

From the INTERNATIONAL BUREAU

PCTNOTIFICATION OF DEFECTS IN
THE INTERNATIONAL APPLICATION

(PCT Articles 3(4)(i) and 14(1) and Rule 28.1)

To: **US (37)**UNITED STATES PATENT AND TRADEMARK
OFFICE
Attention: Box PCT
Room 3A01, South Tower
2900 Crystal Drive
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as receiving Office

Date of mailing (day/month/year) 29 May 2007 (29.05.2007)	International filing date (day/month/year) 31 January 2006 (31.01.2006)
International application No. PCT/US2006/003393	
Applicant NEISTER, S. Edward	

1. ☒ The International Bureau hereby calls the attention of the receiving Office to the defects in the international application as filed, which are specified on the attached:
- ☐ Annex A
 - ☒ Annex B1 (text matter of the international application as filed)
 - ☐ Annex C1 (drawings of the international application as filed)
2. ☐ The International Bureau hereby calls the attention of the receiving Office to the defects in the translation of the international application furnished under Rule 12.3 or 12.4, which are specified on the attached:
- ☐ Annex A
 - ☐ Annex B2 (text matter of the translation of the international application)
 - ☐ Annex C2 (drawings of the translation of the international application)

Additional observations (if necessary):

NOT AN ERROR. THERE'S NO WAY WE CAN
MEASURE THE MARGINS.

SIG HOSTAD
02 JULY 07

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Park Kwang Woon
Facsimile No. +41 22 338 82 70	Facsimile No. +41 22 338 70 90
	Telephone No. +41 22 338 74 12

Form PCT/IB/313 (October 2005)

I/C9OBSTE50

The International Bureau has found that, with regard to the presentation of the text matter of the international application as filed, the physical requirements are not complied with to the extent that compliance therewith is necessary for:

1. ☒ reasonably uniform international publication (Rules 11 and 26.3(a)(i)) (defects to be specified):

	Request	Description	Claims	Abstract
a. ☐ the sheets do not admit of direct reproduction	☐	☐	☐	☐
b. ☐ the element does not commence on a new sheet	☐	☐	☐	☐
c. ☐ sheets are not free from creases, cracks, folds	☐	☐	☐	☐
d. ☐ sheets are not used in the upright position	☐	☐	☐	☐
e. ☐ one side of the sheets is not left unused	☐	☐	☐	☐
f. ☐ the paper of the sheets is not flexible/strong/white/smooth/non-shiny/durable	☐	☐	☐	☐
g. ☐ the sheets are not connected as prescribed (Rule 11.4(b))	☐	☐	☐	☐
h. ☐ sheets are not A4 size (29.7cm x 21cm)	☐	☐	☐	☐
i. ☒ the minimum margins on the sheets are not as prescribed (top: 2cm; left side: 2.5cm; right side: 2cm; bottom: 2cm)		☒	☒	☒
j. ☐ the file reference number indicated on the sheets does not appear in the left-hand corner of the sheets, within 1.5 cm of the top of the sheets		☐	☐	☐
k. ☐ the file reference number exceeds the maximum of 12 characters	☐	☐	☐	☐
l. ☐ the sheets of the description, claims and abstract are not numbered in consecutive Arabic numerals		☐	☐	☐
m. ☐ the sheet numbers are not centered at the top or bottom of the sheets	☐	☐	☐	☐
n. ☐ the sheet numbers are in the margin (see i. above for the size of the margins)		☐	☐	☐
o. ☐ the text matter is not typed or printed	☐	☐	☐	☐
p. ☐ the typing on the sheets is not 1½-spaced		☐	☐	☐
q. ☐ the characters in the text matter on the sheets are less than 0.21 cm high in capital letters	☐	☐	☐	☐
r. ☐ the text matter on the sheets is not in dark, indelible color	☐	☐	☐	☐
s. ☐ the element contains drawings	☐	☐	☐	☐
t. ☐ the sheets contain alterations/overwritings/interlineations/toomany erasures	☐	☐	☐	☐
u. ☐ the sheets contain photocopy marks	☐	☐	☐	☐

2. ☐ satisfactory reproduction (Rules 11 and 26.3(b)(i))

Further observations (if necessary):

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF RECEIPT OF SEARCH COPY

(PCT Rule 25.1)

To:

PHILLIP DECKER
MESMER & DELEAULT, PLLC
ONE NEW HAMPSHIRE AVENUE SUITE 125
PORTSMOUTH, NEW HAMPSHIRE 03801

PALM Tracking Number = 51603393

Date of mailing
(day/month/year)

18 May 2007

Applicant's or agent's file reference
NEI.PCT.2

IMPORTANT NOTIFICATION

International application No.
PCT/US2006/003393

International filing date (day/month/year)
31 Jan 2006

Priority date (day/month/year)
31 Jan 2005

Applicant

NEISTER, S. EDWARD

1. Where the International Searching Authority and the receiving Office are not the same Office:

The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

Where the International Searching Authority and the receiving Office are the same Office:

The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

18 May 2007

(date of receipt).

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing or tables related thereto in computer readable form.
3. Time limit for establishment of international search report and written opinion of the International Searching Authority
The applicant is informed that the time limit for establishing the international search report and the written opinion of the International Searching Authority is three months from the date of receipt indicated above or nine months from the priority date, whichever time limit expires later (Rules 42.1 and 43bis.1(a)).
4. A copy of this notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the receiving Office.

Name and mailing address of the ISA/
Mail Stop PCT, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-3201

Authorized officer

Sigfried Hostad

Telephone No. 703-308-9290 EX 126

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

PCT

NOTIFICATION CONCERNING PAYMENT OF PRESCRIBED FEES

(PCT Rules 14, 15 and 16 and Administrative
Instructions, Sections 102*bis*(c), 304,
323(b), 707(b) and 803)

To:

PHILLIP DECKER
MESMER & DELEAULT, PLLC
ONE NEW HAMPSHIRE AVENUE SUITE 125
PORTSMOUTH, NEW HAMPSHIRE 03801

Date of mailing (day/month/year)	18 May 2007
-------------------------------------	-------------

Applicant's or agent's file reference NEI.PCT.2	PAYMENT DUE see item 3 for time limits
--	---

International application No. PCT/US2006/003393	International filing date/Date of receipt (day/month/year) 31 Jan 2006	Priority date (day/month/year) 31 Jan 2005
--	--	---

Applicant NEISTER, S. EDWARD

1. The applicant is hereby notified that this receiving Office has received:

- ☒ the payment of all the prescribed fees, and ☐ an overpayment, which will be refunded in due course.
- ☐ no or insufficient payment of the prescribed fees and the applicant is hereby invited to pay the balance due, as summarized under item 2, within the time limit(s) indicated under item 3.

2. Fees and payment calculation:

2,340.00	-	2,340.00	=	0.00
Total fees payable		Amount paid		Balance

☐ The details of the calculation are given in the Annex.

3. Time limit(s) for payment and amount(s) payable (Rules 14.1, 15.4 and 16.1(f)):

- ☐ within ONE MONTH from the date of receipt of the international application (for the transmittal fee (if any), the search fee and the international filing fee). The amount payable for each fee is the amount applicable on the date of receipt of the international application.
- ☐ within 16 MONTHS from the priority date (only for the fee for priority document). The applicant's attention is drawn to the fact that the request made by the applicant under Rule 17.1(b) will be considered not to have been made unless the fee is paid within that time limit.

4. Additional observations (if necessary):

- ☐ The search copy will not be transmitted to the International Searching Authority until the search fee is paid (therefore the start of the international search will be delayed) (Rule 23.1(a) and (b)).

Name and mailing address of the receiving Office Mail Stop PCT, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-3201	Authorized officer Sigfried Hostad Telephone No. 703-308-9290 EX 126
---	--

ANNEX TO FORM PCT/RO/102
CALCULATION OF THE PRESCRIBED FEES

International application No.
PCT/US2006/003393

T Transmittal Fee

Prescribed amount: 300.00 **T**
Amount paid: - 300.00
Balance: = 0.00

☒ correct amount
☐ overpayment
☐ balance due

S Search Fee

Prescribed amount: 1,000.00 **S**
Amount paid: - 1,000.00
Balance: = 0.00

☒ correct amount
☐ overpayment
☐ balance due

I International Filing Fee

Fixed amount for first 30 sheets: 1,008.00 **i1**
 $\frac{1}{\text{Number of sheets in excess of 30}} \times \frac{12.00}{\text{Fee per sheet}} = \frac{12.00}{\text{Fee per sheet}}$ **i2**
Additional component: . . . 400 x $\frac{0.00}{\text{Fee per sheet}} = \frac{0.00}{\text{Fee per sheet}}$ **i3**

Reduction where the international application is filed
(See *PCT Applicant's Guide, Volume I, General Part*,
for details on the availability of this reduction):

using the PCT-EASY software: - 0.00 **r**

or

in electronic form where the text of the
description, claims and abstract is not in
character coded format: - 0.00 **r**

or

in electronic form where the text of the
description, claims and abstract is in character
coded format: - 0.00 **r**

Sub-total: = 1,020.00 **i1+i2+i3-r**

Prescribed total amount (*The amount to be entered at I is the sub-total entered at (i1+i2+i3-r), except where the applicant is (or all applicants are) entitled to a reduction of 75%, in which case the amount to be entered at I is 25% of the sub-total (i1+i2+i3-r); certain applicants from certain States are entitled to a reduction of 75% of the international filing fee; see Notes to the Fee Calculation Sheet as annexed to the Request Form, PCT/RO/101, for details*): = 1,020.00 **I**

Amount paid: - 1,020.00
Balance: = 0.00

☒ correct amount
☐ overpayment
☐ balance due

P Fee for Priority Document

Prescribed amount: 20.00 **P**
Amount paid: - 20.00
Balance: = 0.00

☒ correct amount
☐ overpayment
☐ balance due

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
PHILLIP DECKER
MESMER & DELEAULT, PLLC
ONE NEW HAMPSHIRE AVENUE SUITE 125
PORTSMOUTH, NEW HAMPSHIRE 03801

PCT

NOTIFICATION OF THE INTERNATIONAL
APPLICATION NUMBER AND OF THE
INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Confirmation No: 3809

Date of mailing
(day/month/year)

18 May 2007

Applicant's or agent's file reference
NEI.PCT.2

IMPORTANT NOTIFICATION

International application No.
PCT/US2006/003393

International filing date (day/month/year)
31 Jan 2006

Priority date (day/month/year)
31 Jan 2005

Applicant
NEISTER, S. EDWARD

Title of the invention
METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND
PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

- ☒ was transmitted to the International Bureau on 18 May 2007 .
- ☐ has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:
- ☐ because the necessary national security clearance has not yet been obtained.
- ☐ because (reason to be specified):

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION

Completed by: SH

- ☐ Additional license for foreign transmittal not required. This subject matter is covered by a license already granted or the equivalent U.S. national application. Refer to that license for information concerning its scope.
- ☐ License for foreign transmittal not required. 37 CFR. 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).
- ☒ Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on 14 May 2007 :
(date)
- ☐ 37 CFR 5.15(a) ☒ 37 CFR 5.15(b)

Name and mailing address of the receiving Office
Mail Stop PCT, Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450
Facsimile No. 571-273-3201

Authorized officer
Sigfried Hostad
Telephone No. 703-308-9290 EX 126

NEI.PCT.2

1/6

PCT REQUEST 06/03393

CORRECTED COPY

Original (for SUBMISSION)

0	For receiving Office use only	PCT/US 06/03393
0-1	International Application No.	06 06
0-2	International Filing Date	31 JAN[07](31.01[07])
0-3	Name of receiving Office and "PCT International Application"	PCT INTERNATIONAL APPLICATION RO/US
0-4	Form PCT/RO/101 PCT Request	
0-4-1	Prepared Using	PCT-SAFE [EASY mode] Version 3.51.002.177 MT/FOP 20060101/0.20.4rc.2.7
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	United States Patent and Trademark Office (USPTO) (RO/US)
0-7	Applicant's or agent's file reference	NEI.PCT.2
I	Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
II	Applicant	
II-1	This person is	applicant and inventor
II-2	Applicant for	all designated States
II-4	Name (LAST, First)	NEISTER, S. Edward
II-5	Address	152 Brackett Road New Durham, New Hampshire 03855 United States of America
II-6	State of nationality	US
II-7	State of residence	US
II-8	Telephone No	603-859-8600
II-9	Facsimile No.	603-859-4033
II-10	e-mail	eneister@worldpath.net

PCT REQUEST/15016/030353

Original (for SUBMISSION)

IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	DECKER, Phillip
IV-1-2	Address	Mesmer & Deleault, PLLC One New Hampshire Avenue Suite 125 Portsmouth, New Hampshire 03801 United States of America
IV-1-3	Telephone No.	603-766-1910
IV-1-4	Facsimile No.	603-766-1901
IV-1-5	e-mail	phil@biz-patlaw.com
V	DESIGNATIONS	
V-1	The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.	
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	31 January 2005 (31.01.2005)
VI-1-2	Number	60/593,626
VI-1-3	Country	US
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1
VII-1	International Searching Authority Chosen	United States Patent and Trademark Office (USPTO) (ISA/US)

PCT REQUEST / 115005 / 115005

Original (for SUBMISSION)

VIII	Declarations	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	-	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	1	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	

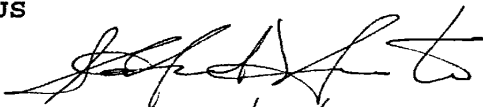
PCT REQUEST/US06/03593

Original (for SUBMISSION)

VIII-4-1	Declaration: Inventorship (only for the purposes of the designation of the United States of America) Declaration of Inventorship (Rules 4.17(iv) and 51bis.1(a)(iv)) for the purposes of the designation of the United States of America.	I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought. This declaration is directed to the international application of which it forms a part (if filing declaration with application). This declaration is directed to international application No. PCT/ (if furnishing declaration pursuant to Rule 26ter). I hereby declare that my residence, mailing address, and citizenship are as stated next to my name. I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications", by application number, country or Member of the World Trade Organization, day, month, and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.
VIII-4-1-1	Prior applications.	

PCT REQUEST, US06, US06

Original (for SUBMISSION)

		I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.
VIII-4-1-1-1	Name (LAST, First)	NEISTER, S. Edward
VIII-4-1-1-2	Residence: (city and either US State, if applicable, or country)	New Durham, New Hampshire
VIII-4-1-1-3	Mailing address:	152 Brackett Road New Durham, NH 03855
VIII-4-1-1-4	Citizenship	United States of America
VIII-4-1-1-5	Inventor's Signature: (The signature must be that of the inventor, not that of the agent)	US 
VIII-4-1-1-6	Date.	1/31/06

PCT REQUEST 015115/030303

Original (for SUBMISSION)

IX	Check list	number of sheets	electronic file(s) attached
IX-1	Request (including declaration sheets)	6	✓
IX-2	Description	13	-
IX-3	Claims	3	-
IX-4	Abstract	1	✓
IX-5	Drawings	8	-
IX-7	TOTAL	31	
	Accompanying Items	paper document(s) attached	electronic file(s) attached
IX-8	Fee calculation sheet	✓	-
IX-10	Original general power of attorney	✓	-
IX-17	PCT-SAFE physical media	-	✓
IX-18	other	PTO 2038 Credit card payment form	
IX-19	Figure of the drawings which should accompany the abstract	5	
IX-20	Language of filing of the international application	English	
X-1	Signature of applicant, agent or common representative		
X-1-1	Name (LAST, First)	NEISTER, S. Edward	
X-1-2	Name of signatory	INVENTOR	
X-1-3	Capacity		

FOR RECEIVING OFFICE USE ONLY (31.01.06)

10-1	Date of actual receipt of the purported international application	IAP7 Rec'd PCT/PTO 31 JAN 2006
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/US
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	
------	--	--

PCT (ANNEX) - FEE CALCULATION SHEET

Original (for SUBMISSION)

(This sheet is not part of and does not count as a sheet of the international application)

0	For receiving Office use only			
0-1	International Application No.		PCT/US 06/03393	
0-2	Date stamp of the receiving Office		31-01-2006	
0-4	Form PCT/RO/101 (Annex)			
0-4-1	PCT Fee Calculation Sheet Prepared Using		PCT-SAFE [EASY model] Version 3.51.002.177 MT/FOP 20060101/0.20.4rc.2.7	
0-9	Applicant's or agent's file reference		NEI.PCT.2	
2	Applicant		NEISTER, S. Edward	
12	Calculation of prescribed fees		fee amount/multiplier	Total amounts (USD)
12-1	Transmittal fee	T	⇔	300 300
12-2-1	Search fee	S	⇔	1000 1000
12-2-2	International search to be carried out by		US	
12-3	International filing fee (first 30 sheets)	i1	1086	1008
12-4	Remaining sheets	1		
12-5	Additional amount	(X) 12		12
12-6	Total additional amount	i2	12	
12-7	i1 + i2 =	i	1098	
12-12	EASY Filing reduction	R	-78	
12-13	Total International filing fee (i-R)	I	⇔	1020 1020
12-14	Fee for priority document			
	Number of priority documents requested	1		
12-15	Fee per document	(X) 20		
12-16	Total priority document fee:	P	⇔	20 20
12-17	TOTAL FEES PAYABLE (T+S+I+P)		⇔	2340 2340
12-19	Mode of payment		other Credit card using PTO 2038	

IAP7 Rec'd PCT/PTO 31 JAN 2006

PTO-1382 (Rev. 07-2004)

Approved for use through 3/31/2007 OMB 0651-0021

U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

PCT/US06/03393

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Express Mail mailing number: ED868788319US	Date of deposit: 31 JAN 2006
File reference no.: NEI.PCT.2	International application no. (if known): 06/03393
Title of the invention: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING..	
Earliest priority date claimed (Day/Month/Year): 31/01/2005	

☒ This is a new International Application

SCREENING DISCLOSURE INFORMATION:

In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (check as many boxes as apply):

- ☐ The invention disclosed was **not** made in the United States of America.
- ☐ There is no prior U.S. application relating to this invention.
- ☒ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (NOTE: priority to these applications may or may not be claimed on the Request (form PCT/RO/101) and this listing does **not** constitute a claim for priority.)

application no.	60/593,626	filed on	31/01/2005
application no.		filed on	

- ☐ The present international application contains additional subject matter not found in the prior U.S. application(s) identified above. The additional subject matter is found on pages _____ and ☐ DOES NOT ALTER ☐ MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 C.F.R. 5.15.

Itemized list of contents

Sheets of Request form:	6	Check no.:	
Sheets of description (excluding sequence listing):	13	Return receipt postcard:	1
Sheets of claims:	3	Power of attorney:	1
Sheets of abstract:	1	Certified copy of priority document (specify):	
Sheets of drawings:		Other (specify):	PTO 2038 credit card pmt. Declaration Floppy disk
Sheets of sequence listing:			
Sequence listing diskette/CD:			
Tables related to sequence listing CD:			

The person signing this form is:

- ☐ Applicant
- ☒ Attorney/Agent (Reg. No.)
39,163
- ☐ Common Representative

Phillip E. Decker

Name of person signing

Signature

This collection of information is required by 37 CFR 1.10 and 1.412. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering information, preparing, and submitting the completed form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Docket: NEI.PCT.2

PCT/US06/03393

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
RO/US

In re Application of: NEISTER, S. Edward]
Serial No.:]
Int'l Filing Date: 31 January 2006]
For: METHOD AND APPARATUS FOR STERILIZING]
AND DISINFECTING AIR AND SURFACES AND]
PROTECTING A ZONE FROM EXTERNAL]
MICROBIAL CONTAMINATION]

Mail Stop PCT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

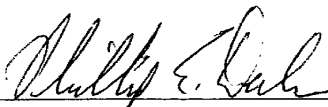
CERTIFICATION UNDER 37 CFR § 1.10

The following correspondence is attached hereto:

- Transmittal Letter to the RO/US
- PCT Request with Declaration – 6 pages
- Power of Attorney – 1 page
- Description – 13 pages
- Claims – 3 pages
- Abstract – 1 page
- Drawings – 8 sheets
- Fee Calculation Sheet – 1 page
- PTO 2038 for \$2,340.00 filing fee
- Return receipt post card
- Floppy disk

I hereby certify that the correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service, label number ED868788319US, under 37 CFR § 1.10 on the date indicated below and is addressed to Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

31 January 2006
Date


Phillip E. Decker

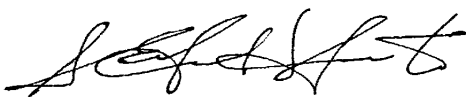
This invention relates to a method, process and apparatus for disinfecting and sterilizing all types of surfaces contaminated with microorganisms and toxic substances to render both inactive. Furthermore, this invention relates to both a method and apparatus for disinfecting and/or sterilizing breathable air and then using this air to protect a confined space from external contamination. The apparatus consists of a new ultra-violet (NUV) source that is more effective than mercury based 254 nm light for destroying DNA of virus, bacteria, spores and cists. It is most effective in breaking chemical bonds in toxic gases that are useful to terrorists. It is combined with other apparatus that remove particulates and byproducts sometimes produced by the NUV source and maintains positive pressure of the confined space so as to prevent the influx of air from outside the protected zone.

PCT

PCT / 1506 / 03303
Original (for SUBMISSION)

13-2-1	Validation messages Request	Green? The title of the invention shall be short and precise. Please verify.
--------	--------------------------------	--

PCT POWER OF ATTORNEY

0-1	PCT Power of Attorney (for an international application filed under the Patent Cooperation Treaty) (PCT Rule 90.4)	
0-1-1	Prepared Using	PCT-SAFE [EASY mode] Version 3.51.002.177 MT/FOP 20060101/0.20.4rc.2.7
1	The undersigned applicant(s)	NEISTER, S. Edward
1-1-1	hereby appoints (appoint) the following person	DECKER, Phillip Mesmer & Deleault, PLLC One New Hampshire Avenue Suite 125 Portsmouth, New Hampshire 03801 United States of America
1-2	as	agent
1-3	to represent the undersigned before	all the competent International Authorities
1-4	in connection with the international application identified below:	
1-4-1	Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
1-4-2	Applicant's or agent's file reference	NEI.PCT.2
1-4-3	International application number (if already available)	
1-4-4	filed with the following Office as receiving Office	United States Patent and Trademark Office (USPTO) (RO/US)
1-5	and to make or receive payments on behalf of the undersigned	
2-1	Signature of applicant, agent or common representative	
2-1-1	Name (LAST, First)	NEISTER, S. Edward
2-1-2	Name of signatory	
2-1-3	Capacity	INVENTOR
3	Date	31 January 2006 (31.01.2006)

PCT/US06/03393

UNITED STATES RECEIVING OFFICE(RO/US) FEE CODING AND RECORDING SHEET										☐ Add'l Sheets	
IDENTIFICATION OF THE INTERNATIONAL APPLICATION											
International application No						International filing date (day/month/year)					
Applicant (Name)											
PAYMENTS						REFUNDS					
Payment on Filing				Deposit Account		Deposit Account		To Deposit Account		To Deposit Account	
				Date		Date		Date		Date	
Deposit Account											
☐ CASH/CHECK				☐ CASH/CHECK		☐ CASH/CHECK		☐ BY CHECK		☐ BY CHECK	
150											
151											
153											
800											
801											
802											
899											
566											
Total Paid:				Total Paid:		Total Paid:		Total Refunded:		Total Refunded:	
159											
States Included for 892:				892:		892:					
States Included for 893:				893:		893:					
CALCULATED FEE AMOUNT = 02/03/2006 ATRAN1 00000126 PCT/US06/03393 01 FC:1601 300.00 OP 02 FC:1602 1000.00 OP 03 FC:1701 1008.00 OP 04 FC:1703 12.00 OP 05 FC:8007 20.00 OP AMOUNT OF DIFFERENCE =											
RO/US Authorization			RO/US Authorization			RO/US Authorization			RO/US Authorization		

Form PCT/RO/102b (U.S. VERSION)
(Rev. 07-92)

U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

5 BACKGROUND

1. Field of the Invention.

This invention teaches a new method for disinfecting and sterilizing air, surfaces of all types and food from microorganisms and toxic chemical substances. More particularly, it relates to a process and apparatus for protecting surfaces in
10 closed or captured environments (zones) from external sources of microbial contamination in an efficient and cost effective process. These zones can be large volumes such as high rise building, cruise ships and jet airliners, or small volumes such as small rooms or surgical operation areas whether in a hospital operating room or on the battle field.

15 2. Description of the Related Art.

All prior art for sterilizing and disinfecting air has been based on using commercially available ultra-violet (UV) lamps or by using magnetic fields. These lamps are either pulsed or continuous. Continuous lamps are mercury based and emit principally at 254 nm. A number of companies are presently producing UV light
20 based apparatus for the destruction of virus, bacteria, spores and pathogens (microorganisms or VSP) that are in room air. This is an effective treatment because it continually exposes room air currents to the treatment light and over time has sufficient exposure time to VSP's. The required exposure times range from 10's to 100's of seconds, depending on the light absorption capability of the different virus and bacteria at the 254 nm. While this is effective for treating the room air of
25 individual rooms, it is not practical for treating large flowing volumes of air that pass quickly down large ducts. Its long treatment time is impractical for treating most surfaces.

Magnetic based apparatus also require time to deactivate or destroy these
30 VSP's. Two such inventions are directed to specific applications. Wesley, U.S. Pat. No. 4,458,153 is directed specifically towards liquid like substances enclosed in pipes, but does not discuss any test results. Sangster, U.S. Pat. No. 5,750,072 requires an injection of a sterilizing fluid as a mist or vapor for the magnetic field to

produce radicals that in turn are used to kill the VSP's. He does not discuss any test results. Hofmann, U.S. Pat. No. 4,524,079 is directed specifically to treating food stuffs. He speaks of requiring up to 100 pulses at frequencies ranging from 5 to 500 kHz. None of these patents are admitted to being prior art by their mention in this background section. Although the action time would be short, the power required to treat large areas and the apparatus design limit its practical application.

The broad ultraviolet spectrum has been divided into three regions depending on its different effects on biological systems. Reference to these regions are predominantly made in medical terminology with UV-A defined as a range or band between 320 nm and 400 nm, UV-B defined as a band between 280 nm and 320 nm, and UV-C defined as encompassing wavelengths shorter than 280 nm. Photochemists and photobiologists do not generally use these terms because absorption spectra of chemical bonds are much narrower than these generally defined bands. Instead, they use the wavelength of the applied radiation to define the observed effects.

Claims have been made that UV-C radiation is used to kill DNA. This is because the mercury lamp emission at 254 nm is close to a good DNA absorption band. None of these claims make reference to any shorter wavelengths and to the primary DNA protein absorption band that peaks at 200 nm (see figure 9). In fact, all literature directs researchers away from using any shorter wavelengths due to the high absorption of molecular water. Mercury lamps are used for wastewater treatment and work well for this application. However, this specification teaches that since we do not live underwater, the protein absorption band offers much more significant action spectra that can be used to kill the DNA of microorganisms more effectively. This concept is a significant advancement and a step change in the technology used for sterilization and disinfection.

During the past few years, new UV emitting lamps based on the excitation of excimers are becoming commercially available. These emitters produce single line or narrow spectral emission at a wavelength determined by the gas composition of the lamp. If the treatment lamp's wavelength is chosen to match closely to the peak of protein absorption of the microorganism's DNA, then a lethal dosage can be delivered to the VSP's in a shorter time. No patent has been found that teaches the use of new ultra-violet (NUV) sources coupled with supporting equipment that can

effectively and efficiently disinfect and sterilize large volumes of air, large and small surfaces, and food stuffs in various stages of preparation.

In this specification, sterilization or sterilize refers to sterilization or high level disinfectant as defined by US FDA. The terms disinfectant and disinfection refers to all other levels of disinfection.

NUV Background

The genetic makeup of all living organisms is contained in their DNA molecule. Replication occurs by the splitting of the DNA molecule, which duplicates itself through a transformation of its structure. Parts of the DNA molecule have been given names such as pyrimidine bases, cytosine, thymine or uracil that form a group of biochemicals that sustain life. The long DNA molecule holds itself together by using simple bonds like those found in sugars.

Researchers believe that the energy of the UV photon causes the formation of a strong (covalent) bond to develop between specific biochemicals. However, the bond strength of the covalent bond is very dependent on the relative position of the participating atoms. When the bond is symmetrical on both sides of a hydrogen atom in the bond, it is referred to as a dimer. A dimer is a very strong bond and is not generally broken during the vaporization of the liquid. UV light is known to produce Thymine, cytosine-thymine, and cytosine dimers. After the formation of the dimer, further replication of the DNA stops. Figure 8 shows the concept of the dimer formation in a DNA molecule.

The DNA molecule absorbs light from about 180 nm to about 300 nm. The most effective wavelength in water is about 254 nm because water absorption increases steadily as the wavelength decreases below 240nm. DNA absorption also increases with lower wavelength. Figure 9 graphically shows this relationship (Von Sonntag; Disinfection by free radicals and UV-radiation. Water Supply 4, 11-18 (1986)).

The commercial light source for UV irradiation near the 260 nm absorption peak of DNA has been produced by using mercury as the source for generating photons. The mercury gas and its pressure in the lamp determine the wavelength of the emitting light. For low-pressure (LP) and low-pressure high output (LPHO) lamps, the emitting wavelength is 254 nm. For medium pressure lamps, the

emission ranges from 200 nm to above 300 nm. However, the strength of the emitted light is not effective below 245 nm for the continuous emitting lamps and below 235 nm for medium pressure lamps. Xenon gas in pulsed lamps produces a similar emission as the medium pressure mercury lamps.

5 DNA action spectra show that absorption increases as the wavelength decreases, with a relative maxima at 260 nm and largest at 200 nm. Many articles indicate the principal action spectra of the DNA absorption is from 245 to 280 nm range and do not address the 200 nm peak. Since water absorption significantly increases below 235 nm, it becomes apparent that DNA effectiveness curves that
10 omit the 200 nm peak apply only to organisms in water.

MS-2 Phage is a marker virus that is used to measure reproduction viability after UV irradiation. Figure 10 is DNA absorption without the influence of water (Gates, F.L. A study of the bactericidal action of ultra violet light III. Jour. General Physiology 14, 31-42 (1930)). Absorption is more than doubled at 222 nm.

15 A recent technical paper (Peak et al, UV action spectra for DNA dimer induction. Photochemistry and Photobiology, 40, 5 (613-620), 1984) suggests that dimer formation is not the only requirement to inactivate DNA. Absorption of other molecular groups in the long DNA chain increase as the wavelength is reduced from 254 nm. Damaging or destroying these bonds may be more effective in deactivating
20 the DNA than compared to the 254 nm band. No one has done a detailed study of the effectiveness of inactivation for the different single line UV emitters that are produced by the new UV source (NUV) excimer lamps. Reports show that damage caused by 254 nm light can be reversed by longer wavelength UV and blue light (Figure 12). 222 nm photons with their higher energy are not expected to cause this
25 'photo-reactivation' phenomenon. However, this theory needs to be confirmed.

An excimer lamp emitting at 222 nm is considered the most effective source because DNA chains and biochemicals have greater absorption at this wavelength. The steep rise in absorption below 250 nm is exhibited by all proteins. It has been fairly well established that the peptide bonds are responsible for the steep rise in
30 absorption exhibited by all proteins. This occurs as well for nucleo-proteins, aromatic amino-acids, diglycine, triglycine, and bovine albumin (McLaren, et al, Photochemistry of Proteins and Nucleic Acids, Pergamon Press, Macmillan Company, 1964). An organic chemist suggests that this lower wavelength is more

effective in breaking bonds and producing dimers in the purine bases and sugar phosphates instead of the pyrimidines. The 222 nm is not strongly absorbed by water vapor and oxygen in the air. A shorter wavelength would be most certainly rendered ineffective by water vapor and oxygen absorption for long irradiation distances in air. Shorter wavelength radiation would significantly increase the production of ozone that is harmful to humans and animals.

Tests

Using a lamp that emits 222 nm, a comparison test with and without water was made to determine the effect of this radiation on organisms. The organism used in all tests was the MS-2 virus, which has become a standard indicator of mutation effectiveness. The EPA report (811-R-96-002) reports a 4.3 average log reduction of the MS-2 virus using mercury light 254nm at an irradiance greater than 128 mj/cm².

Three wavelengths were tested: 222, 253, 259 nm. The 222 nm lamp was tested at three levels of irradiance with the virus in a thin layer of water in order to reduce the absorption effect of water. A separate test was also done with the virus in more water. The 253 and 259 nm lamps were tested at the identical irradiance levels with the virus in water. Controls were made on all tests and a single test dish on each lamp was made to check experimental error.

The 222 nm lamp (Figure 11) produced log 5 reductions at 40 mj/cm² and log 6.5 reductions at 60 mj/cm². The water test produced a 3.2 log reduction, which matched the equivalent calculated irradiance in air. The 253 and 259 nm lamps produced about log 4 reductions at 60 mj/cm². A 3 million reduction in population is about 10 to 100 times more effective than reported mercury 254nm results at the same irradiance.

Analysis

The results of the test indicate that 222 nm light is very effective in causing mutations in organisms. These tests indicate an improvement of between 10 to 1000 times, depending on the intensity of the lamp. It is important to note the improvement of the 259 nm source compared to the 254 nm source. This produced a 10 times improvement in the test sample. It illustrates the importance in using a

UV photon emitter that is near the absorption peak of the DNA or targeted chemical such as proteins, nucleic acids, or amino-acids.

It is important to note that DNA biochemicals will have different absorption spectra and the peak absorption will be shifted by water, pH, temperature, previously absorbed light and surrounding contaminants in the air. The presence of ozone can significantly reduce the resistance to damage and shorten the action kill time. For some applications, ozone is produced to improve the killing efficiency.

For example, tyrosine has a relative maximum at 275 nm, a red shift of 20 nm from the normal DNA curve. The tobacco mosaic virus peaks at 265 nm, but its X-protein at pH 7.3 peaks at 280 nm while the RNA peak occurs at 260 nm. Critical to the destruction of the organism is targeting the proper biochemical so the critical dosage can be delivered in the shortest time. The critical dosage is that dosage that destroys or deactivates the organism and also prevents its replication.

The excimer lamp is a coaxial design that can be made as small as a pencil to as large as 1 meter long. Lamp efficiency is about the same as mercury at 10-25% wall power to UV emission. The design has several advantages over mercury lamps. Most important is that its gas can be chosen to maximize its emission to the absorption peak of the targeted biochemical. Unlike the mercury lamp, the excimer intensity can be varied from near zero to maximum. It will produce 10 to 1000 times more intensity than mercury, depending on the lamp dimensions, and it does not use mercury that will soon become regulated by the EPA.

The energy of the emitted photon is determined by its wavelength. Photon energy is about 5ev at 250nm, and increases for shorter wavelengths. Different bonds in the DNA will be affected with photons of different energy.

Figure 12 illustrates the 254 nm dose required to deactivation different VSP's. The bars represent with (solid) and without (open) photo-reactivation. Note that a dose of 75 mj/cm² is required to deactivate the MS2 Phage virus and prevent photo-reactivation. In the tests shown in Figure 11, half the dose at 222 nm was just as effective as the higher dose at 254 nm. Even though the sample was under water, the 222 nm radiation was still more effective than 254 nm radiation.

The 222 nm photon has more energy and is absorbed by S-N, S-O, O-O, O-H, and many carbon bonds that do not absorb 254 nm. This suggest that 222 nm

light may also prevent DNA repair that has been reported for low level 254 nm UV sources. 21/0506/03393

Toxic Gas Weapons

5 Biotoxins and nerve agents can be used by terrorists as weapons against groups of people. Nothing economical has been developed that could mitigate an attack and prevent the loss of life and incapacitation at the point of attack. While government agencies of the US have developed detectors that could be used in the future to warn people in the confined areas that are under attack, nothing would
10 prevent the attack from being effective.

 Biotoxins and nerve agents are organic molecules that contain either DNA or have long chain carbon molecules. Both of these are susceptible to destruction using NUV light sources. 222 nm will destroy the C=C and C=O bonds causing the destruction of the chemical.

15 The most effective means for delivery of these agents is to spread them in a gas phase through the air ventilation system. A detector would be used to turn on sufficient NUV sources so that the agents are destroyed before exiting the ventilation system into the confined area where the captured population is present. Tests still need to be done in regulated and controlled laboratories to develop the criteria for
20 these sources to be effective and become the first line of defense. However, the concept of using the NUV source as well as the associated support equipment used for treating VSP's is valid and is also contained in the scope of this specification.

Support Equipment Contained in the Apparatus

25 Important to the sterilization and disinfecting apparatus is the use of a high E field electrostatic precipitator (ESP). Figure 13 compares the range of effectiveness with mechanical filters for different pollutant sizes. As illustrated in the fourth column, it is capable of removing VSP's. However, since it can also capture fog and mist, it has the ability to breakdown ozone O₃ into oxygen. Its use prevents levels of
30 ozone from exceeding the EPA exposure safe levels.

 The apparatus includes a humidification system to provide and maintain minimum moisture content at predetermined and controllable levels. In addition, the apparatus contains baffles and zone restriction devices that enhance the zone

protection and minimize the positive pressure required to maintain the protected zone.

SUMMARY OF THE INVENTION

5 Critical to this method is the development of a new ultra-violet (NUV) source that emits single line photons that correspond to the maximum absorption band for DNA. The preferred embodiment is a NUV source at 222 nm. This spectral emission is 10^4 times more effective than standard 254 nm photons for destroying DNA. Kill action times are reduced from 10's to 100's of seconds to times less than
10 0.1 seconds. Photon energy of the NUV source is sufficiently high to break carbon bonds of chemical toxic substances with similar action times. Unique to obtaining short action (kill) times is a determination of the specific wavelength required to destroy the targeted organism or chemical. The NUV source is chosen to supply the single line emission that matches the peak absorption of the targeted organism or
15 chemical.

This makes for a cost effective method for sterilizing and disinfecting air, surfaces and food during normal daily activity, preventing the previous need to restrict occupation and use of areas being treated. Furthermore, the apparatus is capable of effectively and efficiently disinfecting floors, hand rails, objects that are in
20 constant contact with transient populations for the purpose of preventing transmission of disease and toxic substances that can cause injury or illness to these populations. The NUV radiation can be applied to any object or surface that needs to be disinfected and/or sterilized. Testing will determine the correct exposure limits to prevent any harmful effects that could occur when used to disinfect human skin,
25 hands, animal surfaces such as skin, fur, and hair, and critical plastics and materials used in medical devices,

Because the NUV source is a light source, it can be directed to expose different levels of thick materials by using light conducting fibers to distribute the light intensity. An example would have the NUV source disinfecting a floor by directing it
30 at the floor while some of the light is directed to the bottom of a rug or floor scrubbing brush by light fibers imbedded in the brush. In a similar manner, products that have cavities or areas not exposed directly by the external source could be disinfected.

The NUV source can be used to directly disinfect room surfaces or particles and microbes in the room air by directly exposing all objects for the required exposure time. Several sources can be combined to assure exposure to all surfaces and to reduce total exposure time. Rooms contaminated by bioterrorist agents could be treated by moving the NUV source(s) in many directions and moving it (them) around the room during treatment.

Normal breathable air contains many contaminants including moisture droplets, dust, lint, bacteria, virus, cists, spores and possible toxic gases. The NUV source can be used by itself to disinfect air. Sterilization sometimes requires the removal of all particles to the smallest possible size. The NUV source can produce byproducts that must be removed for some treatment applications. These byproducts include oxidized air (ozone), condensable chemical byproducts, and damaged microorganisms. Critical to the apparatus is the removal of these contaminants and byproducts. In some special applications, ozone is added to make treatment more effective. Consequently, the apparatus includes high E field precipitators, ozone generators and ozone destroying light and apparatus to make effective use of the combination of these technologies.

Sterilized air is then used to prevent microbial contamination of a protected zone by preventing the influx of untreated air from outside this zone. The apparatus includes pressurizing equipment and zone baffles that provide sufficient outflow from the protected zone so as no contamination can occur. Protected zones can be as small as a wound area on a battlefield operating table to a cruise ship, airplane, or high rise building with thousands of inhabitants.

A major source of infection and terrorist's activity is directed at food and material handling. Photon emitters have been used to effectively clean food stuffs and surfaces for many years. However, this invention uses the NUV source that makes it cost effective in treating surfaces of food and materials since the action time is almost immediate. The apparatus of this invention is capable of irradiating foodstuffs in conveyor assemblies, stationary carts and in handling routes during the movement from storage to food preparation processes. It can also be used to sterilize/disinfect medical or critical parts on an assembly line prior to packaging.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components of the NUV source therein.

5 Figure 2 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting or sterilizing large volumes of air therein

Figure 3 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting floor
10 surfaces and other surfaces such as chairs, hand rails, counter tops, trays, table tops and the like therein.

Figure 4 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting food prior to handling by kitchen or cooks before serving therein.

15 Figure 5 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for sterilizing air that is used to cover and protect the zone around a surgical operation or procedure independent of the location of the operation therein.

Figure 6 is a perspective schematic view of a preferred embodiment of the present invention illustrating the zone air sterilization apparatus in conjunction with
20 the remote protected operation zone therein.

Figure 7 is a CFD view of a preferred embodiment of the present invention defining the emitted airflow pattern from the sterilization apparatus that is used to cover and protect the zone around a surgical operation or procedure independent of
25 the location of the operation therein.

Figure 8 is a graphic showing dimer formation in a DNA molecule.

Figure 9 is a graph plotting UV absorption of DNA according to wavelength.

Figure 10 is a graph plotting DNA absorption without the influence of water.

Figure 11 plots the effectiveness for reduction of the MS-2 phage virus by
30 different wavelengths of UV radiation.

Figure 12 plots the UV dose required to achieve a four log deactivation of selected microbes.

Figure 13 is a graphic comparing the range of effectiveness of various filters for removing airborne particles.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 The drawings illustrate the invention in its different forms and the apparatus required for sterilization of air and surfaces that contain VSP's. Figure 1 illustrates the NUV light source. Figure 1a shows the NUV source that would be installed inside an air duct. The high voltage electrode 1 is located inside the inner tube of the annular lamp. The ground electrode screen 2 is located on the outside of the
10 annular lamp. The gas that produces the UV photons is located in the annular region 3 between the inner and outer tubes 4. The gas type is chosen so that the emitted UV photons are absorbed by the targeted microorganism or chemical. The preferred embodiment is 222 nm. UV radiation is emitted radially outward 5. Changing the voltage or current between the two electrodes changes the amount of
15 UV radiation that is produced.

Figure 1b illustrates the NUV light source used to direct the UV photons towards a specific location. The NUV source is shown in the center of the drawing as an end view. The specialized reflector 6 end view incorporates a specialized 'gull wing' design so that >90% of the emitted light is directed to the planar surface below.
20 The specialized reflector 6 also incorporates barium sulfate (Ba_2SO_4) as the reflective material in order to maximize the number of photons that are reflected onto the planar surface. In some cases, a cover 6a is necessary to protect the NUV source and reflector from dirt. This cover is transparent to 222nm light. The specialized reflector can also have different shapes that change the directed
25 radiation for different applications.

In use, the NUV source can be made to any size and length. In air ducts, the embodiment shown in Figure 2 item 6b would have the NUV source supported from the side, top or bottom of the duct so that its irradiation travels parallel to the airflow. For unique applications, a second embodiment Figure 5 item 16 would have the
30 NUV source and cylinder reflector supported inside the duct so that irradiation is perpendicular to the airflow. An example of this embodiment would be a NUV source positioned in the center of a tumbling dryer. All garments would be irradiated during the drying process for a length of time that would guarantee disinfection.

Figure 2 illustrates the apparatus required for the disinfection and sterilization of airflow inside a large duct. NUV sources 7 precede an electrostatic precipitator (ESP) 9 by some distance 8 that permits a short action time to complete the destruction of the toxic gases or VSP's. A humidifier 10 may follow the precipitator with control sensors 11 so that the humidity of the exiting air can be selected and maintained. A fan(s) 12 may also be used to pressurize the exiting air so that a slight pressurization can be applied to a protected zone to prevent contaminated air from entering. Depending on the nature of the zone, restricting baffles (not shown) are used to assist in maintaining a positive pressure inside the protective zone.

Figure 3a illustrates the NUV source 13 located inside the forward compartment of a vacuum cleaner or floor cleaning machine. The vacuum cleaner can be either a standup floor model or a canister model. It could also be any device that would support and carry the NUV source close to the floor. The significant part is that the NUV source with reflector 6 consists of the components as described in Figure 1b. Figure 3b illustrates a preferred embodiment with the NUV source contained in a hand held wand. Sensing switches 14 can be included in this embodiment that shut off the NUV source when the wand is not directed correctly to the desired treatment surface.

Figure 4a illustrates the NUV source(s) located above a conveyor that carries raw and unprepared food prior to kitchen preparation as well as industrial packaging assembly lines that carry products that require disinfection. The conveyor assembly 24 is designed to maximize the surface area exposed to the NUV source(s). In some cases, several sources 13 are required because the exposed surface of the food or product can not be changed to expose the entire surface during the illumination time of one NUV source. Tumblers or vibrators are typically used to change the orientation of the foodstuffs and they move along the conveyor. Figure 4b illustrates the NUV source(s) 13 located beside heat lamps 15 or other heating surfaces used to keep the food hot on a serving counter prior to being delivered from the kitchen to the customer. In another embodiment, the NUV source is used to irradiate cool or cold foods, so heat lamps 15 are not used.

Figure 5 illustrates the NUV source located inside an air sterilization apparatus that provides air for remote and separate operation tables. The NUV source 16 is located inside a UV reflector chamber 17 in order to reduce the loss of

UV photons. A light trap 18 stops the UV light prior to the turning vanes 19 that direct the air flow vertically downward onto the operation site. A diffuser 20 ensures that the airflow is uniform across the duct. A high E field electrostatic precipitator (ESP) 21 follows the diffuser to remove particulates and reduce any ozone to oxygen. The airflow then passes through a second diffuser and humidifier 22 to ensure that the airflow is uniform across the duct and that the humidity level is controlled to some preset value. Figure 6 illustrates how the air sterilization apparatus would be used in conjunction with a remote operation site, where the doctor is using remote controlled surgical instruments that are inside the sterilized air zone. Figure 7 illustrates the airflow pattern using CFD computational fluidic design to ensure that the air above the operation zone is uniform and prohibits contaminated air from entering the protected zone.

Although the preferred embodiments of the present invention have been described herein, the above description is merely illustrative. Further modification of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the invention as defined by the appended claims.

CLAIMS

What is claimed is:

1. A disinfecting apparatus comprising:
 - a source of 222 nm wavelength photons; and
 - 5 a photon reflector secured in a spaced relationship to the photon source, whereby the apparatus produces photons that are directed to a selected zone or surface and efficiently destroys DNA of microorganisms.
2. The apparatus of claim 1 further comprising a source of a discrete wavelength of
10 photons other than 222 nm.
3. The apparatus of claim 1, wherein the source of 222 nm photons is an excimer lamp.
- 15 4. The apparatus of claim 1, wherein the photon reflector is a gull wing-shaped director selected to direct at least 90% of emitted light to a planar surface.
5. The apparatus of claim 1, the photon reflector comprising barium sulfate for enhancing its reflective properties.
20
6. The apparatus of claim 1 further comprising a floor cleaning apparatus, the photon source being secured to the floor cleaning apparatus in a position suitable for exposing a floor to photons.
- 25 7. The apparatus of claim 1 further comprising:
 - a handle attached to the photon source; and
 - a surface detection mechanism adapted to shut off the photon source when it is not near a surface to be disinfected.
- 30 8. The apparatus of claim 1 further comprising:
 - an air duct surrounding the photon source; and

a particle removal means in the duct to secured in a spaced relationship to the photon source selected to provide a particular action time in the airflow to disinfect the air.

5 9. The apparatus of claim 8, wherein the particle removal means is an electrostatic precipitator.

10. The apparatus of claim 8, further comprising a humidifier in the air duct downstream of the electrostatic precipitator.

10

11. The apparatus of claim 10, further comprising a humidity sensor downstream of the humidifier.

12. The apparatus of claim 8 further comprising a light trap disposed between the
15 photon source and the particle removal means.

13. The apparatus of claim 8 further comprising turning vanes within the duct to change the direction of airflow.

20 14. The apparatus of claim 8 further comprising a diffuser.

15. A process for disinfecting a substance comprising the steps of
generating photons of 222 nm wavelength; and
directing the photons to a substance to be disinfected, whereby the photons
25 destroy the DNA of microorganisms.

16. The process of claim 15, wherein the photons are directed by reflecting the photons to a desired surface.

30 17. A process for disinfecting a substance in an air stream comprising the steps of
directing the air stream to a source of 222 nm photons; and
exposing the air stream to 222 nm photons, whereby the photons destroy the DNA of microorganisms.

18. ~~The process of claim 17, further~~ comprising the steps of
determining required activity time to disinfect the air stream; and
removing particles from the air stream after the activity time.

5

19. The process of claim 18, further comprising the step of humidifying the air
stream downstream of the removing step.

20. A process for providing a germ-free surgical space comprising the steps of:

10

directing an air stream to a source of 222 nm photons; and

exposing the air stream to 222 nm photons;

removing particles from the air stream; and

directing the air stream vertically downward to a surgical area, whereby a
disinfected airflow surrounds the surgical space and prevents infected air from

15

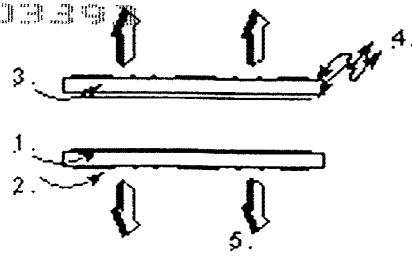
entering.

—

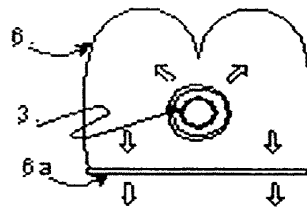
ABSTRACT

This invention relates to a method, process and apparatus for disinfecting and sterilizing all types of surfaces contaminated with microorganisms and toxic substances to render both inactive. Furthermore, this invention relates to both a method and apparatus for disinfecting and/or sterilizing breathable air and then using this air to protect a confined space from external contamination. The apparatus consists of a new ultra-violet (NUV) source that is more effective than mercury based 254 nm light for destroying DNA of virus, bacteria, spores and cists. It is most effective in breaking chemical bonds in toxic gases that are useful to terrorists. It is combined with other apparatus that remove particulates and byproducts sometimes produced by the NUV source and maintains positive pressure of the confined space so as to prevent the influx of air from outside the protected zone.

PCT/US06/03397



a. NUV Lamp



b. Directed Radiation

Figure 1: NUV Source

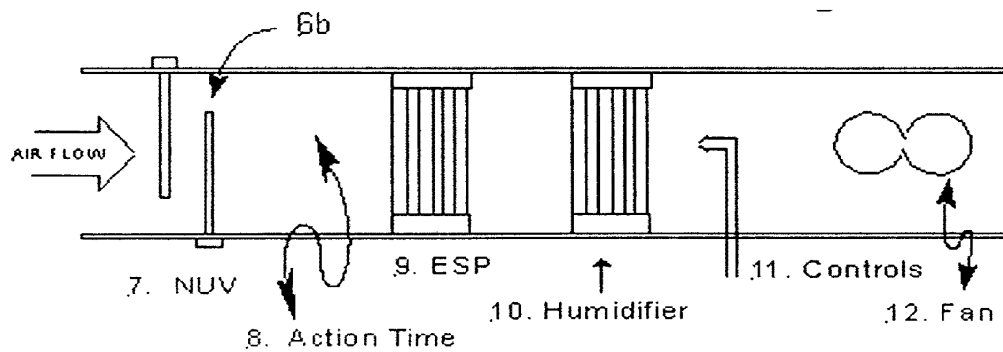
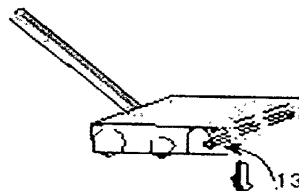
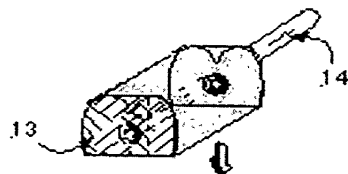


Figure 2: Volumetric Air Treatment

PCT/US06/03393

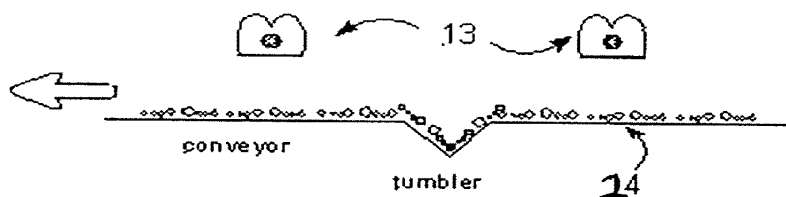


a. Floor Treatment & Cleaner

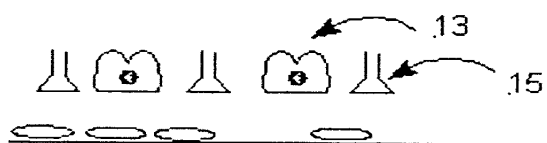


b. Handheld Surface Treatment

Figure 3: Surface Treatment



a. Unprepared food



b. Serving Counter

Figure 4: Food Treatment

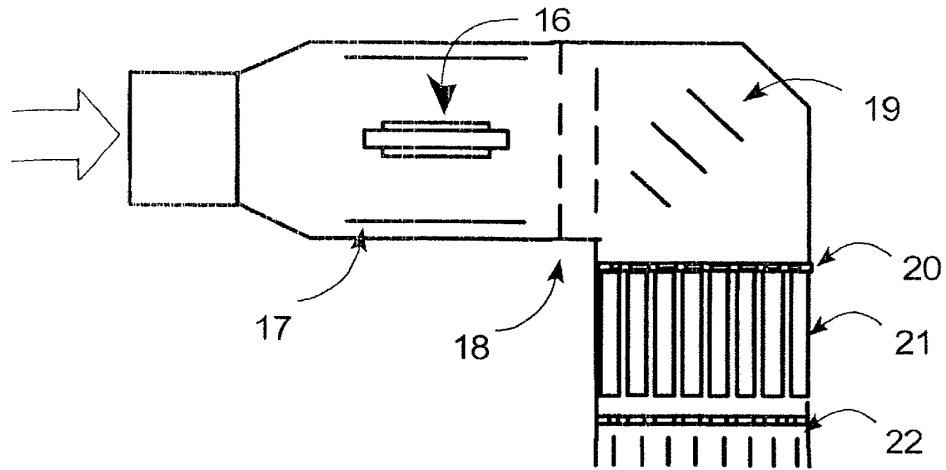


Figure 5: Zone Air Purifier & Sterilizer

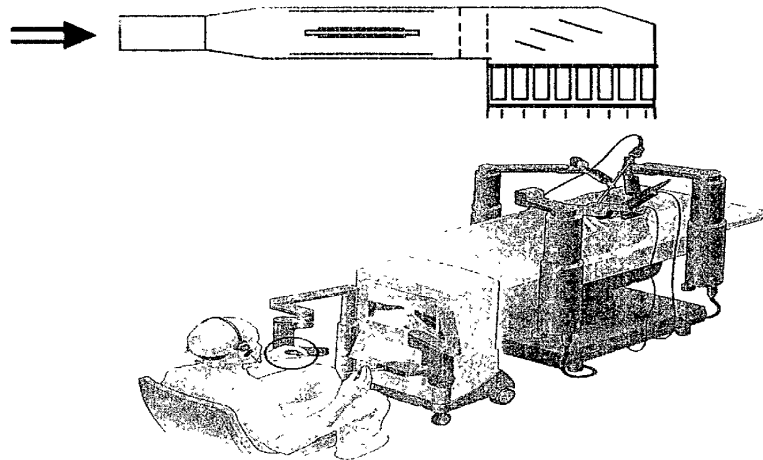


Figure 6: Operating Zone with Sterilizer

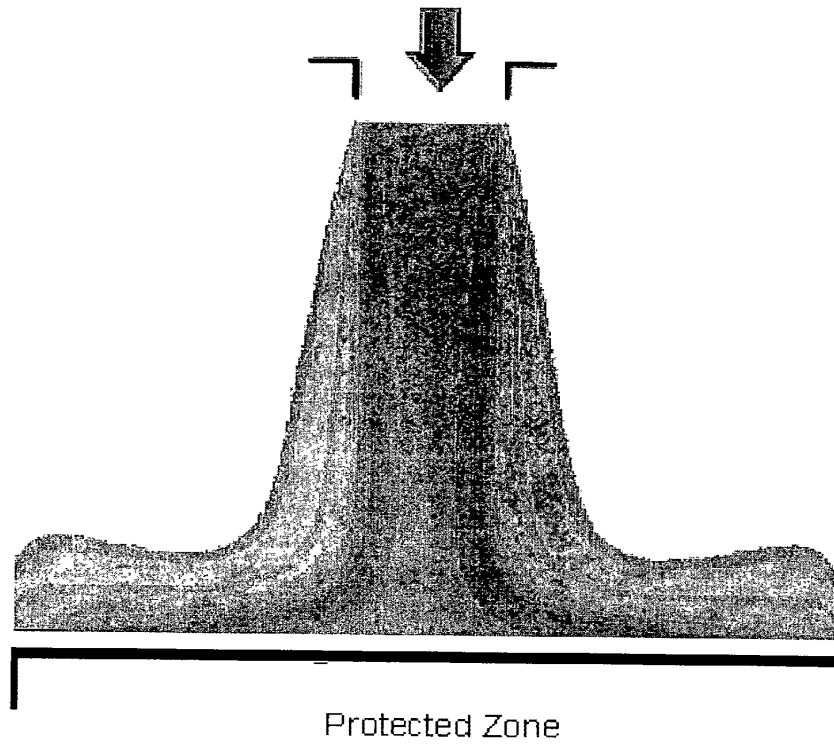
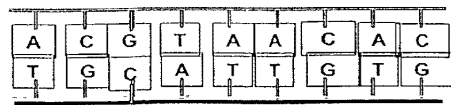
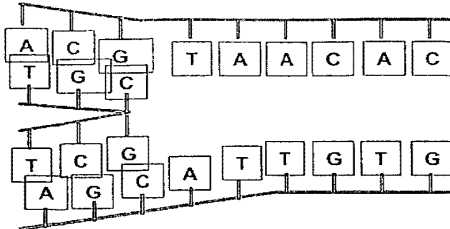


Figure 7: CFD Air Flow

PCT/US06/03393



**HYPOTHETICAL
DNA DOUBLE
STRAND**



REPLICATING DNA



**DIMERIZATION
OF THYMINE
NUCLEOTIDES**

Figure 8: Dimer Formation by UV Photon
(by permission of ERG @ UNH)

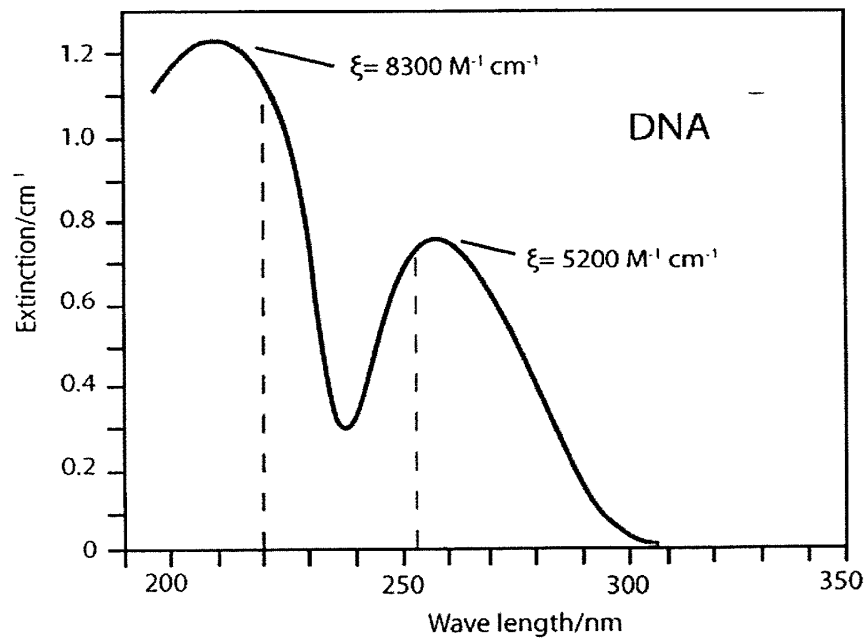
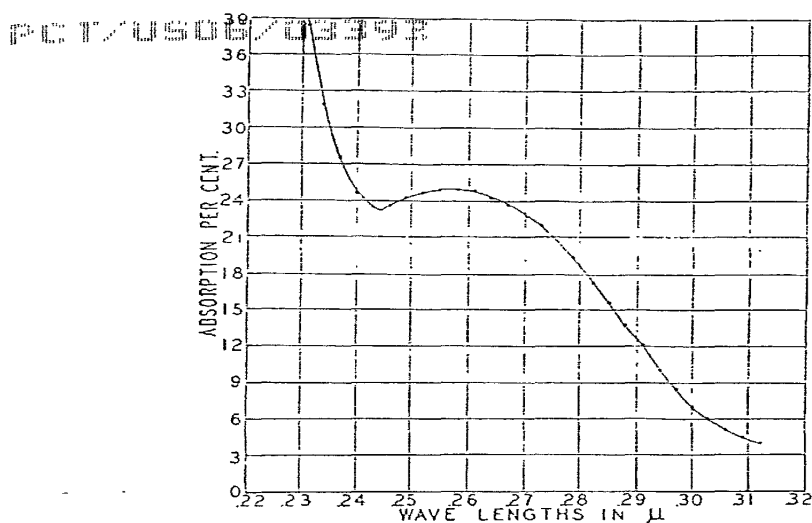


Figure 9: UV Absorption of DNA

Figure 10: *B. coli* @ 0.8u absorption

% Reduction of MS-2 Phage Virus

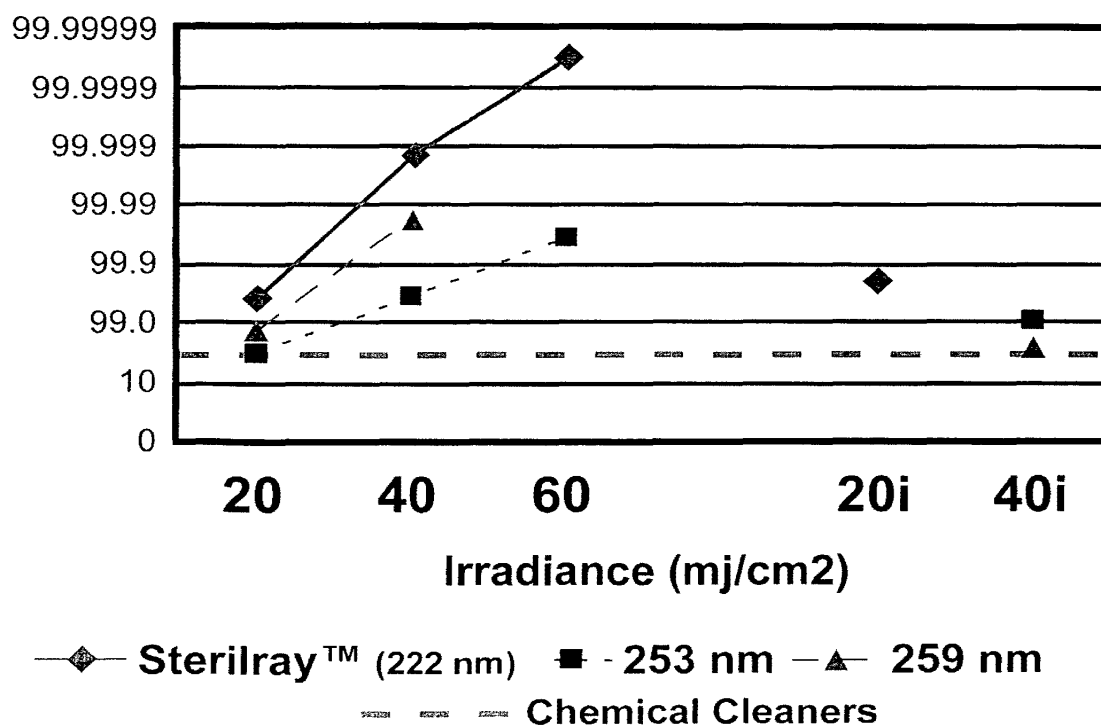


Figure 11: UV Irradiation Test on MS2

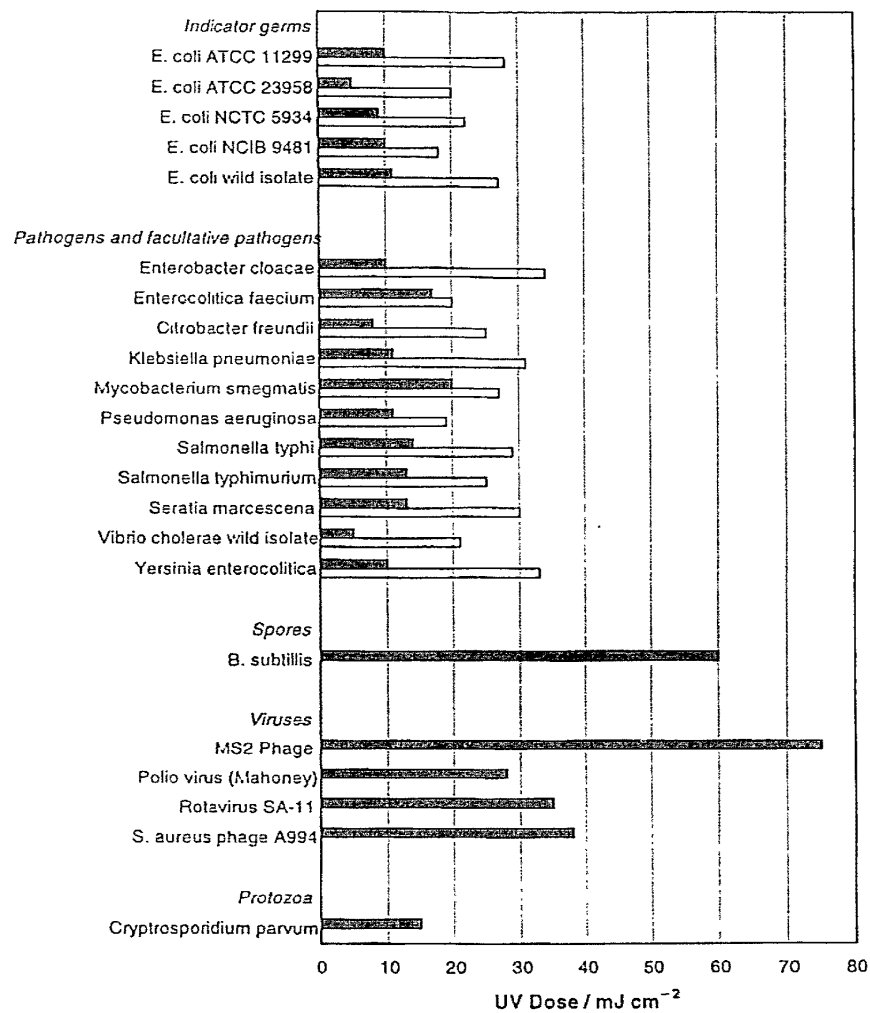


Figure 12: UV dose required for 4 log (99.99%) deactivation

RANGE OF EFFECTIVENESS

THE SIZE OF AIRBORNE PARTICLES IN MICRONS
(1 micron = 1/25,400th of an inch)

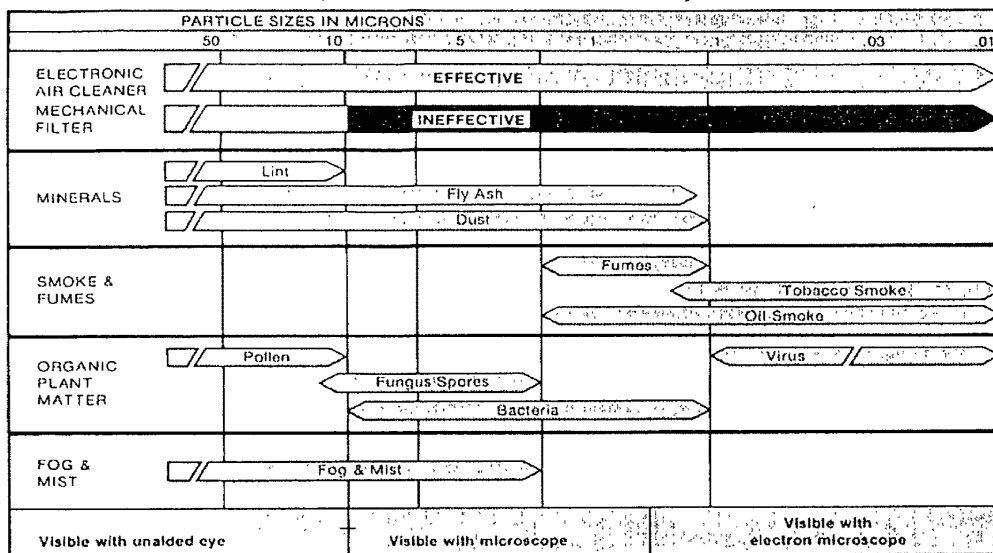


Figure 13: ESP range of effectiveness

IAP7 Rec'd PCT/PTO 31 JAN 2006

PTO-1382 (Rev. 07-2004)

Approved for use through 3/31/2007 OMB 0651-0021

U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

PCT/US06/03393

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

TRANSMITTAL LETTER TO THE UNITED STATES RECEIVING OFFICE

Express Mail mailing number: ED868788319US	Date of deposit: 31 JAN 2006
File reference no.: NEI.PCT.2	International application no. (if known): 06/03393
Title of the invention: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING..	
Earliest priority date claimed (Day/Month/Year): 31/01/2005	

☒ This is a new International Application

SCREENING DISCLOSURE INFORMATION:

In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (check as many boxes as apply):

- ☐ The invention disclosed was **not** made in the United States of America.
- ☐ There is no prior U.S. application relating to this invention.
- ☒ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. (NOTE: priority to these applications may or may not be claimed on the Request (form PCT/RO/101) and this listing does **not** constitute a claim for priority.)

application no.	60/593,626	filed on	31/01/2005
application no.		filed on	

- ☐ The present international application contains additional subject matter not found in the prior U.S. application(s) identified above. The additional subject matter is found on pages _____ and ☐ DOES NOT ALTER ☐ MIGHT BE CONSIDERED TO ALTER the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 C.F.R. 5.15.

Itemized list of contents

Sheets of Request form:	6	Check no.:	
Sheets of description (excluding sequence listing):	13	Return receipt postcard:	1
Sheets of claims:	3	Power of attorney:	1
Sheets of abstract:	1	Certified copy of priority document (specify):	
Sheets of drawings:		Other (specify):	PTO 2038 credit card pmt. Declaration Floppy disk
Sheets of sequence listing:			
Sequence listing diskette/CD:			
Tables related to sequence listing CD:			

The person signing this form is:

- ☐ Applicant
- ☒ Attorney/Agent (Reg. No.)
39,163
- ☐ Common Representative

Phillip E. Decker

Name of person signing

Signature

This collection of information is required by 37 CFR 1.10 and 1.412. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering information, preparing, and submitting the completed form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

PCT/US06/03393

**New International Application
Inventory of Unscannable or Missing
Items**

Serial Number PCT/US 06/03393

Check This Column if Item is Present	Item	Check this column if Item is Missing on Filing
☒	Return Receipt Postcard	
☒	Credit Card	
☐	Check amount \$ _____	
☐	Priority Document CD's	
☐	DNA Diskette/CD's	
☒	PCT EASY Diskette	
☒	Express Mail Label or Envelope	
☒	Transmittal Letter	
☐	Cover Letter	