

(12) UK Patent Application (19) GB (11) 2 372 431 (13) A

(43) Date of A Publication 28.08.2002

(21) Application No 0104662.2

(22) Date of Filing 24.02.2001

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(51) INT CL⁷
A47L 9/00 9/19 , B01D 46/42

(52) UK CL (Edition T)
A4F FFD FSCW
B1T TNRT

(56) Documents Cited
GB 2320419 A **GB 2315231 A**
GB 0956764 A **WO 1994/000046 A1**

(58) Field of Search
UK CL (Edition S) **A4F , B1T TNRT**
INT CL⁷ **A47L 5/22 5/28 5/36 9/10 9/12 9/19 9/28 ,**
B01D 46/10 46/18 46/20 46/42
Online: WPI, EPODOC, PAJ

(54) Abstract Title
Air bleed valve arrangement in a vacuum cleaner

(57) In a vacuum cleaner, particularly of the cyclone separator type, and having a filter immediately upstream of the inlet to the fan, an air bleed valve is provided in case the air flow becomes blocked. The invention is characterised in that a duct is provided which passes through the filter itself, and that the bleed valve is provided in this duct. The motor and fan unit 48 has a fan axis 32 a fan inlet 48a and a filter 42 immediately upstream of said inlet. An inlet duct 52 for bleed air is provided which passes through the centre of the filter, and within this is located the bleed valve 50. If the filter becomes blocked the pressure decreases within the filter housing, and the valve opens and allows air to enter via openings 54, and to pass through the duct 52 thus bypassing the filter.

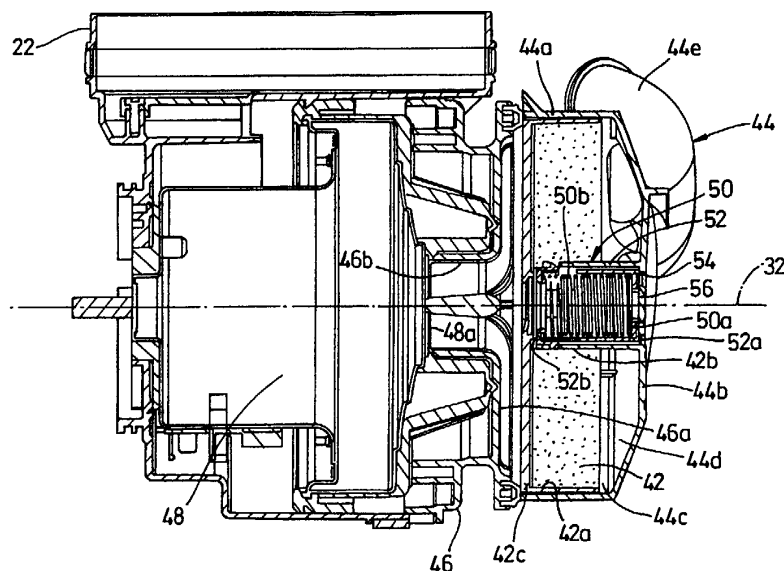


Fig. 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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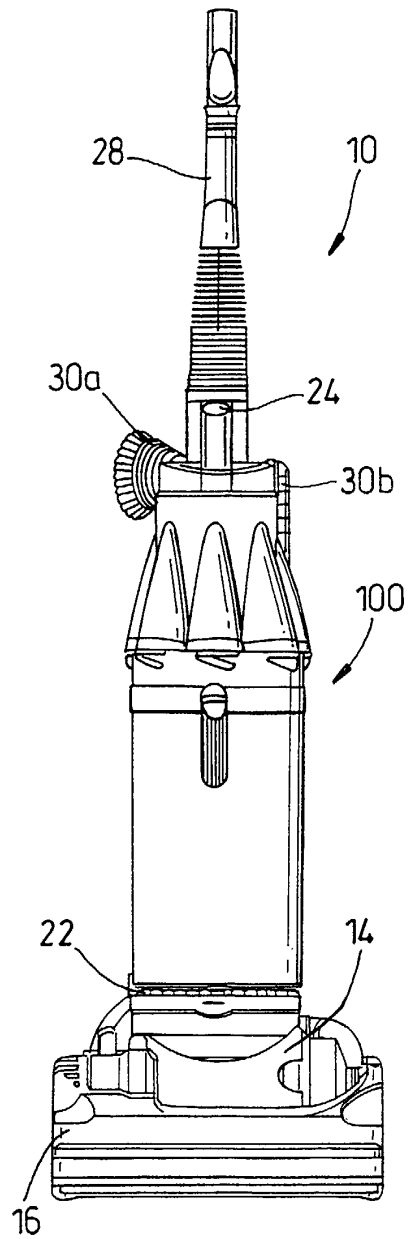


Fig. 1a

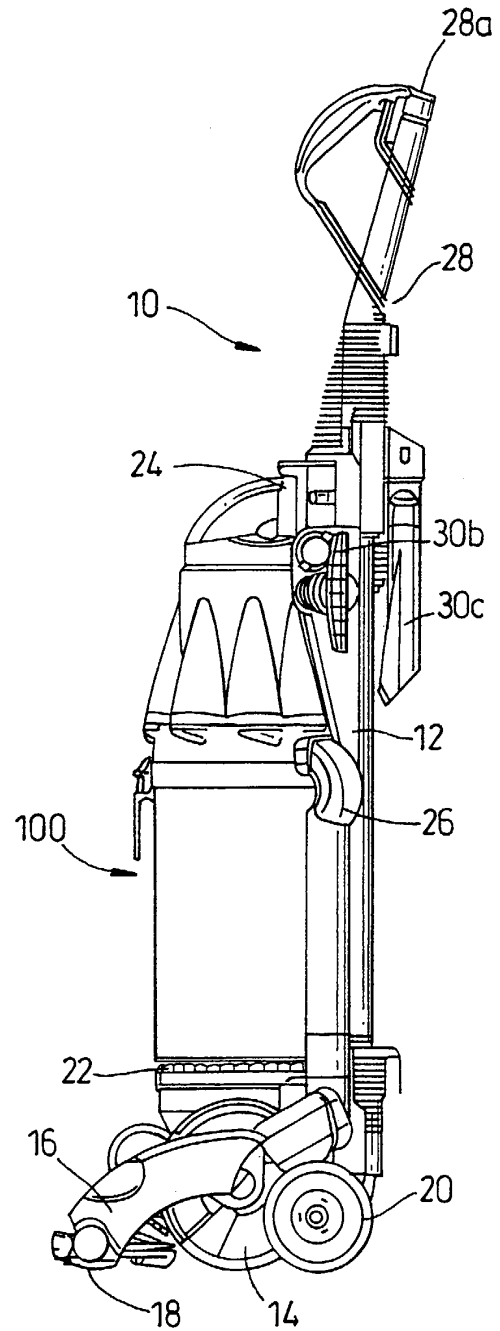
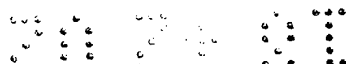
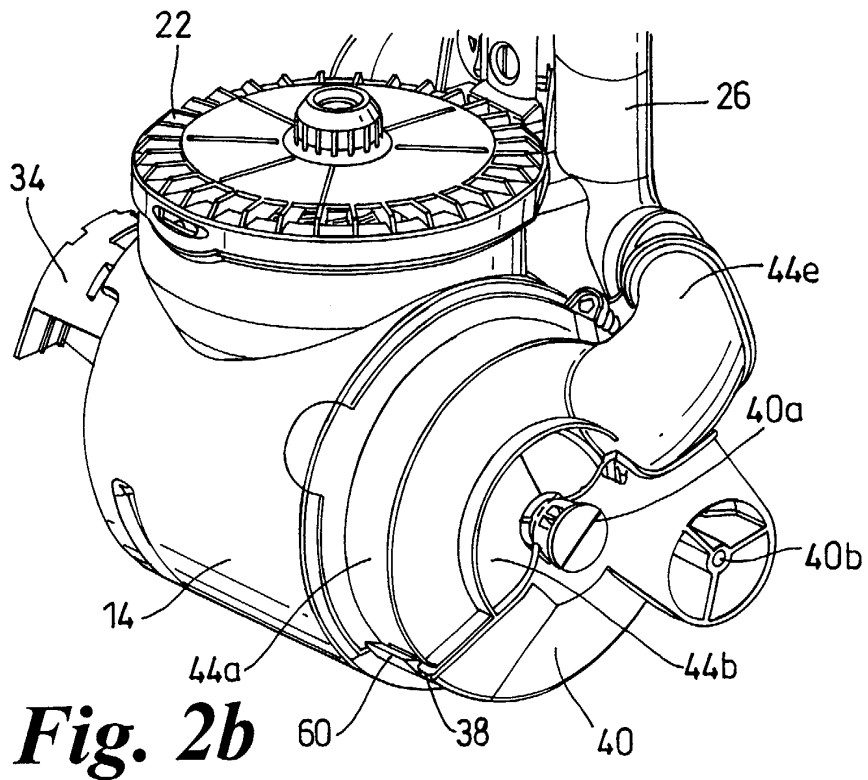
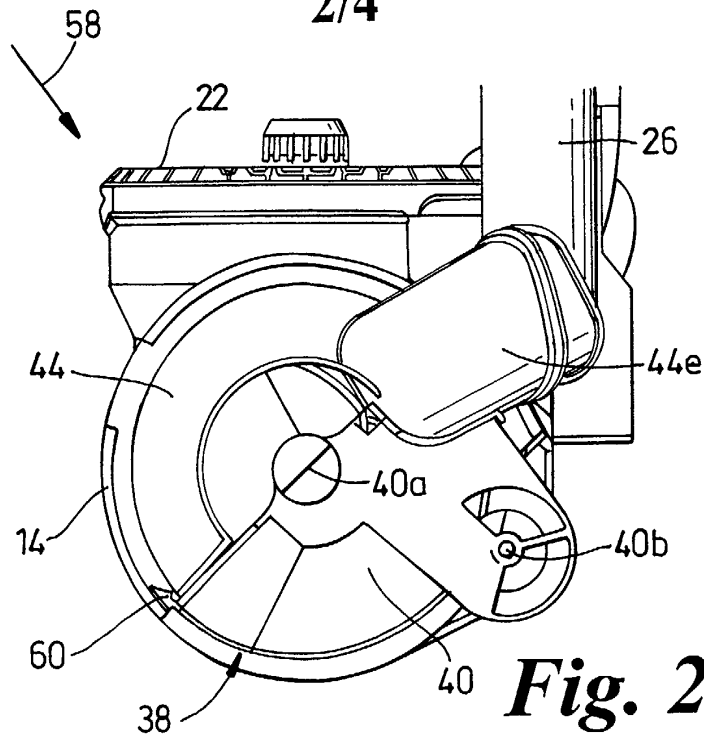


Fig. 1b

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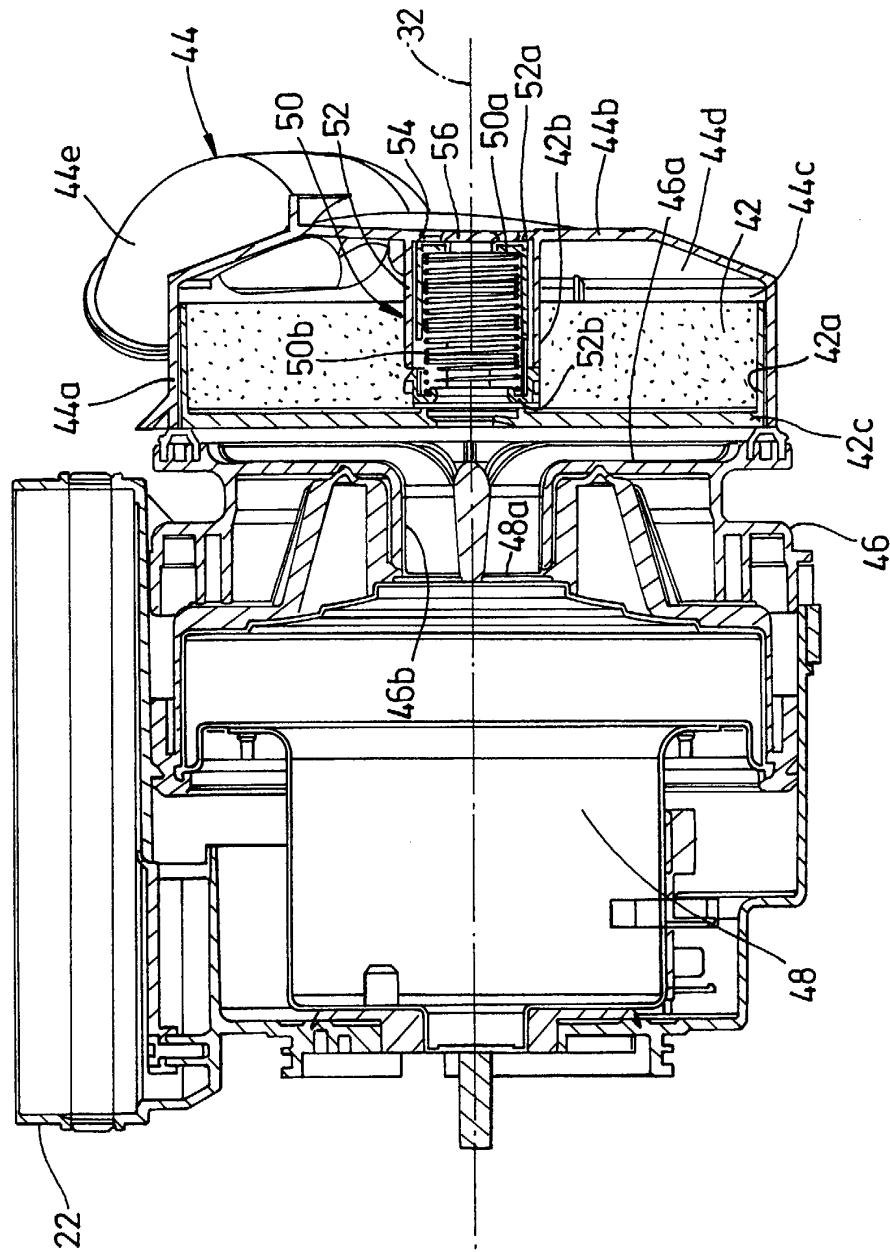


Fig. 3

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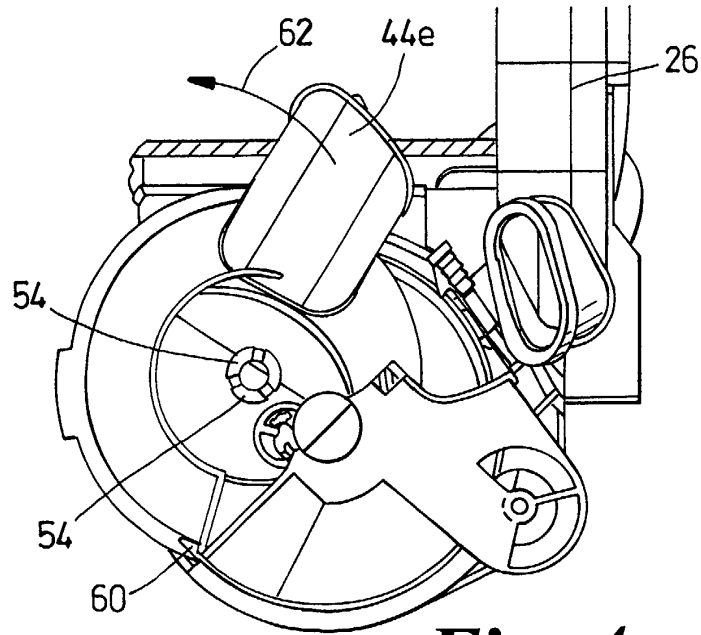


Fig. 4a

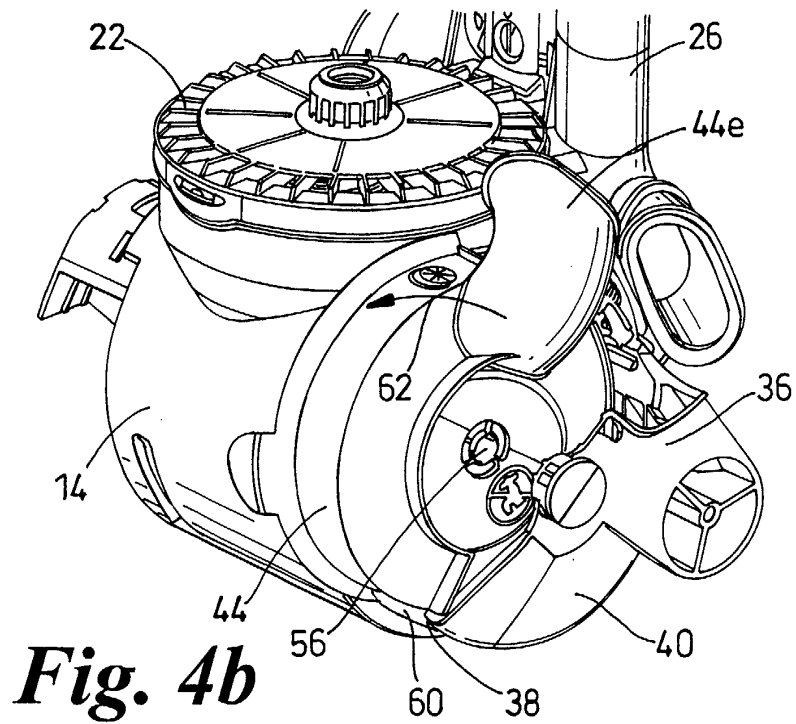


Fig. 4b

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

A Domestic Appliance

The invention relates to a domestic appliance. Particularly, but not exclusively, the invention relates to a vacuum cleaner and more particularly to a domestic vacuum cleaner.

Vacuum cleaners are required to separate dirt and dust from an airflow in order to effect the cleaning of an environment, commonly a domestic environment. Dirt- and dust-laden air is sucked into the appliance via either a floor-engaging cleaner head or a tool connected to the end of a hose and wand assembly and passed to a device for removing from the airflow as much dirt and dust as possible before the cleaned air is exhausted to atmosphere. Very many vacuum cleaners make use of a porous bag through which the dirty air is sucked so that the dirt and dust is retained in the bag whilst cleaned air is exhausted to the atmosphere. In other vacuum cleaners, cyclonic separators are used to separate dirt and dust from the airflow (see, for example, EP 0 042 723). Whichever type of separator is employed, there is commonly a risk of a small amount of dust passing through the separator and being carried to the fan and motor unit, which is used to create the flow of air through the vacuum cleaner whilst it is in operation. The exiting airflow is also made to flow past the motor so as to cool the motor and therefore the optimum operation of the motor is dependent on the airflow being maintained.

It is not desirable that dirt and dust particles are allowed to pass through the fan when the fan is arranged downstream of the separating apparatus of a vacuum cleaner because the fan could become damaged or unbalanced. In order to prevent this happening, some vacuum cleaners include a fine filter, separate from the main dirt and dust collecting apparatus, located between the separating apparatus and the fan (see, for example, GB 2 320 419 and EP 0 366 295). This is termed a “pre-motor filter” and extracts any fine dust particles remaining in the airflow after it has passed through the separating apparatus. Hence the risk of fine dust particles entering the fan is essentially eliminated.

It is known to provide a bleed valve in a vacuum cleaner which will introduce air into the airflow path upstream of the fan, should the airflow path become blocked, so as to maintain the amount of air passing the motor and thus prevent the motor from overheating (see DE 2 726 467). Normally, such bleed valves are provided downstream of the main dirt- and dust- separating apparatus because it is perceived that it will be the main dirt- and dust- separating apparatus which will become clogged or blocked. The presence of a pre-motor filter between the separating apparatus and the fan and motor unit carries with it, however, a risk that the pre-motor filter itself will become clogged or blocked after a period of use. It is also desirable for the pre-motor filter to be located as close as possible to the fan and motor unit and directly upstream of the inlet to the fan for packaging reasons. Such close proximity of the pre-motor filter to the fan and motor unit then prevents a bleed valve from being located between the pre-motor filter and the fan. Hence, if a pre-motor filter is provided immediately upstream of the fan and the pre-motor filter becomes blocked, there is no way of effectively introducing air into the fan downstream of the pre-motor filter.

An object of the present invention is to provide a domestic appliance having a motor and fan unit for creating a flow of air through the appliance and a filter arranged immediately upstream of the fan inlet, in which the risk of overheating of the motor due to blocking of the filter is minimised. Another object of the invention is to provide a domestic appliance in which the disadvantages of the prior art are reduced or eliminated. A further object of the invention is to provide an improved vacuum cleaner.

The invention provides a domestic appliance having a motor and fan unit for creating a flow of air through the appliance and an airflow path for conducting the flow of air from an air inlet to the motor and fan unit, wherein the motor and fan unit has a fan axis and a fan inlet and a filter is arranged in the airflow path immediately upstream of the fan inlet, and wherein a bleed valve is located and arranged so as to introduce bled air directly into the fan inlet via an inlet duct which passes through the filter. The introduction of the bled air along a duct which passes through the filter allows the bleed valve to be located in a position which does not require it to be placed physically

between the pre-motor filter and the fan and motor unit. Hence any packaging constraints which may be in place need not prevent the provision of a bleed valve which will function so as to protect the motor. This results in improved reliability of the appliance because the risk of overheating of the motor is reduced in a situation where, otherwise, a higher risk would have to be accepted.

Preferably, the inlet duct is coaxial with the axis of the fan. This ensures that the bleed air is introduced directly into the eye of the fan without being required to follow a tortuous path.

More preferably, the filter is arranged in a housing which is advantageously releasable from the remainder of the domestic appliance, the release being preferably effected by sliding or rotational movement in a direction which is substantially perpendicular to the axis of the fan. This arrangement is convenient and effective and can be put into practice without the need for complex or expensive components.

Further and advantageous features of the invention are set out in the subsidiary claims.

An embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figures 1a and 1b (collectively, Figure 1) are front and side views, respectively, of a domestic appliance according to the invention;

Figures 2a and 2b (collectively, Figure 2) are side and perspective views, respectively, of a portion of the appliance of Figure 1;

Figure 3 is a sectional view, taken along the line III-III of Figure 2a, of some of the components of the portion of the appliance shown in Figure 2; and

Figures 4a and 4b (collectively, Figure 4) are side and perspective views, similar to Figures 2a and 2b respectively, illustrating the removal of a component of the appliance.

Figures 1a and 1b show a domestic appliance according to the present invention in the form of a vacuum cleaner 10 incorporating cyclonic separating apparatus 100. The vacuum cleaner 10 comprises an upstanding body 12 at a lower end of which is located a motor casing 14 which houses a motor and fan unit. A cleaner head 16 is mounted in a freely articulated fashion on the motor casing 14. A suction inlet 18 is provided in the cleaner head 16 and wheels 20 are rotatably mounted on the motor casing 14 to allow the vacuum cleaner 10 to be manoeuvred over a surface to be cleaned.

The cyclonic separating apparatus 100 is mounted on the upstanding body 12 above the motor casing 14. The cyclonic separating apparatus 100 is seated on a generally circular, horizontal surface formed by a filter cover 22. The filter cover 22 is located above the motor casing 14 and provides a cover for a post-motor filter (not shown). The post-motor filter is provided in order to prevent any particles emanating from the motor from being released to the atmosphere. The cyclonic separating apparatus 100 is also secured to the upstanding body 12 by means of a clip 24 located at the top of the cyclonic separating apparatus 100. The upstanding body 12 incorporates upstream ducting (not shown) for carrying dirty air to an inlet of the cyclonic separating apparatus 100 and downstream ducting 26 for carrying cleaned air away from the cyclonic separating apparatus 100.

The upstanding body 12 further incorporates a hose and wand assembly 28 which may be retained in the configuration shown in the drawings so as to function as a handle for manoeuvring the vacuum cleaner 10 over a surface to be cleaned. Alternatively, the hose and wand assembly 28 may be released to allow the distal end 28a of the wand to be used in conjunction with a floor tool (not shown) to perform a cleaning function, eg on stairs, upholstery, etc. The structure and operation of the hose and wand assembly 28 is not material to the present invention and will not be described any further here, other than to say that the general structure and operation of the hose and wand assembly

28 illustrated in Figures 1a and 1b is similar to that described in US patent number Re 32,257 which is incorporated herein by reference. Also, several tools and accessories 30a, 30b, 30c, are releasably mounted on the upstanding body 12 for storage purposes between periods of use.

In order for the vacuum cleaner 10 to be brought into operation, the motor located in the motor casing 14 is activated so that dirty air is drawn into the vacuum cleaner via either the suction inlet 18 or the distal end 28a of the hose and wand assembly 28. This dirty air (being air having dirt and dust entrained therein) is passed to the cyclonic separation apparatus 100 via the upstream ducting. After the air has passed through the cyclonic separation apparatus 100, it is ducted out of the cyclonic separating apparatus 100 and down the upstanding body 12 to the motor casing 14 via the downstream ducting 26. The cleaned air is used to cool the motor located in the motor casing 14 before being exhausted from the vacuum cleaner 10 via the filter cover 22. The combination of the inlet formed by either the hose and wand assembly 28 or the cleaner head 16, the upstream ducting, the cyclonic separating apparatus 100 and the downstream ducting 26 forms an airflow path within the vacuum cleaner 10 for conducting the flow of air from an air inlet to the motor and fan unit.

The present invention is concerned with the arrangement of the airflow path immediately upstream of the motor casing 14. As can be seen from Figures 1, 2 and 3, the motor casing 14 is generally cylindrical in shape and is arranged so that the longitudinal axis 32 of the motor casing 14 lies generally horizontally and extends laterally across the cleaner head 16. Integrally moulded with the motor casing 14 on one side thereof are mouldings 34 designed and adapted to accommodate a duct (not shown) for carrying dirty air entering the vacuum cleaner 10 via the suction opening 18 in the cleaner head 16. The mouldings 34 also provide one point of support for the cleaner head 16 and a further point of support for one of the wheels 20. These features do not form part of the present invention and will not be described any further here.

On the side of the motor casing 14 remote from the mouldings 34, a filter-receiving portion 36 is provided. The filter-receiving portion 36 is integrally moulded with the motor casing 14 and projects away therefrom in the direction of the axis 32. The filter-receiving portion 36 has a generally part-cylindrical side wall 38, which extends generally parallel to the axis 32, and an end portion 40. The end portion 40 incorporates a second point of support 40a for the cleaner head 16 and a second point of support 40b for the second wheel 20. The configuration of the filter-receiving portion 36 is such that a recess is provided, the recess being open on the uppermost side thereof, so that a filter 42 and a housing 44 therefor may be received and supported in the filter-receiving portion 36. A circular divider portion 46 is provided between the motor casing 14 and the filter-receiving portion 36, the divider portion 46 essentially defining the boundary between the two aforesaid features.

The filter 42 may be a composite filter or may be formed from any other suitable filter material. It may be washable if desired and may also include a layer of HEPA grade filter material. The filter 42 shown here is annular in shape, having a cylindrical outer surface 42a and a cylindrical aperture 42b therethrough. The filter 42 may include a plastics collar 42c, particularly if the filter 42 is a composite, washable filter.

A filter housing 44 surrounds the filter 42. The filter housing 44 is generally cylindrical in shape having a cylindrical wall 44a and an end wall 44b. The cylindrical wall 44a and the end wall 44b between them define an interior cavity 44c which is capable of receiving the filter 42 and which also provides an upstream chamber 44d between the filter 42 and the end wall 44b. The filter housing 44 also has a ducting portion 44e which is provided on the end wall 44b and which communicates with the upstream chamber 44d. The external dimensions of the filter housing 44 are such that the filter housing 44 is able to be received without play in the filter-receiving portion 36. Hence, when the filter 42 is placed inside the filter housing 44 and the filter housing 44 is located within the filter-receiving portion 36, the filter 42 is located immediately upstream of the divider portion 46. The ducting portion 44e is shaped and configured so that, when the filter housing 44 is located in the filter-receiving portion 36, the ducting

portion 44e abuts sealingly against and communicates with the lower end of the downstream ducting 26 (see Figure 2).

The divider portion 46 includes a circular upstream surface 46a in which is located a central aperture 46b. When the fan and motor unit 48 is located in the motor housing 14, it adopts the position relative to the divider portion 46 as shown in Figure 3. As can be seen, the central aperture 46b leads directly into the fan inlet 48a of the fan and motor unit 48. As can also be seen from Figure 3, the fan rotates about the same axis 32 as that of the motor casing 14.

A bleed valve 50 is provided in the filter housing 44. The bleed valve 50 is housed in a duct 52 provided in the filter housing 44 and extending axially from the end wall 44b towards the divider plate 46. The duct 52 lies coaxially with the axis 32 of the motor casing 14 and extends as far as the free edge of the side wall 44a. Hence, when the filter 42 is located within the interior cavity 44c, the duct extends through the whole of the filter 42 and opens downstream thereof. The upstream end of the duct 52 is open to atmosphere via a plurality of apertures 54 forming a generally annular slot in the centre of which is formed a plug 56. The diameter of the generally annular slot is slightly less than the internal diameter of the duct 52.

The bleed valve 50 comprises a valve head 50a which is cup-shaped and adapted to abut in a sealing manner on one side against the end wall 44b so as to close the apertures 54. The valve head 50a has a central aperture of the same diameter as the plug 56. When the valve head 50a is pressed against the end wall 44b, the plug closes the central aperture of the valve head 50a. One end of a compression spring 50b is seated against the side of the valve head 50a remote from the end wall 44b. The other end of the compression spring 50b is seated against an inwardly projecting shaping 52b formed in the downstream end of the duct 52. The strength of the spring 50b is selected so that, when a pressure drop sufficient to indicate that the filter is blocked occurs across the pre-motor filter 42, the valve head 50a is able to move against the bias of the compression spring 50b.

When the vacuum cleaner 10 is operated under normal conditions, the motor and fan unit 48 is operated causing the fan to rotate about the axis 32. Dirty air is thus drawn into the vacuum cleaner 10 via one of the dirty air inlets, ie. either through the suction opening 18 in the cleaner head 16 or through the distal end 28a of the wand and hose assembly 28. The dirty air is passed to the cyclonic separating apparatus 100 via the upstream ducting and dirt and dust is separated from the airflow in the cyclonic separating apparatus 100. The cleaned air then travels down the downstream ducting 26 and passes along the ducting portion 44e of the filter housing 44. The air then enters the upstream chamber 44d and then passes through the pre-motor filter 42 before entering the fan inlet via the central aperture 46b of the divider portion 46. Any dirt and dust particles entrained within the airflow are thus retained in the pre-motor filter 42 so that the risk of damage to or unbalancing of the fan is minimised. The air passes around the motor and fan unit 48 before exiting the vacuum cleaner via a post-motor filter housed beneath the filter cover 22. As previously explained, the post-motor filter is provided so as to prevent any particles generated within the motor from being emitted to the atmosphere.

If the pre-motor filter 42 becomes clogged or blocked so that insufficient cooling air passes to the motor, the pressure drop across the pre-motor filter 52 will increase. The valve head 50a will then move away from the end wall 44b so as to open an airway along the duct 52. Atmospheric air is then allowed to pass through the apertures 54, through the central aperture in the valve head 50a and along the duct 52 so as to enter the airflow path immediately upstream of the motor and fan unit 48. The bled air then passes along the central aperture 46b of the divider portion 46 and directly into the motor and fan unit 48. Indeed, the atmospheric air which is bled into the vacuum cleaner 10 is introduced directly to the fan inlet 48a at the eye of the fan. This has the distinct advantage that the bled air is introduced to the motor along a very direct path having no tortuous bends so that any required cooling is provided as quickly as possible.

Figure 4 illustrates the manner in which the filter housing 44 may be introduced to and released from the filter-receiving portion 36. A simple method of achieving this would be simply to move the filter housing 44 in a lateral direction indicated by arrow 58 in Figure 2a. However, it is preferable to provide a more reliable method of locating the filter housing quickly and accurately in the filter-receiving portion 36. To this end, a projection 60 is provided on the cylindrical wall 44a of the filter housing 44 in a position which allows the projection 60 to abut against the edge of the side wall 38 of the filter-receiving portion 36. In this way, the filter housing 44 can be pivotally moved with respect to the filter-receiving portion 36 about the point of contact between the projection 60 and the cylindrical wall 38. The movement then required to release the filter housing from the filter-receiving portion 36 is illustrated by arrows 62 in Figures 4a and 4b. The ducting portion 44e provides a convenient gripping portion by means of which the filter housing 44 can be moved into and out of the filter-receiving portion 36. Also, a clip, snap-fit release means or other suitable retainer can be provided to ensure that the filter housing 44 remains held fixed in position at all times at which this is required.

The scope of the present invention is not to be restricted to the precise details of the embodiment described above. It will be apparent to a skilled reader that various modifications can be made without departing from the spirit of the invention. For example, the size and shape of the filter 42 can be any convenient or desirable shape and its precise proximity to the motor and fan unit need not be restricted. Furthermore, it is to be understood that the nature of the separating apparatus is immaterial to the present invention and that other details of the vacuum cleaner described and which are not relevant to the present invention may be altered or omitted without detriment.

Claims:

1. A domestic appliance having a motor and fan unit for creating a flow of air through the appliance and an airflow path for conducting the flow of air from an air inlet to the motor and fan unit, wherein the motor and fan unit has a fan axis and a fan inlet and a filter is arranged in the airflow path immediately upstream of the fan inlet, and wherein a bleed valve is located and arranged so as to introduce bled air directly into the fan inlet via an inlet duct which passes through the filter.
2. A domestic appliance as claimed in claim 1, wherein the inlet duct is coaxial with the axis of the fan.
3. A domestic appliance as claimed in claim 1 or 2, wherein the filter is cylindrical and lies coaxially with the fan.
4. A domestic appliance as claimed in any one of the preceding claims, wherein the filter is arranged in a housing having walls which delimit part of the airflow path.
5. A domestic appliance as claimed in claim 4, wherein the housing is releasable from the remainder of the domestic appliance to allow access to the filter.
6. A domestic appliance as claimed in claim 5, wherein the housing is releasable from the remainder of the domestic appliance by sliding or rotational movement in a direction which is substantially perpendicular to the axis of the fan.
7. A domestic appliance as claimed in any one of claims 4 to 6, wherein the bleed valve is located in the housing so as to be removable from the appliance therewith.
8. A domestic appliance as claimed in any one of the preceding claims, wherein the bleed valve is adapted to open so as to bleed air into the fan inlet when the airflow pressure downstream of the filter falls below a predetermined value.

9. A domestic appliance as claimed in any one of the preceding claims, wherein the domestic appliance is a vacuum cleaner.

10. A domestic appliance as claimed in claim 9, wherein cyclonic separating apparatus is located in the airflow path for separating dirt and dust from the air flowing through the appliance.

11. A domestic appliance substantially as hereinbefore described with reference to the accompanying drawings.



Application No: GB 0104662.2
Claims searched: 1-12

12 Examiner: John Wilson
Date of search: 9 May 2001

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.S): A4F; B1T [TNRT]
Int Cl (Ed.7): A47L 5/22 5/28 5/36 9/10 9/12 9/19 9/28; B01D 46/10 46/18 46/20 46/42
Other: Online:- WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2320419 A Notetry - whole document	
A	GB 2315231 A Notetry - whole document	
A	GB 956764 Licentia Patent - whole document	
A	WO 94/00046 A1 Notetry - whole document	

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.