



US 20220290892A1

(19) **United States**(12) **Patent Application Publication**
Ghalebi et al.(10) **Pub. No.: US 2022/0290892 A1**(43) **Pub. Date: Sep. 15, 2022**(54) **AIR PURIFICATION SYSTEM****B01D 46/24** (2006.01)(71) Applicant: **Air Purix Inc.**, Delray Beach, FL (US)**B01D 46/681** (2006.01)**B01D 46/78** (2006.01)(72) Inventors: **Mehrdad Ghalebi**, Delray Beach, FL (US); **Robert L. Diamond**, Palm Beach, FL (US)(52) **U.S. Cl.**CPC **F24F 13/28** (2013.01); **A61L 9/205** (2013.01); **B01D 46/2411** (2013.01); **B01D 46/681** (2022.01); **B01D 46/78** (2022.01); **A61L 2209/212** (2013.01)(21) Appl. No.: **17/692,713**(22) Filed: **Mar. 11, 2022****Related U.S. Application Data**

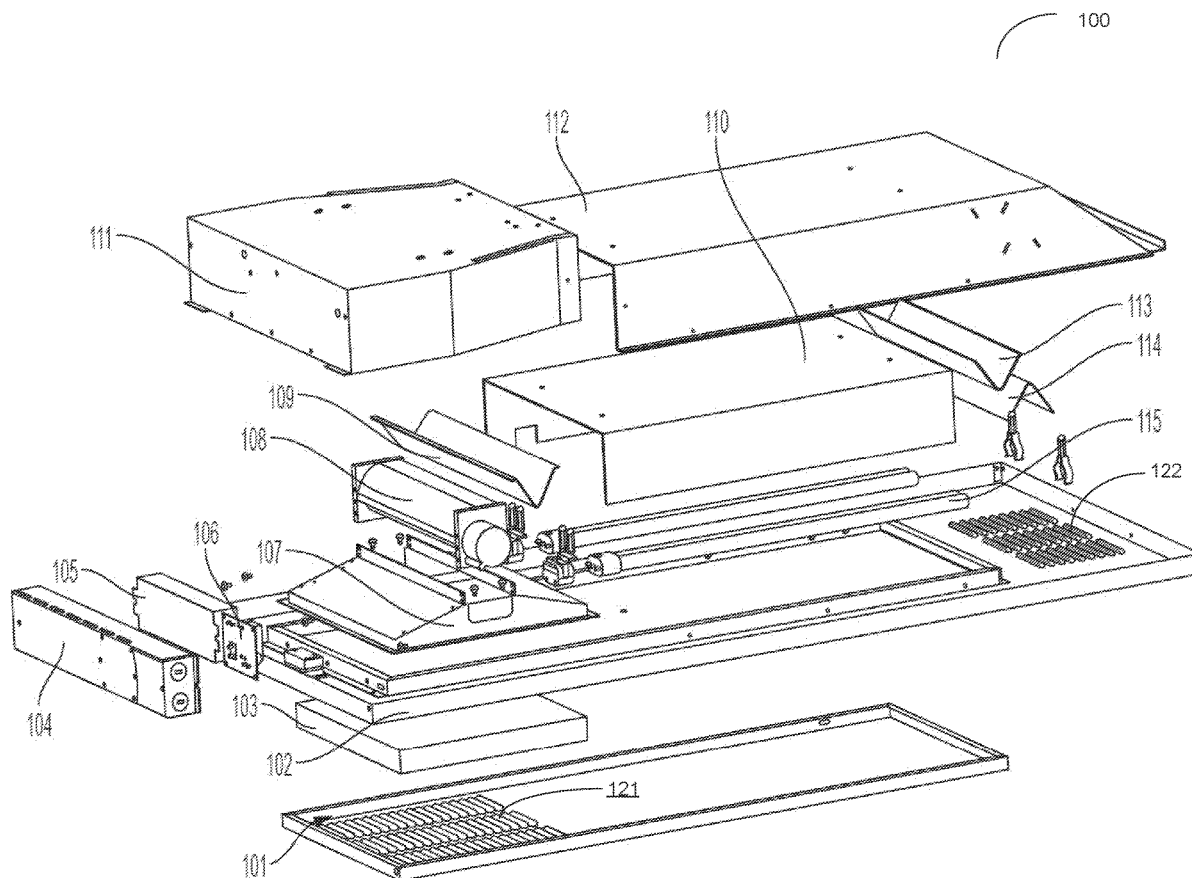
(60) Provisional application No. 63/160,161, filed on Mar. 12, 2021, provisional application No. 63/286,338, filed on Dec. 6, 2021.

Publication Classification(51) **Int. Cl.****F24F 13/28** (2006.01)**A61L 9/20** (2006.01)

(57)

ABSTRACT

An example air purification system comprises: an air guiding funnel; a particle absorbing filter disposed at an intake side of the air guiding funnel; a tangential fan disposed at an outlet side of the air guiding funnel; and an ultra-violet (UV) energy absorbing shell mechanically coupled to an discharge side of the tangential fan.



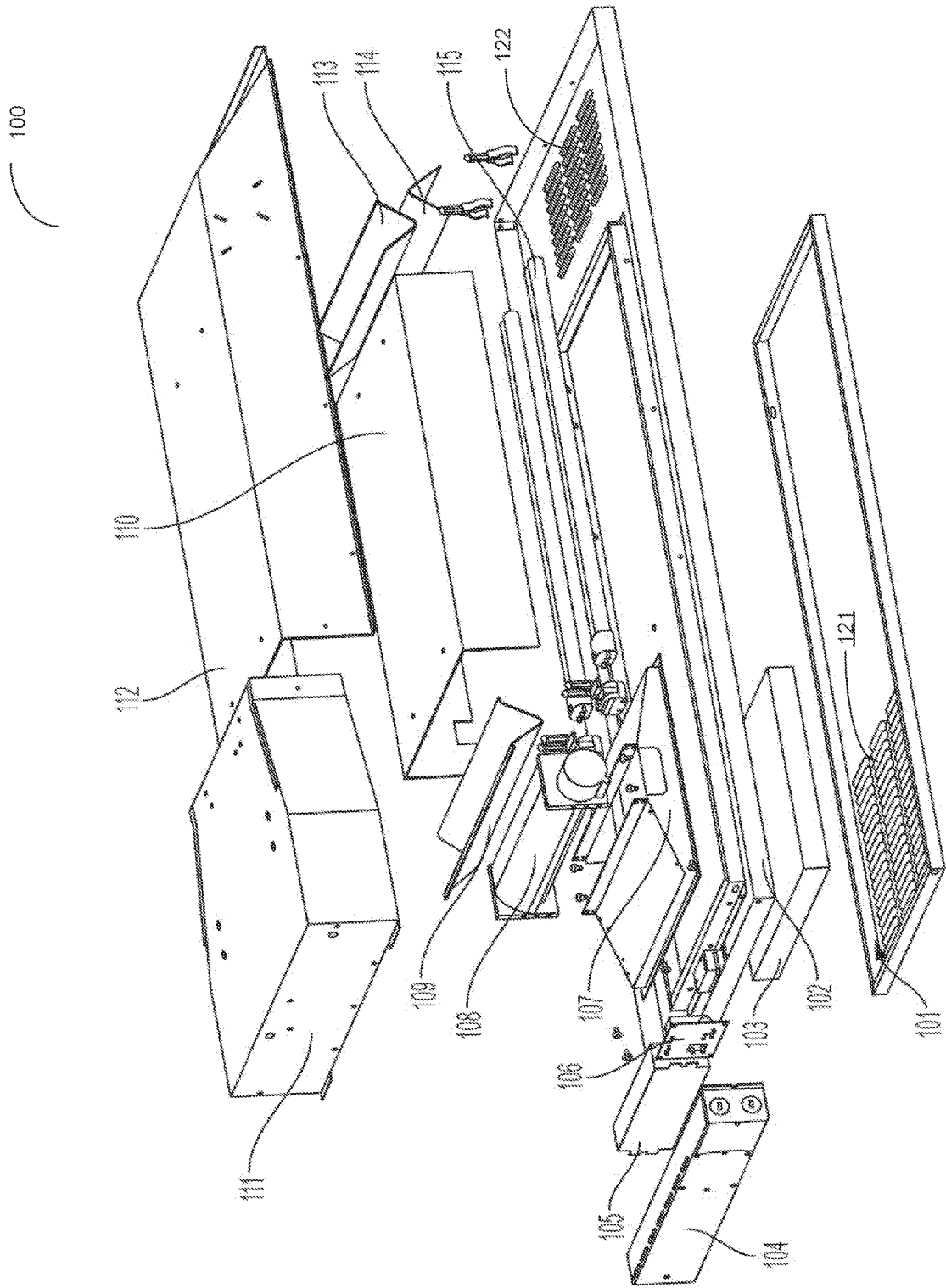


Fig. 1

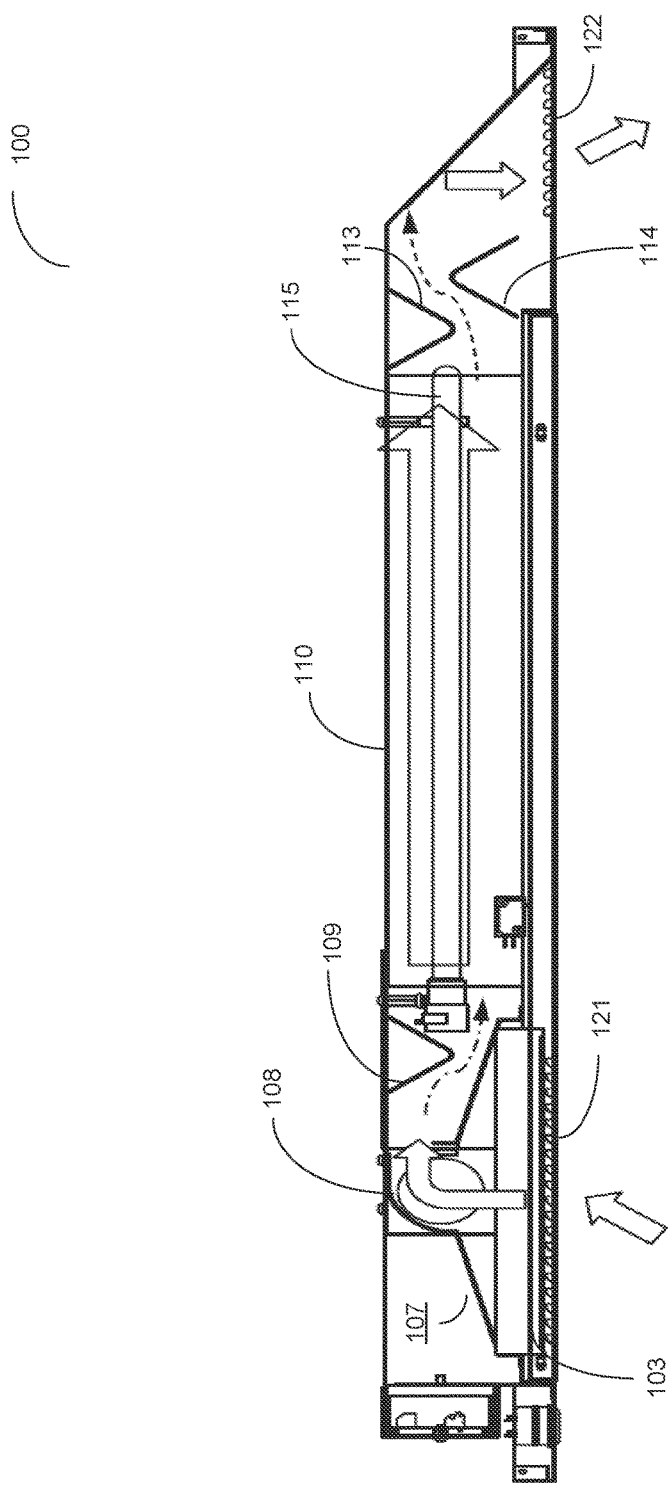


Fig. 2

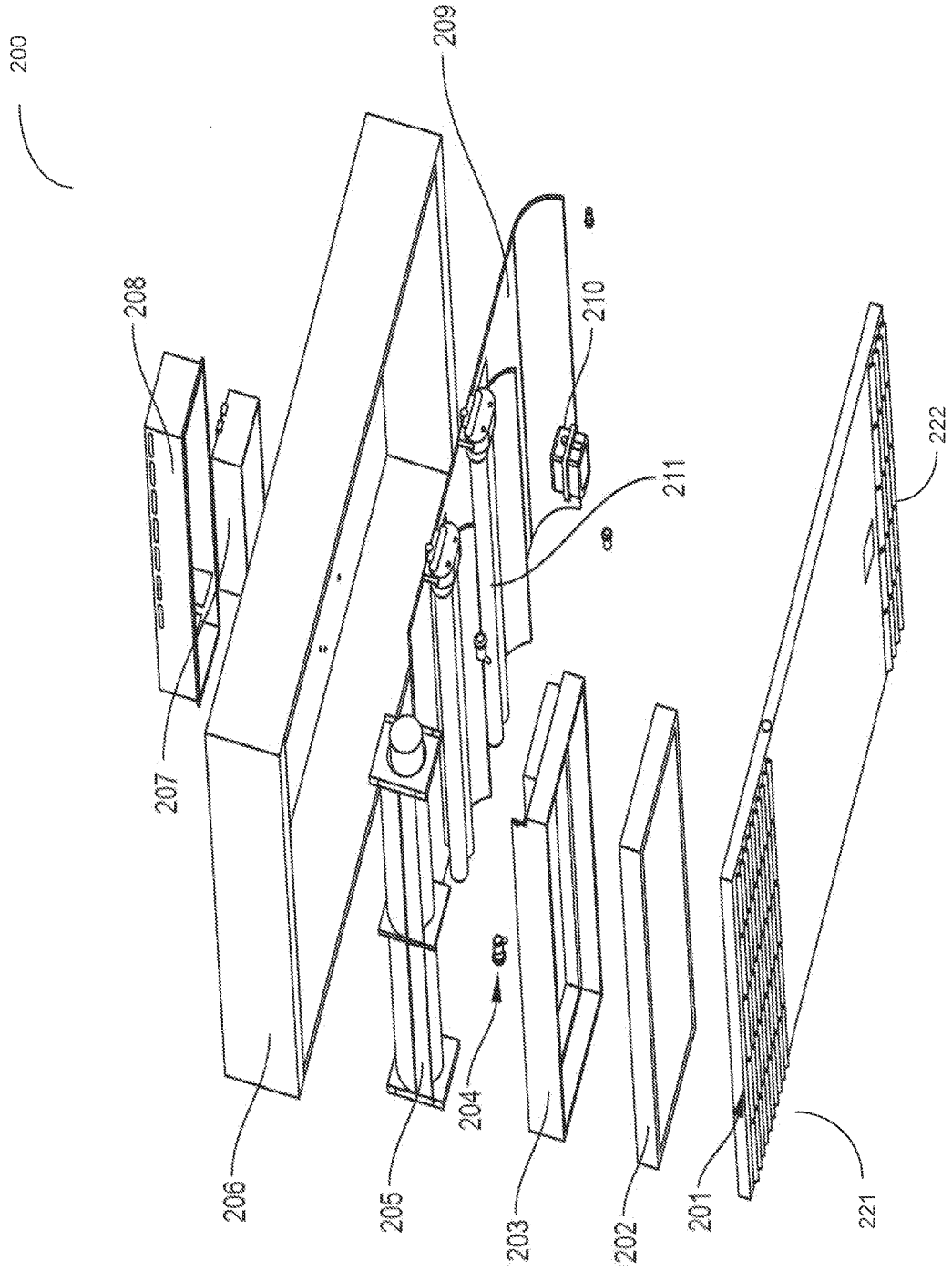


Fig. 3

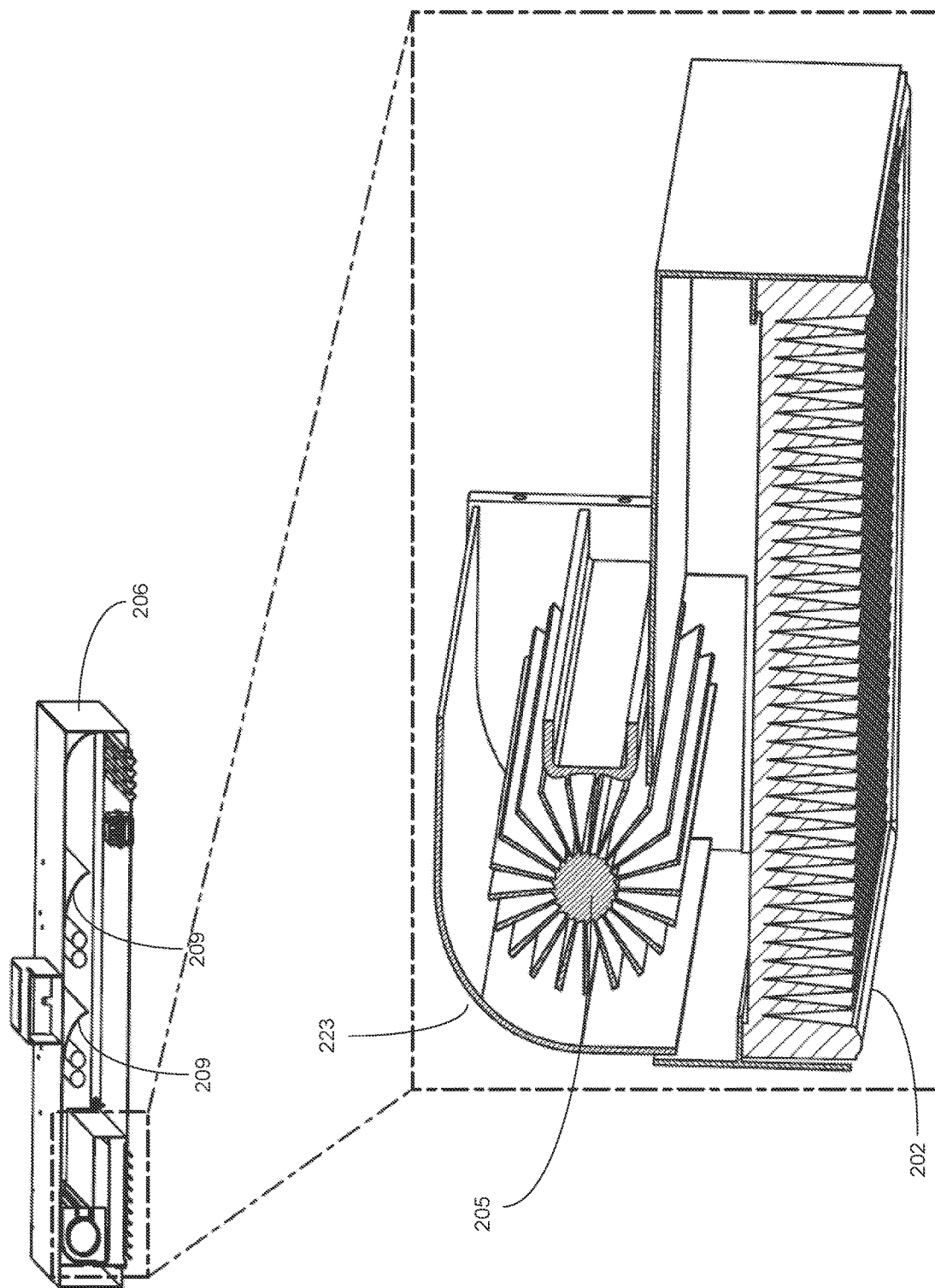


Fig. 4

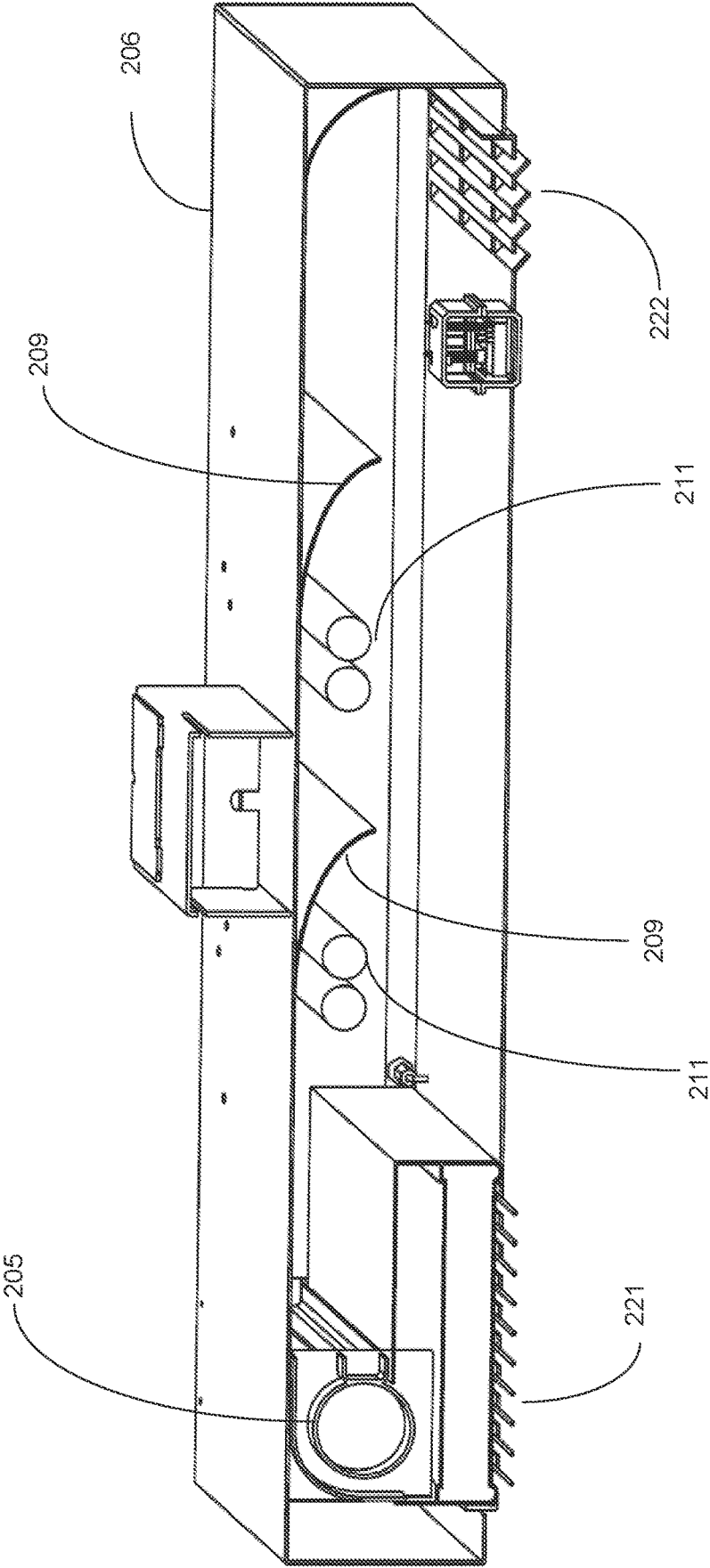


Fig. 5

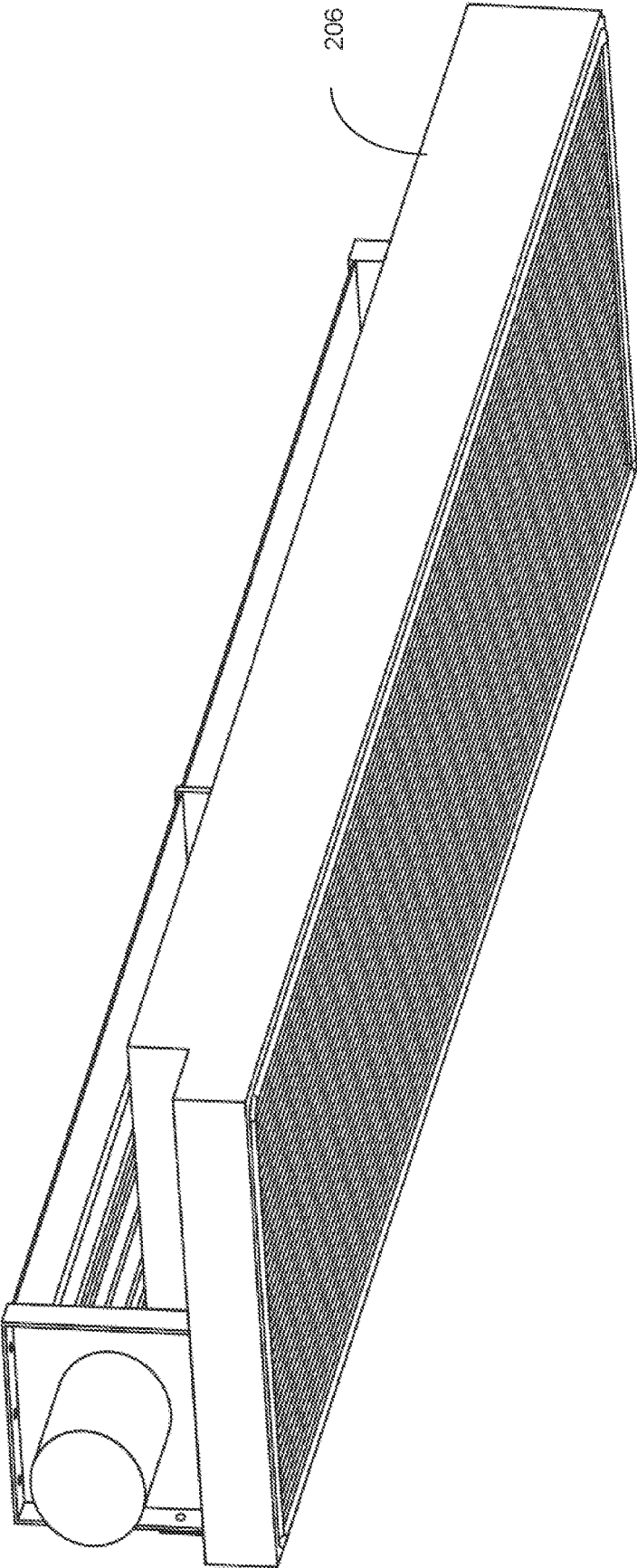


Fig. 6

AIR PURIFICATION SYSTEM

REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 63/160,161, filed Mar. 12, 2021 and U.S. Provisional Patent Application No. 63/286,338, filed Dec. 6, 2021. The above-referenced applications are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure is generally related to air purification systems, and is specifically related to air purification systems and apparatuses employing particle filters and ultraviolet (UV) radiation emitters.

BACKGROUND

[0003] “UV radiation” herein refers to electromagnetic radiation corresponding to the electromagnetic spectrum between the X-rays and visible light. UV radiation may include multiple types of UV rays, including UVA, UVB, and UVC, which differ by their respective wavelength: UVA rays have the longest wavelengths, followed by UVB, and UVC rays which have the shortest wavelengths. Thus, UVC radiation is the highest energy portion of the UV radiation spectrum.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The present disclosure is illustrated by way of examples, and not by way of limitation, and may be more fully understood with references to the following detailed description when considered in connection with the figures, in which:

[0005] FIG. 1 schematically illustrates an exploded view of an example air purification system implemented in accordance with aspects of the present disclosure;

[0006] FIG. 2 schematically illustrates the air flow through the example air purification system implemented in accordance with aspects of the present disclosure;

[0007] FIG. 3 schematically illustrates an exploded view of another example air purification system implemented in accordance with aspects of the present disclosure;

[0008] FIG. 4 schematically illustrates a cross-section view of a tangential fan and an air guiding funnel assembly of an example air purification system implemented in accordance with one or more aspects of the present disclosure;

[0009] FIG. 5 schematically illustrates a cross-section view of the example air purification system implemented in accordance with one or more aspects of the present disclosure; and

[0010] FIG. 6 schematically illustrates an exterior view of an example air purification system implemented in accordance with one or more aspects of the present disclosure.

DETAILED DESCRIPTION

[0011] Described herein are air purification systems employing ultraviolet (UV) radiation emitters.

[0012] An example air purification system, apparatus, or device (referred to as “air purification system” herein) may include a housing containing one or more air trims, one or more particle absorbing filters, one or more fans that force the air through the air trims and particle absorbing filters, and one or more UV radiation emitting devices. The shapes

and locations of the air trims may be designed to control the direction of air moving through the air purification system. The particle absorbing filters may be represented, e.g., by high-efficiency particulate absorbing (HEPA) particle absorbing filters.

[0013] In operation, the airflow is inhaled into the housing through the inlet and is driven by the fan along the air path controlled by the air trims through the filters and around the UV emitting devices, until the airflow leaves the housing through the outlet. The filters retain the particles contained by the air, while the UV radiation effectively eliminates or deactivates a wide range of pathogenic microorganisms, such as bacteria and viruses, thus providing the requisite level of air purification.

[0014] Some amount of the UV radiation emitted by the UV radiation emitting devices would inevitably leak from the housing, e.g., through the air path outlet. The maximum amount of UV radiation that may be emitted by the air purification system may be regulated by various rules and standards. For example, UL507 specifies that the intensity of UVC radiation emitted by a device should not exceed 0.1 $\mu\text{W}/\text{cm}^2$. Accordingly, the housing of the air purification system should effectively attenuate the UV energy (and, specifically, UVC energy, which is the highest energy portion of the UV radiation spectrum) in order to reduce the UV (and, specifically, UVC) leakage to values below the allowed maximum, while not obstructing the flow of air through the air filters and around the UV radiation emitting devices.

[0015] FIG. 1 schematically illustrates an exploded view of an example air purification system implemented in accordance with aspects of the present disclosure. As shown in FIG. 1, the example air purification system 100 includes a housing formed by top covers 111 and 112, and the bottom cover 102.

[0016] The top covers 111-112, which are attached to each other in an airtight manner, have respective form factors of convex polyhedrons formed by flat panel facets, such that the convex polyhedrons have their respective bottom facets removed and effectively replaced by the bottom cover 102, which is attached to the assembly formed by the top covers 111-112 in an airtight manner. The assembly formed by the top covers 111-112, which acts as the air intake chamber, contains the air guiding funnel 107 and the tangential fan 108, while providing mechanical support to the whole structure. The bottom cover 102 is equipped with a lid 101, which encloses an opening within the bottom cover 102 and may be removed to provide access for replacing UV radiation emitting devices 115 and/or particle absorbing filters 103 as required. In some implementations, at least part of the surface of the lid 101 is occupied by a group of suction louvers collectively forming an air inlet 121. At least part of the surface of the bottom cover 102 is occupied by a group of exhaust louvers collectively forming an air outlet 122.

[0017] Thus, the bottom cover 102 equipped with the lid 101 control the air intake and discharge. In the illustrative example of FIG. 1, the air is drawn at a pre-defined (e.g., 45 degrees) angle with respect to the imaginary longitudinal axis of the UV reflector 110 through the air inlet 121 and discharged at another pre-defined (e.g., 45 degrees) angle with respect to the imaginary longitudinal axis of the UV reflector 110 through air outlet 122. The air intake and discharge parameters are defined by the shapes, positions, configurations (e.g., the angle of the slats forming the

louvers), and/or sizes of the air inlet **121**, the air outlet **122**, and/or the louvers forming the air inlet **121** and the air outlet **122**. The shapes, positions, configurations, and/or sizes of the air inlet **121**, the air outlet **122**, and/or the louvers forming the air inlet **121** and the air outlet **122** may be adjusted in order to accommodate a specific application and/or provide the desired performance parameters (i.e., the volume of the air passing through the louvers in a unit of time, the noise levels, etc.).

[0018] The particle absorbing filter **103** is positioned adjacently to the air inlet **121** and is employed for absorbing the particles that are contained in the air passing through the filter. The particle absorbing filter may be represented, e.g., by a high-efficiency particulate absorbing (HEPA) filter. The type, size, and/or other parameters of the particle absorbing filter **103** may be chosen to satisfy the requirements of a particular application. In particular, the size of the particle absorbing filter **103** may be chosen that is capable to provide a requisite performance measured by the volume of the air processed by the air purification system **100** in a unit of time. The volume of the air space above the particle absorbing filter **103** may be maximized within the overall fixture height, in order to allow for efficient air circulation within the UV energy absorbing shell formed by the UV reflector **110**, the bottom cover **102**, and the lid **101**.

[0019] The air guiding funnel **107** is an air conduit that is shaped to efficiently push the air through the UV energy absorbing shell formed by the UV reflector **110**, the bottom cover **102**, and the lid **101**.

[0020] In some implementations, the UV reflector **110** may be formed by three flat panels arranged to form a rectangular parallelepiped without the bottom facet and two end facets. The bottom side of the UV reflector **110** is attached, in an airtight manner, to the bottom cover **102**. The opening created by the missing end facet on the left side of the UV reflector **110** provides an air path to the discharge of the tangential fan **108**, such that the air path from the discharge of the tangential fan **108** is at least partially obstructed by the UV isolator **109**. The opening created by the missing end facet on the right side of the UV reflector **110** provides an air path leading to the air outlet **122**, such that the air path is at least partially obstructed by UV isolators **113** and **114**. Thus, the UV isolators **109**, **113**, and **114** may also act as effective air trims that control the air flow through the UV energy absorbing shell.

[0021] The inner surfaces of the flat panels forming the UV reflector **110** may be polished to provide a high reflectance (e.g., a reflectance value exceeding a predefined high reflectance threshold), thus collectively forming a light path to be followed by UV energy emitted by the UV radiation emitting devices **115**. The light path may be constructed in a manner ensuring that any airborne particles (including pathogenic microorganisms) that are present within the air passing through the UV energy absorbing shell would be exposed to the maximum possible amount of the UV radiation emitted by the UV radiation emitting devices **115**. Conversely, at least some of the surfaces of the UV isolators **109**, **113**, and **114**, top covers **111-112**, and/or bottom cover **101** may have very low reflectance (e.g., a reflectance value falling below a predefined low reflectance threshold), such that each surface would absorb at least a predefined portion of UV energy (and, specifically UVC energy) incident upon these surfaces (e.g., 95% of the incident UV energy). Accordingly, the resulting light path formed by the inner

surfaces of the energy absorbing shell would prevent the UV radiation from escaping the UV energy absorbing shell in order to satisfy the pertinent rules and standards with respect to the amount of the UV energy (and, specifically UVC energy) that is allowed to be emitted by the air purification system.

[0022] In the illustrative example, the air guiding funnel **107** has an inlet through which the filtered air enters the air guiding funnel **107**. The inlet is located on the filter side (i.e., the bottom side in the example of FIG. 1) of the air guiding funnel **107** and matches the shape and size of the particle absorbing filter **103**. In the assembled state, the air guiding funnel **107** is attached to the particle absorbing filter **103** in an airtight manner, such that no unfiltered air would be able to enter the air guiding funnel **107**. The opposite to the particle absorbing filter side of the air guiding funnel **107** is the fan side (i.e., the top side in the example of FIG. 1), which in the assembled state is mechanically coupled to an intake side of the tangential fan **108**. Thus, the air guiding funnel **107** is an airtight enclosure having a larger opening matching the size and shape of the particle absorbing filter **103** and providing a sealed air path connecting the larger opening with a smaller opening matching the size and shape of the tangential fan **108**.

[0023] In the illustrative example of FIG. 1, the air guiding funnel **107** has a cross section represented by an isosceles trapezoid, such that the larger of the two parallel sides of the trapezoid is oriented towards the particle absorbing filter **103**, while the smaller of the two parallel sides of the trapezoid is oriented towards the tangential fan **108**. The two trapezoidal walls are connected by two rectangular covers, thus forming the funnel shape. In various other implementations, other suitable shapes and form factors may be employed for driving the air through the particle absorbing filter **103** and into the UV energy absorbing shell formed by the UV reflector **110**, the bottom cover **102**, and the lid **101**, provided that the chosen shape would have a larger opening matching the size and shape of the particle absorbing filter **103** and a sealed air path connecting the larger opening with a smaller opening matching the size and shape of the tangential fan **108**.

[0024] As noted herein above, the air is driven through the air purification system **100** by the tangential fan **108**, which employs a cylindrical impeller to drive the outside air through the air inlet **121**, the particle absorbing filter **103**, the air guiding funnel **107** and to the UV energy absorbing shell formed by the UV reflector **110**, the bottom cover **102**, and the lid **101**. In some implementations, the fan may be driven by a direct current (DC) motor, and its rotation rate may be controlled by a pulse width modulator (PWM) driver.

[0025] The maximum amount of UV radiation that may be emitted by the air purification system may be regulated by various rules and standards. For example, UL507 specifies that the intensity of UVC radiation emitted by a device should not exceed 0.1 $\mu\text{W}/\text{cm}^2$. Accordingly, the housing of the air purification system should effectively attenuate the UV energy (and, specifically, UVC energy, which is the highest energy portion of the UV radiation spectrum) in order to reduce the UV (and, specifically, UVC) leakage to values below the allowed maximum, while not obstructing the flow of air through the particle absorbing filters and around the UV radiation emitting devices.

[0026] As noted herein above, the UV energy absorbing shell is formed by the UV reflector **110**, the bottom cover

102, and the lid **101**. The UV reflector **110** has a polished inner surface which contains the UV energy inside the UV energy absorbing shell and directs the UV rays emitted by the UV radiation emitting devices **115** along the UV energy absorbing shell so that any airborne particles (including pathogenic microorganisms) that are present within the air passing through the UV energy absorbing shell would be exposed to maximum possible amount of UV radiation.

[0027] As noted herein above, the air path from the discharge of the tangential fan **108** is at least partially obstructed by the UV isolator **109**. The opening on the right side of the UV reflector **110** is an air path that is at least partially obstructed by UV isolators **113** and **114**. Thus, the UV isolators **109**, **113**, and **114** may also act as effective air trims that control the air flow through the UV energy absorbing shell. Furthermore, each UV isolator **109**, **113**, and **114** may be shaped to impede an otherwise possible path to the outside world for UV radiation emitted by the UV radiation emitting devices **115**. In some implementations, each UV isolator **109**, **113**, and **114** may have a form factor of a beam having a V-shaped cross section. As schematically illustrated by FIG. 2, a pair of UV isolators **109**, **113** located at the outlet end of the UV reflector **110** may be positioned in such a manner that their longitudinal axes would be perpendicular to the imaginary longitudinal axis of the UV reflector **110**, and their respective V-shaped cross-sections would be symmetrically oriented. Thus, the UV isolators **109**, **113** would prevent the UV radiation originated within the UV reflector **110** from escaping the UV energy absorbing shell formed by the UV reflector **110**, the bottom cover **102**, and the lid **101**, while leaving the air path open for the air to reach the outlet **122**. Similarly, the UV isolator **109** may be positioned in such a manner that that its imaginary longitudinal axis would be perpendicular to the imaginary longitudinal axis of the UV reflector **110**. The UV isolator **109** may be positioned relative to the surface of the air guiding funnel **107** in such a manner that that the UV radiation originated within UV reflector **110** would be prevented from escaping the UV energy absorbing shell, while leaving the air path open for the air driven by the tangential fan **108** to enter the UV energy absorbing shell. Each UV isolator **109**, **113**, and **114** may be painted or coated in order to absorb at least a predefined portion of UV energy incident upon the surface of the UV isolator. At least some of the surfaces of the UV isolators **109**, **113**, and **114** may have very low reflectance (e.g., a reflectance value falling below a predefined low reflectance threshold), such that each surface would absorb at least a predefined portion of UV energy (and, specifically UVC energy) incident upon the surface (e.g., 95% of the incident UV energy).

[0028] In various implementations, the above-referenced and/or other parts of the air purification system may be made of metal, plastic, composite, and/or other suitable materials. Surfaces of the above-referenced parts may be machined, polished, coated, painted, and/or otherwise processed.

[0029] The UV radiation emitting devices **115** are employed for producing UV radiation which effectively eliminates or deactivates a wide range of pathogenic microorganisms which may be contained in the air being supplied to the air purification system. In various implementations, the UV radiation emitting devices **115** may be represented, e.g., by light emitting diode (LED) lamps, low-pressure mercury-vapor lamps, amalgam lamps, high-intensity discharge (HID) lamps, plasma lamps, etc., which emit UV

radiation having wavelengths within a certain range, e.g., between 200 and 280 nm. The UV radiation emitting devices **115** may be powered by an external power supply via the UV ballast circuit **105**, which may be employed for ramping up the input voltage and producing a requisite output voltage for driving the UV radiation emitting devices **115**. In the illustrative example of FIG. 1, the UV ballast circuit **105** is attached to the bottom cover **102**. Access to the UV ballast circuit **105** may be provided by the ballast cover **104**.

[0030] Operation of the UV ballast circuit **105**, UV radiation emitting devices **115**, and fan **108** may be controlled by the control circuit **106**. In some implementations, the control circuit **106** may enable additional functionalities such motion detection and/or Internet-of-Things (IOT) capabilities. In an illustrative example, one or more motion detectors disposed within and/or outside of the air purification system **100** may transmit motion detection signals to the control circuit **106**, which may switch the radiation emitting devices **115** and the fan **108** on responsive to receiving motion detection signal(s) from one or more motion detectors, and may further switch the radiation emitting devices **115** and the fan **108** on upon expiration of a timeout triggered by the motion detection signal(s). In another illustrative example, the control circuit **106** may, in the absence of motion detector signals, maintain the speed of the fan **108** and/or voltage level supplied to the UV radiation emitting devices **115** at their respective standby levels. Upon receiving motion detection signal(s) from one or more motion detectors, the control circuit **106** may increase the speed of the fan **108** and/or voltage level supplied to the UV radiation emitting devices **115**, and may return to the standby fan speed and radiation emitting device voltage levels upon expiration of a timeout triggered by the motion detection signal(s). In yet another illustrative example, the control circuit **106** may receive control signals (e.g., fan on/off, UV radiation emitting devices on/off, fan speed, voltage level supplied to the UV radiation emitting devices **115**, etc.) via a wireless communication interface (e.g., Bluetooth or Wi-Fi interface).

[0031] FIG. 2 schematically illustrates the air flow through the example air purification system **100**. As schematically illustrated by FIG. 2, in operation, the air is drawn, by the tangential fan **108**, through the air inlet **121**, particle absorbing filter **103**, and air guiding funnel **107**. Upon exiting the air guiding funnel **107**, the air flow is forced, by the tangential fan **108** to change the flow direction by 90 degrees and enter the UV energy absorbing shell formed by the UV reflector **110**. While moving along the UV energy absorbing shell, the air is exposed to the UV energy radiated by the UV emitting devices **115**. The filtered and purified air is then discharged through the air outlet **122**.

[0032] Therefore, the particles contained by the air are retained by the particle absorbing filter **103**, while the UV radiation emitted the UV radiation emitting devices effectively eliminates or deactivates a wide range of pathogenic microorganisms which may be contained in the air being supplied to the air purification system, thus providing the requisite level of air purification.

[0033] The use of the tangential fan and the air guiding funnel allow reducing the vertical size of the air purification system and controlling the noise level emitted by the air purification system, thus making the air purification system

suitable for various applications, including elevator cabins, medical facilities, conference rooms, performance auditoriums, etc.

[0034] FIG. 3 schematically illustrates an exploded view of another example air purification system implemented in accordance with aspects of the present disclosure. As shown in FIG. 3, the example air purification system 200 includes a housing formed by the housing 206 and a matching bottom cover 201. In some implementations, at least part of the surface of the bottom cover 201 is occupied by a group of suction louvers collectively forming an air inlet 221, while another part of the surface of the bottom cover 201 is occupied by a group of exhaust louvers collectively forming an air outlet 222.

[0035] Thus, the bottom cover 201 equipped by the air inlet 221 and the air outlet 222 controls the air intake and discharge. In the illustrative example of FIG. 1, the air is drawn at a pre-defined (e.g., 45 degrees) angle through the air inlet 221 and discharged at another pre-defined (e.g., 45 degrees) angle from through air outlet 222. The air intake and discharge parameters are defined by the shapes, positions, configurations (e.g., the angle of the slats forming the louvers), and/or sizes of the air inlet 221, the air outlet 222, and/or the louvers forming the air inlet 221 and the air outlet 222. The shapes, positions, configurations, and/or sizes of the air inlet 221, the air outlet 222, and/or the louvers forming the air inlet 221 and the air outlet 222 may be adjusted in order to accommodate a specific application and/or provide the desired performance parameters (i.e., the volume of the air passing through the louvers in a unit of time, the noise levels, etc.).

[0036] The particle absorbing filter 202 is positioned adjacently to the air inlet 121 and is employed for absorbing the particles that are contained in the air passing through the filter. The particle absorbing filter may be represented, e.g., by a high-efficiency particulate absorbing (HEPA) filter.

[0037] The air guiding funnel 203, retained in its position by a pair of latch retainers 204, is an air conduit that is shaped to efficiently push the air through the UV energy absorbing shell formed by the housing 206.

[0038] The twin barrel tangential fan 205 employs a cylindrical impeller to drive the outside air through the air inlet 221, the particle absorbing filter 202, the air guiding funnel 203 and to the UV energy absorbing shell formed by the housing 206. In some implementations, the fan may be driven by a direct current (DC) motor, and its rotation rate may be controlled by a pulse width modulator (PWM) driver.

[0039] The UV radiation emitting devices 211 disposed within the housing 206 may be powered by an external power supply via the UV driver/ballast circuit 207 disposed within the cover 208, which may be employed for ramping up the input voltage and producing a requisite output voltage for driving the UV radiation emitting devices 211.

[0040] The UV reflector 209 disposed within the housing 206 has a polished inner surface which contains the UV energy inside the housing 206 and directs the UV rays emitted by the UV radiation emitting devices 211 along the housing 206 so that any airborne particles (including pathogenic microorganisms) that are present within the air passing through the housing 206 would be exposed to maximum possible amount of UV radiation. The UV reflector 209 may be represented by a reflecting plain surface with concave edges, which are designed to create vortices of the air

passing through the housing 206 in order to force the air to circulate through the housing 206 multiple times thus increasing the exposure of the air to UV radiation emitted by the UV radiation emitting devices 211.

[0041] Operation of the UV radiation emitting devices 211 and fan 205 may be controlled by the control circuit 210. In some implementations, the control circuit 210 may enable additional functionalities such motion detection and/or Internet-of-Things (IOT) capabilities.

[0042] FIG. 4 schematically illustrates a cross-section view of a tangential fan and an air guiding funnel assembly of an example air purification system. The air flow is forced, by the tangential fan cover 223 to change the flow direction by 90 degrees and enter the UV energy absorbing shell formed by the UV reflectors 209.

[0043] FIG. 5 schematically illustrates the air flow through the example air purification system 200. As schematically illustrated by FIG. 5, in operation, the air is drawn, by the tangential fan 205, through the air inlet 221, particle absorbing filter 202, and air guiding funnel 203. The air flow is forced, by the tangential fan 108 to change the flow direction by 90 degrees and enter the UV energy absorbing shell formed by the UV reflectors 209. While moving along the UV energy absorbing shell, the air is exposed to the UV energy radiated by the UV emitting devices 211. The filtered and purified air is then discharged through the air outlet 122.

[0044] FIG. 6 schematically illustrates an exterior view of an example air purification system implemented in accordance with one or more aspects of the present disclosure. The use of the tangential fan and the air guiding funnel allow reducing the vertical size of the air purification system and controlling the noise level emitted by the air purification system, thus making the air purification system suitable for various applications, including elevator cabins, medical facilities, conference rooms, performance auditoriums, etc.

[0045] Accordingly, an air purification system, device, or apparatus ("air purification system") implemented in accordance with aspects of the present disclosure, may include an air conduit (e.g., represented by an air guiding funnel); a particle absorbing filter disposed at an intake side of the air guiding funnel; a tangential fan disposed at an outlet side of the air guiding funnel; and an ultra-violet (UV) energy absorbing shell disposed at a discharge side of the tangential fan.

[0046] In some implementations, the air purification system may further include a housing enclosing the air guiding funnel, the tangential fan, the UV energy absorbing shell, and the particle absorbing filter.

[0047] In some implementations, the UV energy absorbing shell may contain one or more UV radiation emitting devices.

[0048] In some implementations, the UV energy absorbing shell may contain one or more shapes that are configured to form a light path to be followed by UV energy emitted by the UV radiation emitting devices and to control a direction of air moving through the UV energy absorbing shell.

[0049] In some implementations, the UV energy absorbing shell contains a plurality of low reflectance surfaces, wherein each reflectance surface is configured to absorb at least a predefined portion of UV energy that is incident upon the reflective surface.

[0050] In some implementations, the UV energy absorbing shell contains one or more air trims that are configured to control a direction of air moving through the UV energy absorbing shell.

[0051] In some implementations, the UV energy absorbing shell may contain one or more air trims that are configured to control a direction of air moving through the UV energy absorbing shell.

[0052] In some implementations, the air guiding funnel may include two trapezoidal walls are connected by two rectangular covers.

[0053] In some implementations, the air guiding funnel may have an inlet matching a shape of the particle absorbing filter.

[0054] In some implementations, the air guiding funnel may include: an inlet matching a shape of the particle absorbing filter; and a sealed air path connecting the inlet with an outlet matching a shape of the tangential fan.

[0055] In some implementations, the tangential fan may include a cylindrical impeller configured to drive outside air through the particle absorbing filter and through the air guiding funnel to the UV energy absorbing shell.

What is claimed is:

1. An air purification system, comprising:
an air guiding funnel;
a particle absorbing filter disposed at an intake side of the air guiding funnel;
a tangential fan disposed at an outlet side of the air guiding funnel; and
an ultra-violet (UV) energy absorbing shell disposed at a discharge side of the tangential fan.
2. The air purification system of claim 1, further comprising:
a housing enclosing the air guiding funnel, the tangential fan, the UV energy absorbing shell, and the particle absorbing filter.
3. The air purification system of claim 1, wherein the UV energy absorbing shell contains one or more UV radiation emitting devices.
4. The air purification system of claim 1, wherein the UV energy absorbing shell comprises a UV reflector having a plurality of reflective surfaces that collectively form a light path to be followed by UV energy emitted by the UV radiation emitting devices
5. The air purification system of claim 1, wherein the UV energy absorbing shell contains a plurality of low reflectance surfaces, wherein each reflectance surface is configured to absorb at least a predefined portion of UV energy that is incident upon the reflective surface.
6. The air purification system of claim 1, wherein the UV energy absorbing shell contains one or more air trims that are configured to control a direction of air moving through the UV energy absorbing shell.
7. The air purification system of claim 1, wherein the UV energy absorbing shell contains a plurality of shapes that are configured to form a light path to be followed by UV energy emitted by the UV radiation emitting devices and to control a direction of air moving through the UV energy absorbing shell.
8. The air purification system of claim 1, wherein the air guiding funnel has an inlet matching a shape of the particle absorbing filter.

9. The air purification system of claim 1, wherein the air guiding funnel comprises:

- an inlet matching a shape of the particle absorbing filter; and
- a sealed air path connecting the inlet with an outlet matching a shape of the tangential fan.

10. The air purification system of claim 1, wherein the air guiding funnel comprises two trapezoidal walls are connected by two rectangular covers.

11. The air purification system of claim 1, wherein the tangential fan comprises a cylindrical impeller configured to drive outside air through the particle absorbing filter and through the air guiding funnel to the UV energy absorbing shell.

12. An air purification apparatus, comprising:

- an air conduit;
- a particle absorbing filter disposed at an intake side of the air conduit;
- a fan disposed at an outlet side of the air conduit; and
- an ultra-violet (UV) radiation emitting device disposed at an discharge side of the fan.

13. The air purification apparatus of claim 12, wherein the UV radiation emitting device is enclosed by a UV energy absorbing shell.

14. The air purification apparatus of claim 13, wherein the UV energy absorbing shell comprises a plurality of reflective surfaces collectively forming a light path to be followed by UV energy emitted by the UV radiation emitting devices, wherein each reflective surface of the plurality of reflective surfaces is configured to absorb at least a predefined portion of UV energy that is incident upon the reflective surface.

15. The air purification apparatus of claim 13, wherein the UV energy absorbing shell contains one or more air trims that are configured to control a direction of air moving through the UV energy absorbing shell.

16. The air purification apparatus of claim 12, wherein the UV energy absorbing shell contains a plurality of shapes that are configured to form a light path to be followed by UV energy emitted by the UV radiation emitting devices and to control a direction of air moving through the UV energy absorbing shell.

17. The air purification apparatus of claim 12, wherein the air conduit has a first opening matching a shape of the particle absorbing filter.

18. The air purification apparatus of claim 12, wherein the air conduit comprises:

- a first opening matching a shape of the particle absorbing filter; and
- a sealed air path connecting the first opening with a second opening matching a shape of the tangential fan.

19. The air purification apparatus of claim 12, wherein the air conduit comprises two trapezoidal walls are connected by two rectangular covers.

20. The air purification apparatus of claim 12, wherein the fan comprises a cylindrical impeller configured to drive outside air through the particle absorbing filter and through the air conduit to a UV energy absorbing shell enclosing the UV radiation emitting device.

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