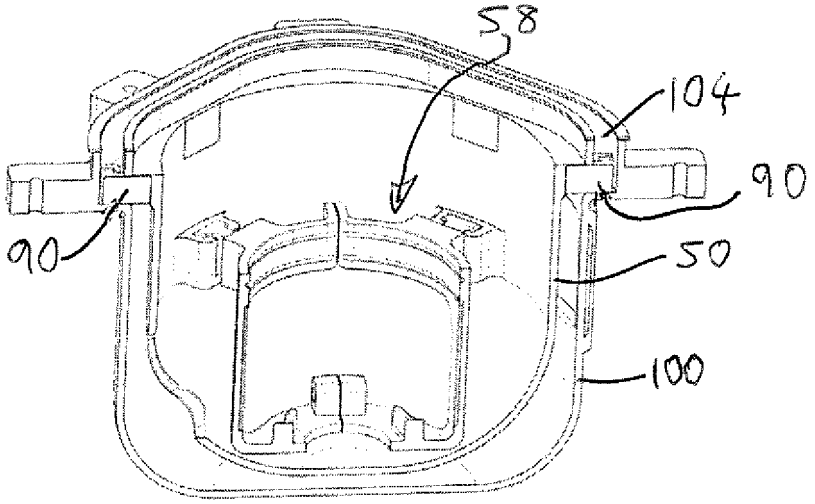


FIG 8A

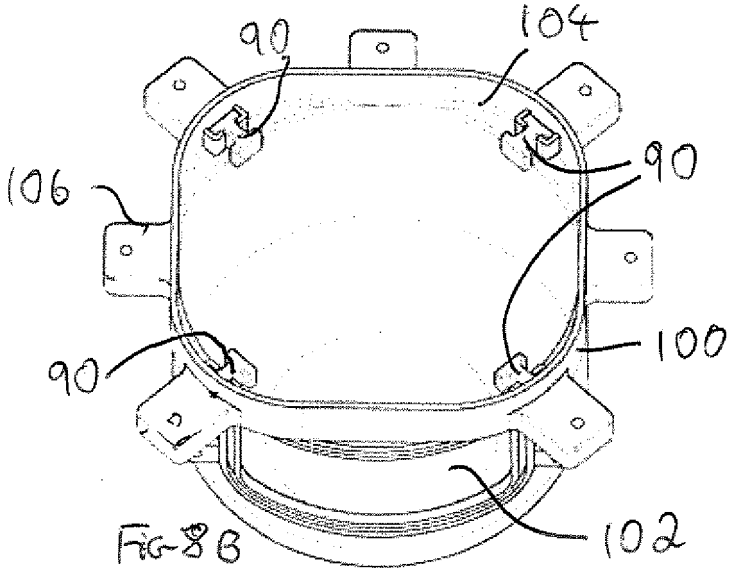


FIG 8B

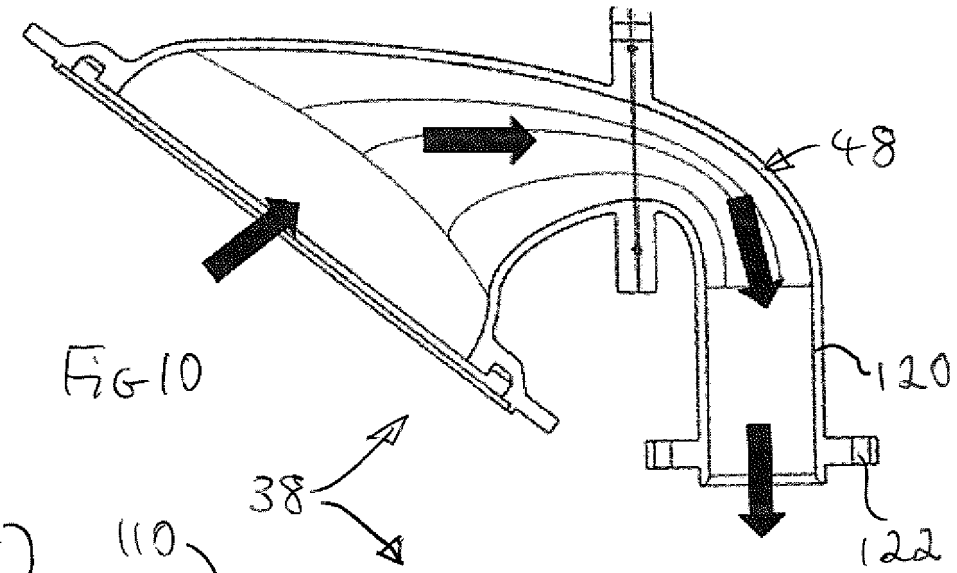


FIG 10

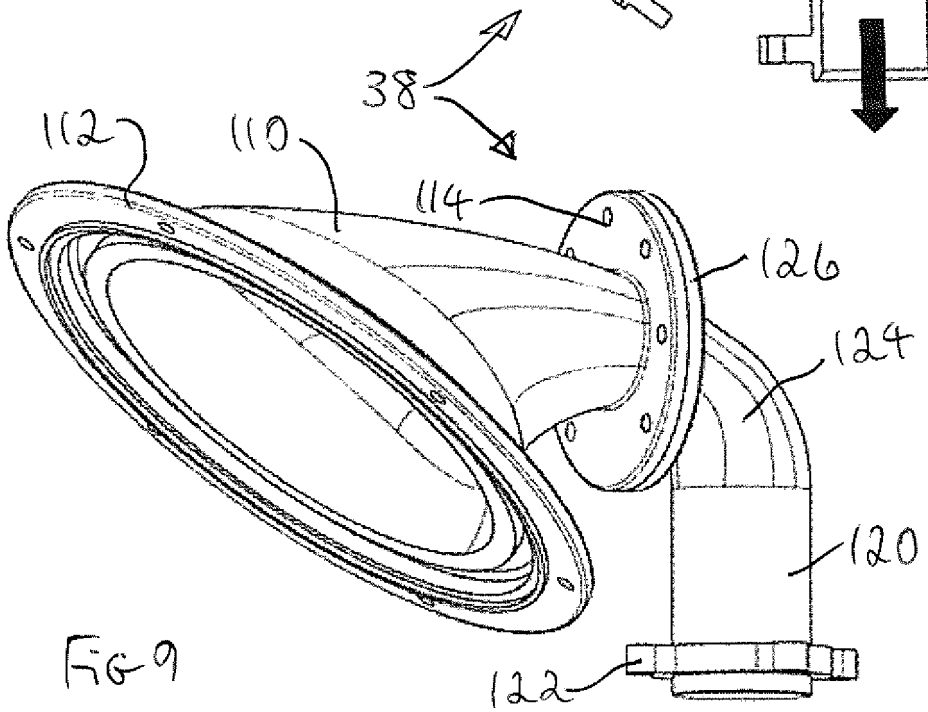
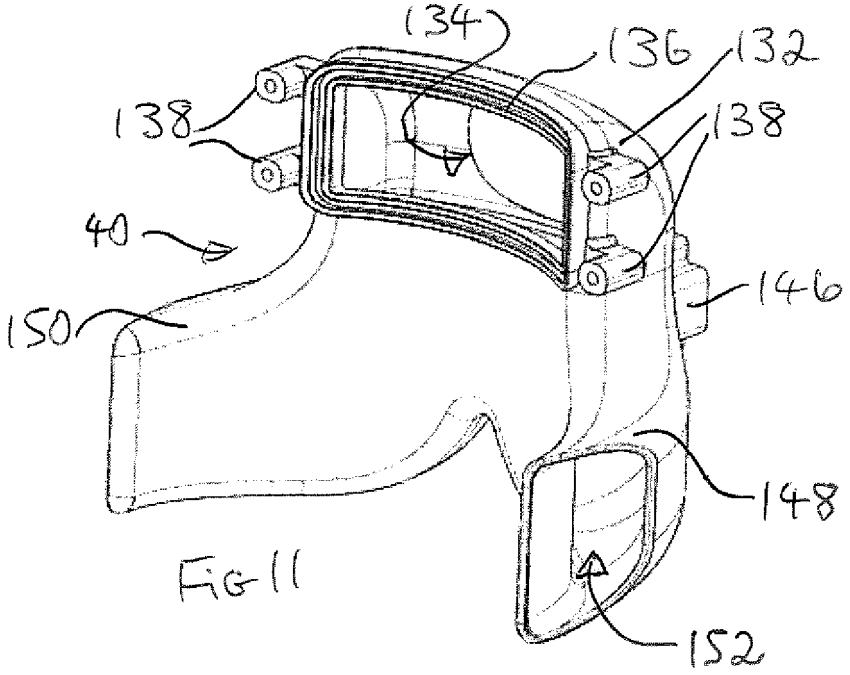


FIG 9


134
136
132
138
138
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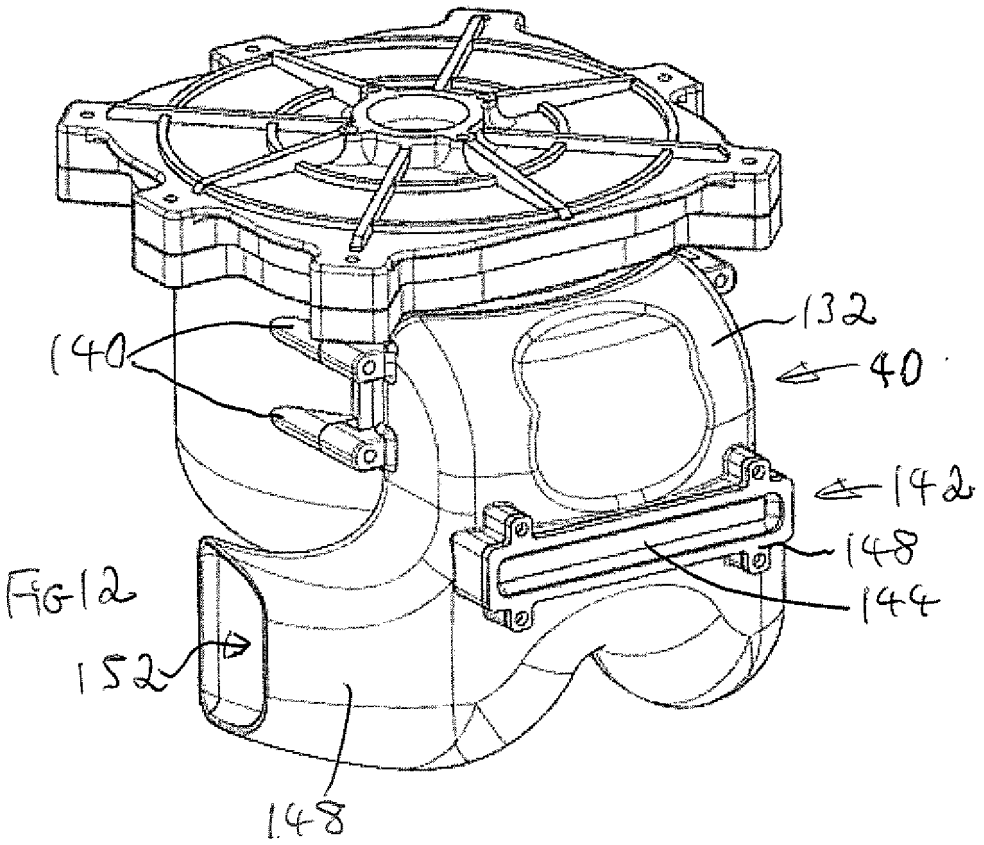
146
150
148
152

Fig 11


132
140
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142
148
144
152
148

Fig 12

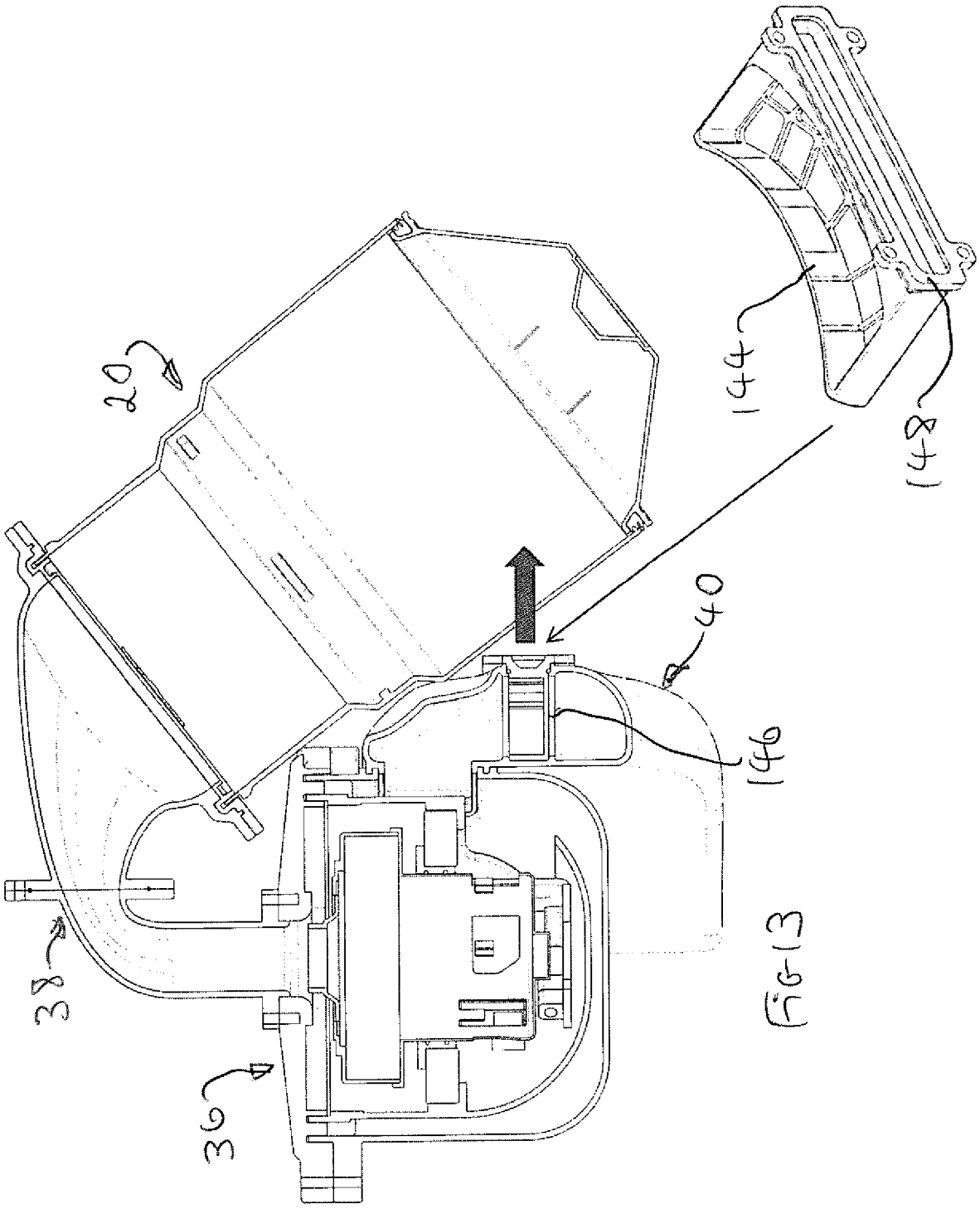

FIG 13

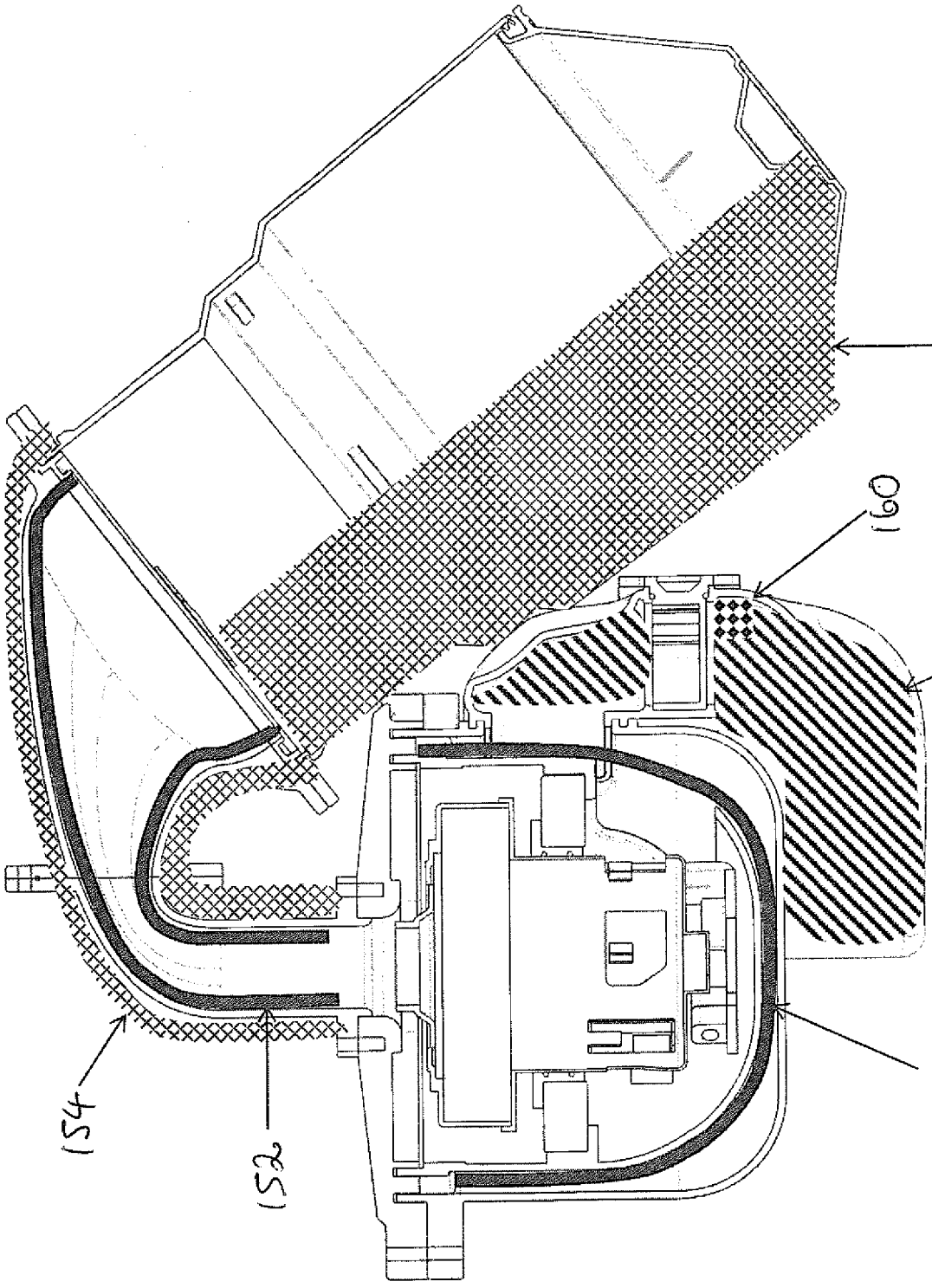

Fig 14

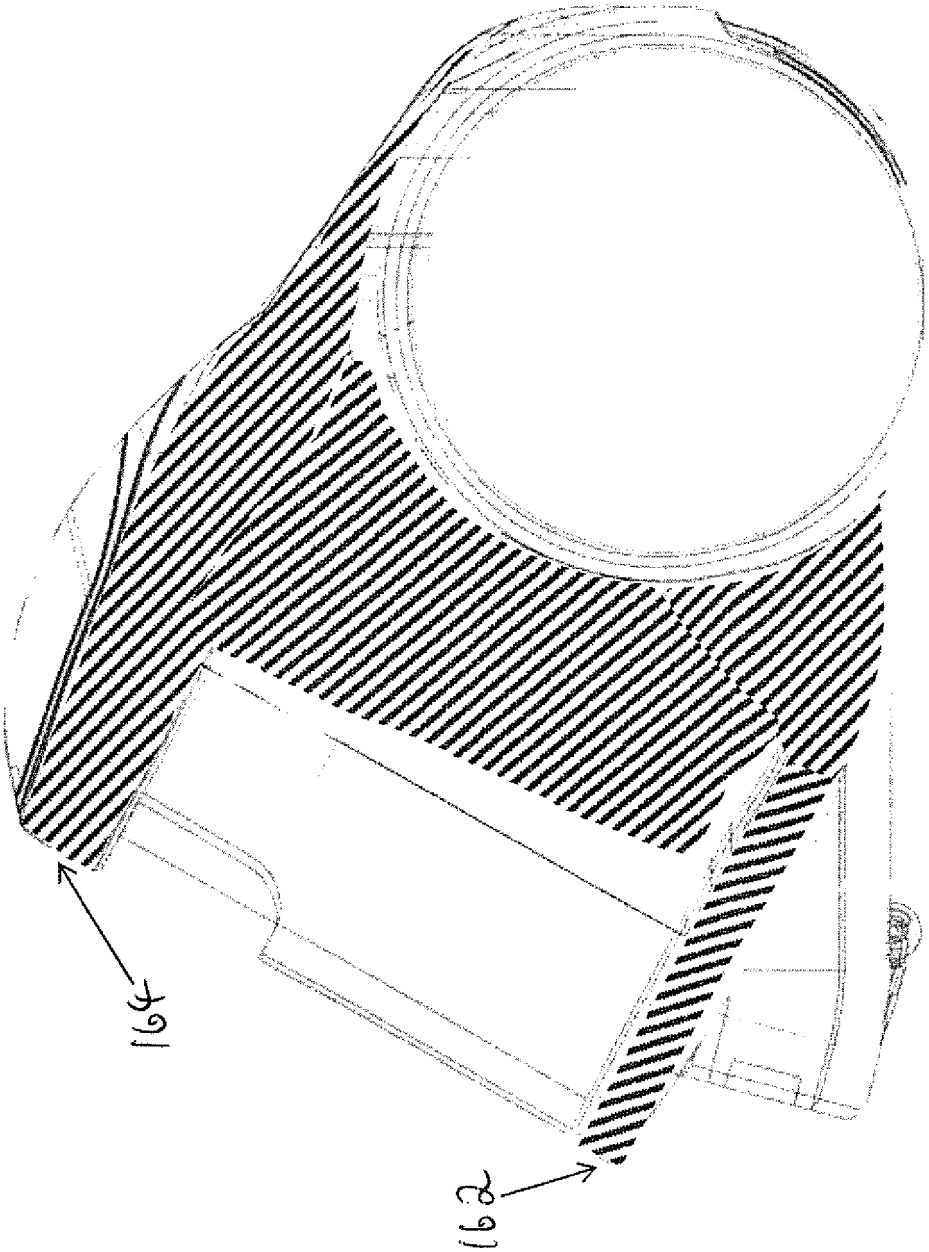

Fig 15

Title: Vacuum Cleaner

Description of Invention

This invention relates generally to vacuum cleaners (suction cleaners).

Vacuum cleaners are well known appliances, utilising a suction airflow to draw dust and other matter from whatever is being cleaned. The airflow passes through a dust separator and collector wherein dust entrained in the suction airflow is separated from the airflow and retained for later disposal. For effective cleaning, a high rate of airflow is required and to create this a vacuum cleaner requires a powerful source of suction in the form of a fan or impeller capable of creating the high airflow and a correspondingly-powerful electric motor to drive the fan. At present, it is not uncommon to find a vacuum cleaner whose electrical power consumption is of the order of 1.5kw to 2.0kw, or possibly even higher.

One problem associated with such vacuum cleaners is that a high level of noise may be generated by the airflow in the cleaner, and by the motor and fan which create the airflow. It is desirable, particularly for domestic use, that the noise emitted by a vacuum cleaner should be reduced as far as possible, and it is broadly an object of the present invention to address this requirement.

According to one aspect of the invention, we provide a source of suction for a vacuum cleaner; comprising an electric motor in driving connection with an airflow-creating fan; the motor and fan being disposed within a housing part; wherein the motor is supported within the housing part by a flexible mounting means.

The invention also provides a vacuum cleaner having such a source of suction.

The flexible mounting means may comprise a number of support elements made of resilient material, e.g. natural or synthetic rubber or the like, of suitable hardness, to provide for adequate support of the motor and fan whilst suppressing transmission of vibrations therebetween.

There may be, for example, four support elements, spaced circumferentially about the motor, having regard to its axis of rotation.

Each support element may be of a shape which engages with complementary formations, respectively associated with the motor and with the housing part, whereby they are held together. Thus, fasteners such as screws need not be provided to hold the motor on the housing part. By way of example, in the embodiment described herein, each support element may have a generally I-shaped cross-sectional shape, with transverse end portions joined by an intermediate portion, and the end portions may engage in complementary slots in mounting formations associated with the motor on the one hand and the housing part on the other hand.

The mounting formations associated with the motor may be provided on a motor holding member which holds the motor. It may comprise a body which embraces an external surface of the motor to hold it, and preferably further resilient elements are interposed between the motor holding member and the motor. The motor holding member may comprise two or more components, secured together to hold the motor therebetween; the components may be held together by fasteners such as screws which can be tightened to clamp the motor therebetween.

The housing part within which the motor and fan are supported by the flexible mounting means may be an inner housing part, which may be disposed within a further, outer, housing part. The inner housing part may be supported in the outer housing part by further flexible mounting means. The further flexible mounting means may comprise further support elements, which may be generally similar, or possibly identical, to the first said support elements. They may be of the same, or a different hardness from that of the first support elements.

The outer housing part may be supported in a body of the vacuum cleaner in any suitable manner.

Air may flow into the fan in the direction of the rotational axis of the motor, and thence through the motor (for cooling purposes) and out of the motor into the first housing part and second housing part. The first housing part may have an opening into the second housing part, and the second housing part an exhaust opening from which air is led into an exhaust duct, which may extend to the ambient atmosphere.

The opening from the first housing part into the second housing part may be adjacent the opening from the second housing into the exhaust duct, at an opposite part of the second housing part from that having its opening into the exhaust duct, or may be at any position therebetween.

A further aspect of the invention is concerned with the configuration of the exhaust duct as aforesaid. Particularly, it may be of increasing cross-sectional area as it extends away from the outer housing part to the external atmosphere. Thus, the airflow speed in the duct decreases as its final exit to the ambient atmosphere is reached, reducing production of noise from this source.

In particular, the exhaust duct may be bifurcated, leading to two airflow outlets.

The exhaust duct may be provided with an exhaust (post-motor) filter. Whilst the dust separator of a vacuum cleaner may be effective at removing substantially all dust entrained in the suction airflow drawn from whatever is being cleaned, the brushes of the type of electric motor commonly used in vacuum cleaners may themselves cause some carbon dust to be created, and an exhaust filter is effective at preventing such carbon dust (and any cleaning dust which might pass the dust separator) from being emitted to the external atmosphere. The exhaust filter may comprise a filter element which is insertable and removable from the exhaust duct in a direction transverse to a longitudinal direction of the passage at the position where the filter element is disposed. The filter element may be accessible for removal and replacement from the exterior of the cleaner, and be removable from and replaceable into a formation in the body of the cleaner, such formation being accessible, for example, when the dust separator/collector of the cleaner is removed from the body.

Yet a further aspect of the invention is concerned with the configuration of an airflow duct extending from the dust separator/collector of the cleaner to the inlet of the airflow-creating fan of the cleaner.

In accordance with this aspect of the invention, an airflow duct entering the inlet of the fan may have a substantially straight portion which is substantially in line with the direction of the inlet, and whose length is at least twice the diameter of the inlet. Possibly the substantially straight portion of the duct may be more than two times, e.g. three times, the diameter of the fan inlet, if such a substantially straight portion of the duct can be accommodated in the body of the vacuum cleaner.

The cross-sectional area of the airflow duct may be at least equal to the cross-sectional area of the fan inlet throughout the entire duct. The duct may decrease in cross-sectional area, as far as the substantially straight portion thereof, or possibly it may increase.

As a further contribution to reduction of noise emitted by the vacuum cleaner, at least one wall portion, defining a part of passage or space wherein air flows in use of the cleaner, may be provided on at least one of its internal and external surfaces with a covering of a sound-deadening material. Thus, if an airflow passage is defined by a hollow cylinder, the hollow cylinder may be provided with a covering of a sound-deadening material on its interior surface (i.e. the outside of the airflow passage) and/or its exterior surface.

The invention will now be described by way of example with reference to the accompanying drawings, of which:

Figure 1 is a perspective view of the exterior of a vacuum cleaner embodying the invention, from the front and one side;

Figure 2 is a view of the cleaner of figure 1, from the rear and the other side;

Figure 3 is a perspective view of internal components of the vacuum cleaner;

Figure 4 is a section through the internal components shown in figure 3;

Figure 5 is a perspective view of a motor assembly included in the components shown in figure 4;

Figure 6 is a perspective view of a component of a motor holding assembly, shown holding the motor in figure 5;

Figure 7 is a perspective view of the motor holding assembly, disposed in an inner housing part;

Figure 8A is a cut-away perspective view of the housing part shown in figure 7, disposed within an outer housing part;

Figure 8B is a perspective view of the outer housing part shown in figure 8A.

Figures 9 and 10 are respectively a perspective view and a section through an air duct assembly forming part of the vacuum cleaner;

Figures 11 and 12 are perspective views from different angles of a further air duct assembly incorporated in the vacuum cleaner, the latter showing its position in relation to the motor assembly;

Figure 13 is a section through the assembly showing figure 12, additionally showing the disposition of a filter in relation to the air duct assembly;

Figure 14 is a section as figure 13, showing possible disposition of sound-insulating material in relation thereto;

Figure 15 is a lateral elevation of the cleaner, showing possible external disposition of the sound-insulating material.

Referring firstly to figures 1 and 2, these show a vacuum cleaner 10 having a body 12 with a pair of wheels 14 disposed one each side of the body. Herein, the wheels will be referred to as being disposed at the rear part of the body, and terms such as forwardly and like expressions will be used in relation to such an orientation. Within the body, in the space between the wheels 14, there are accommodated components described hereafter concerned with creating the suction airflow of the cleaner. A lower body portion 16 extends forwardly from the region between the wheels 14, and an upper body portion 18 also extends forwardly, spaced above the lower body portion 16. A dust separator and collector unit 20 is removably disposed between the lower and upper body portion 16, 18. The dust separator and collector may be of the type comprising one or more cyclone devices, for example a primary cyclone through which the suction airflow of the cleaner is caused firstly to flow upon entering the separator, followed by a plurality of secondary cyclones connected in parallel with one another, the secondary cyclones being of smaller size than the primary cyclone in order to remove small dust particles from the suction airflow after larger dust particles have been removed by the primary cyclone. The separator/collector unit 20 provides for collection and retention of separated dust for later disposal, e.g. by opening a door part at the lower end of the unit. Such arrangements of cyclones are well known in vacuum cleaners, and any appropriate arrangement of cyclones may be

utilised. Alternatively, any other type or arrangement of dust separator/collector, such as are commonly used in vacuum cleaners, may be provided.

Figure 1 shows a fitting 22 beneath the front end of the lower body part 16 of the cleaner, for connection of a suction hose to lead the suction airflow to the cleaner from whatever is being cleaned.

A castor wheel or wheels 24 is provided beneath the fitting 22, so that the vacuum cleaner can be pulled over a floor surface by the suction hose when in use. The dust separator and collector assembly 20 is removable from the body of the cleaner for emptying of collected dust, clearance of blockages, and so forth, and to this end the upper body part 18, or a portion thereof, may pivot upwardly to enable release of the dust separator and collector from the cleaner.

Referring now to figure 3 of the drawings, this shows the dust separator/collector unit 20, having an exterior casing 28 generally of cylindrical configuration decreasing in diameter in stages as it extends upwardly. An opening 30 in the side of the casing 28 provides for suction airflow into the unit 20 from a duct (not shown) leading from the hose connection fitting 22 of the cleaner. The lower end of the casing 28 is closed by a hinged door 32 held closed by a catch 34, and openable by release of the catch 34 to permit emptying of collected dust from the unit 20. After having passed through the unit 20, the suction airflow passes to the source of suction of the cleaner, indicated generally at 36 in figure 3, by way of an airflow transfer duct assembly indicated generally at 38 and described in greater detail hereafter. The source of suction 38 contains an electric motor, supported in a housing assembly as described hereafter, and the airflow leaves the source of suction 36 by way of an exhaust duct 40 also described in greater detail hereafter.

Referring now to figure 4 of the drawings, the source of suction 36 contains an electric motor 42 whose axis of rotation is vertically oriented, in driving connection with a fan disposed within a fan housing 44 atop the motor. Suction airflow enters the fan within the fan housing 44 through an inlet 46, aligned with a vertically oriented part 120 of an inlet duct component 48 of the transfer duct assembly 38. After having passed through the fan within the housing 44, the airflow passes through the motor 42 and, leaving the motor, follows the path indicated by the heavy arrows in figure 4 to enter the exhaust duct assembly 40 and thence into the ambient atmosphere. The motor and fan are together supported in a double-walled housing comprising an inner somewhat cup-shaped housing part 50 and an outer housing part 52 which is also somewhat cup-shaped. The two housing parts are closed at their open upper ends by a cover 54 having an opening with which the inlet 46 of the fan housing 44 aligns, and to which the vertical portion 48 of the transfer duct 38 is connected. The two housing parts have openings in them to allow for flow of air from the motor to the exhaust duct assembly.

Referring now to figures 5 and 6, these show an upper part of fan housing 44 with its inlet 46, and a lower part of a cylindrical casing of the motor 42. Brush holders 56 of the motor protrude outwardly of the motor's cylindrical casing. The casing of the motor is embraced by a two-part holding member, comprising two components 58, 60, the component 58 being shown in figure 6. It comprises a semi-circular portion 62 at whose opposite ends there are provided outwardly extending flanges 64 which abut face to face with the corresponding flanges on the component 60, and receive screwed fasteners to hold the two components to one another with their semi-circular portions as 62 embracing the casing of the motor 42. Midway between the end flanges of the component 58, a wall portion 66 extends downwardly to connect to a lower generally semi-circular portion 68 which lies beneath the casing of the motor 42. This part has two abutments 70 with apertures for receiving screw fasteners by which it is secured to the corresponding part of the motor holding

component 60. The semi-circular part 62 of component 58, and the wall part 66 thereof are lined with strips of resilient material such as rubber of a suitable hardness, indicated at 72, so that the motor is resiliently supported relative to the assembled motor holding member.

The top part of the motor holding member as a whole is provided with four outwardly facing support formations 74, spaced circumferentially at 90 degrees from one another around the motor holding member with two of the formations on the component 58 and two on the component 60. Each formation 74 comprises a block extending outwardly from the semi-circular part 62 of the respective component, having an undercut slot 76 extending upwardly into it from its downwardly presented surface. Each slot receives one end of a generally I-shaped support element 78 of rubber or like material, each support element comprising an intermediate portion 80 which extends radially relative to the rotational axis of the motor and fan, having respective transverse portions 82 at its opposite ends. The innermost transverse end portions of each support element 78 are not, of course, visible in figure 5 since they lie and fit closely within the undercut slots 76.

With reference now to figure 7 of the drawings, this shows, in cut-away view, part of the motor holding member disposed within the inner housing part 50. The outermost transverse end portions 82 of the support elements 78 are received in upwardly-open T-shaped slots provided in inwardly extending abutments 86 spaced about the interior of the inner housing part 50. Hence, the motor is supported within the inner housing part 50 entirely by the resilient rubber support elements 78, without any contacting engagement between elements of rigid or substantially rigid material, which could transmit noise vibrations between the motor and fan and the inner housing 50. The above mentioned opening in the housing part 50 for flow of air outwardly thereof is shown at 94.

Referring now to figures 8A and 8B of the drawings, these show the inner motor housing part 50 disposed within the outer motor housing part 52, the housing parts being spaced from one another. The outer housing part 52 has a circular cup-shaped main body 100 with a cylindrical peripheral wall whose lower end is closed by an annular inwardly curved wall leading into a flat circular base. There is a circumferentially-extending opening 102 in the body 100 above the base for airflow out of the housing part. At its uppermost end the outer housing part has an outwardly extending rim part 104 and upstanding wall, which in plan view is square but with arcuate "corners". A number of mounting flanges 106 extend outwardly from the rim part 104.

The inner housing part 50 also has an outwardly extending upper rim part 92 which is square in plan view but with arcuate "corners". Beneath the rim part, the inner housing part has a cylindrical peripheral wall with a generally part-spherical inwardly curving wall leading into a flat base of a smaller diameter than that of the flat base of the outer housing part 52. Hence, there is an increased space between the inner and outer housing part, in their base regions, compared with that between their cylindrical parts.

The spacing between the inner and outer housing parts is preferably at least about 8mm or so, for effective reduction of noise emissions; if space permits, it could be greater. It is of course greater in the base regions of the housing parts, and this is helpful for noise attenuation.

The inner housing part 50 is suspended within the outer housing part 52 by four circumferentially spaced rubber support elements 90 which are generally similar, and may be substantially identical, to the support elements 82, being of generally I-shape with a radially extending portion and transverse end portions. The innermost transverse parts of the support elements 90 engage in downwardly-open undercut formations at the "corners" of the upper rim part 92 of the inner housing part 50.

Inwardly of the arcuate "corners" of the rim 104, the outer housing part is provided with formations 108 defining undercut upwardly-open recesses in which the outermost transverse parts of the support elements 90 are engaged.

Hence, the motor is held firstly by the motor holding member 58, 60 with its resilient strips of material 72 which provide a first degree of insulation against transmission of vibration and hence noise from the motor. The motor holding member is resiliently supported relative to the inner housing part 50 by the resilient support elements 82, and the inner housing part 50 is in turn resiliently supported relative to the outer housing part 52 by the support elements 90. Such support of the motor and fan provides a high degree of insulation against transmission of noise from the motor and fan to the body of the cleaner and hence contributes significantly to quiet operation of cleaner. The support elements 82 are circumferentially offset by 45° from the elements 90, which is helpful for noise and vibration isolation, and is efficient in its use of space in the vicinity of the inner and outer housing parts.

Referring now to figures 9 and 10 of the drawings, these show in more detail the transfer duct assembly 38 by which the suction airflow travels from the dust separator/collector 20 of the cleaner to the fan and motor thereof. The transfer assembly 38 comprises a first member 150 whose general configuration is that of a horn whose centre line is curved, tapering from a flange 112 at its larger end to a flange 114 at its smaller end. The flange 112 provides for securement to a further flange 116 (figure 3) which faces the top of the dust separator/collector 20 to sealingly engage with it when the dust separator is installed in position in the body of the cleaner. A pre-motor filter may be accommodated within the flange 116 above the dust separator/collector.

The transfer duct assembly 38 further comprises the fan inlet duct component 48, which comprises the straight portion 120 having a flange 122 adjacent its

lowermost end for connection to the cover 54. Above the straight portion 120, there is a curved portion 124 curving round in continuation of the tapering curved horn shape of the member 110. The curved part 124 ends at a flange 126 engaging the flange 114 face to face and secured thereto by fasteners spaced circumferentially around the two flanges. The straight portion 120 is cylindrical, and has a length which is at least twice the diameter of the fan inlet 46. This is advantageous in terms of effective performance of the cleaner, giving good airflow through the fan and associated components. If space available in the body of the cleaner permits, the straight section could be more than two times, e.g. three times, the diameter of the fan inlet. Further, the cross-sectional area of the air path through the transfer duct assembly 38 is at all positions along its length greater than or equal to the cross sectional area of the fan inlet.

It is usual for the inlet to the fan of a vacuum cleaner source of suction to be circular in shape, as is the case in the present embodiment. If, however, for some reason, e.g. for packaging reasons because of space constraints in a cleaner, it differs to some extent from an exact and complete circle such as by having one or more flattened peripheral regions or being generally elliptical, the length of the straight section of the airflow duct leading to the fan inlet may be related to the maximum diameter of the fan inlet or the length of the major axis in the case of an ellipse.

If required, the transfer duct by which the suction airflow is drawn from the dust separator/collector of the cleaner to the source of suction may be split or divided into two or more parallel-connected parts through which respective parts of the airflow travel. In referring to the cross-sectional area of the transfer duct assembly, we mean the total area for airflow, made available by such parallel-connected parts.

It will be appreciated that components above-described as separate parts secured to one another may be secured by other means, or may be combined into a lesser number of parts formed integrally with one another.

Referring now to figures 11, 12 and 13 of the drawings, these show in more detail, in relation to the entire source of suction 36, the configuration of the exhaust duct assembly 40 by which the suction airflow, having passed through the dust separator/collector, fan, motor, and motor housing parts, is conveyed to be exhausted into the ambient atmosphere.

The exhaust duct assembly comprises an upper part 132 with an opening 134 by which air exhausted from the outer housing part 52 of the motor assembly by way of its opening 102 can enter the interior of the exhaust duct. The opening 134 is surrounded by a sealing face 136 which engages the cylindrical external surface of the outer housing part 52, with a suitable gasket or other sealing element to ensure air-tightness. The duct part 132 is secured to the outer housing part 52 by screws passing through lugs 138 on the duct part 132 and screwed into lugs 140 on the exterior surface of the outer housing part. The duct part 130 curves downwardly to extend to an exhaust (post-motor) filter indicated generally at 142.

The exhaust filter 142 comprises a formation 146 in the duct part 132 which receives a slide-in filter holding member 144 which is in the form of a tray able to accommodate a filter element of any suitable type. The formation 146 has a front surface engaged by a flange 148 at the front of the filter holding member 144, and screws or any other suitable fastening method may be used to hold the filter holding member 144 in position when it is installed in the cleaner.

Access may be gained to the filter holding member 144 from the exterior of the body of the machine when the dust separator/collector has been removed therefrom. After removal of the holding screws or other fasteners by which the

filter holding member is held in engagement with the formation 146, the flange 148 may be grasped and the filter holding member be pulled forwardly to remove it from the formation 146, enabling a filter element held thereby to be washed or replaced.

Beneath the formation 146, the exhaust duct 130 is bifurcated, dividing into two parts 148, 150, which are curved to extend rearwardly and circumferentially on opposite sides of the outer housing part 52. The parts 148, 150 end in respective outlet apertures of which that for the duct part 148 is indicated at 152. The outlet apertures face grilles or other openings in the body of the cleaner; possibly they might be arranged to discharge air through centre parts of the wheels of the cleaner.

The above arrangement of the exhaust duct provides an increasing cross-sectional area for airflow from the aperture 134 at which exhaust airflow enters the duct to the outlet apertures as 152 of the duct. This assists noise reduction, by reducing the speed of airflow through the duct before it is discharged to the ambient atmosphere.

Referring now to figures 14 and 15 of the drawings, these show how the noise emitted mainly by the cleaner can further be reduced by provision of suitable sound-insulating materials on selected surfaces. Figure 14 shows that substantially all the available external surface of the inner housing part 50 may be covered with a similarly cup-shaped element 150 of such a material, e.g. a foamed plastics or like material. The transfer duct assembly 38 may be provided throughout its interior surface with a thin layer 152 of insulating material, e.g. a foamed material of higher density. The external surfaces of the duct assembly 38 may be covered with a thicker layer 154 of such material, and the part of the separator/collector assembly 20 which lies against the body 12 of the cleaner and therefore is not visible in use thereof may be covered with a similarly thick layer 156 of insulating material. The exhaust duct 130 may have a layer of a sound-insulating material (e.g. reconstituted

felt) 158 on at least some of its interior surfaces, and a relatively thick element 160 of insulating foamed material may be provided where the exhaust duct is divided into its two parts 148, 150.

Figure 15 of the drawings shows that selected external parts of the cleaner, such as the lower and upper body parts 16, 18 respectively may be provided with external elements of insulating material at 162, 164. Such elements reduce the potential for noise emission as a result of vibration of the body parts, as well as acting as bumper strips on contact regions of the cleaner.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Further features of one or more aspects of the invention are set out in the numbered clauses provided below.

Clauses

1. A source of suction for a vacuum cleaner; comprising an electric motor in driving connection with an airflow-creating fan; the motor and fan being disposed within a housing part; wherein the motor is supported in the housing part by a flexible mounting means.

2. A source of suction according to clause 1 wherein there is no rigid connection between the motor and fan on the one hand and the housing part on the other hand.

3. A source of suction according to clause 1 or clause 2 wherein the flexible mounting means comprises a number of support elements of resilient material.

4. A source of suction according to clause 3 wherein the support elements are of rubber or a rubber-like material.

5. A source of suction according to any one of the preceding clauses wherein the support elements are substantially equally spaced circumferentially about the motor having regard to its axis of rotation.

6. A source of suction according to any one of clauses 3 to 5 wherein each support element has a shape engaging with complementary formations, respectively associated with the motor and with the housing part, whereby the motor and the housing part are supported relative to one another.

7. A source of suction according to clause 6 wherein the mounting formations associated with the motor are provided on a motor holding member which holds the motor.

8. A source of suction according to clause 7 wherein the motor holding member comprises a body which embraces an external surface of the motor to hold it.

9. A source of suction according to clause 7 or clause 8 wherein one or more resilient elements are interposed between the motor holding member and the motor.

10. A source of suction according to any one of clauses 7 to 9 wherein the motor holding member comprises two or more components secured together to hold the motor therebetween.

11. A source of suction according to clause 9 or clause 10 as appendent thereto wherein said components are held together by fasteners to clamp the motor therebetween.

12. A source of suction according to any one of the preceding clauses wherein the housing part comprises an inner housing part, disposed within an outer housing part.

13. A source of suction according to clause 12 wherein the inner housing part is supported in the outer housing part by further flexible mounting means.

14. A source of suction according to clause 13 wherein the further flexible mounting means comprises further support elements of resilient material.

15. A source of suction according to clause 14 wherein the further support elements are as the support elements claimed in any one of clauses 4 to 6 engageable with complementary formations respectively associated with the inner housing part and the outer housing part.

16. A source of suction according to clause 14 or clause 15 wherein the further support elements are circumferentially offset from the support elements between the motor and inner housing part.

17. A source of suction according to any one of clauses 13 to 16 wherein the inner housing part has an opening for airflow therefrom into the outer housing part, and the outer housing part has an exhaust opening for airflow into an exhaust duct.

18. A source of suction according to any one of clauses 12 to 17 wherein the inner and outer housing parts have a spacing of at least about 8mm between peripheral wall portions thereof.

19. A source of suction according to clause 18 wherein the inner and outer housing parts have base regions providing at least parts of an increased spacing therebetween.

20. A source of suction according to clause 17, or clause 18 or clause 19 as appendent thereto, further comprising a said exhaust duct for extending from the source of suction to the exterior of the vacuum cleaner.

21. A source of suction according to clause 20 wherein the exhaust duct has a cross-sectional area for airflow which is greater at its outlet than at the entry of airflow to the passage.

22. A source of suction according to clause 20 or 21 wherein the exhaust duct has more than one airflow outlet.

23. A source of suction according to clause 22 wherein the exhaust duct is bifurcated, having two outlets for airflow.

24. A source of suction according to any one of clauses 20 to 23 wherein the exhaust duct includes an exhaust filter.

25. A source of suction according to clause 24 wherein the exhaust filter comprises a filter element insertable and removable from the exhaust duct in a direction generally transverse to a longitudinal direction of the duct at the position where the filter element is disposed.

26. A source of suction according to clause 25 wherein the filter element is disposed so as to be accessible for removal and replacement from the exterior of the cleaner.

27. A source of suction for a vacuum cleaner comprising an airflow-creating fan and a motor for driving same, and an airflow duct for flow of air to an inlet of the fan; wherein the airflow duct has a substantially straight portion leading to the inlet and whose length is from one to three times the diameter of the inlet.

28. A source of suction according to clause 27 wherein the straight portion is at least twice the diameter of the inlet.

29. A source of suction according to clause 26 or clause 27 wherein the airflow duct has a cross-sectional area at least equal to that of the fan inlet, throughout the length of the duct.

30. A vacuum cleaner incorporating a source of suction according to any one of clauses 1 to 25 and/or according to any of clauses 26 to 28.

31. A vacuum cleaner according to clause 30 wherein at least one wall portion, defining a part of a passage or space wherein air flows in use of the

cleaner, is provided on at least one of its external and internal surfaces with a covering of a sound-deadening material.

32. A vacuum cleaner wherein at least one wall portion, defining a part of a passage or space wherein air flows in use of the cleaner, is provided on at least one of its external and internal surfaces with a covering of a sound deadening material.

33. A vacuum cleaner comprising a body provided on at least one part of its exterior surface with a covering of a sound and/or vibration deadening material.

Claims

1. A vacuum cleaner wherein at least one wall portion, defining a part of a passage or space wherein air flows in use of the cleaner, is provided on at least one of its external and internal surfaces with a covering of a sound deadening material.

2. A vacuum cleaner according to claim 1 wherein the passage or space is defined by a hollow cylinder, the hollow cylinder being provided with the covering of a sound-deadening material on an interior surface and/or exterior surface thereof.

Intellectual Property Office

Application No:	GB1603229.4	**Examiner:**	Mr David J Evans
Claims searched:	1-2	**Date of search:**	10 May 2016

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-2	EP 1525838 A1 (TOSHIBA TEC KK) see abstract and noise blocking member 14d of figure 1 for example.
X	1-2	US 4435877 A1 (BERFIRLD) see abstract and figures 3 & 6 especially.
X	1-2	US 6035485 A1 (HOLSTEN) refer to abstract and figures 3 & 6.
X	1-2	GB 545531 A (HOOVER) especially see figures 1-4.
X	1-2	DE 3630710 A1 (VORWERK & INTERHOLDING) see abstract translation and figure 2.
X	1-2	JP 2010110395 A (MITSUBISHI ELECTRIC CORP) refer to abstract translation and figures 1 & 12.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A47L

The following online and other databases have been used in the preparation of this search report

EPODOC & WPI

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
A47L	0009/00	01/01/2006
A47L	0009/24	01/01/2006