



(51) International Patent Classification:

B01D 46/00 (2006.01) F04D 29/62 (2006.01)
B01D 46/02 (2006.01) F04D 29/64 (2006.01)
B01D 46/10 (2006.01) F04D 29/70 (2006.01)
F04D 25/08 (2006.01) F04F 5/16 (2006.01)
F04D 29/40 (2006.01)

(21) International Application Number:

PCT/GB2019/050093

(22) International Filing Date:

14 January 2019 (14.01.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1800982.9 22 January 2018 (22.01.2018) GB

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: A FAN ASSEMBLY WITH A PARTICULATE FILTER, AN ACTIVATED CARBON FILTER AND A CATALYST FOR OXIDATIVE DECOMPOSITION OF VOLATILE ORGANIC COMPOUNDS

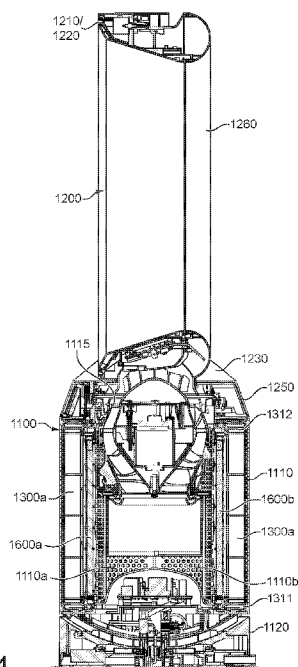


FIG. 4

(57) Abstract: The present invention provides a fan assembly comprising a fan body comprising an air inlet, a motor-driven impeller contained within the fan body and arranged to generate an airflow, a nozzle mounted on and supported by the fan body, the nozzle being arranged to receive the airflow from the fan body and to emit the airflow from the fan assembly, a particulate filter media mounted on the fan body over the air inlet, and a catalyst for oxidative decomposition of volatile organic compounds that is supported on the fan assembly downstream of the particulate filter media.



MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

**A FAN ASSEMBLY WITH A PARTICULATE FILTER, AN ACTIVATED CARBON FILTER AND
A CATALYST FOR OXIDATIVE DECOMPOSITION OF VOLATILE ORGANIC COMPOUNDS**

FIELD OF THE INVENTION

The present invention relates to a fan assembly and a filter assembly arranged to be mounted
5 over the air inlet of a fan assembly.

BACKGROUND OF THE INVENTION

An air purifier is a device which removes contaminants from the air. Conventional air purifiers
solely use particulate filters that physically capture airborne particles by size exclusion, with a
10 high-efficiency particulate air (HEPA) filter removing at least 99.97% of 0.3 µm particles. More
advanced air purifiers might also make use of additional technologies to remove additional
contaminants. For example, some more advanced air purifiers use ultra-violet (UV) light to kill
microorganisms, such as viruses, bacteria and moulds, which may be present in the air.

15 Some air purifiers use activated carbon filters to filter volatile chemicals from the air. Activated
carbons are well known carbonaceous materials that are processed to have a large number of
open or accessible micropores and mesopores that increase the surface area available for
adsorption or chemical reactions. For example, WO2016/128734 describes a fan assembly that
has a tubular, barrel-type filter that is mounted on the cylindrical body of the fan assembly, The
20 filter comprises a two-layer structure of filter media that includes an outer layer of a pleated
HEPA filter surrounding an inner layer of activated carbon cloth.

Whilst activated carbon filters can be quite effective against some of the large volatile organic
compounds (VOCs), they do not provide an effective means of removing smaller, more
25 polarised compounds. For example, formaldehyde (CH₂O) is one such compound, the levels of
which are of growing international concern due to the associated health risks, particularly in
relation to indoor air. In addition, when used for air purification, activated carbons filter out
contaminants by adsorption, and therefore only have a limited capacity, such that activated
carbon filters eventually require replacement or regeneration if filtering performance is to be
30 maintained.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide air purifying fan assembly that can remove volatile organic compounds (VOCs) without detrimentally impacting on other aspects of the purification and/or air delivery performance of the air purifying fan assembly. To do so, according to a first aspect the present invention provides a fan assembly comprising a fan body comprising an air inlet, a motor-driven impeller contained within the fan body and arranged to generate an airflow, a nozzle mounted on and supported by the fan body, the nozzle being arranged to receive the airflow from the fan body and to emit the airflow from the fan assembly, a particulate filter media mounted on the fan body over the air inlet, and a catalyst for oxidative decomposition of volatile organic compounds that is supported on the fan assembly downstream of the particulate filter media.

By incorporating a catalyst that is capable of oxidative decomposition of volatile organic compounds at ambient temperature, the present invention provides an air purifying fan assembly that can permanently oxidise VOCs, such as formaldehyde, to carbon dioxide (CO₂) using atmospheric oxygen. This approach has many benefits over the conventional solution of using carbon capture as it overcomes the issues of saturation and the potential for off-gassing of a harmful compound.

The catalyst may be supported directly on the fan assembly. In this case, the catalyst may be attached to one or more surfaces of the fan assembly that are on a path along which air flows through the fan assembly. Preferably, the catalyst is attached to a surface of the fan body that provides the air inlet. The air inlet may be provided by a perforated section/portion of the fan body and the catalyst may then be attached to the perforated section/portion of the fan body.

The catalyst may be provided in the form of particles. A plurality of the catalytic particles may then be attached using adhesive. Alternatively, a plurality of the catalytic particles may be partially embedded in one or more surfaces of the fan assembly. For example, this could be achieved using a melt-adhering process.

The catalyst may be supported on an air permeable substrate that is mounted to the fan assembly on a path along which air flows through the fan assembly. Preferably, the catalyst is mounted on the fan body over the air inlet. The air permeable substrate may be mounted to an internal surface of the fan body and the particulate filter media is then mounted on an external surface of the fan body over the air inlet. Alternatively, the air permeable substrate may be mounted on an external surface of the fan body over the air inlet and the particulate filter media is then mounted on the fan body over the air permeable substrate.

The catalyst may be provided in the form of particles and a plurality of the catalytic particles are then mounted on or embedded within the air permeable substrate. The plurality of catalytic particles may be mounted on a surface of the air permeable substrate. Alternatively, the plurality of catalytic particles may be laminated between a first layer of the air permeable substrate and a
5 second layer of the air permeable substrate. Alternatively, the plurality of catalytic particles may be dispersed throughout the air permeable substrate.

The air permeable substrate may any of a nonwoven fabric material and a foam material. The air permeable substrate may comprise a polymer foam material (e.g. polyurethane foam) and
10 the plurality of catalytic particles may be dispersed throughout the foam. The air permeable substrate may be provided by an inner filter assembly, the inner filter assembly comprising a filter frame supporting the substrate.

The particulate filter media may be provided by an outer filter assembly, the outer filter
15 assembly comprising a filter frame supporting the particulate filter media. The outer filter assembly may comprise a filter seal that is arranged to engage the fan body to prevent air from passing around the edges of the outer filter assembly. The filter seal may extend around the entire periphery of the filter frame. The particulate filter media may be arranged so as to cover an entirety of an area defined within the periphery the filter frame. The outer filter assembly may
20 be arranged to cover/extend over an entirety of the air inlet of the fan body (e.g. cover/extend over an entirety of an area over which the air inlet extends). Preferably, the particulate filter media comprises a high-efficiency particulate air (HEPA) particulate filter media.

The outer filter assembly may be releasably attached to the main body. The outer filter
25 assembly may further comprise a shroud mounted over the outer filter assembly. Preferably, the shroud is releasably attached to the outer filter assembly.

The fan assembly may further comprise an activated carbon filter media mounted on the fan
body downstream of the particulate filter media and upstream of the catalyst. The activated
30 carbon filter media may be provided by the outer filter assembly. The activated carbon filter media may then be supported by the filter frame of the outer filter assembly. The particulate filter media may then have an inner face that faces towards the fan body when the outer filter assembly is mounted on the fan body and the activated carbon filter media is then mounted adjacent to the inner face of the particulate filter media.

The fan assembly may further comprise an intermediate filter assembly mounted on the fan
body over the air inlet and covered by the outer filter assembly, wherein the intermediate filter
35

assembly comprises the activated carbon filter media. Preferably, the intermediate filter assembly is releasably attached to any of the main body and the outer filter assembly.

The catalyst may comprise one or more of a transition metal supported on a substrate and a non-noble metal oxide. The non-noble metal oxide may comprise a non-noble metal selected from manganese, copper, cobalt, chromium, titanium, cerium, zirconium, vanadium and iron. The catalyst may comprise a manganese oxide. The transition metal may be one or more of ruthenium (Ru), rhodium (Rh), palladium (Pd), silver (Ag), osmium (Os), iridium (Ir), platinum (Pt), gold (Au), rhenium (Re), molybdenum (Mo), vanadium (V), iron (Fe), and manganese (Mn), and is preferably one or more of palladium (Pd), platinum (Pt), and gold (Au). The substrate may be any of a metal oxide, a semimetal oxide and carbon. The substrate may comprise a metal or semimetal selected from cerium (Ce), zirconium (Zr), titanium (Ti), silicon (Si), tin (Sn), aluminium (Al), vanadium (V), iron (Fe), manganese (Mn) and lanthanum (La), and is preferably any of cerium (Ce), titanium (Ti), aluminium (Al), and vanadium (V). Preferably, the catalyst comprises any of platinum on alumina (Pt/Al₂O₃), platinum on titania (Pt/TiO₂) and gold on cerium oxide (Au/CeO₂).

According to a second aspect there is provided a fan assembly comprising a fan body comprising an air inlet, a motor-driven impeller contained within the fan body and arranged to generate an airflow, and a nozzle mounted on and supported by the fan body, the nozzle being arranged to receive the airflow from the fan body and to emit the airflow from the fan assembly. The fan assembly further comprises an inner filter assembly mounted on the fan body over the air inlet and an outer filter assembly mounted on the fan body over the inner filter assembly, wherein the outer filter assembly comprises a particulate filter media and the inner filter assembly comprises a catalyst for oxidative decomposition of volatile organic compounds.

The outer filter assembly may further comprise an activated carbon filter media. Preferably, the activated carbon filter media is upstream of the particulate filter media. The fan assembly may further comprise an intermediate filter assembly mounted on the fan body over the inner filter assembly and covered by the outer filter assembly, the intermediate filter assembly comprising an activated carbon filter media. The inner filter assembly may comprise an air-permeable substrate and the catalyst is provided in the form of a plurality of catalytic particles that are mounted on or embedded within the air permeable substrate.

According to a third aspect there is provided a filter assembly arranged to be mounted over the air inlet of a fan assembly. The filter assembly comprises a filter frame supporting an air-permeable substrate and a plurality of the particles that are mounted on or embedded within the

air permeable substrate, wherein the particles consist of a catalyst for oxidative decomposition of volatile organic compounds.

The plurality of catalytic particles may be mounted on a surface of the air permeable substrate.

- 5 Alternatively, the plurality of catalytic particles may be laminated between a first layer of the air permeable substrate and a second layer of the air permeable substrate. Alternatively, the plurality of catalytic particles may be dispersed throughout the air permeable substrate.

- 10 The air permeable substrate may comprise any of a nonwoven fabric material and a foam material. The air permeable substrate may comprise a polymer foam material (e.g. polyurethane foam) and the plurality of catalytic particles may be dispersed throughout the foam.

- 15 According to a fourth aspect there is provided a method of manufacturing a filter assembly that is arranged to be mounted over the air inlet of a fan assembly. The method comprises mounting on or embedding within an air-permeable substrate a plurality of particles, wherein the particles consist of a catalyst for oxidative decomposition of volatile organic compounds. The method may further comprise mounting the air-permeable substrate on to a filter frame.

- 20 The plurality of the catalytic particles may be attached using adhesive. The method may then comprise applying an adhesive to the surface of the air-permeable substrate and then disposing the plurality of particles onto the adhesive. Alternatively, the plurality of the catalytic particles may be embedded in one or more surfaces of the fan body, for example, using a melt-adhering process.

- 25 The plurality of the catalytic particles may be embedded within the air-permeable substrate by lamination. The method may then comprise disposing the plurality of particles on to a first layer of the air-permeable substrate, disposing a second layer of the air-permeable substrate over the plurality of particles disposed on the first layer, and bonding together the first layer and second layer of the air-permeable substrate so that the plurality of particles are retained between the
30 first layer and second layer of the air-permeable substrate.

- The plurality of the catalytic particles may be embedded within the air-permeable substrate by air-laying. The method may then comprise forming a first web of fibres, disposing the plurality of particles into the first web of fibres, forming a second web of fibres on the first web of fibres, and
35 bonding together the first web of fibres and the second web of fibres to form the air-permeable substrate with the plurality of particles disposed within the air-permeable substrate.

BRIEF DESCRIPTION OF THE INVENTION

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1a is a schematic illustration of a first example of a process for attaching catalytic particles to a fan body;

Figure 1b is a schematic illustration of a second example of a process for attaching catalytic particles to a fan body;

Figure 2a is a schematic illustration of a first example of a process for manufacturing a catalytic oxidation filter;

Figure 2b is a schematic illustration of a second example of a process for manufacturing a catalytic oxidation filter;

Figure 2c is a schematic illustration of a third example of a process for manufacturing a catalytic oxidation filter;

Figure 3a is a front view of an embodiment of a fan assembly;

Figure 3b is a right side view of the fan assembly of Figure 3a;

Figure 4 is a right side cross-section view, taken along line A- A in Figure 3a;

Figure 5 is an enlarged view of a portion of the cross-section view of Figure 4;

Figure 6 is a perspective view of a main body section of the fan assembly of Figures 3a and 3b;

Figure 7a is a perspective view of an inner filter assembly of the fan assembly of Figures 3a and 3b;

Figure 7b is a rear view of the inner filter assembly of Figure 7a;

Figure 7c is a top view of the inner filter assembly of Figure 7a;

Figure 7d is an exploded view of the inner filter assembly of Figure 7a;

Figure 8 is a rear perspective view of an outer filter assembly of the fan assembly of Figures 3a and 3b; and

Figure 9 is a rear perspective view of a perforated shroud of the fan assembly of Figures 3a and 3b.

DETAILED DESCRIPTION OF THE INVENTION

There will now be described an air purifying fan assembly that can remove and destroy volatile organic compounds (VOCs), particularly single carbon VOCs such as formaldehyde, formic acid, methanol etc. The term "fan assembly" as used herein refers to a fan assembly configured to generate and deliver an airflow for the purposes of thermal comfort and/or environmental or climate control HVAC (Heating, Ventilating, and Air Conditioning) systems. Such a fan assembly may be capable of generating one or more of a dehumidified airflow, a humidified airflow, a purified airflow, a filtered airflow, a cooled airflow, and a heated airflow.

The fan assembly comprises a body or stand, a motor-driven impeller contained within the fan body and arranged to generate an airflow, and a nozzle mounted on and supported by the fan body, the nozzle being arranged to receive the airflow from the fan body and to emit the airflow from the fan assembly. The fan body is provided with at least one air inlet through which air enters the body (i.e. through which air is drawn into the fan body by the motor-driven impeller). A particulate filter media is then mounted on the fan body over the air inlet, and a catalyst for oxidative decomposition of volatile organic compounds at ambient temperature is supported on the fan assembly downstream (i.e. relative to the airflow generated by the impeller) of the particulate filter media. The catalyst may either be supported directly on the fan assembly or be supported on an air permeable substrate that is mounted on the fan body over the air inlet.

Whilst there are various materials that may be suitable heterogeneous catalysts for the oxidation of VOCs at ambient temperature, there are two main types of materials that are particular effective heterogeneous catalysts:

1) Supported transition metals.

Suitable supported transition metal catalysts typically take the form of nanoparticles (<100nm) of the transition metal dispersed on the surface of a substrate or catalyst support, wherein the substrate can be in the form of particles or a framework that typically comprises a metal oxide, semimetal oxide or carbon. By way of example, suitable transition metals include ruthenium (Ru), rhodium (Rh), palladium (Pd), silver (Ag), osmium (Os), iridium (Ir), platinum (Pt), gold (Au), rhenium (Re), molybdenum (Mo), vanadium (V), iron (Fe), and manganese (Mn), whilst suitable metal oxide support materials can comprise a metal selected from cerium (Ce), zirconium (Zr), titanium (Ti), silicon (Si), tin (Sn), aluminium (Al), vanadium (V), iron (Fe), manganese (Mn) and lanthanum (La).

2) Non-noble metal oxides.

Suitable non-noble metal oxides catalysts typically take the form of particles of the metal oxide. By way of example, suitable non-noble metal oxide can comprise a non-noble metal selected from manganese, copper, cobalt, chromium, titanium, cerium, zirconium, vanadium and iron.

Of these two main types of catalytic materials, the supported transition metals have been shown to be particularly effective catalysts for the removal of VOCs through catalytic oxidative decomposition. For example, suitable supported transition metal catalysts include gold on titania (Au/TiO₂), gold on cerium oxide (Au/CeO₂), platinum on titania (Pt/TiO₂), platinum on tin (Pt/Sn), platinum and palladium on tin oxide (Pt/Pd/SnO) and platinum on alumina (Pt/Al₂O₃). Of these, platinum on alumina (Pt/Al₂O₃), gold on cerium oxide (Au/CeO₂), and platinum on titania

(Pt/TiO₂) have been demonstrated in the embodiments described herein as effective catalysts for oxidative decomposition of VOCs.

If the catalyst is supported directly on the fan assembly then the catalyst is attached to one or more surfaces of the fan body that are on the path along which air flows through the body of the fan assembly. Preferably, the catalyst is attached to a surface of the fan body that provides or is adjacent to the air inlet. For example, the air inlet may be provided by a perforated section/portion of the fan body and the catalyst would then be attached to this perforated section/portion of the fan body. Typically, the catalyst is provided in the form of particles and a plurality of the catalytic particles would then be attached to the fan body.

By way of example, the catalytic particles could be attached to the fan body using an adhesive. As illustrated in Figure 1a, this adhesive mounting process would typically involve applying an adhesive to a surface of the fan body before disposing the plurality of particles onto the adhesive (A1) to form a layer of catalyst particles that are adhered onto the surface of the fan body (A2).

As an alternative example, the catalytic particles could be attached to the fan body by melt-adhering. The term "melt-adhering", as used herein refers to a process wherein two objects are brought together whilst at least one of the objects is at least partially melted before allowing the objects to cool and solidify so that they adhere to one another. As illustrated in Figure 1b, such a melt-adhering process would typically involve at least partially melting the surface of the fan body (i.e. by heating the surface) and then disposing the catalytic particles on the at least partially melted surface (B1) before allowing it to cool and solidify so that the catalytic particles are adhered to/partially embedded the surface (B2).

If the catalyst is supported on an air permeable substrate then the air permeable substrate may be mounted on an internal surface of the fan body covering/extending over the air inlet. The particulate filter media would then be mounted on an opposing external surface of the fan body over the air inlet. In other words, the particulate filter media would be mounted externally over the air inlet whilst the air permeable substrate supporting the catalyst is mounted over the opposing, internal side of the air inlet so that the air inlet is disposed between them with the particulate filter media upstream of both the catalyst supported on the air permeable substrate and the air inlet. Alternatively, the air permeable substrate supporting the catalyst may be mounted on an external surface of the fan body over the air inlet. The particulate filter media would then be mounted over the air permeable substrate so that the particulate filter media is upstream of both the catalyst supported on the air permeable substrate and the air inlet.

Typically the catalyst is provided in the form of particles and a plurality of the catalytic particles would then be mounted on or embedded within the air permeable substrate. For example, the plurality of catalytic particles could be mounted on a surface of the air permeable substrate. Alternatively, the plurality of catalytic particles could be laminated between a first layer of the air permeable substrate and a second layer of the air permeable substrate. As a further alternative, the plurality of catalytic particles could be dispersed throughout the air permeable substrate.

By way of example, the air permeable substrate could comprise a nonwoven fabric material, such as a melt-blown or spunbond nonwoven thermoplastic polymer (e.g. polypropylene (PP), polyethylene (PE), polyester (PET) etc.). The catalytic particles could then be mounted on to a surface of the air-permeable substrate using an adhesive. As illustrated in Figure 2a, this adhesive mounting process would typically involve applying an adhesive to the surface of the air-permeable substrate before disposing the plurality of particles onto the adhesive (C1) to form a layer of catalyst particles that are adhered onto the surface of the substrate (C2).

Alternatively, the catalytic particles could be embedded within the air-permeable substrate by lamination. As illustrated in Figure 2b, such a lamination process would typically involve disposing the plurality of particles on to a first layer of the air-permeable substrate material, disposing a second layer of the air-permeable substrate material over the plurality of particles disposed on the first layer (D1), and then bonding together the first layer and second layer of the air-permeable substrate material so that the plurality of particles are retained between the first layer and second layer of the air-permeable substrate (D2). For example, this bonding of the the first layer and second layer could be achieved by thermal bonding using a heat sealer, curing oven or calendaring through heated rollers, ultrasonic bonding, chemical bonding etc.

As a further alternative, the catalytic particles could be embedded within the air-permeable substrate by incorporation during air-laying, wherein air-laying is a process in which a randomly oriented web of fibres is formed using a stream of air. As illustrated in Figure 2c, such a process of incorporation during air-laying would typically involve forming a first web of fibres, disposing the plurality of particles into the first web of fibres (E1), forming a second web of fibres on the first web of fibres, and bonding together the first web of fibres and the second web of fibres to form the air-permeable substrate with the plurality of particles disposed within the air-permeable substrate (E2). Once again, this bonding of the first web and second web could be achieved by thermal bonding using a heat sealer, curing oven or calendaring through heated rollers, ultrasonic bonding, chemical bonding etc.

As a yet further example, the air permeable substrate could comprise a foam material such as a polymer foam material (e.g. polyurethane foam). The catalytic particles could then be dispersed throughout the foam. In particular, the catalytic particles could be dispersed within the pores of an open-cell solid foam material.

5 Figures 3a and 3b are external views of a detailed embodiment of a free-standing air purifying fan assembly 1000, and Figure 4 show a sectional view through lines A-A of Figures 3a and 3b. Figure 5 then shows an enlarged sectional view of the body 1100 of the air purifying fan assembly 1000 illustrated in Figures 3a and 3b.

10 As shown in Figures 4 and 5, the body 1100 comprises a substantially cylindrical main body section 1110 mounted on a substantially cylindrical lower body section 1120. The main body section 1110 has a smaller external diameter than the lower body section 1120. The main body section 1110 has a lower annular flange 1111 that extends radially/perpendicularly away from the lower end of the main body section 1110. The outer edge of the lower annular flange 1111 is
15 substantially flush with the external surface of the lower body section 1120. The removable filter assemblies 1300 are then mounted on the main body section 1110, resting on the lower annular flange 1111 of the main body section 1110. In this embodiment, the main body section 1110 further comprises an upper annular flange 1112 that extends radially/perpendicularly away from an opposite, upper end of the main body section 1110. The outer edge of the upper annular
20 flange 1112 is then substantially flush with the external surface of a base/neck 1250 of the nozzle 1200 that connects to upper end of the main body section 1110.

As shown in Figures 4 and 5, the main body section 1110 comprises a perforated cylindrical housing 1119 that contains various components of the fan assembly 1000. The perforated
25 housing 1119 comprises two separate arrays of apertures which act as the air inlets 1130a, 1130b of the body 1100 of the fan assembly 1000. A first air inlet 1130a of the fan assembly 1000 is provided by a first array of apertures provided on a first half/portion of the circular cylindrical housing 1119 that extends over the entire length/height of the main body section 1110, and a second inlet 1130b of the fan assembly 1000 is provided by a second array of
30 apertures provided on a second half/portion of the circular cylindrical housing 1119 that extends over the entire length/height of the main body section 1110. Alternatively, each of the air inlets 1130a, 1130b could comprise one or more grilles or meshes mounted within windows formed in the main body section 1110.

35 The lower body section 1120 comprises a further housing containing components of the fan assembly 1000 other than those contained within main body section 1110. The lower body section 1120 is mounted on a base 1140 for engaging a surface on which the fan assembly

1000 is located. Specifically, the base 1140 supports the fan assembly 1000 when located on a surface with the nozzle 1200 uppermost relative to the base 1140. In this embodiment, the lower body section 1120 houses a pan drive gear (not shown) that is engaged by a pan pinion (not shown). The pan pinion is driven by an oscillation motor 1160 housed within the bottom of the main body section 1110. Rotation of the pan pinion by the oscillation motor 1160 therefore causes the main body section 1110 to rotate relative to the lower body section 1120. A mains power cable (not shown) for supplying electrical power to the fan assembly 1000 extends through an aperture 1121 formed in the lower body section 1120. The external end of the cable is then connected to a plug for connection to a mains power supply.

The main body section 1110 houses the impeller 1150 for drawing the primary airflow through the air inlets 1130a, 1130b and into the body 1100. Preferably, the impeller 1150 is in the form of a mixed flow impeller. The impeller 1150 is connected to a rotary shaft 1151 extending outwardly from a motor 1152. In the embodiment illustrated in Figures 4 and 5, the motor 1152 is a DC brushless motor having a speed which is variable by a main control circuit 1170 in response to control inputs provided by a user. The motor 1152 is housed within a motor bucket 1153 that comprises an upper portion 1153a connected to a lower portion 1153b. The upper portion 1153a of the motor bucket further comprises a diffuser 1153c in the form of an annular disc having curved blades.

The motor bucket 1153 is located within, and mounted on, an impeller housing 1154 that is mounted within the main body section 1110. The impeller housing 1154 comprises a generally frusto-conical impeller wall 1154a and an impeller shroud 1154b located within the impeller wall 1154a. The impeller 1150, impeller wall 1154a and an impeller shroud 1154b are shaped so that the impeller 1150 is in close proximity to, but does not contact, the inner surface of the impeller shroud 1154b. A substantially annular inlet member 1155 is then connected to the bottom of the impeller housing 1154 for guiding the primary airflow into the impeller housing 1154.

In the embodiment illustrated in Figures 4 and 5, the air vent/opening 1115 through which the primary airflow is exhausted from the body 1100 is defined by the upper portion of the motor bucket 1153a and the impeller wall 1154a. A flexible sealing member 1156 is then attached between the impeller housing 1154 and the main body section 1120. The flexible sealing member 1156 prevents air from passing around the outer surface of the impeller housing 1154 to the inlet member 1155. The sealing member 1156 preferably comprises an annular lip seal, preferably formed from rubber.

The nozzle 1200 is mounted on the upper end of the main body section 1110 over the air vent 1115 through which the primary airflow exits the body 1100. The nozzle 1200 comprises a neck/base 1250 that connects to upper end of the main body section 1110, and has an open lower end which provides an air inlet 1240 for receiving the primary airflow from the body 1100.

5 The external surface of the base 1250 of the nozzle 1200 is then substantially flush with the outer edge of the upper annular flange 1112 of the main body section 1110. The base 1250 therefore comprises a housing that covers/encloses any components of the fan assembly 1000 that are provided on the upper surface 1112 of the main body section 1110.

10 In the embodiment illustrated in Figures 4 and 5, the main control circuit 1170 is mounted on the upper surface of the upper annular flange 1112 that extends radially away from the upper end of the main body section 1110. The main control circuit 1170 is therefore housed within base 1250 of the nozzle 1200. In addition, an electronic display 1180 is also mounted on the upper annular flange 1112 of the main body section 1110 and therefore housed within base 1250 of the nozzle
15 1200, with the display 1180 being visible through an opening or at least partially transparent window provided in the base 1250. Optionally, one or more additional electronic components may be mounted on the upper surface of the upper annular flange 1112 and consequentially housed within base 1250 of the nozzle 1200. For example, these additional electronic components may one or more wireless communication modules, such as Wi-Fi, Bluetooth etc.,
20 and one or more sensors, such as an infrared sensor, a dust sensor etc., and any associated electronics. In particular, these additional electronic components preferably include one or more chemical sensors for detecting VOCs, such as a total VOC sensor and/or one or more sensors for detecting specific VOCs such as formaldehyde. Any such additional electronic components would then also be connected to the main control circuit 1170.

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The nozzle 1200 comprises an interior passage 1230 for conveying air from the air inlet 1240 of the nozzle 1200 to at least one air outlet 1210 of the nozzle 1200. The nozzle 1200 therefore comprises one or more casing sections 1260 that define the interior passage 1230. These casing sections 1260 also define or are provided with at least one slot 1220 that forms an air
30 outlet 1210 of the nozzle 1200. The airflow drawn through the fan assembly 1000 by the motor-driven impeller 1150 and emitted from the air outlet 1210 of the fan assembly 1000 is referred to hereafter as a primary airflow. The nozzle 1200 also defines a central/inner opening/bore 1500. The nozzle 1200 therefore forms a loop that extends around and surrounds the bore 1500. Any portion of the primary airflow that is emitted from the air outlet 1210 entrains air from outside the
35 fan assembly 1000 so that it is drawn through the bore 1500, with this entrained air being referred to herein as a secondary airflow. The primary airflow therefore combines with the entrained secondary airflow to form a combined, or amplified, airflow projected forward from the

front of the nozzle. The nozzle 1200 therefore acts as an air amplifier to supply both the primary airflow and the entrained secondary airflow to the user.

In the embodiment illustrated in Figures 3a, 3b and 4, the nozzle 1200 has an elongate annular shape, often referred to as a stadium shape, and defines an elongate opening 1500 having a height greater than its width. The nozzle 1200 therefore comprises two relatively straight sections 1201, 1202 each adjacent a respective elongate side of the opening 1500, an upper curved section 1203 joining the upper ends of the straight sections 1201, 1202, and a lower curved section 1204 joining the lower ends of the straight sections 1201, 1202.

In the illustrated embodiment, both an inner filter assembly 1600 and an outer filter assembly 1300 are located upstream from each of the air inlets 1130a, 1130b of the main body section 1110, such that the air drawn into the main body section 1110 by the impeller 1150 is filtered by both filter assemblies prior to entering the main body section 1110. Specifically, each of the air inlets 1130a, 1130b is covered by a corresponding inner filter assembly 1600, with each inner filter assembly 1600 then being covered by a respective outer filter assembly 1300 so that the outer filter assembly 1300 is upstream (i.e. relative to the airflow generated by the impeller) of the corresponding inner filter assembly 1600.

Accordingly, Figure 6 shows a perspective view of the main body section 1110 of the fan assembly 1000, with the outer and inner filter assemblies removed from near side of the main body section 1110 and with the outer and inner filter assemblies 1300a, 1600a mounted on the opposing, far side of the main body section 1110 with a perforated shroud 1400a attached to the outer surface of the outer filter assembly 1300a.

The outer filter assembly 1300 comprises a filter frame 1310 supporting both a particulate filter media 1322 and an activated carbon filter media 1321, with the outer filter assembly 1300 being arranged so that the activated carbon filter media 1321 is downstream of the particulate filter media 1322 when the outer filter assembly 1300 is mounted on the fan assembly 1000. The inner filter assembly 1600 then comprises a separate filter frame 1610 supporting an air permeable substrate 1610 carrying a plurality of catalytic particles. Specifically, the plurality of catalytic particles are mounted on or embedded within the air permeable substrate 1610.

The two separate inner filter assemblies 1600a, 1600b are each configured to be located on and cover one of the two air inlets 1130a, 1130b that are provided on the opposing halves of the main body section 1110. Each inner filter assembly 1600 therefore substantially has the shape of a semi-cylinder/tube that can therefore be located concentrically over the main body section

1110. In other words, each inner filter assembly 1600 has the shape of a partial tube that is configured to cover a portion of the periphery/outer surface of the generally cylindrical main body section 1110.

5 Figures 7a to 7d illustrate an embodiment of an inner filter assembly 1600 suitable for use with the fan assembly of Figures 3 to 6. In this embodiment, each inner filter assembly 1600 comprises a filter frame 1610 that supports an air permeable substrate 1620 carrying a plurality of catalytic particles (not shown). The air permeable substrate 1620 is arranged so as to cover the surface area defined by the filter frame 1610. Each inner filter frame 1610 substantially has
10 the shape of a semi-cylinder with two straight sides that are parallel to the longitudinal axis of the filter frame 1610 and two curved ends that are perpendicular to the longitudinal axis of the filter frame 1610. The two straight sides of the filter frame 1610 are then each provided with a pair of arms/tabs 1630 that are arranged to engage with corresponding recesses or holes provided on the main body section 1110 so as to retain the inner filter assembly 1600 over the
15 air inlet. The filter frame 1610 is preferably made of a resilient plastic material, such as a thermoplastic polymer (e.g. polycarbonate (PC), acrylonitrile butadiene styrene (ABS). The inner filter assembly 1600 can then be mounted onto the main body section 1110 by positioning the inner filter assembly 1600 over the air inlet 1130 and pushing towards the main body section 1110. Outward flexing of the resilient filter frame 1610 would then allow the tabs 1630 to engage
20 the recesses/through-holes provided on the main body section 1110.

The two separate outer filter assemblies 1300a, 1300b are each configured to be located over and cover one of the inner filter assemblies 1600a, 1600b that in turn cover the air inlets 1130a, 1130b provided on the opposing halves of the main body section 1110. Each outer filter
25 assembly 1300 therefore substantially has the shape of a semi-cylinder/tube that can therefore be located concentrically over one of the inner filter assemblies 1600a, 1600b and the main body section 1110. In other words, each outer filter assembly 1300 has the shape of a partial tube that is configured to cover a portion of the periphery/outer surface of the generally cylindrical main body section 1110.

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Figure 8 illustrates a perspective view of an embodiment of an outer filter assembly 1300 suitable for use with the fan assembly of Figures 3 to 6. In this embodiment, each outer filter assembly 1300 comprises a filter frame 1310 that supports both an activated carbon filter media 1321 and a particulate filter media 1322. For example, the particulate filter media could
35 comprise a pleated polytetrafluoroethylene (PTFE) or glass microfiber nonwoven fabric, whilst the activated carbon filter media could comprise either a pleated carbon cloth or activated carbon granules retained between layers of air-permeable material.

The outer filter assembly 1300 is arranged so that the activated carbon filter media is downstream of the particulate filter media when the outer filter assembly 1300 is mounted on the fan assembly. In this regard, the particulate filter media 1322 has an inner face that faces
5 towards the main body section 1110 when the outer filter assembly 1300 is mounted on the main body section 1110 and the activated carbon filter media 1321 is mounted adjacent to the inner face of the particulate filter media 1322.

In the embodiment illustrated in Figure 8, each outer filter frame 1310 substantially has the
10 shape of a semi-cylinder with two straight sides that are parallel to the longitudinal axis of the filter frame 1310 and two curved ends that are perpendicular to the longitudinal axis of the filter frame 1310. Both the activated carbon filter media 1321 and the particulate filter media 1322 are arranged so as to cover the surface area defined by the filter frame 1310.

The filter frame 1310 is provided with a first end flange 1311 that extends radially/perpendicularly away from a first curved end of the filter frame 1310 and a second end flange 1312 that extends radially/perpendicularly away from an opposite, second curved end of the filter frame 1310. Each filter frame 1310 is then also provided with a first side flange 1313 that extends perpendicularly away from a first side of the filter frame 1310, from a first end of the
20 first end flange 1311 to a first end of the second end flange 1312, and a second side flange 1314 that extends perpendicularly away from a second side of the filter frame 1310, from a second end of the first end flange 1311 to a second end of the second end flange 1312. The first end flange 1311, second end flange 1312, first side flange 1313 and second side flange 1314 are integrally formed with one another to thereby form a ridge or rim that extends around
25 the entire periphery of the filter frame 1310. The flanges 1311-1314 provide surfaces to which the filter media can be sealed (e.g. using glue on the downstream side of filter assembly 1310) and also provide surfaces that allow the filter frame 1310 to form a seal with the main body 1110 of the fan assembly 1000 (e.g. with corresponding flanges on the main body section 1110) to prevent air from leaking into or out of the fan body 1100 without passing through the filter media.

Each filter assembly 1300 further comprises a flexible seal 1330 provided around the entirety of an inner periphery of the filter frame 1310 for engaging with the main body section 1110 to prevent air from passing around the edges of the filter assembly 1300 to the air inlet 1110 of the main body section 1120, as illustrated in Figure 8. The flexible filter seal 1330 preferably
35 comprises lower and upper curved seal sections that substantially take the form of an arc-shaped wiper or lip seal, with the each end of the lower seal section being connected to a corresponding end of the upper seal section by two straight seal sections that each substantially

take the form of a wiper or lip seal. The upper and lower curved seal sections are therefore arranged to contact the curved upper and lower ends of the main body section 1110, whilst the straight seal sections are arranged to contact one or other of two diametrically opposed, longitudinal flanges 1113, 1114 that extend perpendicularly away from the main body section 1110. Preferably, the filter frame 1310 is provided with a recess (not shown) that extends around the entirety of the inner periphery of the filter frame 1310 and that is arranged to receive and support the seal 1330. In the illustrated embodiment, this recess extends across an inner surface of both the first side flange 1313 and second side flange 1314, and across an inner edge of both the first end and the second end of the filter frame 1310. The filter media 1321, 1322 are then supported on the outer, convex face of the filter frame 1310, extending across the area between the first and second flanges 1311, 1312 and the first second side flanges 1313, 1314.

As illustrated in Figure 6, a perforated shroud or protective casing 1400 is then releasably attached concentrically to the filter frame 1310 so as to cover the outer filter assembly 1300 when located on the main body section 1110. Figure 9 shows a perspective view of such a perforated shroud 1400 that is substantially in the shape of a semi-cylinder. The perforated shroud 1400 therefore has two curved ends 1401, 1402 that are perpendicular to the longitudinal axis of the perforated shroud 1400 and two straight edges 1403, 1404 that are parallel to the longitudinal axis of the perforated shroud 1400. The perforated shrouds 1400 each comprise an array of apertures which provide an air inlet 1405 through the shroud 1400. Alternatively, the air inlet 1405 of the shroud 1400 may comprise one or more grilles or meshes mounted within windows in the shroud 1400. It will also be clear that alternative patterns of air inlet arrays are envisaged within the scope of the present invention. When mounted on filter frame, the shrouds 1400 protect the filter media 1321-1322 from damage, for example during transit, and also provide a visually appealing outer surface covering the outer filter assemblies 1300, which is in keeping with the overall appearance of the fan assembly 1000. The array of apertures that define the air inlet 1405 of the shroud 1400 are sized to prevent larger particles from passing through to the filter assembly 1300 and blocking, or otherwise damaging, the filter media 1321-1324.

In order to releasably attach each perforated shroud 1400 to a respective outer filter frame 1310, the perforated shroud is provided with a first end flange 1411 that extends radially/perpendicularly away from the first curved end 1401 of the perforated shroud 1400 and a second end flange 1412 that extends radially/perpendicularly away from the opposite, second curved end 1402 of the perforated shroud 1400. The first end flange 1411 and second end flange 1412 of the perforated shroud 1400 are arranged to slide over the end flanges 1311, 1312 of the filter frame 1310 so that the perforated shroud 1400 is supported on the outer filter

frame 1310. The first end flange 1411 and second end flange 1412 of the perforated shroud 1400 are then each formed with a through-hole 1420a, 1420b that is arranged to be releasably engaged by a corresponding shroud retention member 1340a, 1340b provided on the end flanges of the outer filter frame 1310.

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As illustrated in Figure 8, a first shroud retention member 1340a is provided on the first end flange 1311 of the outer filter frame 1310 and a second shroud retention member 1340b provided on the opposing, second end flange 1312 of the outer filter frame 1310. The first shroud retention member 1340a and the second shroud retention member 1340b each
10 comprise a resilient catch or hook that is arranged to engage a corresponding through-hole 1420a, 1420b provided on the shroud 1400. The resilient catch or hook provided on each end flange 1311, 1312 of the filter frame 1310 comprises a resilient arm/tab 1341 that extends in a direction that is parallel to a plane that bisects the filter frame 1310. A distal end of the resilient arm/tab 1341 is then provided with a sloped projection 1342 that projects/extends away from the
15 exterior/external surface of the flange 1311, 1312 and slopes downwards towards the distal end of the resilient arm/tab 1341.

When the shroud 1400 is slid onto the filter frame 1310, the sloped projection 1342 contacts an end flange 1311, 1312 of the shroud 1400 thereby forcing the resilient arm/tab 1341 to bend/flex
20 downwards. The sloped projection 1342 then enters the through-hole 1420a, 1420b provided on the end flange 1411, 1412 of the shroud 1400 when the shroud 1400 is far enough over the filter frame 1310 such that the resilient arm/tab 1341 is then free to return to it's original unbent configuration, with the sloped projection 1342 extending through the through-hole 1420a, 1420b. When a user wishes to separate the shroud 1400 from the filter frame 1310, they apply a
25 downward force onto each sloped projection 1342 and simultaneously begin to slide the shroud 1400 away from the filter frame 1310. The downward force causes the resilient arm/tab 1341 to bend/flex downwards and out of engagement with the through-hole 1420a, 1420b such that the shroud 1400 is then free to slide off the filter frame 1310.

30 In order to assist with the mounting of the shroud 1400 onto the filter frame 1310, both the first end flange 1311 and second end flange 1312 of the filter frame 1310 are formed with alignment ribs 1351, 1352 that are each arranged to cooperate with a corresponding track or channel or groove 1431, 1432 provided on the shroud 1400 in order to guide the shroud 1400 onto the
35 outer filter frame 1310 such that each of the shroud retention members 1340 engages a respective shroud retention through-hole 1420a, 1420b. Each alignment rib 1351, 1352 is straight and extends in a direction that is parallel to a longitudinal plane that bisects the filter

frame 1310 (i.e. parallel to the direction in which the shroud 1400 will be slid on and off the filter frame 1310) and is therefore perpendicular to the longitudinal axis of the filter frame 1310.

In the illustrated embodiment, both the first end flange 1311 and second end flange 1312 of the filter frame 1310 are formed with a first pair of alignment ribs 1351 that project/extend away from and extend along the exterior/external surface of the flange 1311, 1312, with a first of the pair of alignment ribs 1351 being provided adjacent to the first side of the flange and a second of the pair of alignment ribs 1351 being provided adjacent to the second side of the flange. The shroud 1400 is then formed with a pair of corresponding grooves or channels 1431, with each of the pair of grooves or channels corresponding to one of the first pair of alignment ribs 1351. These grooves or channels 1431 taper outwardly from an inner end 1431a to a mouth 1431b through which one of first pair of the alignment ribs 1351 can enter (i.e. slide into) the groove/channel 1431. The mouth 1431b is therefore larger than the inner end 1431a of the channel 1431, thereby making it easier to align each rib 1351 with the mouth 1431b of the corresponding channel/groove 1431, with the tapering of the groove/channel 1431 then guiding the rib 1351 towards the inner end 1431a and a position in which the shroud 1400 is aligned so that the through-holes 1420a, 1420b will be engaged by the shroud retention member 1340 provided on the corresponding flange 1311, 1312 of the filter frame 1310.

Both the first end flange 1311 and second end flange 1312 of the filter frame 1310 are also formed with a second pair of alignment ribs 1352 that project/extend away from and extend along the exterior/external surface of the flange 1311, 1312, with each of the second pair of alignment ribs 1352 being provided on opposite sides of the shroud retention member 1340 provided on the flange 1311, 1312. The shroud 1400 is then formed with one further groove or channel 1432 that extends into the inner surface of the shroud flange 1411, 1412 around the through-hole 1420. This further groove or channel 1432 also tapers outwardly from an inner end 1432a to a mouth 1432b through which both of the second pair of alignment ribs 1352 can enter (i.e. slide into) the groove/channel 1432. The mouth 1432b is therefore larger than the inner end 1432a of the channel 1432 thereby making it easier to align the second pair of alignment ribs 1352 with the mouth 1432b of the further channel/groove 1432, with the tapering of the further groove/channel 1432 then guiding the second pair of alignment ribs 1352 towards the inner end 1432a and the position in which the shroud 1400 is aligned so that the through-holes 1420a, 1420b will be engaged by the shroud retention member 1340 provided on the corresponding flange 1311, 1312 of the filter frame 1310.

As shown in Figure 8, each filter frame 1310 is provided with two engagement members 1371a, 1371b. A first engagement member 1371a is provided on the first edge 1313 of the filter frame

1310 and a second engagement member 1371b on the opposing, second edge 1314 of the filter frame 1310, the first engagement member 1371a being configured to be engaged by the first retention assembly 1500a and the second engagement member 1371b being configured to be engaged by the second retention assembly 1500b. Specifically, the first edge 1313 of the filter frame 1310 is that provided on a first of the straight sides of the filter frame 1310 whilst the second edge 1314 of the filter frame 1310 is that provided on a second of the straight sides of the filter frame 1310, with these two straight sides being parallel to the longitudinal axis of the filter frame 1310. The first engagement member 1371a and the second engagement member 1371b therefore project perpendicularly away from the straight sides of the filter frame 1310.

In the illustrated embodiment, the first engagement member 1371a provided on the first edge 1313 of the filter frame 1310 is located towards a first end 1311 of the filter frame 1310, and the second engagement member 1371b provided on the second edge 1314 of the filter frame 1310 is located towards an opposing, second end 1312 of the filter frame 1310. The distance between the first engagement member 1371a and the first end 1311 of the filter frame 1310 is equal to the distance between the second engagement member 1371b and the second end 1312 of the filter frame 1310. The first engagement member 1371a is therefore adjacent to a first corner of the filter frame 1310 and the second engagement member 1371b is adjacent to a diagonally opposing second corner of the filter frame 1310. Specifically, as the filter frame 1310 substantially has the shape of a semi-cylinder, the first engagement member 1371a of the filter frame 1310 is located on a first straight edge of the filter frame 1310 towards the top curved end of the filter frame 1310, whilst the second engagement member 1371b of the filter frame 1310 is located on a second straight edge of the filter frame 1310 towards the bottom curved end of the filter frame 1310.

The first engagement member 1371a and the second engagement member 1371b are each configured to be engaged by a retention assembly 1500 of the fan assembly 1000 when the filter frame 1310 is mounted on the fan assembly 1000. In the illustrated embodiment, the first and second engagement members 1371a, 1371b each comprise a pair of hooks that face in opposing directions. Each hook comprises a projection 1372 extending from the filter frame that has a distal end 1373 that is angled relative to a proximal end, with the distal end 1373 extending in a direction that is parallel to the longitudinal axis of the filter frame 1310. In particular, each pair of hooks comprises a single projection 1372 extending from the filter frame 1310 that has a distal end 1373 comprising a pair of angled portions that are parallel to the longitudinal axis of the filter frame 1310 and that extend in opposing directions. In other words, the first and second engagement members 1371a, 1371b each comprise a generally T-shaped projection that extends from a horizontal edge of the filter frame 1310, with the pair of hooks

being provided by the distal end of the T-shaped projection. The first and second engagement members 1371a, 1371b therefore each have two-fold rotational symmetry.

The filter frame 1310 as a whole therefore has two-fold rotational symmetry such that the filter frame 1310 can be mounted on the fan assembly 1000 irrespective of which of the curved ends of the filter frame 1310 is located at the top (i.e. in either of two opposing orientations). Furthermore, the two filter frames 1310a, 1310b mounted on the fan assembly 1000 are identical and are therefore interchangeable.

As shown in Figure 6, in order to retain the outer filter assemblies 1300a, 1300b on the main body section 1110, the fan assembly 1000 comprises a pair of retention assemblies 1500a, 1500b that cooperate to releasably retain the two outer filter assemblies 1300a, 1300b on the fan body 1100. To do so, each retention assembly 1500 is configured to engage with one or more of the engagement members 1371 provided on the outer filter frame 1310 when the filter frame 1310 is mounted on the fan assembly 1000. Each retention assembly 1500 then further comprises a release mechanism 1560 that is arranged to cause the retention assembly 1500 to release the outer filter assembly 1300 when operated by a user.

In the illustrated embodiment, the fan assembly 1000 comprises two retention assemblies 1500a, 1500b that each mounted/attached to the outer surface of the main body section 1110 so that they extend longitudinally along the outer surface of the main body section 1110, with the retention assemblies 1500a, 1500b being diametrically opposed to one another. In other words, the two retention assemblies 1500a, 1500b are located opposite one another on the main body section 1110 such that a plane passing through a longitudinal axis of the first retention assembly 1500a and a longitudinal axis of the second retention assembly 1500b bisects the main body section 1110. The retention assemblies 1500a, 1500b are therefore separated by 180 degrees. The outer surface of the main body section 1110 is therefore divided into two separate halves by the two separate retention assemblies 1500a, 1500b. The first air inlet 1130a and the second air inlet 1130b therefore extend around a periphery of the fan body 1100, except for the locations of the retention assemblies 1500a, 1500b, and respectively cover the entirety of the area between the first retention assembly 1500a and the second filter assembly 1500b.

The first retention assembly 1500a is configured to releasably engage the first filter frame 1310a adjacent to a first straight edge of the first filter frame 1310a and the second retention assembly 1500b is configured to releasably engage the first filter frame 1310a adjacent to an opposing, second straight edge of the first filter frame 1310a. In order to minimise the surface area

consumed by the retention assemblies, the first retention assembly 1500a is configured to also releasably engage the second filter frame 1310b adjacent to a first straight edge of the second filter frame 1310b and the second retention assembly 1500b is configured to also releasably engage the second filter frame 1310b adjacent to an opposing, second straight edge of the second filter frame 1310b. The two retention assemblies 1500a, 1500b therefore cooperate to retain both the first filter frame 1310a and the second filter frame 1310b on the main body section 1110 by each engaging opposite edges of the two filter frames 1310a, 1310b. The release mechanisms 1560 of each of the first retention assembly 1500a and the second retention assembly 1500b are therefore arranged to cause the respective retention assembly 1500 to simultaneously release the two filter frames 1310a, 1310b when operated by a user.

In the illustrated embodiment, the outer filter assembly provides an outermost layer of particulate filter media that serves to remove any particles which could potentially cause damage to the fan assembly, and also ensures that the air emitted from the nozzle is free from most particulates. In addition, this outermost layer of particulate filter media also ensures that the majority of particles are filtered prior to the airflow reaching both the activated carbon filter media and the inner filter assembly, thereby protecting both the activated carbon filter media and the inner filter assembly from physical damage and/or from becoming saturated by such particles. Furthermore, the additional layer of activated carbon filter media that is upstream of the inner filter assembly acts to filter out chemicals from the airflow that may not be dealt with by the catalyst. This additional layer of activated carbon filter media therefore not only provides an additional layer of air filtration but also acts to protect the catalyst from chemicals that could otherwise poison the catalyst and that would therefore be detrimental to the lifetime of the inner filter assembly. Moreover, keeping the catalyst entirely separate to both the particulate and activated carbon filter media provides a further advantaged in that the limited lifetime particulate and activated carbon filters can then be removed and either cleaned or replaced without disturbing the catalyst, which should not require any cleaning or replacement.

In the illustrated embodiment, the catalyst for oxidative decomposition of VOCs is provided by an inner filter assembly that is mounted to an external surface of the fan body over the air inlet. However, as described above, in an alternative embodiment, this inner filter assembly could be mounted on an internal surface of the fan body over the air inlet. This is possible because the inner filter assembly that carries the catalyst should not require any cleaning or replacement such that the end user should not be required to access the inner filter assembly. The inner filter assembly could therefore be disposed internally within the fan assembly during manufacture or assembly, which has the advantage that the inner filter assembly is then protected by the fan assembly and cannot easily be tampered with by the end user.

Additionally, providing the catalyst as part of a separate filter assembly increases the potential for recycling the catalyst at the end of the life of the fan assembly as it is then straightforward to separate the catalyst from the remainder of the fan assembly.

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In the illustrated embodiment, the catalyst is provided downstream of a sealed HEPA particulate filter such that air drawn into the fan assembly cannot pass around the particulate filter before passing through the air permeable substrate of the inner filter assembly. This is particularly advantageous in ensuring that the inner filter assembly can remain effective for the lifetime of the product as without this sealed HEPA particulate filtration the air permeable substrate of the inner filter assembly could become loaded with particulates that would cause flow rate through the inner filter assembly to drop and could potentially degrade catalyst. However, whilst some conventional domestic purifiers use HEPA particulate filter media, they do not provide sealed HEPA particulate filtration. To the contrary, most conventional domestic purifiers aim to achieve high clean air delivery rates (CADR) by using high air flow rates that cannot be achieved cost effectively with sealed HEPA particulate filtration. Indeed, some domestic purifiers use HEPA particulate filter media that have bypass holes formed within the media so that high air flow rates can be maintained. In contrast, the fan assembly described herein is intended to operate at maximum flow rates of no more than 100 litres per second, and preferably at maximum flow rates of no more than 50 litres per second.

In a yet further alternative to the illustrated embodiment, the catalyst could be supported directly on the fan assembly, without the need for a separate filter assembly. As described above, this could be achieved by attaching the catalytic particles directly to a surface of the fan body, i.e. using an adhesive. Whilst this approach has the advantage of doing away with the additional components of the filter frame and the air permeable substrate, the effectiveness with which the catalyst removes VOCs from the airflow will be reduced.

In addition, in the illustrated embodiment the outer filter assembly provides both the outermost layer of particulate filter media and an intermediate layer of activated carbon filter media. However, in an alternative embodiment, the activated carbon filter media could be provided by a separate, intermediate filter assembly that would then be mounted on the fan body over the air inlet and covered by the outer filter assembly. The activated carbon filter media could then comprise any of a pleated carbon cloth, activated carbon powder or granules retained between layers of air-permeable material, and one or more activated carbon monoliths.

By way of example, such an intermediate filter assembly could comprise a filter frame supporting the activated carbon filter media. The filter frame of the intermediate filter assembly could then be provided with detents or inward projections on opposing edges that engage with corresponding recesses/through-holes on the main body of the fan assembly. Outward flexing of the filter frame would then allow projections to disengage recesses/through-holes. The outer filter assembly would then be mounted to the fan body over the intermediate filter assembly so that the particulate filter media is upstream of both the air inlet and the activated carbon filter media. A seal provided around periphery of the intermediate filter assembly would fit within the seal around periphery of outer filter assembly, and would abut against a peripheral surface of the filter frame of the outer filter assembly, to thereby ensure that the airflow passes through both the outer filter assembly and the intermediate filter assembly before reaching the air inlet.

Providing the activated carbon filter media as part of the outer filter assembly reduces the number of components and simplifies the process of removing the particulate filter media and the activated carbon filter media from the fan assembly. However, as the particulate filter media and the activated carbon filter media may have different lifetimes, it may be advantageous to provide these as separate filter assemblies, so that it is straightforward for the end use to simply remove and replace the appropriate filter assembly when the associated filter media requires replacement.

It will be appreciated that individual items described above may be used on their own or in combination with other items shown in the drawings or described in the description and that items mentioned in the same passage as each other or the same drawing as each other need not be used in combination with each other. In addition, the expression "means" may be replaced by actuator or system or device as may be desirable. In addition, any reference to "comprising" or "consisting" is not intended to be limiting in any way whatsoever and the reader should interpret the description and claims accordingly.

Furthermore, although the invention has been described in terms of preferred embodiments as set forth above, it should be understood that these embodiments are illustrative only. Those skilled in the art will be able to make modifications and alternatives in view of the disclosure which are contemplated as falling within the scope of the appended claims. For example, those skilled in the art will appreciate that the above-described invention might be equally applicable to other types of environmental control fan assemblies, and not just free standing fan assemblies. By way of example, such a fan assembly could be any of a freestanding fan assembly, a ceiling or wall mounted fan assembly and an in-vehicle fan assembly.

By way of further example, whilst the above described embodiments all relate to fan assemblies having a circular cylindrical fan body, various features described above would be equally applicable to embodiments in which the fan body has a shape other than cylindrical. For example, the fan body could have the shape of an elliptic cylinder, a cube or any other prism.

CLAIMS

1. A fan assembly comprising:
5 a fan body comprising an air inlet;
a motor-driven impeller contained within the fan body and arranged to generate an airflow;
a nozzle mounted on and supported by the fan body, the nozzle being arranged to receive the airflow from the fan body and to emit the airflow from the fan assembly;
10 a particulate filter media mounted on the fan body over the air inlet; and
a catalyst for oxidative decomposition of volatile organic compounds that is supported on the fan assembly downstream of the particulate filter media.
- 15 2. The fan assembly as claimed in claim 1, wherein the catalyst is supported directly on the fan assembly.
3. The fan assembly as claimed in claim 2, wherein the catalyst is attached to one or more surfaces of the fan assembly that are on a path along which air flows through the fan assembly.
- 20 4. The fan assembly as claimed in any of claims 2 or 3, wherein the air inlet is provided by a perforated portion of the fan body and the catalyst is attached to the perforated portion of the fan body.
- 25 5. The fan assembly as claimed in any of claims 2 to 4, wherein the catalyst is provided in the form of particles and a plurality of the catalytic particles are attached using adhesive.
6. The fan assembly as claimed in any of claims 2 to 4, wherein the catalyst is provided in the form of particles and a plurality of the catalytic particles are partially embedded within one or more surfaces of the fan assembly.
- 30 7. The fan assembly as claimed in claim 1, wherein the catalyst is supported on an air permeable substrate that is mounted to the fan assembly on a path along which air flows through the fan assembly.
- 35 8. The fan assembly as claimed in claim 7, wherein the air permeable substrate is mounted to an internal surface of the fan body and the particulate filter media is mounted on an external surface of the fan body over the air inlet.

9. The fan assembly as claimed in claim 7, wherein the air permeable substrate is mounted on an external surface of the fan body over the air inlet and the particulate filter media is mounted on the fan body over the air permeable substrate.

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10. The fan assembly as claimed in any of claims 7 to 9, wherein the catalyst is provided in the form of particles and a plurality of the catalytic particles are mounted on or embedded within the air permeable substrate.

10 11. The fan assembly as claimed in claim 10, wherein the plurality of catalytic particles are any of:

mounted on a surface of the air permeable substrate;

laminated between a first layer of the air permeable substrate and a second layer of the air permeable substrate; and

15 dispersed throughout the air permeable substrate.

12. The fan assembly as claimed in any of claims 7 to 10, wherein the air permeable substrate comprises any of a nonwoven fabric material and a foam material, and preferably comprises a polymer foam material.

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13. The fan assembly as claimed in 12, wherein the air permeable substrate comprises a foam material and the plurality of catalytic particles are dispersed throughout the foam.

14. The fan assembly as claimed in any of claims 7 to 13, wherein the air permeable substrate is provided by an inner filter assembly, the inner filter assembly comprising a filter frame supporting the substrate.

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15. The fan assembly as claimed in any preceding claim, wherein the particulate filter media is provided by an outer filter assembly, the outer filter assembly comprising a filter frame supporting the particulate filter media.

30

16. The fan assembly as claimed in claim 15, wherein the outer filter assembly comprises a filter seal that is arranged to engage the fan body to prevent air from passing around the edges of the outer filter assembly.

35

17. The fan assembly as claimed in claim 16, wherein the filter seal extends around the entire periphery of the filter frame, and preferably wherein the particulate filter media is arranged so as to cover an entirety of an area defined within the periphery the filter frame.

5 18. The fan assembly as claimed in any of claims 16 or 17, wherein the outer filter assembly is arranged to cover/extend over an entirety of (an area of which the air inlet extends) the air inlet of the fan body.

10 19. The fan assembly as claimed in any of claims 15 to 18, wherein the outer filter assembly is releasably attached to the main body.

20. The fan assembly as claimed in any preceding claim, wherein the particulate filter media comprises a high-efficiency particulate air (HEPA) particulate filter media.

15 21. The fan assembly as claimed in any preceding claim, and further comprising an activated carbon filter media mounted on the fan body downstream of the particulate filter media and upstream of the catalyst.

20 22. The fan assembly as claimed in claim 21 when dependent upon claim 15, wherein the activated carbon filter media is provided by the outer filter assembly.

23. The fan assembly as claimed in claim 22, wherein the activated carbon filter media is supported by the filter frame of the outer filter assembly.

25 24. The fan assembly as claimed in claim 21 when dependent upon claim 15, and further comprising an intermediate filter assembly mounted on the fan body over the air inlet and covered by the outer filter assembly, wherein the intermediate filter assembly comprises the activated carbon filter media.

30 25. The fan assembly as claimed in claim 24, wherein the intermediate filter assembly is releasably attached to any of the main body and the outer filter assembly.

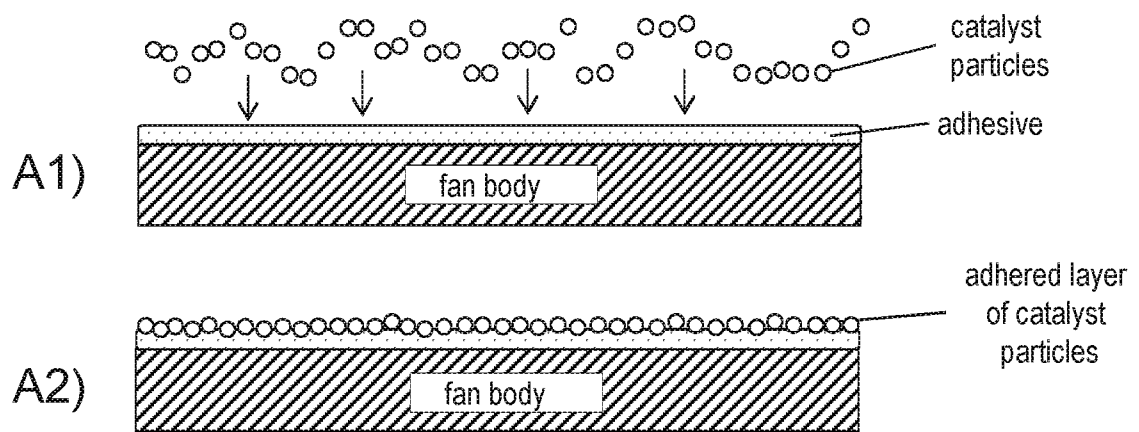


FIG.1a

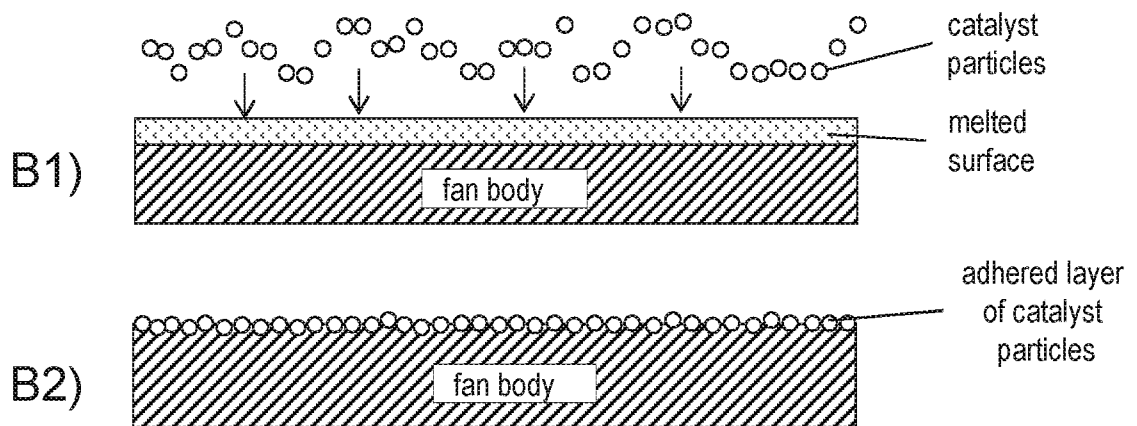


FIG.1b

2 / 9

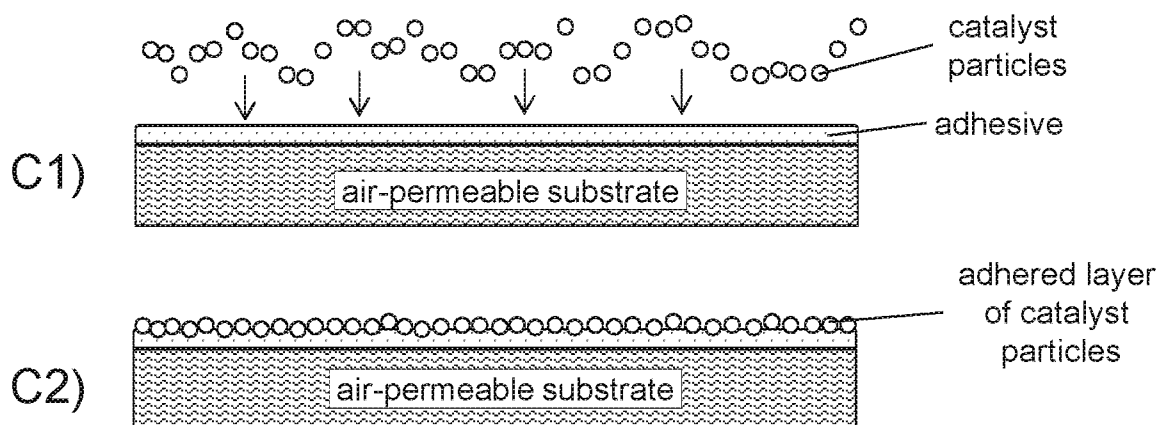


FIG.2a

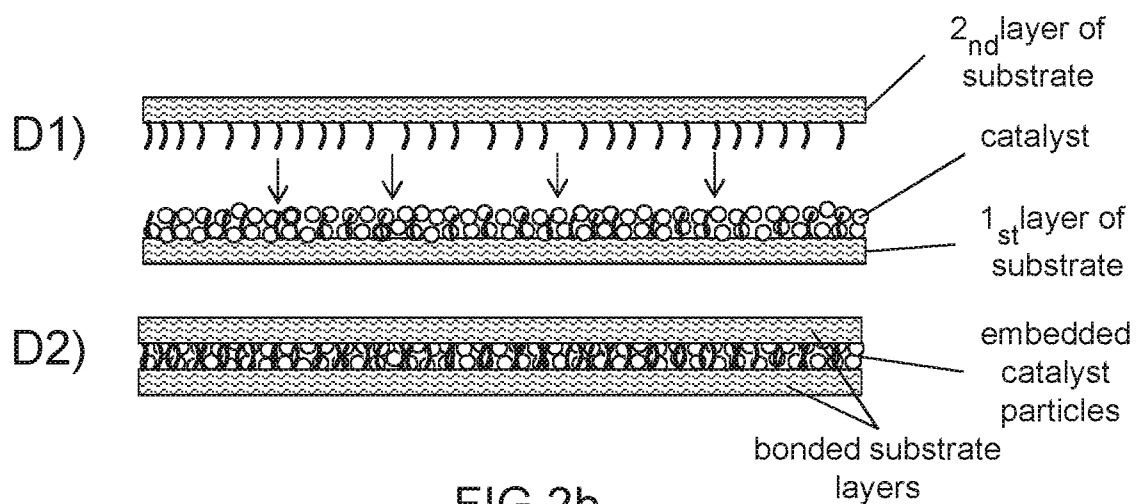


FIG.2b

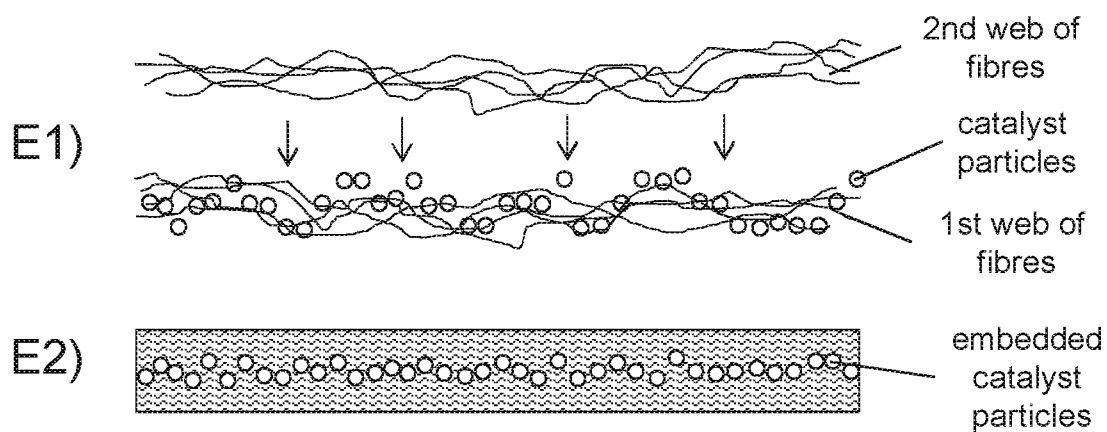


FIG.2c

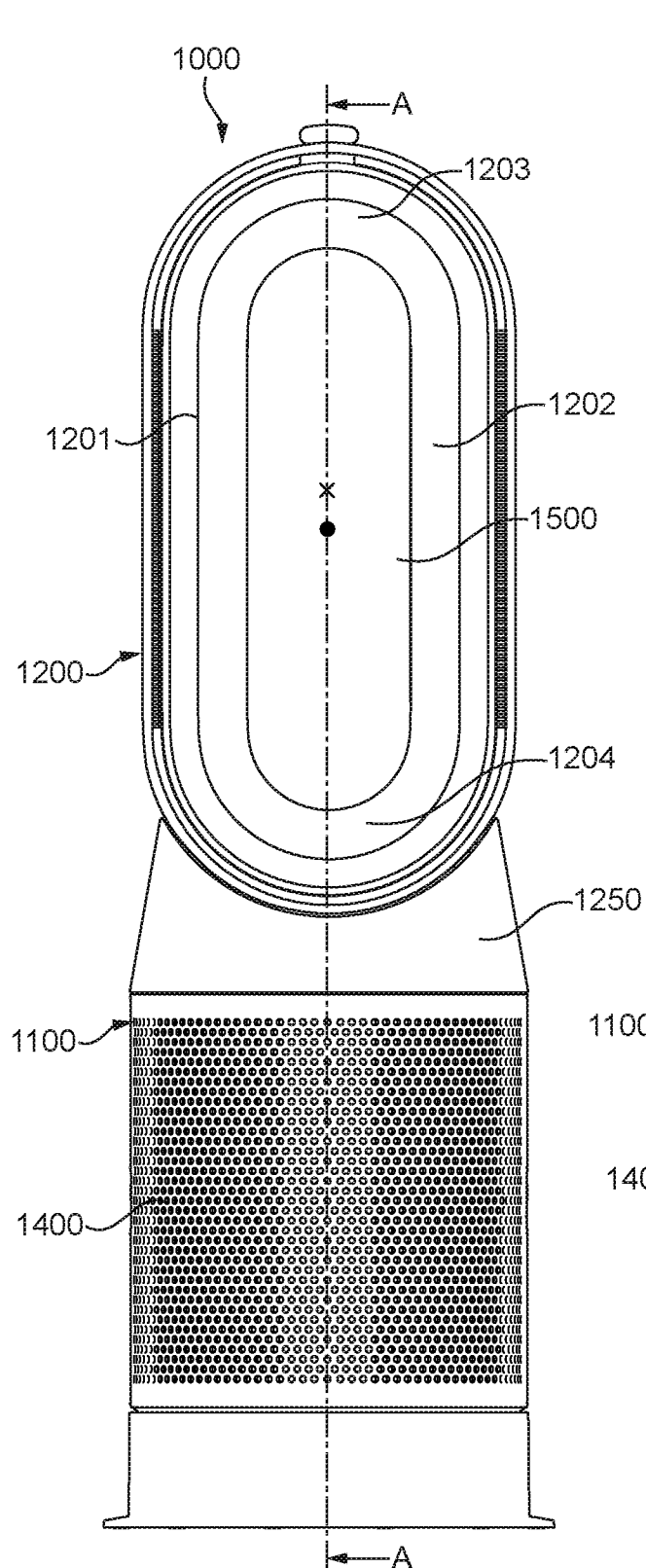


FIG. 3a

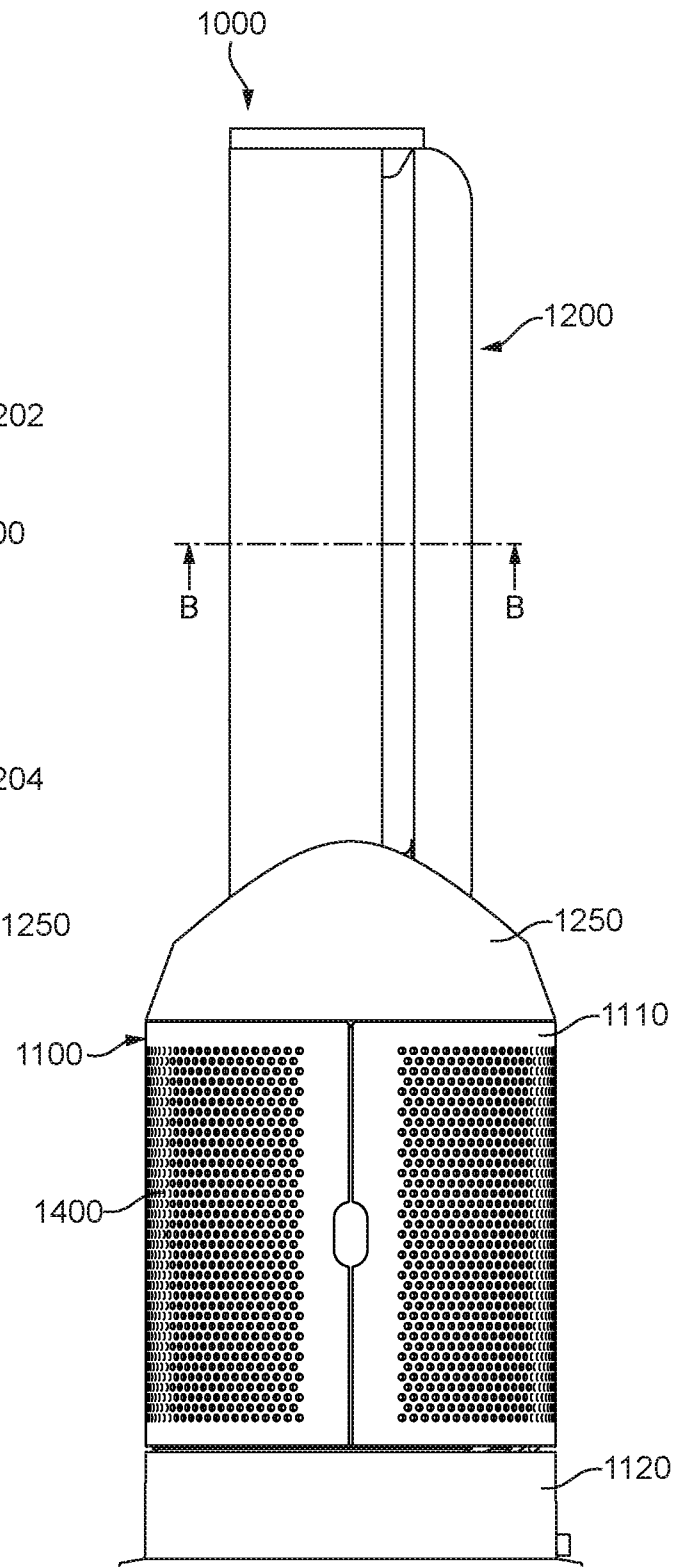


FIG. 3b

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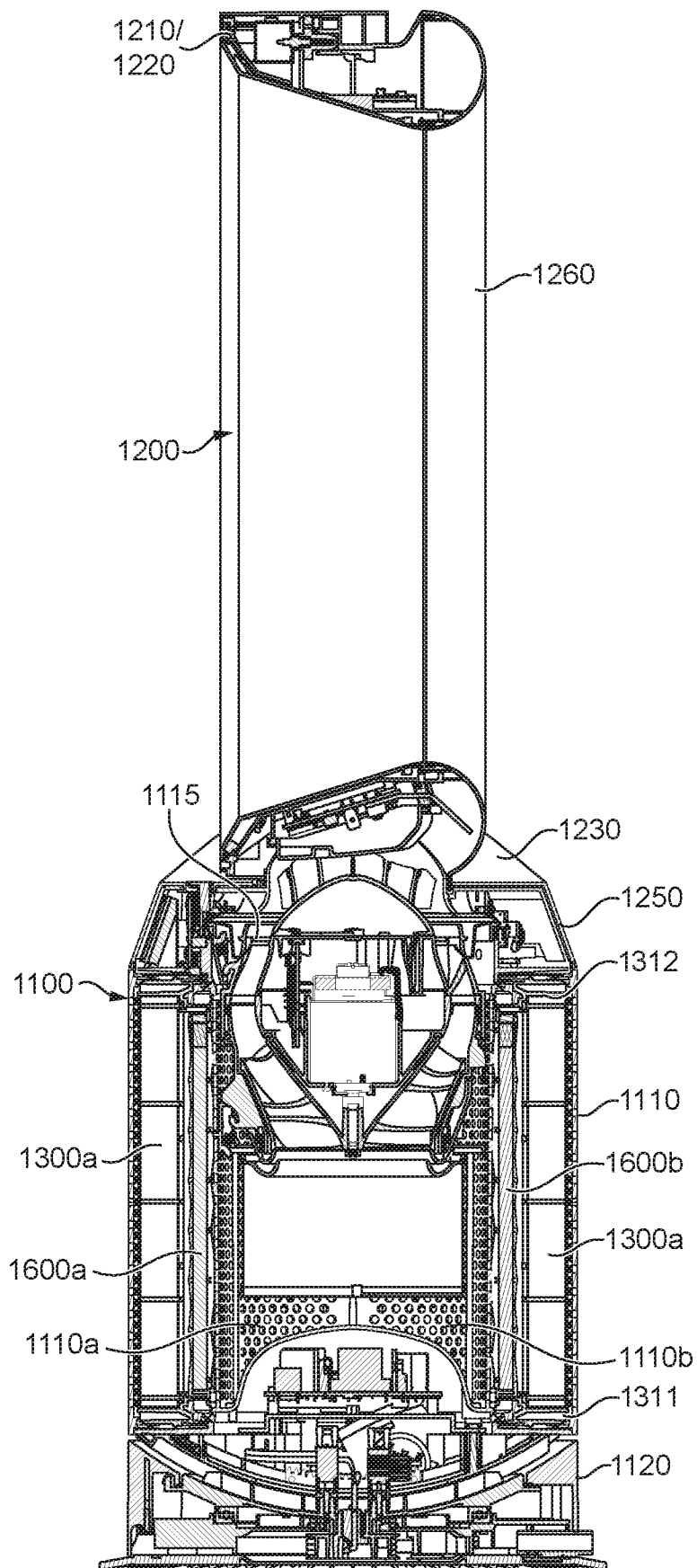


FIG. 4

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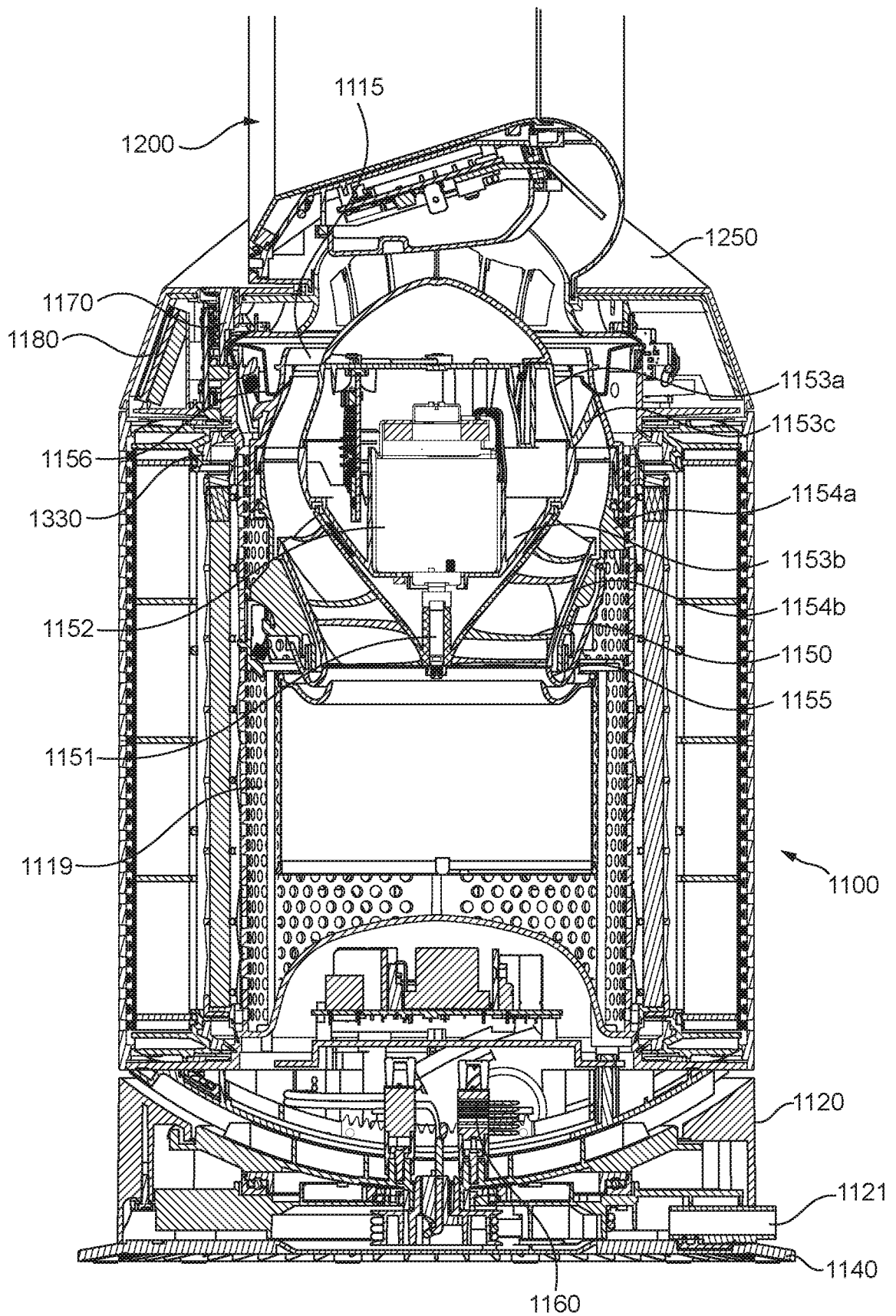


FIG. 5

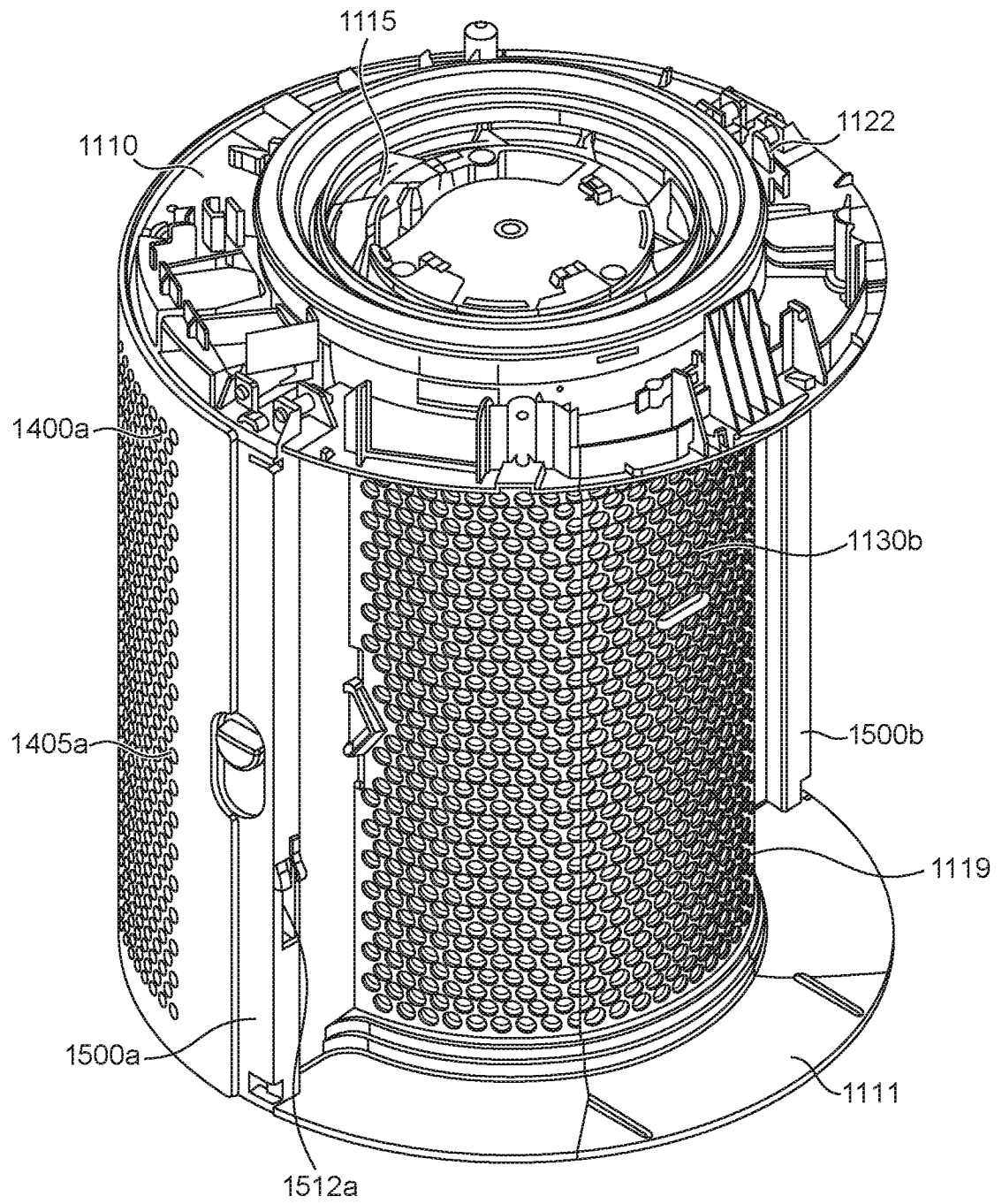


FIG. 6

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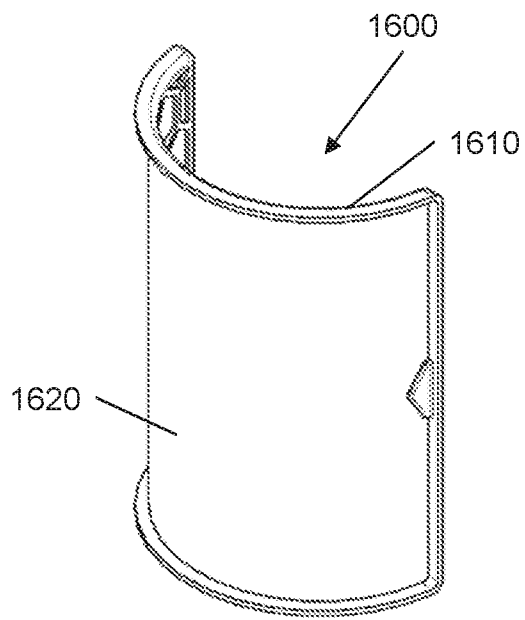


FIG. 7a

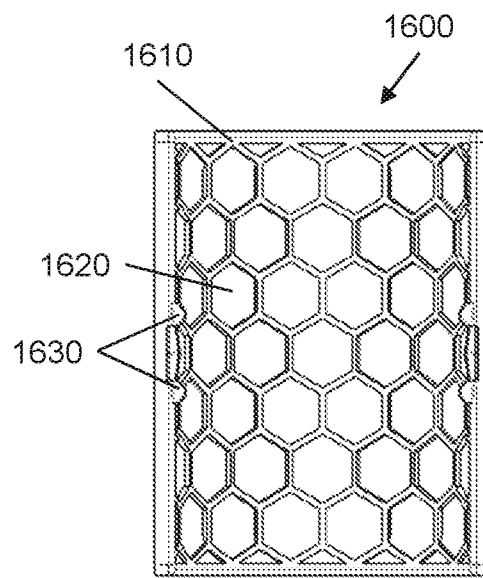


FIG. 7b

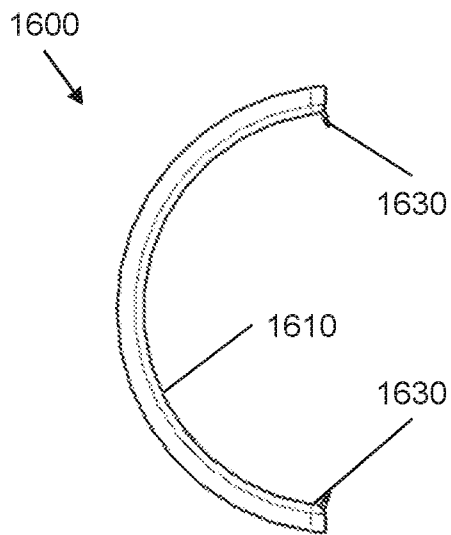


FIG. 7c

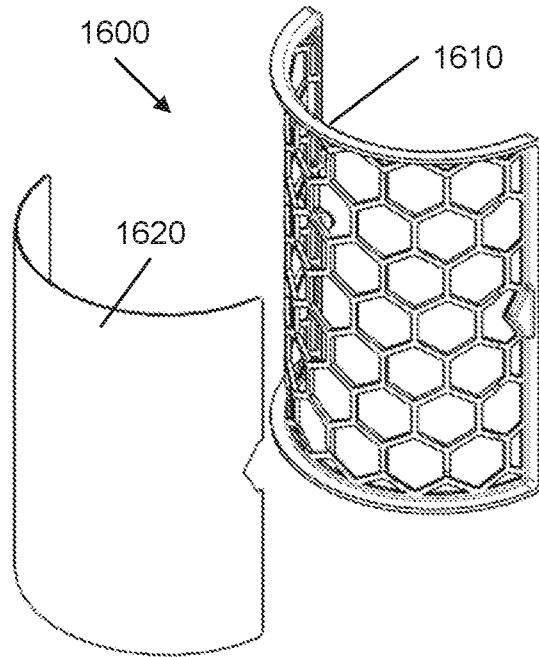
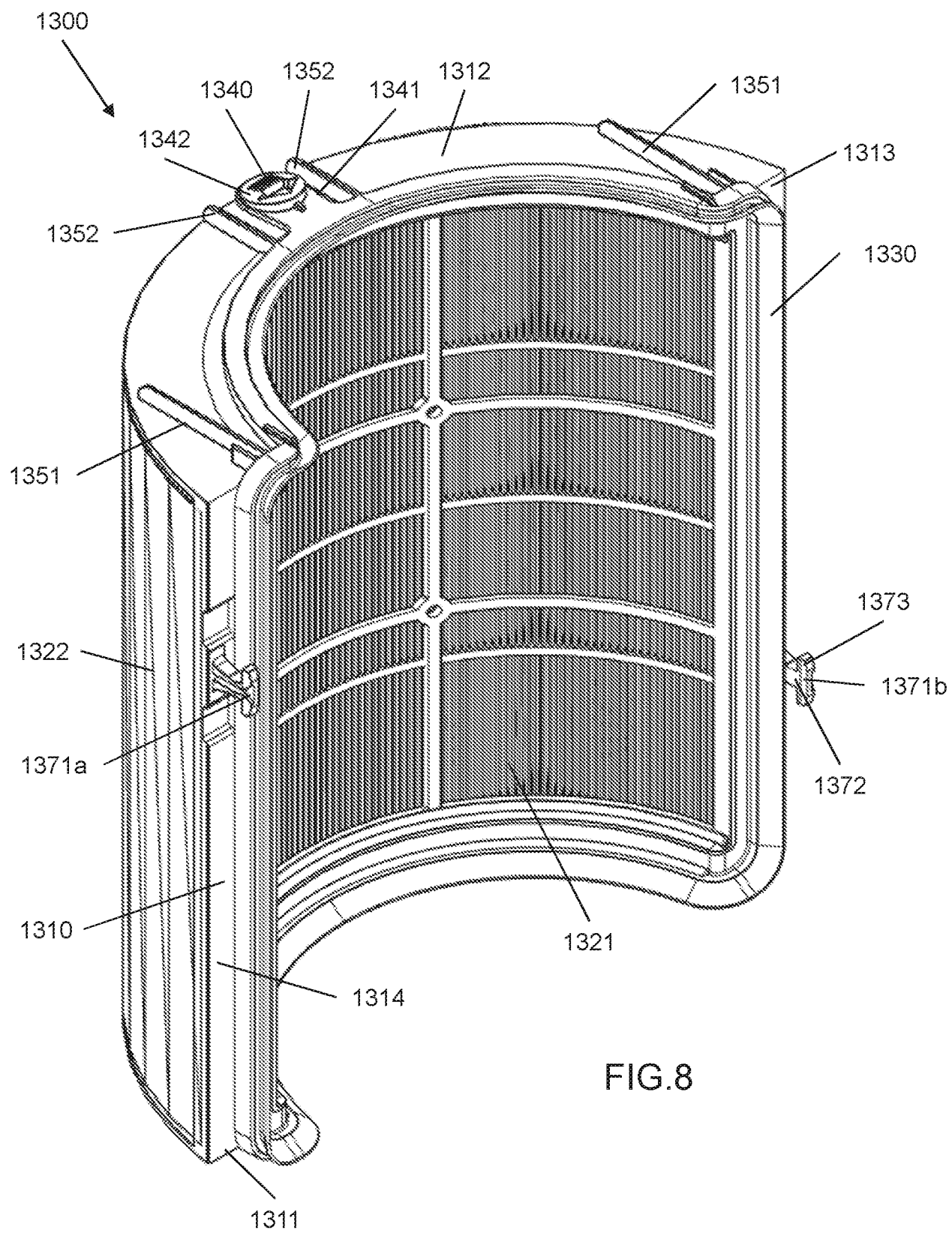


FIG. 7d



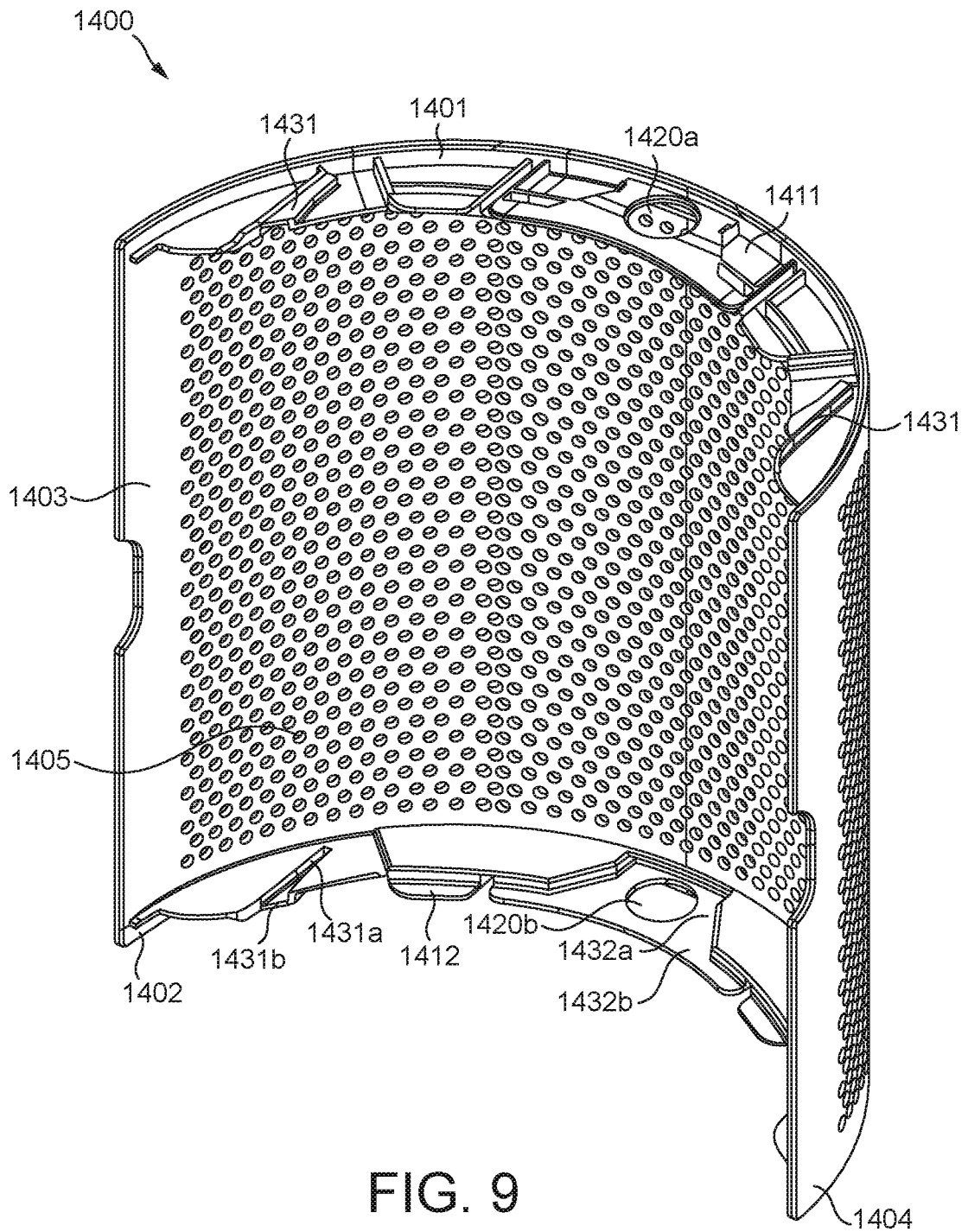


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/050093

A. CLASSIFICATION OF SUBJECT MATTER

INV. B01D46/00 B01D46/02 B01D46/10 F04D25/08 F04D29/40
F04D29/62 F04D29/64 F04D29/70 F04F5/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01D F04F F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/128734 A1 (DYSON TECHNOLOGY LTD [GB]) 18 August 2016 (2016-08-18) page 10, line 27 - page 11, line 14 page 18, lines 8-16 page 22, lines 7-18 page 24, line 10 - page 26, line 28 figures 1,4,5a,6,7,12-14 -----	1-25
X A	US 2009/010801 A1 (MURPHY OLIVER J [US] ET AL) 8 January 2009 (2009-01-08) paragraphs [0043] - [0046], [0052] - [0054], [0057] figures 1,5A,5B -----	1-8,21 9-20, 22-25
X A	CN 206 604 315 U (MA NING) 3 November 2017 (2017-11-03) claims 1,2 paragraphs [0014] - [0021]; figures 1,2 ----- -/--	1 2-25



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

10 April 2019

Date of mailing of the international search report

17/04/2019

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Authorized officer

Baumlin, Sébastien

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/050093

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 2017/144128 A1 (CARRION ALEXANDER [US] ET AL) 25 May 2017 (2017-05-25) paragraphs [0001], [0237] - [0054] claim 1 figures 1,2,4A,6B -----	1-25

INTERNATIONAL SEARCH REPORT

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International application No

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