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(54) **Title:** DISINFECTION SYSTEM FOR AIRCRAFT AND METHOD TO DISINFECT AIRCRAFT INTERIORS

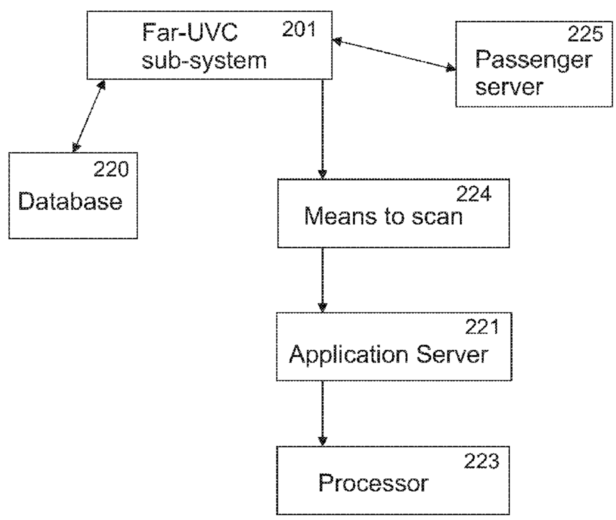

FIG. 1

(57) **Abstract:** A disinfection system and method for aircraft interiors based on a control of the intensity and irradiation of ultraviolet waves, particularly FAR-UVC in the range of 220nm to 224nm such that allows its application without causing clinical problems with humans, to be used during flight operation, as well as preparation of aircrafts, pre-boarding and deplaning.

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[Continued on next page]

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Published:

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"Disinfection system for aircraft and Method to disinfect aircraft interiors"

[0001] The present invention relates to a system and a method to disinfect aircraft interiors, based on a control of the intensity and irradiation of ultraviolet waves, particularly "FAR-UVC" in the range of 220nm to 224nm such that allows its application without causing clinical problems with humans.

Background

[0002] Airborne-mediated microbial diseases represent one of the major challenges to worldwide public health. Common examples are influenza, appearing in seasonal and pandemic forms, and bacterially based airborne-mediated diseases such as tuberculosis, increasingly emerging in multi-drug resistant form.

[0003] In order to avoid this public health concerns, efforts have been intensified to prevent transmission of infections that are airborne using environmental controls.

[0004] Microbial pathogenic contaminations have world widely represented a serious health hazard to humans. Viruses, as a member of microbial contaminants, seriously threaten human health due to their high environmental resistance, having small sizes, and causing an extensive range of diseases.

[0005] The global aviation industry has enjoyed decades of steady growth, even in the face of previous global catastrophes such as the 9/11 terrorist attacks in 2001 and the global financial crisis of 2008. Aviation has been largely resilient with passenger travel demands increasing at a steady pace of approximately 4.5% annually (International Air Transportation Association). In 2020, the global aviation industry has experienced a 70%–95% reduction in passenger demand.

[0006] However, aviation has never been impacted by a global pandemic of the current proportion, which novel coronavirus officially known as COVID-19, has pervaded over 46 countries, infecting over 3.7 million people and causing millions of deaths since December 2019.

[0007] Infections like COVID-19 (Sars-Cov-2), H1N1 (Influenza virus A), SARS (Sars-Cov) and MERS (Mers-Cov) are mainly transmitted through infected respiratory droplets and close contact with infected people. Thus, these infections have the potential to be nationally and internationally spread from air travel.

[0008] The current crisis has forced aviation industry to adjust quickly to adapt to the situation. With many aircraft grounded due to significant decrease of passenger demand, the manufacturers and airlines try to find alternate, quick and effective measures to be able to survive as the crisis continue worldwide.

[0009] Aviation experts concur that increasing passengers´ confidence in their personal safety is a complex challenge that must be overcome before commercial aviation can move on to what will likely be a new era that is vastly different than what passengers have become accustomed to, as aviation industries become one of the important sectors that contribute to the global economic growth.

[0010] In this sense, ultraviolet light exposure is a direct antimicrobial approach, whose effectiveness against different strains of airborne microorganisms has long been established.

[0011] Ultraviolet irradiation uses short-wave ultraviolet (UVC) energy to inactivate viruses, bacteria, and fungus, so they are unable to replicate and potentially cause disease. Thus, UVC energy disrupts the deoxyribonucleic acid (DNA) of a wide range of microorganisms, rendering them harmless.

[0012] Recently, UVC light disinfection systems have been increasingly used in health care settings in an attempt to decrease the transmission of pathogens and prevent health care associated infections.

[0013] In fact, the use of ultraviolet rays for disinfection has been known for several years, however the level of applied wave frequency 254nm is harmful to human health causing skin cancers and cataracts in the eye corneas.

[0014] Most UV disinfection systems use germicidal lamps emitting UVC around 254nm, but these lamps can be used to disinfect unoccupied spaces only.

[0015] Yet, some studies have aimed to investigate the in vitro efficacy of 222nm Far-UVC on the disinfection surface contamination, when exposed in aerosol droplets of sizes similar to those generated during sneezing and coughing.

[0016] Recently at Kobe University (Japan) and Columbia University (USA) it was found that the applied wave frequency level of 222nm is not harmful to human health and has the same disinfection efficiency compared to 254nm.

[0017] Previous reports also demonstrated that 222nm UVC light, belonging to Far-UVC spectrum (207-222nm), has the same highly effective germicidal properties as 254nm UVC. However, Far-UVC light has a very limited penetration depth in the skin or eye, due to its strong absorbance in biological materials, thus it cannot penetrate even the outer (non-living) layers of human skin or eye, being less harmful than 254nm UVC.

[0018] Further, Far-UVC efficiently inactivates airborne aerosolized viruses, with a low dose of 2 mJ/cm^2 of 222nm light inactivated >95% of aerosolized H1N1 influenza virus, and low doses of 1.7 and 1.2 mJ/cm^2 inactivated 99.9% of aerosolized coronavirus alpha and beta, respectively.

[0019] Based on these results, continuous Far-UVC exposure would result in 99.9% inactivation in about 25 minutes.

[0020] Thus, as all human coronaviruses have similar genomic sizes, so Far-UVC light would be expected to show similar inactivation efficiency against other human coronaviruses, including Sars-CoV-2 (COVID-19 disease).

[0021] According to American Conference of Governmental Industrial Hygienists (ACGIH), the exposure dose limit during a workday is 3 mJ/cm^2. Therefore, Far-UVC light has the same anti-microbial properties than conventional germicidal UVC light (254nm), but without producing the corresponding health effects, what makes it a promising, safe and inexpensive tool to reduce the spread of airborne-mediated microbial diseases, in which low dose-rate Far-UVC light could be safely used in indoor public locations.

[0022] Despite that, a Harvard study published in October 2020 listed the non-pharmaceutical interventions propose for risk mitigation of SARS-

Cov-2 transmission for passengers and crewmembers during air travel. The interventions include the consistent operation of ventilation systems, disinfection of surfaces, consistent wearing of face masks, and procedures during boarding and deplaning to maximize social distancing among passengers and crewmembers. One of the interventions mentioned in this study is the UV Disinfection, but its use in pre-boarding and on board at cruise situations were considered not applicable.

[0023] Nevertheless, there are solutions being developing to help to sanitize the environment of an aircraft cabin by using the UV. In this sense, document US9623133 discloses a disinfection system to perform a disinfection process inside an aircraft lavatory when the lavatory is not in use and the disinfection system is inactive when the lavatory is in use. There is an activation system that controls activation and deactivation of the disinfection system. Further, this disinfection system comprises a source of far ultraviolet radiation which is located in or on a ceiling of the lavatory to perform the disinfection process on at least one surface inside the lavatory. A sensor system detects whether the lavatory is occupied or unoccupied so the UV must be used only when it is unoccupied.

[0024] Although the document US9623133 describes the use of the Far-UV to sanitize the lavatory of an aircraft, it is necessary to have the door closed and the lavatory unoccupied to use the Far-UV. Further, it does not consider a methodology to control and to monitor the Far-UV application in a restrict rage of radiation and intensity to avoid damages to the human health and that is the reason why it has to be used in an unoccupied area. Additionally, this prior art document teaches the use of the Far-UV in a wavelength around 150nm and 240nm and does not consider the use of a wavelength of 222nm with 3 $mJ/cm^2/h$ of irradiation.

Objectives of the invention

[0025] As a result, the present invention aims to provide a disinfection system for aircraft interiors based on a control of the intensity and irradiation of ultraviolet waves, Far-UVC, allowing its safe application in an occupied area without causing clinical problems to humans.

[0026] It is also an aim of this invention, to provide a method to disinfect aircraft interiors with ways to control of the intensity and irradiation of Far-UVC waves in order to allow the disinfection of occupied areas without causing clinical problems to humans.

Brief description of the invention

[0027] The aim of this invention is a disinfection system for aircraft interiors that comprises:

a Far-UVC sub-system installed in aircraft interior areas previous defined for sanitization; and

at least a database comprising information about the aircraft interior areas and its availability to the Far-UVC sub-system during the preparation of the aircraft and on board at cruise;

the Far-UVC sub-system comprising:

(i) means to scan air and surfaces inside the aircraft interior areas using the database information;

(ii) an application server capable to store data of the disinfection process and signals of other systems in the aircraft; and

(iii) at least a processor unit to calculate, to evaluate, to monitor and to control the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas during the preparation of the aircraft and on board at cruise, sending the data of the disinfection process to be stored in the application server.

[0028] It is also an aim of this invention a method to disinfect aircraft interior, comprising the steps of:

(a) Making information about the aircraft interior areas available to a Far-UVC sub-system;

(b.1) If the aircraft interior areas are power off a switch of the Far-UVC sub-system is kept power off;

(b.2) If the aircraft interior areas are power on the Far-UVC sub-system calculates and evaluates the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas and compare to predefined minimum parameters;

(c.1) If the aircraft interior areas did receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters, the switch of the Far-UVC sub-system is kept power off;

(c.2) If the aircraft interior areas still have to receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters the switch of the Far-UVC sub-system is kept power on and a disinfection system is activated;

(d) Monitoring and controlling the Far-UVC sub-system intensity and radiation according to predefined minimum parameters;

(e.1) If the Far-UVC sub-system intensity and radiation are out of the predefined minimum parameters, dimmers and filters are switched on to control the UV intensity and irradiation rate and it returns to step (d);

(e.2) If the Far-UVC sub-system intensity and radiation are according to the predefined minimum parameters it is verified if the exposition time of the Far-UVC sub-system is activated in a less time than a predefined time parameter;

(f.1) If the exposition time of the Far-UVC sub-system is in a less time than a predefined time parameter, it returns to step (d);

(f.2) If the exposition time of the Far-UVC sub-system is according to the predefined time parameter, disinfection process data are stored, and it returns to step (a) wherein the Far-UVC sub-system is switched off;

(g) Providing steps (a) to (f.2) during the preparation of the aircraft and on board at cruise.

Description of the drawings

[0029] Figure 1 - is a flowchart of the disinfection system for aircraft interiors, objection of this invention; and

[0030] Figure 2 – is a flowchart of the method to disinfect aircraft interiors, objection of this invention.

Detailed description of the invention

[0031] According to one principal embodiment, and as illustrated in figure 1, the disinfection system for aircraft interiors, i.e., cabin, lavatory and cockpit, object of this invention comprises a Far-UVC sub-system 201 installed in aircraft interior areas previous defined for sanitization and at least a database 220 comprising information about the aircraft interior areas and its availability to the Far-UVC sub-system 201 during the preparation of the aircraft and on board at cruise.

[0032] More specifically, the Far-UVC sub-system comprises means to scan air and surfaces 224 inside the aircraft interior areas using the databases 220 information. These means to scan air and surfaces 224 are at least UV lamps and sensors, such as UV Radiometers and UV Spectroradiometers, that are installed in strategic points in the interior areas previously defined by sanitization protocols and which will be able to do a scan in the air and in the surfaces of the components installed in these interior areas of the aircraft to be able to calculate the intensity and energy of the ultraviolet waves applied in that location. Further, the Far-UVC sub-system also calculates and defines as initial data, the necessary time of the ultraviolet waves exposition which will varies from the interior area, size, amount of surfaces and the sanitization protocol for each environment.

[0033] The initial data from the means to scan the air and surfaces 224 are then stored in an application server 221 which is capable to store data of the disinfection process and signals of other systems in the aircraft. These initial data are accessed and used by at least a processor unit 223 to calculate, to evaluate, to monitor and to control the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas during the preparation of the aircraft and on board at cruise, when the passenger and crewmembers are already using the interior areas, according to minimum predefined parameters. All these data of the disinfection processes are sent to be stored in the application server 221, such as data, hour, time, exposition, intensity, irradiation and others. These information are stored to be monitored and to be consulted any time.

[0034] Further, the processor unit 223 also uses dimmers and filters to modify the intensity and the energy of the ultraviolet waves applied in the aircraft interior areas when it is necessary to adequate these parameters to the minimum predefined parameters.

[0035] In this sense, the radiation of the ultraviolet waves applied in the aircraft interior areas according to the predefined minimum parameters is $3mJ/cm^2/h$. Yet, the intensity of the ultraviolet waves Far-UVC is in the rage of 220nm to 224nm, preferably 222nm and the time of the exposition is predefined by Far-UVC sub-system according to the internal area and sanitization protocols.

[0036] The disinfection system also comprises a passenger server 225 that executes user interface commands to the Far-UVC sub-system, allowing interactions between the passenger and the Far-UVC sub-system. These interactions are made by a touch display of a video monitor or other input device connected to the Far-UVC sub-system and which provides the passenger permission to voluntarily cancel the process for scan of sanitization near the passenger localization.

[0037] The information introduced in the disinfection system by the passenger by the input device are also stored in the application server in other to be considered when the disinfection system is monitoring the exposition of the aircraft interior areas to the ultraviolet waves Far-UVC to follow the sanitizations protocols.

[0038] A method to disinfect aircraft interior is also an object of this invention. As illustrated in figure 2, this method starts with the switch of the Far-UVC sub-system in an OFF position 202.

[0039] Further, the information about the aircraft interior areas are made available 203 to the Far-UVC sub-system 201. These are necessary information to know if the aircraft interiors, i.e., cabin, lavatory, cockpit and others, are power on and available for the Far-UVC sub-system.

[0040] If the aircraft interior areas are power off, the switch of the Far-UVC sub-system 201 is kept power off 202, since it means that no sanitization is need yet. However, if the aircraft interior areas are power on 204 the Far-UVC sub-system 201 calculates and evaluates the intensity, energy and time exposition of the ultraviolet waves already applied in the aircraft interior areas 207 and compare to predefined minimum parameters, verifying if the touch surfaces of the interior areas received at least $3mJ/cm^2/h$ for necessary time predefined by the Far-UVC according to the internal area and sanitization protocols.

[0041] If the aircraft interior areas, specially the main touch surfaces, did receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters, the switch of the Far-UVC sub-system 201 is kept power off 202, but if the aircraft interior areas still have to receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters, the switch of the Far-UVC sub-system 201 is kept power ON 205 and the disinfection system is activated.

[0042] The method to disinfect aircraft interior also provides a step of monitoring and controlling the Far-UVC sub-system intensity and radiation 208 according to the predefined minimum parameters. In this step, it is verified if the Far-UVC sub-system is with intensity in range of 220nm to 224nm and with radiation of $3mJ/cm^2/h$.

[0043] If the Far-UVC sub-system intensity and radiation are out of these predefined minimum parameters, dimmers and filters are switched on 210 to control the UV intensity and irradiation rate and it returns to the step of Far-UVC sub-system calculation 207 to be improved and to reach out the predefined minimum parameters.

[0044] On the other hand, if the Far-UVC sub-system intensity and radiation are according to the predefined minimum parameters, it is verified if the exposition time of the Far-UVC sub-system is activated in a less time than a predefined time parameter 209 initially set. If the exposition time of the Far-UVC sub-system is in a less time than a predefined time parameter, it returns to step of Far-UVC sub-system calculation 207 to be improved and to fulfill these predefined minimum parameters. But if the exposition time of the Far-UVC sub-system is according to the predefined time parameter, the last disinfection process data are stored, and it returns to the beginning when the Far-UVC sub-system is switched off 202.

[0045] It is important to stand out that these method steps are provided during the preparation of the aircraft and also on board at cruise, that is, when the passenger and the crewmembers are onboard and using the aircraft interior areas.

[0046] Further, this method to disinfect aircraft interior areas has also the step of receiving passenger's interface commands 206 in real time by an input device and capable to request voluntarily the cancelation of the steps of scan of sanitization around this passenger localization by the touch display or other input device as already described. In this case, if these commands are received, the method returns to the beginning and the Far-UVC sub-system is switched off 202.

[0047] The radiation exposition of the ultraviolet waves applied in the aircraft interior areas 204 according to predefined minimum parameters is $3mJ/cm^2/h$. Yet, the intensity of the ultraviolet waves Far-UVC is in the rage of 220nm to 224nm and the time of the exposition is predefined by Far-UVC sub-system according to the internal area and sanitization protocols.

[0048] This method is constantly monitoring and controlling the application of the Far-UVC in a restricted range of intensity and irradiance to avoid damage to human health, allowing the applications with passenger and or crewmembers in the disinfected interior areas.

[0049] Also, the record and storage of the Far-UVC applications history ensure the optimization of applications in selected intervals.

[0050] In this sense, the disinfection system and method can be used without the need to exclude people and for this reason they can be used during flight operation, as well as preparation of aircrafts, pre-boarding and deplaning, which will add value to the product with regard to people's health security.

[0051] So, having described an example of a preferred embodiment, it should be understood that the scope of this invention covers other possible variations, being limited only by the content of the attached claims, including the possible equivalents.

CLAIMS

1. Disinfection system for aircraft interiors, characterized by the fact that comprises:

a Far-UVC sub-system (201) installed in aircraft interior areas previous defined for sanitization; and

at least a database (220) comprising information about the aircraft interior areas and its availability to the Far-UVC sub-system (201) during the preparation of the aircraft and on board at cruise;

the Far-UVC sub-system (201) comprising:

(i) means to scan air and surfaces (224) inside the aircraft interior areas using the database (220) information;

(ii) an application server (221) capable to store data of the disinfection process and signals of other systems in the aircraft; and

(iii) at least a processor unit (223) to calculate, to evaluate, to monitor and to control the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas during the preparation of the aircraft and on board at cruise, sending the data of the disinfection process to be stored in the application server (221).

2. The system, according to claim 1, wherein the means to scan air and surfaces (224) are at least UVC lamps and sensors, which are capable to do a scan in air and in surfaces of components of the aircraft interior areas.

3. The system, according to claim 2, wherein the application server (221) stores the inicial data from the means to scan air and surfaces (224) which are accessed and used by the processor unit (223) to calculate, to evaluate, to monitor and to control the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas according to minimum parameters.

4. The system, according to claim 3, wherein the processor unit (223) further uses dimmers and filters to modify the intensity and energy of the ultraviolet waves applied in the aircraft interior areas.

5. The system, according to claim 1, wherein it further comprises an passenger server (225) that execute user interface commands with the Far-UVC sub-system allowing an interaction of the passenger with the Far-UVC sub-system by means of a touch display of a video monitor.

6. The system, according to claim 1, wherein the radiation exposition of the ultraviolet waves applied in the aircraft interior areas according to predefined minimum parameters is $3mJ/cm^2/h$ and the time is predefined by the Far-UVC sub-system to the internal area and sanitization protocols.

7. The system, according to claim 6, wherein the intensity of the ultraviolet waves Far-UVC is in the rage of 220nm to 224nm.

8. Method to disinfect aircraft interior, characterized by comprising the steps of:

(a) Making information about the aircraft interior areas available (203) to a Far-UVC sub-system (201);

(b.1) If the aircraft interior areas are power off a switch of the Far-UVC sub-system (201) is kept power off (202);

(b.2) If the aircraft interior areas are power on the Far-UVC sub-system (201) calculates and evaluates the intensity, energy and time exposition of the ultraviolet waves applied in the aircraft interior areas (204) and compare to predefined minimum parameters;

(c.1) If the aircraft interior areas did receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters, the switch of the Far-UVC sub-system (201) is kept power off (202);

(c.2) If the aircraft interior areas still have to receive the energy and time exposition of the ultraviolet waves according to the predefined minimum parameters the switch of the Far-UVC sub-system (201) is kept power on (205) and a disinfection system is activated;

(d) Monitoring and controlling the Far-UVC sub-system intensity and radiation (208) according to predefined minimum parameters;

(e.1) If the Far-UVC sub-system intensity and radiation are out of the predefined minimum parameters, dimmers and filters are switched on (210) to control the UV intensity and irradiation rate and it returns to step (d);

(e.2) If the Far-UVC sub-system intensity and radiation are according to the predefined minimum parameters it is verified if the exposition time of the Far-UVC sub-system is activated in a less time than a predefined time parameter (209);

(f.1) If the exposition time of the Far-UVC sub-system is in a less time than a predefined time parameter, it returns to step (d);

(f.2) If the exposition time of the Far-UVC sub-system is according to the predefined time parameter, disinfection process data are stored and it returns to step (a) and the Far-UVC sub-system is switched off (202);

(g) Providing steps (a) to (f.2) during the preparation of the aircraft and on board at cruise.

9. The method, according to claim 8, wherein after the step (c.2) and before the step (d) it might further comprises the steps of:

(c.3) Receiving passenger's interface commands (206) in real time by an input device requesting the cancelation of the steps of scan of sanitization around this passenger localization, returning it to step (a) and the Far-UVC sub-system is switched off (202).

10. The method, according to claim 8, wherein the radiation exposition of the ultraviolet waves applied in the aircraft interior areas (204) according to predefined minimum parameters is $3mJ/cm^2/h$ and the time is predefined by the Far-UVC sub-system to the internal area and sanitization protocols.

11. The method, according to claim 8, wherein the intensity of the ultraviolet waves Far-UVC is in the rage of 220nm to 224nm.

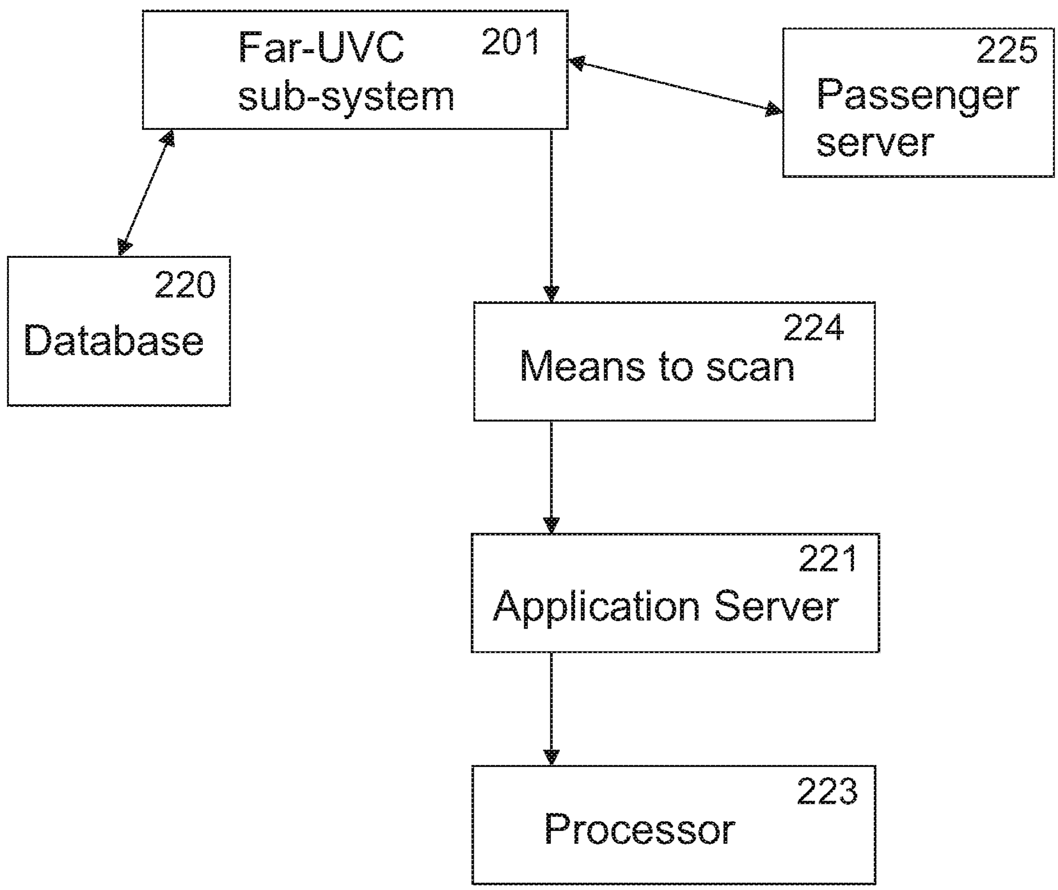
Far-UVC
sub-system
201
225
Passenger
server
220
Database
224
Means to scan
221
Application Server
223
Processor

FIG. 1

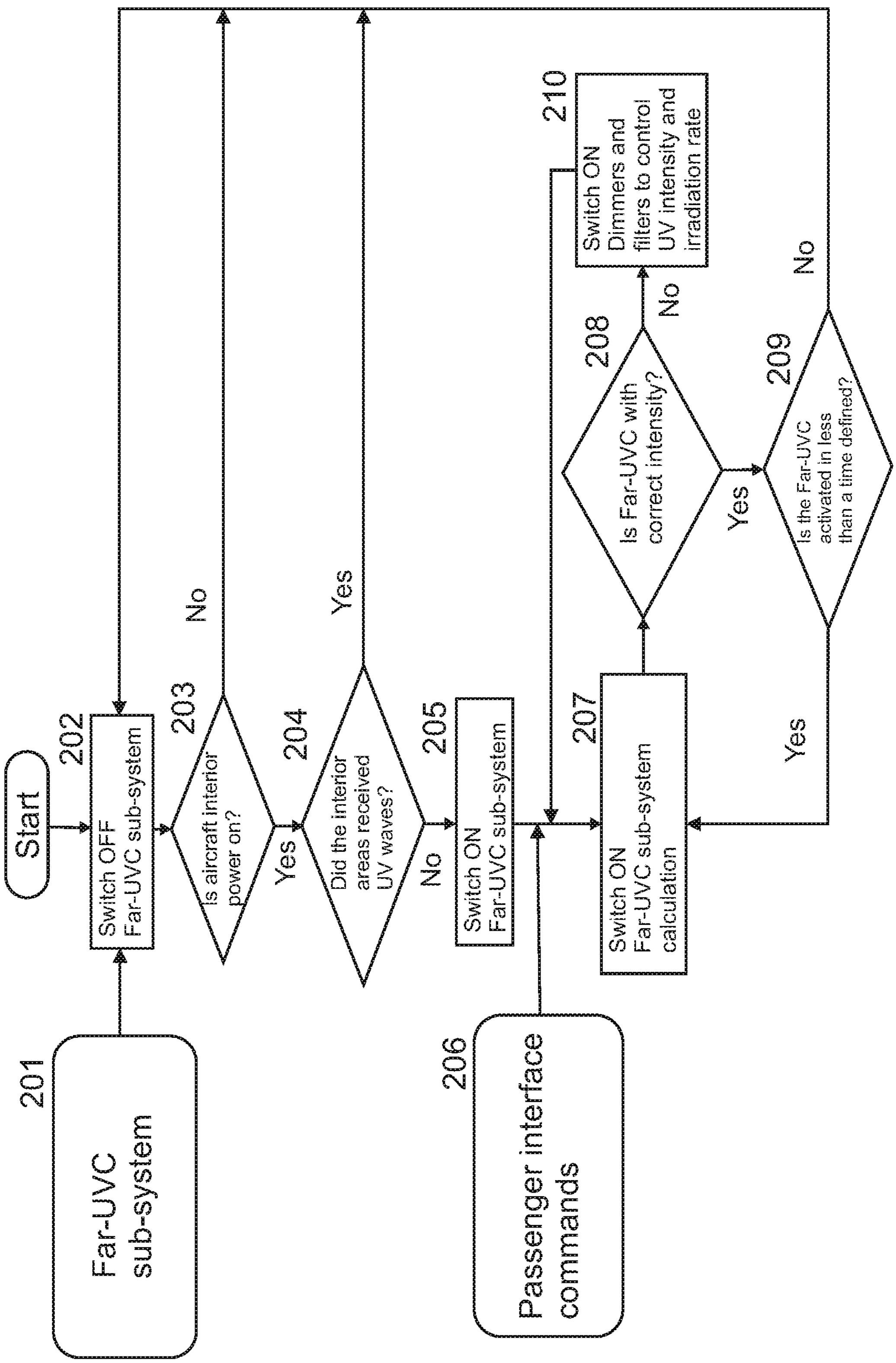
Start
201
Far-UVC sub-system
202
Switch OFF Far-UVC sub-system
203
Is aircraft interior power on?
No
Yes
204
Did the interior areas received UV waves?
Yes
No
205
Switch ON Far-UVC sub-system
206
Passenger interface commands
207
Switch ON Far-UVC sub-system calculation
208
Is Far-UVC with correct intensity?
No
Yes
209
Is the Far-UVC activated in less than a time defined?
No
Yes
210
Switch ON Dimmers and filters to control UV intensity and irradiation rate

FIG. 2

INTERNATIONAL SEARCH REPORT

International application Nº
PCT/BR2021/050138

A. CLASSIFICATION OF SUBJECT MATTER
IPC: A61L 2/10 (2006.01), A61L 2/24 (2006.01)
CPC: A61L 2/10, A61L 2/24

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)

A61L 2/10 (2006.01); A61L 2/24 (2006.01)

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

INPI-BR database

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

DWPI -"sanitization"; ("ultraviolet" or "UV" or "UVC" or "UV-C"); "radiation"; ("airplane" or "aircraft")

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claims Nº
Y	US 10702618 B2 (BOEING CO [US]) 07 July 2020 (2020-07-07) **[col. 5, lines 21-35; col. 5, lines 46-48; col5, lines 61-65; col. 6, lines 38-56; col. 8, lines 24-42; col. 9, lines 7-20; elem. 128]**	1, 3, 4, 5, 6, 7, 8, 9, 10, 11
Y	WO 2016164364 A1 (KREITENBERG ARTHUR [US]) 13 Oct 2016 (2016-10-13) **[parag. 091, 103, 110, 111, 124-126, 132, 133, 136, 137, 139-142]**	1, 2, 3, 8, 9
Y	GB 2549192 A (BOEING CO [US]) 11 October 2017 (2017-10-11) **[pg. 5, lines 20-25; pg. 14, line 3 – pg. 16, line 18; figs. 8 and 9; pag. 16, lines 3-18]**	1,5, 8

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to stablish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
2021-12-21	12/01/2022

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claims N°
Y	US 2007053188 A1 (LUMINATOR HOLDING LP) 08 March 2007 (2007-03-08) **[parag. 0011, 0039, 0040-0041, 0043, 0047]**	1,2
Y	WO 2020223820 A1 (HUNT BARRY [CA]) 12 November 2020 (2020-11-12) **[parag. 0055-0057]**	4,8
Y	BR 102017017951 A2 (BOEING CO [US]) 03 April 2018 (2018-04-03) **[parag. 0011, 0032-0033, elem. 120]**	3,4, 8
Y	US 8753575 B2 (NEISTER S EDWARD [US]) 17 June 2014 (2014-06-17) **[figs. 11, 12]**	6,7, 10, 11
Y	US 10228622 B2 (BOEING CO [US]) 12 March 2019 (2019-03-12) **[abstract; col. 6, lines 10-13; col. 6, lines 19-60]**	1,8
A	US 10874760 B2 (XENEX DISINFECTION SERVICES INC [US]) 29 December 2020 (2020-12-29)	- - -
E, Y	US 2021113723 A1 (RAFFEL SYSTEMS LLC [US]) 22 April 2021 (2021-04-22)	1,8
E, Y	US 2021346561 A1 (BOEING CO [US]) 11 November 2021 (2021-11-11)	1,8

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application Nº
PCT/BR2021/050138

Patent documents cited in search report	Publication date	Patent family members	Publication date
US 10702618 B2	2020-07-07	US 2018369434 A1	2018-12-27
		US 2020289690 A1	2020-09-17
WO 2016164364 A1	13/10/16	EP 2772272 A1	2014-09-03
		ES 2621733 T3	2017-07-05
		JP 2014162474 A	2014-09-08
		JP 6439253 B2	2018-12-19
		US 2014241941 A1	2014-08-28
		US 8907304 B2	2014-12-09
		US 2015064065 A1	2015-03-05
		US 8999238 B2	2015-04-07
		US 2015209458 A1	2015-07-30
		US 9144618 B2	2015-09-29
		US 2015209460 A1	2015-07-30
		US 9149549 B2	2015-10-06
		US 2016136314 A1	2016-05-19
		US 10159761 B2	2018-12-25
		US 2016375166 A1	2016-12-29
		US 10195298 B2	2019-02-05
		US 2015209459 A1	2015-07-30
		US 10406253 B2	2019-09-10
		US 2019160190 A1	2019-05-30
		US 10500296 B2	2019-12-10
		WO 2016164362 A1	2016-10-13
GB 2549192 A	2017-10-11	GB 201703789 D0	2017-04-26
		GB 2549192 B	2020-06-24
		CA 2960250 A1	2017-09-30
		CN 107264808 A	2017-10-20
		JP 2017206231 A	2017-11-24
		JP 6945306 B2	2021-10-06
		US 2017283092 A1	2017-10-05
		US 10793291 B2	2020-10-06
US 2007053188 A1	2007-03-08	None	
WO 2020223820 A1	2020-11-12	US 2020384138 A1	2020-12-10
BR 102017017951 A2	2018-04-03	CA 2971265 A1	2018-02-24
		EP 3287146 A1	2018-02-28
		JP 2018069029 A	2018-05-10
		US 2018055959 A1	2018-03-01
		US 9993571 B2	2018-06-12
US 8753575 B2	2014-06-17	US 2010028201 A1	2010-02-04
		CA 2600923 A1	2007-07-26
		CN 101238363 A	2008-08-06
		DK 1866627 T3	2013-11-18
		ES 2437204 T3	2014-01-09
		US 2014227132 A1	2014-08-14
		US 9700642 B2	2017-07-11
		US 2017304472 A1	2017-10-26
		US 2018353629 A9	2018-12-13

Patent documents cited in search report	Publication date	Patent family members	Publication date
		US 2020030469 A1	2020-01-30
		WO 2007084145 A2	2007-07-26
--------------------------------	----------------	--------------------------------	---------------
US 10228622 B2	2019-03-12	US 2018373157 A1	2018-12-27
		BR 102018013043 A2	2019-01-15
		CA 3006530 A1	2018-12-26
		CN 109121273 A	2019-01-01
		EP 3421053 A1	2019-01-02
		JP 2019030635 A	2019-02-28
		US 2019171111 A1	2019-06-06
		US 10852638 B2	2020-12-01
		US 2021063891 A1	2021-03-04
--------------------------------	----------------	--------------------------------	---------------
US 10874760 B2	2020-12-29	US 2019328920 A1	2019-10-31
		EP 3206721 A1	2017-08-23
		US 2017216472 A1	2017-08-03
		US 10391189 B2	2019-08-27
		US 2021113728 A1	2021-04-22
		WO 2016061380 A1	2016-04-21
--------------------------------	----------------	--------------------------------	---------------
US 2021113723 A1	2021-04-22	CN 112675324 A	2021-04-20
		CN 213373949 U	2021-06-08
--------------------------------	----------------	--------------------------------	---------------
US 2021346561 A1	2021-11-11	CA 3119128 A1	2021-11-20
		CN 113616822 A	2021-11-09
		CN 113616823 A	2021-11-09
		CN 113616824 A	2021-11-09
		CN 113616825 A	2021-11-09
		CN 113694225 A	2021-11-26
		EP 3915592 A2	2021-12-01
		EP 3915595 A2	2021-12-01
		EP 3915596 A2	2021-12-01
		EP 3915597 A2	2021-12-01
		EP 3922275 A1	2021-12-15
		EP 3922276 A1	2021-12-15
		JP 2021176517 A	2021-11-11
		JP 2021180835 A	2021-11-25
		JP 2021183125 A	2021-12-02
		US 2021346539 A1	2021-11-11
		US 2021346540 A1	2021-11-11
		US 2021346541 A1	2021-11-11
		US 2021361793 A1	2021-11-25
--------------------------------	----------------	--------------------------------	---------------