



(51) International Patent Classification:

A61L 2/20 (2006.01) B32B 27/12 (2006.01)
A61L 101/06 (2006.01) C23C 16/455 (2006.01)
B01D 39/08 (2006.01) D04H 1/4374 (2012.01)
B32B 5/26 (2006.01)

(21) International Application Number:

PCT/US2015/047091

(22) International Filing Date:

27 August 2015 (27.08.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/042,398 27 August 2014 (27.08.2014) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: CHLORINE DIOXIDE DECONTAMINATION SYSTEM AND METHODS

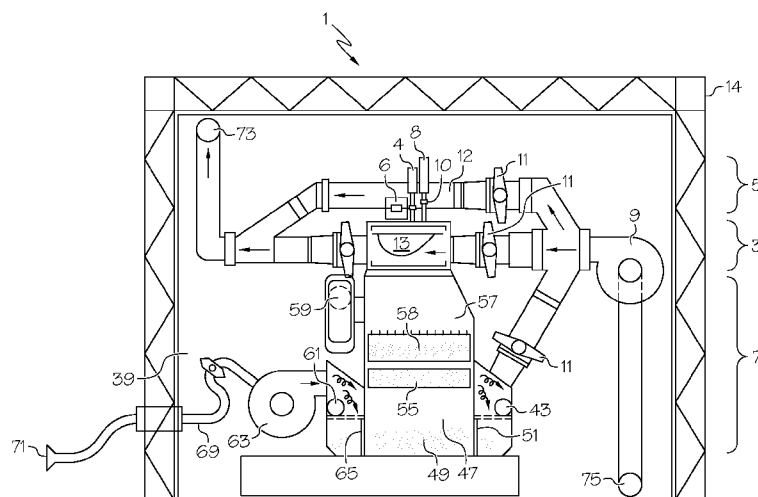


FIG. 1

(57) Abstract: A scalable, portable and modular chlorine dioxide fumigant decontamination system having an activating area and a neutralizing area which may be housed separately or as a single operationally connected unit, and which may be configured as a closed loop system connected to a decontamination chamber for decontamination of articles, or as an open loop system for decontamination of interiors and large confined spaces, and employing a specialized activating cup that is permeable to air yet substantially impermeable to water and chlorine dioxide reaction by-products such that directing air through the activation cup releases nearly pure chlorine dioxide fumigant. Methods and articles relating to the system are also described.

**Published:****(88) Date of publication of the international search report:**

9 September 2016

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/47091

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61L 2/20, A61L 101/06, B01D 39/08, B32B 5/26, B32B 27/12, C23C 16/455, D04H 1/4374 (2016.01)

CPC - A61L 2/20, A61L 12/10, B01D 39/08, B01D 46/0032, B32B 27/12, C23C 16/455, D04H 1/4374

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)

IPC(8)- A61L 2/20, A61L 101/06, B01D 39/08, B32B 5/26, B32B 27/12, C23C 16/455, D04H 1/4374 (2016.01);

CPC- A61L 2/20, A61L 12/10, B01D 39/08, B01D 46/0032, B32B 27/12, C23C 16/455, D04H 1/4374

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

USPC- 118/725, 422/28, 422/29, 422/37, 422/255, 422/294, 422/298, 442/110, 442/381, 442/414;

Patents and NPL (classification, keyword; search terms below)

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

Pub West (US EP JP WO), Pat Base (AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO), Google Patent, Google Scholar, Free Patents Online; search terms: chlorine, dioxide, ClO2, fumigate, decontaminate, sterilize, sanitize, disinfect, cup, holder, container, vessel, bowl, electret, electric, charge, static, triboelectric, microfiber...

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0266448 A1 (REGITS et al.) 27 January 2010 (27.01.2010), Figs. 1A, 1B, 2, 3; para [0032], [0033], [0038]-[0043]	1, 6, 8
--		7
Y		2-5, 31A, 31B, 32, 33
A		7
Y	US 2004/0211731 A1 (FERGUSON et al.) 28 October 2004 (28.10.2004), para [0014], [0020], [0051], [0055], [0063]	2-5, 31A, 31B, 32, 33
--		2-5, 31A, 31B, 32, 33
A		2-5, 31A, 31B, 32, 33
Y	US 2013/0101477 A1 (BOTH et al.) 25 April 2013 (25.04.2013), para [0038]-[0040], [0064], [0067], [0099]	2-5, 31A, 31B, 32, 33
--		2-5, 31A, 31B, 32, 33
A		2-5, 31A, 31B, 32, 33
Y	US 2003/0133834 A1 (KARLE) 17 July 2003 (17.07.2003), para [0005]-[0045]	2-5, 31A, 31B, 32, 33
--		2-5, 31A, 31B, 32, 33
A		2-5, 31A, 31B, 32, 33
Y	US 5,597,645 A (PIKE et al.) 28 January 1997 (28.01.1997), col 1, ln 66 to col 2, ln 9; col 3, ln 8-15; col 8, ln 12-27; col 9, ln 56-64	2-5, 31A, 31B, 32, 33
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A		



Further documents are listed in the continuation of Box C.



* Special categories of cited documents:

"A" document defining the general 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 establish 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 date 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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

07 June 2016

Date of mailing of the international search report

12 JUL 2016

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/47091

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1 (in part), 2-8, and 31-33, drawn to a decontamination system with a particular fumigant activation cup.

Group II: Claims 1 (in part) and 9-16, drawn to a decontamination system comprising a leak abatement space and a ClO₂ fumigant neutralization space.

Group III: Claims 1 (in part), 17-25, and 30, drawn to a decontamination system comprising a sealed housing.

-- Please See Supplemental Box --

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1 (in part), 2-8, 31-33

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continued from Box No. III, Observations where unity of invention is lacking,

Group IV: Claim 26, drawn to a method for generating chlorine dioxide fumigant in a directed flow with a minimum of water.

Group V: Claims 27-29, drawn to a method for neutralizing chlorine dioxide (ClO₂) fumigant.

The inventions listed as Groups I, II, III, IV, and V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups IV and V do not require a decontamination system comprising:

a chlorine dioxide (ClO₂) fumigant activating area,
optionally, a by-pass flow area,
a neutralizing area;

a first variable speed air blower in direct fluid communication with the ClO₂ fumigant activating area, the by-pass flow area and the neutralizing area;

a valve system for dedicating air flow from the blower to one or more of the areas,

wherein the activating area comprises an activation cup configured to receive reagents for in situ generation of ClO₂ fumigant, said activation cup being permeable to air and substantially impermeable to water and reaction byproducts, further wherein the activation cup is suspended in the activation area such that air flowing from the first variable speed air blower into the activation area flows through and around the activation cup such that generated ClO₂ fumigant passes out of the activation cup with the air flow while water and reaction by-products remain in the activation cup, as required by Groups I, II, and III.

Groups I, III, IV, and V do not require a leak abatement space and a ClO₂ fumigant neutralization space, said ClO₂ fumigant neutralization space comprising:

(a) a first treatment station comprising ultraviolet light (UV), the first treatment station being in operational communication with a variable air blower, wherein the blower may be the first variable air blower or an additional variable air blower, said variable air blower set to blow fumigant waste air at a high speed through the first treatment station, "high" being defined as sufficient to degrade ClO₂ present in the fumigant waste air, thereby resulting in partially treated air;

(b) a second treatment station comprising a reservoir of liquid neutralizing solution, said second treatment station divided into at least three chambers, a first chamber in direct communication with the first treatment station, a second main chamber adjacent the first chamber, and a third chamber located on the opposite side of the second chamber than the first chamber, said first, second and third chambers being separated by diffusion plates, further where the blower of step (a) is positioned so that air flow from the first treatment center hits the first chamber at an oblique angle, wherein a combination of "high" flow speed, an oblique flow force, and forcing of the air through the diffusion plates result in turbulence in the reservoir and degrading of ClO₂ still present in the partially treated air, resulting in substantially treated air,

(c) a third treatment station comprising a humidification filter positioned over the reservoir, said humidification filter configured to capture, contain and return neutralizing solution to the reservoir while permitting substantially treated air to pass through; and

(d) a fourth treatment station comprising coated zeolite, as required by Group II.

Groups I, II, IV, and V do not require the activating area and neutralizing area may be housed together in one sealed housing or housed separately in independent sealed housings, as required by Group III.

Groups I, II, III, and V do not require a method for generating chlorine dioxide fumigant in a directed flow with a minimum of water, the method comprising:

(a) providing an activation cup comprising:

an outer layer of crush-resistant thermally bondable non-woven fibers molded into a transversely bisected aerodynamically-shaped shell, said shell open at the top and having an interior surface and an exterior surface, said exterior surface and interior surface comprising a pattern of corrugations;

at least one filter layer including one filter layer adjacent and adherent to an inner surface of the outer layer, wherein at least one filter layer comprises high-loft electret charged fluorine-coated polyolefin microfibers, wherein the activation cup is adapted to retain water and reaction by-products while permitting gas to pass through;

(b) flexibly suspending the activation cup;

(c) adding dry reagents for production of ClO₂ fumigant to the cup;

(d) directing an air flow toward the cup at a low speed such that the corrugations create turbulence resulting in vibration of the cup and acceleration of ClO₂ generation, "low" being defined as insufficient to degrade ClO₂;

(e) adding water to the cup; thereby initiating generation of ClO₂ fumigant that is directed out of the cup with the air flow while water and ClO₂ generation reaction by-products are substantially retained in the cup, as required by Group IV.

Groups I, II, III, and IV do not require a method for neutralizing chlorine dioxide (ClO₂) fumigant in a sealed neutralizing area, said neutralizing area comprising a leak abatement space and a neutralizing space, said neutralizing space comprising a series of treatment stations and at least one blower, the method comprising:

(a) blowing ClO₂ fumigant to-be-neutralized into a treatment station comprising ultraviolet light resulting in partially neutralized air, said blowing effectuated at a speed high enough to degrade ClO₂;

(b) blowing the partially neutralized air from the UV treatment station through a diffusion plate and into a treatment station comprising a neutralizing solution reservoir, thereby creating bubbling and frothing in the reservoir and resulting in substantially neutralized air;

(c) capturing and returning solution to the reservoir with a treatment station comprising a humidification filter that permits the substantially neutralized air to pass through the filter and into a treatment area comprising coated zeolite;

(d) passing the substantially neutralized air through the coated zeolite to neutralize any remaining ClO₂ and other toxic gaseous by-products remaining,

resulting in neutralized air; and,

(e) optionally, passing the neutralized air through activated carbon to remove odiferous molecules which may be present in the neutralized air, as required by Group V.

-- Please See Supplemental Box --

Continued from Box No. III, Observations where unity of invention is lacking.

Shared Common Features

The only feature shared by Groups I, II, III, IV, and V that would otherwise unify the groups is fumigant activation cup. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by US 2010/0266448 A1 to Regits, et al. (hereinafter 'Regits'). Regits discloses a chlorine dioxide/CIO₂ fumigant (para [0030]).

The only feature shared by Groups I, II, III, and IV that would otherwise unify the groups is fumigant activation cup. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Regits. Regits discloses a fumigant activation cup (Figs. 1A, 2; para [0032], [0038]-[0041], dispensing assembly, 222, top assembly, 207, bowl, 208.).

The only feature shared by Groups I, II, and V that would otherwise unify the groups is a CIO₂ fumigant neutralization space. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Regits. Regits discloses CIO₂ fumigant neutralization space (Figs. 1A; para [0032], [0038]-[0041], mini decontamination system, 2345, comprising a chemical scrubbers, 333.).

The only feature shared by Groups I, II, and III that would otherwise unify the groups is a decontamination system, comprising: a chlorine dioxide (CIO₂) fumigant activating area, optionally, a by-pass flow area, a neutralizing area; a first variable speed air blower in direct fluid communication with the CIO₂ fumigant activating area, the by-pass flow area and the neutralizing area; a valve system for dedicating air flow from the blower to one or more of the areas, wherein the activating area comprises an activation cup configured to receive reagents for in situ generation of CIO₂ fumigant, said activation cup being permeable to air and substantially impermeable to water and reaction byproducts, further wherein the activation cup is suspended in the activation area such that air flowing from the first variable speed air blower into the activation area flows through and around the activation cup such that generated CIO₂ fumigant passes out of the activation cup with the air flow while water and reaction by-products remain in the activation cup. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Regits.

Regits discloses a decontamination system (para [0033]), comprising:

a chlorine dioxide (CIO₂) fumigant activating area (Figs. 1A, 15; para [0033], gas tight tent, 1502.), optionally, a by-pass flow area (Figs. 1A, 1B; para [0033], [0038], [0043], gas conduit, 109, splits to scrubber, 333, or to CIO₂ generation, 444.),
a neutralizing area (Fig. 1A; para [0041], [0042], assembly, 207, dispenses neutralizing chemical.);
a first variable speed air blower in direct fluid communication with the CIO₂ fumigant activating area, the by-pass flow area and the neutralizing area (Fig. 1A; para [0038], [0039], recirculation blower, 401... higher air flow than CIO₂ blower, 444.);
a valve system for dedicating air flow from the blower to one or more of the areas (Fig. 1A; para [0039], valve check, 402.), wherein the activating area comprises an activation cup configured to receive reagents for in situ generation of CIO₂ fumigant, said activation cup being permeable to air and substantially impermeable to water and reaction byproducts (Figs. 1A, 2, 15; para [0032], [0038]-[0041], dispensing assembly, 222, top assembly, 207, bowl, 208, CIO₂ supply duct, 108, sparge tubing, 212, return duct, 109, conduit to mini decontamination system conduit, 2345, comprising a chemical scrubbers, 333... dispensing assembly holds H₂O, 209, and sparging exit holes, 210, to deliver CIO₂ to the enclosed sealed space, 100.), further wherein the activation cup is suspended in the activation area such that air flowing from the first variable speed air blower into the activation area flows through and around the activation cup such that generated CIO₂ fumigant passes out of the activation cup with the air flow while water and reaction by-products remain in the activation cup (Figs. 1A, 2; para [0039]-[0041], top assembly, 207, comprising bottom bowl, 208, within dispensing assembly, 222, and sparging tube, 212, submerged within H₂O, 209, to deliver CIO₂ to the enclosed sealed space, 100.).

The only feature shared by Groups II and V that would otherwise unify the groups is a neutralization space, comprising: air blower and air blowing speed; UV treatment station for treating air; degrading CIO₂; a treatment station comprising a reservoir of liquid neutralizing solution and diffusion plates; capture and return solution to the reservoir with a treatment station comprising a humidification filter that permits the substantially neutralized air to pass through the filter and into a treatment area comprising coated zeolite. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is obvious over Regits, in view of US 2013/0101477 A1 to Both, et al. (hereinafter 'Both').

Regits discloses a neutralization space (Figs. 1A; para [0032], [0038]-[0041], mini decontamination system, 2345, comprising a chemical scrubbers, 333.), comprising:

air blower and air blowing speed (Fig. 1A; para [0038], [0039], recirculation blower, 401... higher air flow than CIO₂ blower, 444.);
degrading CIO₂ (para [0030], decontamination with chlorine dioxide.);
a treatment station comprising a reservoir of liquid neutralizing solution and diffusion plates (Figs. 1A, 2; para [0032], [0038]-[0041], dispensing assembly, 222, having top assembly, 207, bowl, 208, comprising water, 209, and neutralizing chemicals... wherein the bowl, 208, is illustrated with diffusion plates adjacent sparge tube, 212.);
capture and return solution to the reservoir with a treatment station comprising a filter that permits the substantially neutralized air to pass through the filter and into a treatment area (para [0032], [0034], [0043], mini decontamination system conduit, 2345 to a chemical scrubbers, 333, comprising filter, 301.);
but does not specifically disclose a humidification filter and said treatment area comprising coated zeolite.
However, regarding the humidification filter, Regits discloses a humidity source (para [0045]) and filtering with charcoal (para [0043]). To a person of ordinary skill in the art, it would have been obvious to filter humidification in order to optimize the filtering of air for reintroduction into the decontamination treatment system.
Further regarding the coated zeolite, Both further discloses a filter comprising coated zeolite (para [0003], [0053], [0054]). To a person of ordinary skill in the art, it would have been obvious to substitute the filter as taught by Both for use in the humidification filter as in Regits in order to remove airborne contaminants (Both: para [0002]), because Regits and Both are directed towards air filters comprising charcoal for use with humidity (Both: para [0001], [0053], [0161]).

-- Please See Supplemental Box --

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/47091

Continued from Box No. III, Observations where unity of invention is lacking,

The only feature shared by Groups IV and V that would otherwise unify the groups is ClO₂ and other toxic gaseous by-products. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Regits. Regits discloses ClO₂ and other toxic gaseous by-products (para [0006], [0035], [0205], chlorine dioxide for decontamination of contaminated items such as animal devices, incubators, bio-reactors, computer equipment, etc.).

The only feature shared by Groups III and V that would otherwise unify the groups is a seal. However, this shared technical feature does not represent a contribution over prior art, because the shared technical feature is anticipated by Regits. Regits discloses a seal (para [0006], [0029]).

As the technical features were known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I, II, III, IV and V therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.