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(54) **OZONE-DISRUPTING ULTRAVIOLET LIGHT SANITIZING SYSTEMS AND METHODS**

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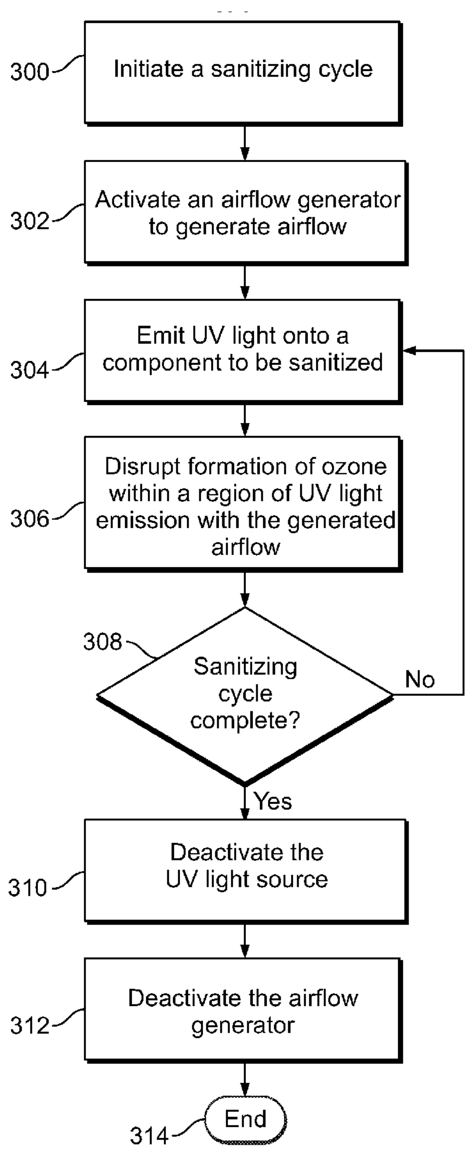
(57) **ABSTRACT**

An ultraviolet (UV) light sanitizing system is configured to sanitize a surface of a component. The UV light sanitizing system includes a UV light assembly including a UV light source that is configured to emit UV light onto the surface of the component. An airflow generator is configured to generate airflow within a region of UV light emission between the UV light source and the surface of the component. The airflow generated by the airflow generator disrupts formation of ozone.



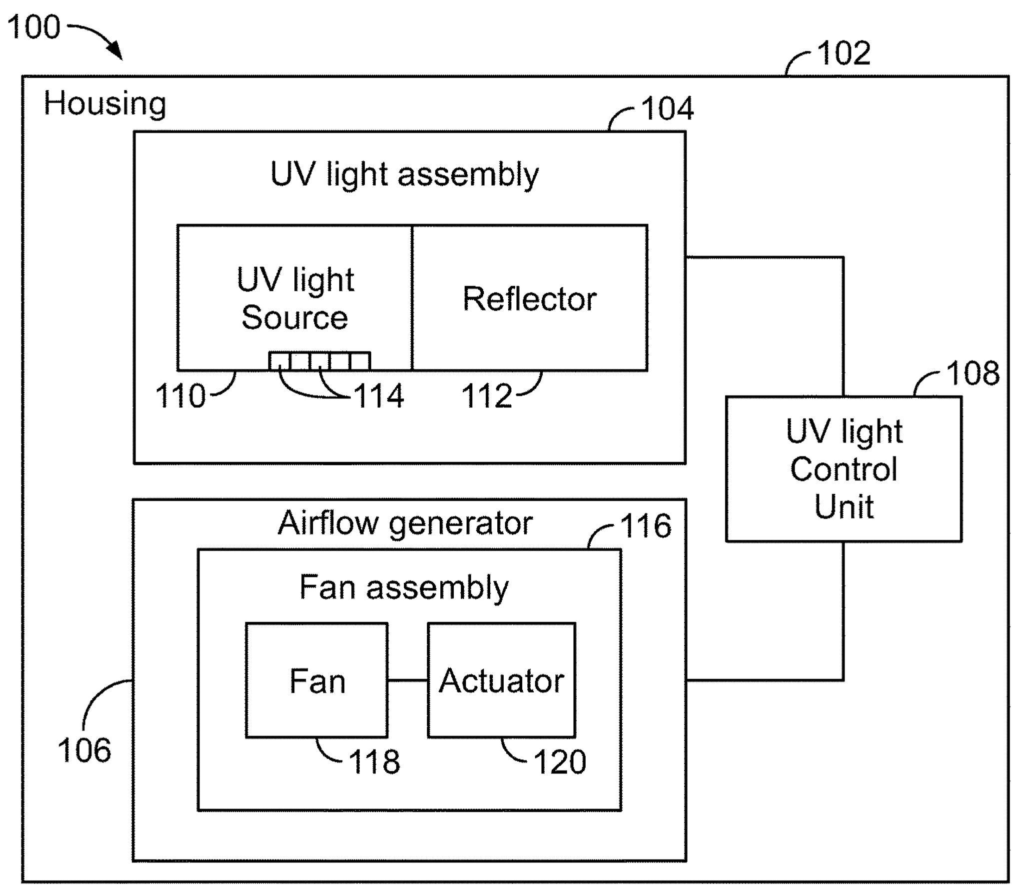

100
102
Housing
104
UV light assembly
UV light
Source
Reflector
110
114
112
108
UV light
Control
Unit
Airflow generator
116
Fan assembly
Fan
Actuator
106
118
120

FIG. 1

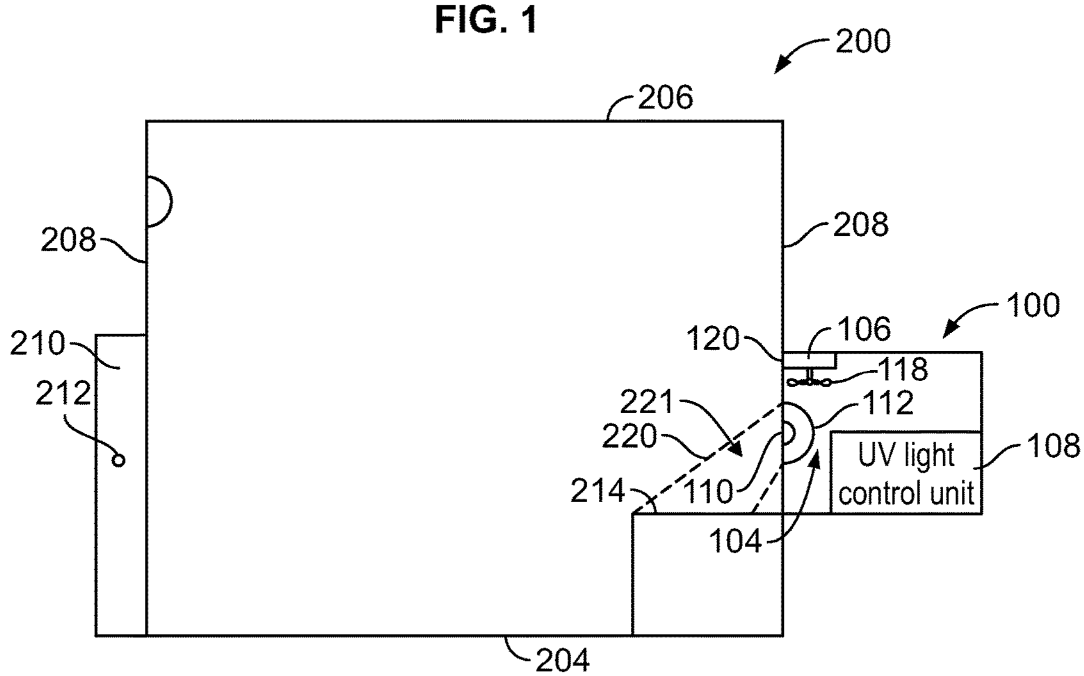

200
206
208
208
100
210
212
120
106
118
221
112
220
UV light
control unit
108
214
110
104
204

FIG. 2

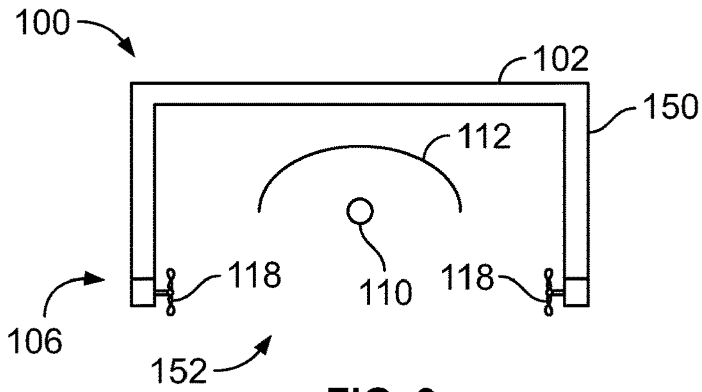


FIG. 3

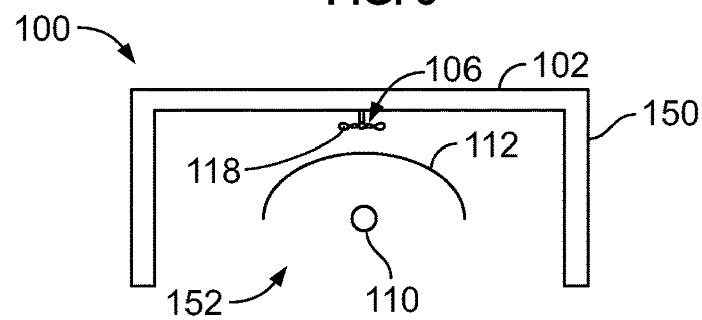


FIG. 4

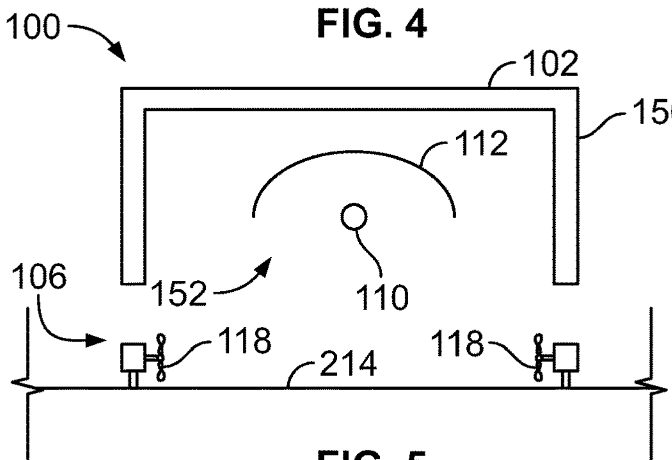


FIG. 5

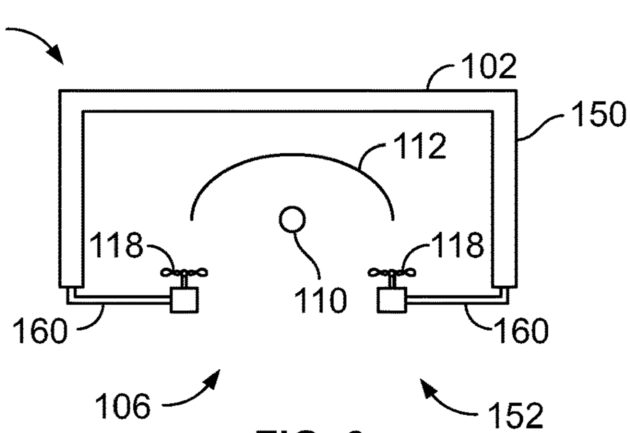


FIG. 6

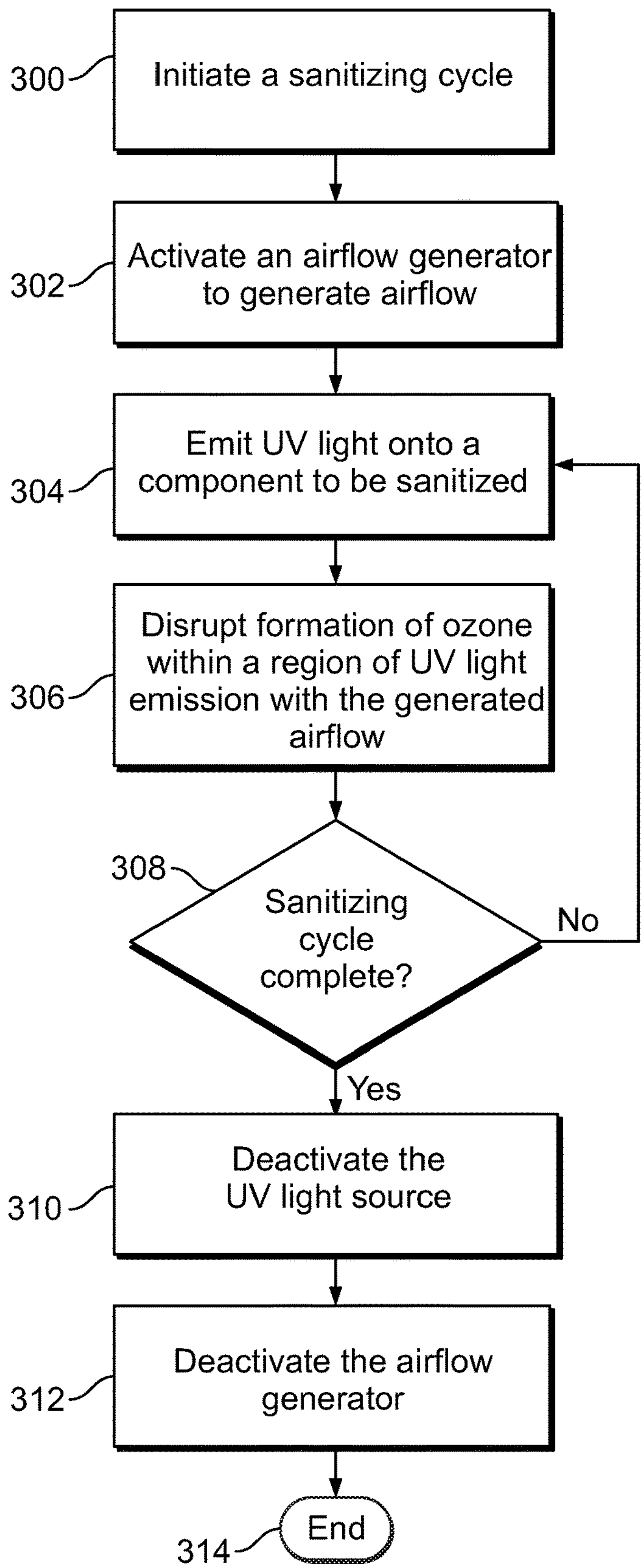

300
Initiate a sanitizing cycle
302
Activate an airflow generator to generate airflow
304
Emit UV light onto a component to be sanitized
306
Disrupt formation of ozone within a region of UV light emission with the generated airflow
308
Sanitizing cycle complete?
No
Yes
310
Deactivate the UV light source
312
Deactivate the airflow generator
314
End

FIG. 7

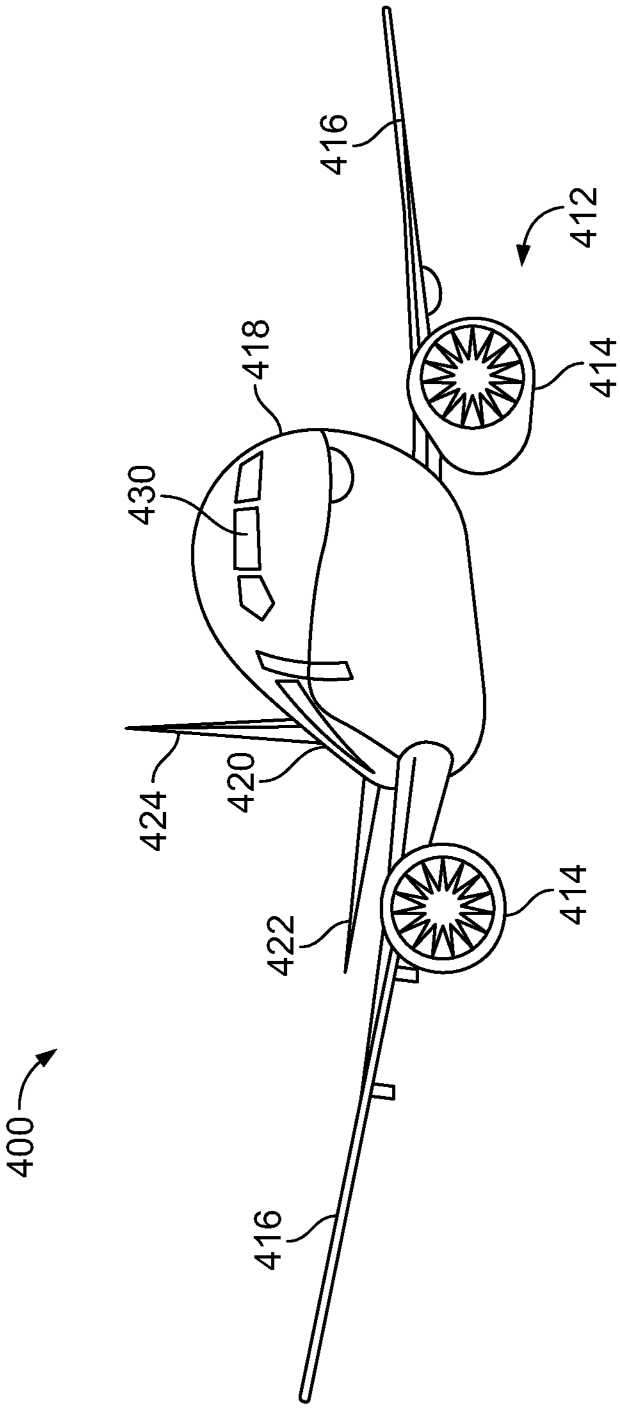


FIG. 8

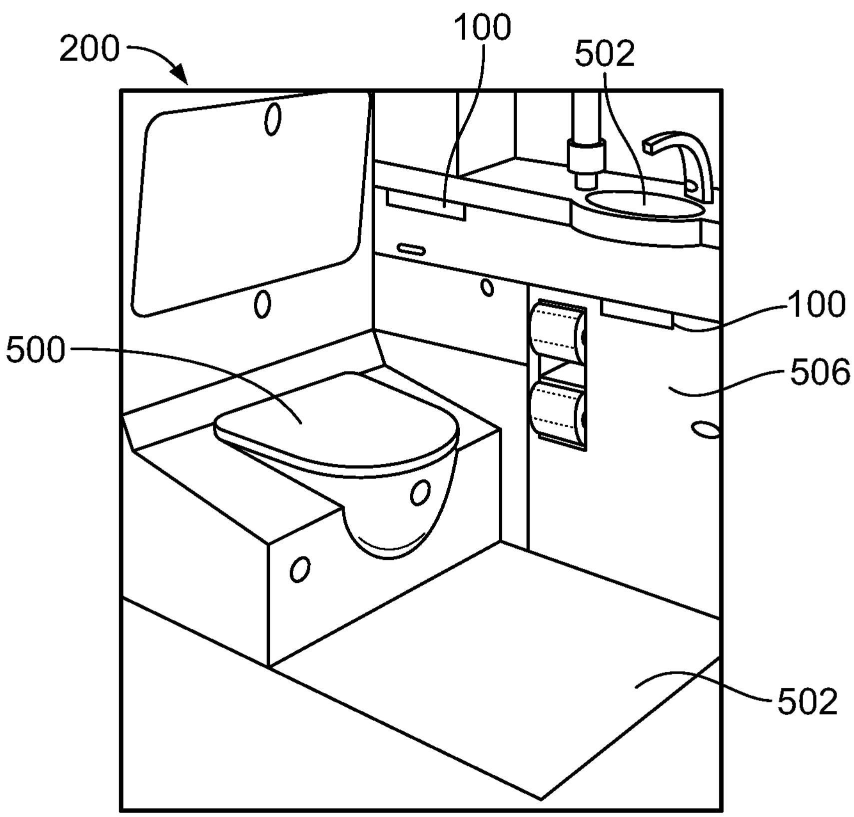


FIG. 9

OZONE-DISRUPTING ULTRAVIOLET LIGHT SANITIZING SYSTEMS AND METHODS

FIELD OF THE DISCLOSURE

[0001] Embodiments of the present disclosure generally relate to systems and methods for sanitizing surfaces with ultraviolet light, such as within lavatories of commercial aircraft, and, more particularly, to ozone-disrupting ultraviolet light sanitizing systems and methods.

BACKGROUND OF THE DISCLOSURE

[0002] Commercial aircraft are used to transport passengers between various locations. A typical commercial aircraft includes one or more lavatories within an internal cabin.

[0003] Systems are currently being developed to disinfect or otherwise sanitize surfaces within aircraft lavatories that use ultraviolet (UV) light. For example, it has been found that far UV light efficiently disinfects exposed surfaces within a lavatory.

[0004] Interaction of UV light with air creates ozone. As the UV light passes through air, the interaction of the UV light with oxygen molecules generates ozone molecules.

[0005] Ozone is an irritant, both to individuals and structures. For example, certain individuals may be susceptible to breathing disorders from prolonged exposure to ozone. Further, ozone is a reactive gas that may degrade surfaces of various structures.

[0006] Accordingly, the amount of ozone within confined spaces is typically controlled. The Federal Aviation Administration (FAA) provides regulations and guidelines regarding the presence of ozone onboard an aircraft. For example, an FAA regulatory guideline limits the amount of ozone within an internal cabin of an aircraft to an average of 100 parts ozone per billion over an eight hour timeframe. Further, the FAA regulatory guideline also limits the amount of ozone within an internal cabin of an aircraft to 250 parts ozone per billion within a three hour peak timeframe.

[0007] Accordingly, aircraft operators seek to limit the amount of ozone within an aircraft. One known disinfecting method limits the amount of generated ozone by placing a sterilizing UV light in close proximity to a surface that is to be sterilized. For example, the UV light may be within one to six inches from a surface that is to be sterilized. The close proximity of the UV light to the surface limits ozone production, as the ozone travels through a shorter distance of ambient air. However, various structures are not able to be within such a close proximity to a UV light. For example, a UV light may not be effectively positioned within a few inches of a toilet or floor within a lavatory.

SUMMARY OF THE DISCLOSURE

[0008] A need exists for a system and method of limiting the amount of ozone within a confined space. A need exists for a system and method of disrupting ozone generation within a confined space.

[0009] With those needs in mind, certain embodiments of the present disclosure provide an ultraviolet (UV) light sanitizing system that is configured to sanitize a surface of a component. The UV light sanitizing system includes a UV light assembly including a UV light source that is configured to emit UV light onto the surface of the component, and an airflow generator that is configured to generate airflow within a region of UV light emission between the UV light source and the surface of the component. The airflow generated by the airflow generator disrupts formation of ozone.

[0010] In at least one embodiment, the UV light sanitizing system includes a housing. The UV light assembly is secured within the housing. The airflow generator may be secured to the housing. Optionally, the airflow generator may be remotely located from the housing. For example, the airflow generator may be configured to be secured proximate to a portion of the component.

[0011] In at least one embodiment, a UV light control unit is operatively coupled to the UV light assembly and the airflow generator. The UV light control unit is configured to control operation of the UV light assembly and the airflow generator. The UV light control unit is configured to activate the UV light source during a sanitizing cycle. The UV light control unit may be configured to activate the airflow generator before the UV light source is activated during the sanitizing cycle.

[0012] In at least one embodiment, the airflow generator includes a fan assembly. The fan assembly may include at least one fan operatively coupled to at least one actuator.

[0013] The airflow generator is configured to generate airflow along and/or across the region of UV light emission.

[0014] Certain embodiments of the present disclosure provide a UV light sanitizing method that is configured to sanitize a surface of a component. The UV light sanitizing method includes emitting UV light onto the surface of the component with a UV light source of a UV light assembly, using an airflow generator to generate airflow within a region of UV light emission between the UV light source and the surface of the component, and disrupting formation of ozone with the airflow generated by the airflow generator.

[0015] Certain embodiments of the present disclosure provide a vehicle that includes an internal cabin. A lavatory is within the internal cabin. The lavatory includes a component. A UV light sanitizing system is disposed within the lavatory and configured to sanitize a surface of the component.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** illustrates a schematic diagram of an ultraviolet (UV) light sanitizing system, according to an embodiment of the present disclosure.

[0017] FIG. **2** illustrates a schematic diagram of a UV light sanitizing system for an enclosed space, according to an embodiment of the present disclosure.

[0018] FIG. **3** illustrates a simplified view of a UV light sanitizing system, according to an embodiment of the present disclosure.

[0019] FIG. **4** illustrates a simplified view of a UV light sanitizing system, according to an embodiment of the present disclosure.

[0020] FIG. **5** illustrates a simplified view of a UV light sanitizing system, according to an embodiment of the present disclosure.

[0021] FIG. **6** illustrates a simplified view of a UV light sanitizing system, according to an embodiment of the present disclosure.

[0022] FIG. **7** illustrates a flow chart of a method of sanitizing a component with UV light, according to an embodiment of the present disclosure.

[0023] FIG. **8** illustrates a perspective front view of an aircraft, according to an embodiment of the present disclosure.

[0024] FIG. **9** illustrates a perspective internal view of a lavatory, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0025] The foregoing summary, as well as the following detailed description of certain embodiments will be better understood when read in conjunction with the appended drawings. As used herein, an element or step recited in the singular and preceded by the word "a" or "an" should be understood as not necessarily excluding the plural of the elements or steps. Further, references to "one embodiment" are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements having a particular condition may include additional elements not having that condition.

[0026] Certain embodiments of the present disclosure provide an ultraviolet (UV) light sanitizing system that includes a light source, such as a far UV light source, and a fan assembly that is configured generate airflow proximate to the UV light source and/or a surface of a component that is configured to be sterilized with UV light emitted from the UV light source. The airflow generated by the fan assembly disperses (for example, sweeps away) air away from the light source during operation, thereby eliminating, minimizing, or otherwise reducing ozone.

[0027] FIG. **1** illustrates a schematic diagram of a UV light sanitizing system **100**, according to an embodiment of the present disclosure. The UV light sanitizing system **100** includes a housing **102** that retains a UV light assembly **104**, an airflow generator **106**, and a UV light control unit **108**. The UV light assembly **104**, the airflow generator **106**, and the UV light control unit **108** may be disposed within the housing **102**, such as within an internal chamber defined by outer walls. Optionally, one or more of the UV light assembly **104**, the airflow generator **106**, and the UV light control unit **108** may be mounted on an outer surface of the housing **102**. In at least one other embodiment, the airflow generator **106** and/or the UV light control unit **108** may be remotely located from the housing **102**. For example, the airflow generator **106** may be secured on and/or proximate (for example, within less than five inches) to a surface of a component that is configured to be sanitized by UV light emitted from the UV light assembly **104**.

[0028] The UV light assembly **104** includes a UV light source **110** and a reflector **112**. The UV light source **110** may be secured within a volume of space defined by the reflector **112**. For example, the reflector **112** may be a parabolic reflector (such as formed of aluminum, and/or having internal mirror reflecting surfaces), and the UV light source **110** may be within an internal volume of space defined by the parabolic reflector. Optionally, the reflector **112** may be shaped differently than a parabola. As another example, the UV light source **110** itself may include the reflector **112**. In at least one other embodiment, the UV light assembly **104** may not include the reflector **112**.

[0029] The UV light source **110** is operatively coupled to the UV light control unit **108**. The UV light source **110** may include one or more UV light elements **114**, such as an arc lamp(s), laser(s), light emitting diode(s) (LEDs), microfilament(s), bulbs, fiber optic elements, and/or the like that are configured to emit UV light onto one or more structures within a confined space during a sanitizing cycle. In at least one embodiment, the UV light elements **114** are configured to emit far UV light. Alternatively, the UV light elements **114** may be configured to emit other types of UV light, such as UVA light, UVB light, UVC light, vacuum UV light, and/or the like. In at least one embodiment, the UV light source **110** may include UV light elements that are configured to emit UV light with different UV bands (for example, at different wavelengths and different frequencies). For example, one UV light element may be configured to emit far UV light, while another UV light element may be configured to emit UVC light.

[0030] The UV light control unit **108** is coupled to the UV light assembly **104** through one or more wired or wireless connections, and is configured to control operation of the UV light assembly **104**. The UV light control unit **108** outputs an activation signal that is received by the UV light assembly **104**, in particular the UV light source **110**. The activation signal activates and controls the UV light source **110** during a sanitizing cycle in which the UV light source **110** emits UV light onto one or more structures within a confined space. The UV light control unit **108** may include or otherwise be coupled to a memory that stores data regarding the sanitizing cycle.

[0031] The airflow generator **106** is also operatively coupled to the UV light control unit **108**, such as through one or more wired or wireless connections. In at least one embodiment, the airflow generator **106** includes a fan assembly **116** including a fan **118** (such as a rotor with blades) operatively coupled to an actuator **120** (such as an electric motor). The airflow generator **106** may be or include an electronic spooling fan, a bladeless fan, one or more oscillating vanes, and/or the like. The airflow generator **106** is configured to generate airflow in the region where UV light is emitted from the UV light source **110** and/or onto a surface where the emitted UV light is directed.

[0032] In operation, the UV light control unit **108** activates the UV light source **110** to emit UV light onto a surface to be sanitized during a sanitizing cycle. As the UV light source **110** is activated to emit UV light, the UV light control unit also activates the airflow generator **106** to generate airflow in the region of UV light emission (such as between the UV light source **110** and the surface to the sanitized by the emitted UV light). In at least one embodiment, when the UV light control unit **108** initiates the sanitizing cycle, the UV light control unit **108** may first activate the airflow generator **106** to generate airflow before the UV light source **110** is activated to emit UV light. For example, the airflow generator **106** may be activated for one second before the UV light source **110** is activated, in order for the airflow generator **106** to achieve a full operational speed before UV light is emitted from the UV light source **110**. Optionally, the airflow generator **106** may be activated for a period of less than one second before the UV light source **110** is activated. In at least one other embodiment, the UV light source **110** and the airflow generator **106** may be activated simultaneously. Alternatively, the airflow generator **106** may be activated after the UV light source **110** is activated.

[0033] The airflow generator **106** is operated during the sanitizing cycle. For example, the airflow generator **106** may be operated to generate airflow through and/or within a region of UV light emission for as long as the UV light source **110** emits UV light (such as for two or three seconds). In at least one embodiment, the airflow generator **106** may remain active to generate airflow for a predetermined period of time after the UV light source **110** is deactivated, such as for an additional one or two seconds.

[0034] As indicated, the airflow generator **106** may include the fan assembly **116**, which may include the fan **118** operatively coupled to the actuator **120** The UV light control unit **108** may be operatively coupled to the actuator **120**, such as through one or more wired or wireless connections. The actuator **120** may be an electronic or electric motor, one or more solenoids, or the like that causes the fan **118** to rotate, such as through a rotor operatively coupled to the actuator **120**. Blades coupled to the rotor generate airflow as the rotor of the fan rotates. The fan **118** may cause airflow to be directed towards the UV light source **110**, across the UV light source **110**, and/or across an aperture or other such opening in the housing **102** through which UV light is emitted. For example, the fan **118** may operate to blow air onto and/or around the UV light source **110**. Optionally, the fan **118** may operate to draw air into, onto and/or around the UV light source **110**. The fan **118** may cause airflow to be directed towards a surface that is configured to be sanitized by the UV light emitted from the UV light source **110**, and across the surface. For example, the fan **118** may operate to blow air onto and/or across the surface that is being sanitized by the UV light. Optionally, the fan **118** may operate to draw air into, onto, and/or around the surface that is being sanitized by the UV light.

[0035] In general, the airflow generator **106** is configured to generate airflow in at least a portion of a region of UV light emission between the UV light source **110** and the surface of a component that is being sanitized by the UV light emitted by the UV light source **110**. The airflow generator **106** generates the airflow along and/or across the region of UV light generation.

[0036] The UV light sanitizing system **100** exploits a chemical process through which UV light converts oxygen (O_2) molecules into ozone (O_3) molecules. To create one ozone molecule, UV light photons excite two O_2 molecules from a ground state to an excited state. The two excited O_2 molecules typically bump into each other before they decay to a less-excited state. The rate of ozone production in a given volume is therefore not linear in relation to the concentration of excited O_2 molecules. Rather, the rate of ozone of production is proportional to the square of the concentration of excited O_2 molecules. In a typical lavatory application, UV light is concentrated in a small volume within the lavatory (for example, the region between the UV light source **110** and a surface, such as a countertop, that is to be disinfected). Almost all the excited O_2 molecules are produced in the small volume of space.

[0037] The airflow generator **106** disrupts production of ozone by generating airflow in at least a portion of the region of UV light generation, thereby dispersing the excited O_2 molecules. In doing so, the excited O_2 molecules are unlikely (or less likely) to bump into each other before they decay to a less-excited state. The airflow generator **106** generates the airflow proximate to (for example, within 6 or less inches) the UV light source **110** and/or the surface to be disinfected. The generated airflow then circulates throughout the enclosed space, carrying the excited O_2 molecules along with it, thereby dispersing the excited O_2 molecules from the region close to the UV light source **110** into an entire enclosed space, such as a lavatory.

[0038] For example, assume the volume ratio of the region of the UV light source **110** to an entire region of a lavatory is 1:100. Excited O_2 molecules with concentration X in the small region are diffused to a concentration of X/100 in the entire lavatory. Because the ozone production rate is proportional to the square of the concentration, the diffusion reduces the ozone production rate by a factor of 100^2 (that is, a factor of 10,000). The time constant for excited O_2 decaying to ground-state O_2 is unchanged, so decay becomes far more likely than ozone production. Such dramatic reduction in ozone production reduces the need for costly ozone countermeasures.

[0039] The UV light sanitizing system **100** provides efficient and effective sanitation through emission of UV light onto a surface. The UV light sanitizing system **100** saves energy, cycle time, and conditioned air, as compared to an alternative of completely flushing air from the enclosed space. Further, compared to using an ozone filter, the UV light sanitizing system **100** saves energy, cycle time, and maintenance time and effort.

[0040] As used herein, the term "control unit," "central processing unit," "CPU," "computer," or the like may include any processor-based or microprocessor-based system including systems using microcontrollers, reduced instruction set computers (RISC), application specific integrated circuits (ASICs), logic circuits, and any other circuit or processor including hardware, software, or a combination thereof capable of executing the functions described herein. Such are exemplary only, and are thus not intended to limit in any way the definition and/or meaning of such terms. For example, the UV light control unit **108** may be or include one or more processors.

[0041] The UV light control unit **108** is configured to execute a set of instructions that are stored in one or more data storage units or elements (such as one or more memories), in order to process data. For example, the UV light control unit **108** may include or be coupled to one or more memories. The data storage units may also store data or other information as desired or needed. The data storage units may be in the form of an information source or a physical memory element within a processing machine.

[0042] The set of instructions may include various commands that instruct the UV light control unit **108** as a processing machine to perform specific operations such as the methods and processes of the various embodiments of the subject matter described herein. The set of instructions may be in the form of a software program. The software may be in various forms such as system software or application software. Further, the software may be in the form of a collection of separate programs, a program subset within a larger program or a portion of a program. The software may also include modular programming in the form of object-oriented programming. The processing of input data by the processing machine may be in response to user commands, or in response to results of previous processing, or in response to a request made by another processing machine.

[0043] The diagrams of embodiments herein may illustrate one or more control or processing units, such as the UV light control unit **108**. It is to be understood that the processing or control units may represent circuits, circuitry, or portions thereof that may be implemented as hardware with associated instructions (e.g., software stored on a tangible and non-transitory computer readable storage medium, such as a computer hard drive, ROM, RAM, or the like) that perform the operations described herein. The hardware may include state machine circuitry hardwired to perform the functions described herein. Optionally, the hardware may include electronic circuits that include and/or are connected to one or more logic-based devices, such as microprocessors, processors, controllers, or the like. Optionally, the UV light control unit **108** may represent processing circuitry such as one or more of a field programmable gate array (FPGA), application specific integrated circuit (ASIC), microprocessor(s), and/or the like. The circuits in various embodiments may be configured to execute one or more algorithms to perform functions described herein. The one or more algorithms may include aspects of embodiments disclosed herein, whether or not expressly identified in a flowchart or a method.

[0044] As used herein, the terms "software" and "firmware" are interchangeable, and include any computer program stored in a data storage unit (for example, one or more memories) for execution by a computer, including RAM memory, ROM memory, EPROM memory, EEPROM memory, and non-volatile RAM (NVRAM) memory. The above data storage unit types are exemplary only, and are thus not limiting as to the types of memory usable for storage of a computer program.

[0045] FIG. **2** illustrates a schematic diagram of the UV light sanitizing system **100** for an enclosed space **200**, according to an embodiment of the present disclosure. The enclosed space **200** may be defined by a floor **204**, a ceiling **206**, and walls **208** extending between the floor **204** and the ceiling **206**. A door **210** may be moveably secured to one of the walls **208**. The door **210** may include a lock **212** that is configured to securely lock the door **210** in a closed position. When the lock **212** is in a locked position, the door **210** is unable to be opened. When the lock **212** is in an unlocked position, the door **210** may be opened.

[0046] The enclosed space **200** may be a confined space onboard a commercial aircraft. For example, the enclosed space **200** may be a lavatory onboard an aircraft. As another example, the enclosed space **200** may be a galley onboard an aircraft. As yet another example, the enclosed space **200** may be a passenger area onboard an aircraft. The enclosed space **200** may or may not include the door **210**. The enclosed space **200** may be within various other vehicles, structures, and/or the like. For example, the enclosed space **200** may be a room within a commercial, municipal, or residential building, or a room onboard a train, bus, ship, or the like.

[0047] The enclosed space **200** may include at least one component **214** to be sanitized (for example, disinfected, sterilized, or otherwise cleaned) after use. For example, the component **214** may be a toilet, sink, floor, cabinet, wall, and/or the like within a lavatory of an aircraft.

[0048] As shown, the UV light sanitizing system **100** may be flush-mounted with one of the walls **208**. Optionally, the UV light sanitizing system **100** may be mounted on an outer surface of the wall **208**. In at least one other embodiment, the UV light sanitizing system **100** may be secured to the ceiling **206**. In at least one other embodiment, the UV light sanitizing system **100** may be secured to the floor **204**, and/or the component **214**.

[0049] The UV light assembly **104** is configured to emit UV light **220** onto a surface of the component **214** during a sanitizing cycle. The UV light **220** is emitted in a region of UV light emission **221** between the UV light assembly **104** and the surface of the component **214** during the sanitizing cycle. The airflow generator **106**, which may include the fan **118** operatively coupled to the actuator **120**, generates airflow in at least a portion of the region of UV light emission (such as before, during, and/or after the emission of UV light from the UV light assembly **104**), thereby disrupting generation of ozone, as described above.

[0050] FIG. **3** illustrates a simplified view of the UV light sanitizing system **100**, according to an embodiment of the present disclosure. The housing **102** may include opaque outer walls **150** connected to a light outlet passage **152**, such as an aperture or other such opening, a transparent window (such as formed of glass or clear plastic), and/or the like. The light source **110** may be secured to the housing **102** through fasteners, brackets, or other such mounting features. In at least one embodiment, the light source **110** may be secured to the reflector **112** through at least one retaining member, such as a socket(s), a bracket(s), a fastener(s), a guide track(s), rail(s), a clasp(s), a sleeve(s), and/or the like.

[0051] The airflow generator **106** may include one or more fans **118** secured to the housing **102** proximate to the light outlet passage **152**. The fan(s) **118** may be oriented to blow and/or draw air across the light outlet passage **152**. That is, the fan(s) **118** may be oriented and configured to blow and/or draw air across a portion of the region of UV light emission.

[0052] FIG. **4** illustrates a simplified view of a UV light sanitizing system **100**, according to an embodiment of the present disclosure. In this embodiment, the airflow generator **106** may be mounted to the housing **102** behind the UV light source **110**. The airflow generator **106** may include one or more fans **118** that are configured to blow and/or draw air into and/or around the UV light source **110**, thereby reducing ozone formation and cooling at the UV light source **110** at the same time.

[0053] FIG. **5** illustrates a simplified view of a UV light sanitizing system **100**, according to an embodiment of the present disclosure. In this embodiment, the airflow generator **106** may be remotely located from the housing **102**. For example, the airflow generator **106** may be mounted onto and/or proximate to the component **214**, and configured to blow and/or draw air onto and/or across the surface of the component **214** that is configured to be sanitized by the UV light emitted by the UV light source **110**.

[0054] FIG. **6** illustrates a simplified view of a UV light sanitizing system **100**, according to an embodiment of the present disclosure. In this embodiment, the airflow generator **106** may be mounted to the housing **102** through one or more brackets **160**. One or more fans **118** are directed toward the interior of the housing **102** and/or the UV light source **110**.

[0055] Referring to FIGS. **1-6**, before, during, and/or after a sanitizing cycle, the airflow generator **106** generates airflow within at least a portion of a region of UV light emission between the UV light source **110** and the component **214** that is sterilized through the UV light generated by the UV light source **110**. By generating the airflow within at least a portion of the region of UV light emission, excited oxygen molecules are dispersed throughout the enclosed space **200**, thereby reducing the likelihood of ozone molecules forming.

[0056] The enclosed space **200** may also include vents and/or additional fans located therein and/or throughout. The vents and/or additional fans are configured to reduce air stagnation at areas within the enclosed space **200**.

[0057] FIG. **7** illustrates a flow chart of a method of sanitizing a component with UV light, according to an embodiment of the present disclosure. Referring to FIGS. **1** and **7**, at **300**, the UV light control unit **108** initiates a sanitizing cycle (such as after use of a lavatory onboard an aircraft by an individual). At **302**, the UV light control unit **108** activates the airflow generator **106** to generate airflow. At **304**, the UV light control unit **108** activates the UV light source **110** to emit UV light onto a component to be sanitized. Step **302** may occur prior to **304**. Optionally, steps **302** and **304** may occur simultaneously. At **306**, formation of ozone is disrupted within a region of UV light emission by the generated airflow.

[0058] At **308**, the UV light control unit **108** determines whether the sanitizing cycle is complete. If the sanitizing cycle is not complete, the method returns to **304**. If, however, the sanitizing cycle is complete at **308**, the method proceeds to **310**, at which the UV light control unit **108** deactivates the UV light source **110**. At **312**, the UV light control unit **108** then deactivates the airflow generator **106**. Step **310** may occur prior to step **312**. Optionally, steps **310** and **312** may occur simultaneously. The method ends at **314**.

[0059] FIG. **8** illustrates a perspective front view of an aircraft **400**, according to an embodiment of the present disclosure. The aircraft **400** includes a propulsion system **412** that may include two turbofan engines **414**, for example. Optionally, the propulsion system **412** may include more engines **414** than shown. The engines **414** are carried by wings **416** of the aircraft **400**. In other embodiments, the engines **414** may be carried by a fuselage **418** and/or an empennage **420**. The empennage **420** may also support horizontal stabilizers **422** and a vertical stabilizer **424**.

[0060] The fuselage **418** of the aircraft **400** defines an internal cabin, which may include a cockpit **430**, one or more work sections (for example, galleys, personnel carry-on baggage areas, and the like), one or more passenger sections (for example, first class, business class, and coach sections), and an aft section in which an aft rest area assembly may be positioned. Each of the sections may be separated by a cabin transition area, which may include one or more class divider assemblies. Overhead stowage bin assemblies may be positioned throughout the internal cabin. The internal cabin includes one or more chambers, such as lavatories, for example. One or more UV light sanitizing systems **100** (shown and described with respect to FIGS. **1-7**, for example) may be located within the internal cabin.

[0061] Alternatively, instead of an aircraft, embodiments of the present disclosure may be used with various other vehicles, such as automobiles, buses, locomotives and train cars, watercraft, and the like. Further, embodiments of the present disclosure may be used with respect to fixed structures, such as commercial and residential buildings.

[0062] FIG. **9** illustrates a perspective internal view of a lavatory **200**, according to an embodiment of the present disclosure. As noted, the lavatory **200** is an example of the enclosed space **200** shown and described with respect to FIG. **2**, for example. The lavatory **200** may be onboard an aircraft, as described above. Optionally, the lavatory **200** may be onboard various other vehicles. In other embodiments, the lavatory **200** may be within a fixed structure, such as a commercial or residential building.

[0063] The lavatory **200** includes a base floor **502** that supports a toilet **500**, cabinets **506**, and a sink **502**. UV light sanitizing systems **100** are secured within the lavatory **200** and are configured to be activated during a sanitizing cycle to sanitize (for example, disinfect, sterilize, or otherwise clean) various structures within the lavatory **200**, such as the toilet **500**, the floor **502**, the cabinets **506**, and/or the sink **502**.

[0064] As described herein, embodiments of the present disclosure provide UV light sanitizing systems and methods that eliminate, minimize, or otherwise reduce ozone within a confined space. The UV light sanitizing systems and methods disrupt ozone generation within a confined space.

[0065] While various spatial and directional terms, such as top, bottom, lower, mid, lateral, horizontal, vertical, front and the like may be used to describe embodiments of the present disclosure, it is understood that such terms are merely used with respect to the orientations shown in the drawings. The orientations may be inverted, rotated, or otherwise changed, such that an upper portion is a lower portion, and vice versa, horizontal becomes vertical, and the like.

[0066] As used herein, a structure, limitation, or element that is "configured to" perform a task or operation is particularly structurally formed, constructed, or adapted in a manner corresponding to the task or operation. For purposes of clarity and the avoidance of doubt, an object that is merely capable of being modified to perform the task or operation is not "configured to" perform the task or operation as used herein.

[0067] It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments (and/or aspects thereof) may be used in combination with each other. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the various embodiments of the disclosure without departing from their scope. While the dimensions and types of materials described herein are intended to define the parameters of the various embodiments of the disclosure, the embodiments are by no means limiting and are exemplary embodiments. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the various embodiments of the disclosure should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Moreover, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects. Further, the limitations of the following claims are not written in means-plus-function format and are not intended to be interpreted based on 35 U.S.C. § 112(f), unless and until such claim limitations expressly use the phrase "means for" followed by a statement of function void of further structure.

[0068] This written description uses examples to disclose the various embodiments of the disclosure, including the best mode, and also to enable any person skilled in the art to practice the various embodiments of the disclosure, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the various embodiments of the disclosure is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if the examples have structural elements that do not differ from the literal language of the claims, or if the examples include equivalent structural elements with insubstantial differences from the literal language of the claims.

What is claimed is:

1. An ultraviolet (UV) light sanitizing system that is configured to sanitize a surface of a component, the UV light sanitizing system comprising:

a UV light assembly including a UV light source that is configured to emit UV light onto the surface of the component; and

an airflow generator that is configured to generate airflow within a region of UV light emission between the UV light source and the surface of the component, wherein the airflow generated by the airflow generator disrupts formation of ozone.

2. The UV light sanitizing system of claim **1**, further comprising a housing, wherein the UV light assembly is secured within the housing.

3. The UV light sanitizing system of claim **2**, wherein the airflow generator is secured to the housing.

4. The UV light sanitizing system of claim **2**, wherein the airflow generator is remotely located from the housing, wherein the airflow generator is configured to be secured proximate to a portion of the component.

5. The UV light sanitizing system of claim **1**, further comprising a UV light control unit operatively coupled to the UV light assembly and the airflow generator, wherein the UV light control unit is configured to control operation of the UV light assembly and the airflow generator.

6. The UV light sanitizing system of claim **5**, wherein the UV light control unit is configured to activate the UV light source during a sanitizing cycle.

7. The UV light sanitizing system of claim **6**, wherein the UV light control unit is configured to activate the airflow generator before the UV light source is activated during the sanitizing cycle.

8. The UV light sanitizing system of claim **1**, wherein the airflow generator comprises a fan assembly including at least one fan operatively coupled to at least one actuator.

9. The UV light sanitizing system of claim **1**, wherein the airflow generator is configured to generate airflow along the region of UV light emission.

10. The UV light sanitizing system of claim **1**, wherein the airflow generator is configured to generate airflow across the region of UV light emission.

11. An ultraviolet (UV) light sanitizing method that is configured to sanitize a surface of a component, the UV light sanitizing method comprising:

emitting UV light onto the surface of the component with a UV light source of a UV light assembly;

using an airflow generator to generate airflow within a region of UV light emission between the UV light source and the surface of the component; and

disrupting formation of ozone with the airflow generated by the airflow generator.

12. The UV light sanitizing method of claim **11**, further comprising securing the UV light assembly within a housing.

13. The UV light sanitizing method of claim **12**, further comprising securing the airflow generator to the housing.

14. The UV light sanitizing method of claim **12**, further comprising remotely locating the airflow generator from the housing, wherein the remotely locating comprises securing the airflow generator proximate to a portion of the component.

15. The UV light sanitizing method of claim **11**, further comprising:

operatively coupling a UV light control unit to the UV light assembly and the airflow generator; and

using the UV light control unit to control operation of the UV light assembly and the airflow generator.

16. The UV light sanitizing method of claim **15**, wherein the using the UV light control unit comprises activating the UV light source during a sanitizing cycle.

17. The UV light sanitizing method of claim **16**, wherein the using the UV light control unit comprises activating the airflow generator before the UV light source is activated during the sanitizing cycle.

18. The UV light sanitizing method of claim **15**, wherein the using the airflow generator comprises generating airflow along the region of UV light emission.

19. The UV light sanitizing method of claim **15**, wherein the using the airflow generator comprises generating airflow across the region of UV light emission.

20. A vehicle comprising:

an internal cabin;

a lavatory within the internal cabin, wherein the lavatory comprises a component; and

an ultraviolet (UV) light sanitizing system disposed within the lavatory and configured to sanitize a surface of the component, the UV light sanitizing system comprising:

a housing;

a UV light assembly including a UV light source that is configured to emit UV light onto the surface of the component, wherein the UV light assembly is secured within the housing;

an airflow generator that is configured to generate airflow within a region of UV light emission between the UV light source and the surface of the component, wherein the airflow generated by the airflow generator disrupts formation of ozone, wherein the airflow generator is configured to generate airflow one or both of along and across the region of UV light emission; and

a UV light control unit operatively coupled to the UV light assembly and the airflow generator, wherein the UV light control unit is configured to control operation of the UV light assembly and the airflow generator, wherein the UV light control unit is configured to activate the UV light source during a sanitizing cycle.

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