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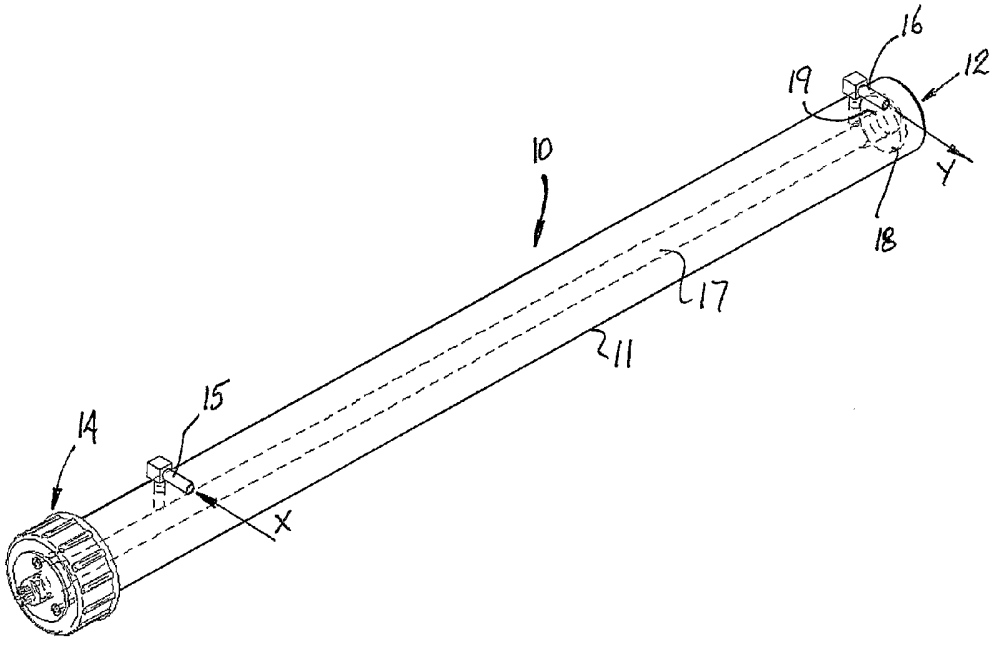
(54) **Title:** AN OZONE GENERATOR



(57) **Abstract:** An ozone generator (10) comprising a hollow elongated tubular housing (11), at least one ultraviolet lamp (17) in the housing (11) and an inlet (15) at one end of the housing (11) and an outlet (16) at the opposite end of the housing (11) such that air containing oxygen flowing into the inlet (15) is exposed to ultraviolet light from the lamp (17) and converted into ozone for exit through the outlet (16).

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AN OZONE GENERATOR

Technical Field

This invention relates to apparatus for generating ozone. The apparatus of the invention is particularly suited to generating ozone for use in treating contaminated water but may used for generating ozone for many other applications.

Background Art

Ozone can be generated by a number of different methods with a common method used for example in ozone air purifiers being by corona discharge using high voltage electricity. In this method, air or oxygen is passed through pair of high voltage electrodes separated by a dielectric material. Whilst this form of ozone generator produces relatively high volumes of ozone, energy consumed in producing ozone is relatively high and the electrodes usually are required to be cooled by water or air. Ozone can also be generated by exposing air containing oxygen to ultraviolet light of particular wavelengths however to date this method only produces relatively small amounts of ozone.

One application for ozone is for sterilizing water in a water treatment plants however as ozone has a relatively short half life, the ozone generator is required to be located near to the treatment plant. The corona discharge systems which are known are not particularly suited to this application particularly where the water treatment plant may be in a remote location or self powered. The use of ultraviolet lamps for production of ozone in these situations would be preferred however current arrangements do not provide sufficient volumes of ozone.

Summary of the Invention

The present invention aims to provide an improved ozone generator which may be used for generating ozone for example for use in water treatment apparatus but which is also applicable to the generation of ozone for other applications. Other objects and advantages of the invention will become apparent from the following description.

The present invention thus provides in one preferred aspect, an ozone generator comprising a hollow elongated housing, at least one ozone producing ultraviolet light source in said housing and extending therealong, an inlet at one end of said housing and an outlet at the opposite end of said housing whereby air containing oxygen flowing into said inlet is exposed to ultraviolet light and converted into ozone for exit through said outlet.

Preferably air is pumped into the housing by any suitable air pump. The housing

suitably comprises a tubular housing and the ultraviolet light source comprises an elongated ultraviolet lamp. Where the ozone generator includes only a single ultraviolet lamp, it may be located coaxially within the housing. Where the ozone generator includes more than one ultraviolet lamp, the respective lamps may be arranged at spaced locations within the housing

Preferably one end of the housing is closed by a removable end cap which permits placement of the ultraviolet lamp or lamps within the housing or removal of the lamp or lamps from the housing. The end cap may be in threaded engagement with the housing. The end cap alternatively may be pushed axially onto the end of the housing so as to be frictionally and sealingly engaged with the housing. Preferably the end cap supports the end of the ultraviolet lamp or lamps which contains the electrical terminals or connectors to the lamp or lamps. The end cap suitably supports the ultraviolet lamp or lamps with the electrical terminals or connectors externally of the housing. The end cap suitably includes in one embodiment a holder or holder for receiving the end or ends of the ultraviolet lamp or lamps containing the terminals or connectors. Alternatively, a support member or members for supporting the ultraviolet lamp or lamps may be secured to the end cap. The support member or members suitably acts as a seal or seals to seal the lamp or lamps to the end cap. A support member may comprise an annular flange which is secured to the end cap, the flange having a central aperture to receive the terminal end of a lamp therein. A support member may additionally include a support boss having a bore therein for receiving the terminal end of a lamp. The bore suitably tapers in diameter so as to be of frustoconical configuration to enhance sealing of the support member to a lamp. The support member suitably comprises a resilient or elastic material.

Preferably the opposite end of the housing is closed by an end cap or by an integrally formed end wall. The end cap or end wall may include a socket for receiving the opposite end of an ultraviolet lamp which is free of the connectors or terminals. Where the housing is provided with an integrally formed end wall, the socket may comprise an integrally formed socket. The socket suitably comprises a blind socket which is moulded integrally with the end wall. Where a plurality of lamps are provided, the end cap or end wall suitably includes a corresponding number of the aforesaid sockets.

The lamp or lamps may be additionally or alternatively supported by one or more spacers which support the lamp or lamps at a position or positions along its or

their length. The spacer may include one or more openings therethrough or indentations therein for the passage of air and/or ozone therepast. The spacer or spacers is/are suitably free for rotation within the housing.

The inlet and outlet may be provided in the tubular housing such as in the side wall of the tubular housing. Alternatively the inlet and/or outlet may be formed in the end caps or end wall of the housing. In a particularly preferred form, the inlet is provided in the end cap. The inlet may be angled to the longitudinal axis of the housing such that air or oxygen flowing into the housing is caused to undergo a circular path for example by moving in a spiraling or swirling manner around the lamp or lamps from one end of the housing to the other end thereof.

In another arrangement, the inlet may be provided in the end wall or end cap opposite the end cap supporting the terminal end or ends of the lamp or lamps.

The tubular housing suitably is formed of plastics for example as a plastic moulding and the end cap or caps are also suitably formed of plastics.

Brief Description of the Drawings

In order that the invention may be more readily understood and put into practical effect reference will now be may to the company drawings which illustrate the preferred embodiments of the invention and wherein:

Fig. 1 is a perspective view of an ozone generator according to an embodiment of the invention;

Fig. 2 is a top view of the ozone generator of Fig. 1;

Fig. 3 is a sectional view along line A-A of Fig. 2;

Fig. 4 is an end view of the ozone generator of Fig. 1;

Fig. 5 is an enlarged sectional view of a support member for an ultraviolet lamp of the ozone generator;

Figs. 6 and 7 are opposite perspective view of a further embodiment of ozone generator according to the invention;

Fig. 8 is a top view of the ozone generator of Fig. 6;

Fig. 9 is a sectional view along line B-B of Fig. 7;

Fig. 10 is an end view of the ozone generator of Fig. 6;

Fig. 11 is an enlarged view of the region C of Fig. 5;

Figs. 12 and 13 are opposite perspective views of another embodiment of ozone generator according to the invention;

Fig. 14 is an end view of the ozone generator of Fig 12; and

Fig. 15 is a longitudinal sectional view of the ozone generator.

Detailed Description of the Preferred Embodiments

Referring to the drawings and firstly to Figs. 1 to 5, there is illustrated an ozone generator 10 according to a first embodiment of the present invention comprising an elongated hollow tubular housing 11 which is closed or sealed at one end 12 by an integrally formed end wall 13 and closed or sealed at its opposite end by a removable end cap 14 which in the illustrated embodiment is in screw-engagement with the housing 11 and externally castellated to facilitate is detachment from or engagement with the housing 11. The housing 11 further has an inlet 15 at the end of the housing 11 adjacent the cap 14 and an outlet 16 at its opposite end.

Supported within the housing 11 is an elongated tubular ultraviolet lamp 17 which when connected to a suitable power source emits ultraviolet light at a wavelength typically of less than 210 nanometers and usually 185 nanometers, to convert oxygen exposed to the ultraviolet light into ozone within the housing 11. The lamp 17 is supported by an annular disk-like support member 18 adjacent the end 12 of the housing 11 which has an outer diameter slightly less than the inner diameter of the housing 11 for neat receipt within the housing 11. The support member 18 has a central aperture 19 of a diameter slightly less than the outer diameter of the end 20 of the lamp 17. The end 20 is received within and in frictional engagement with the wall of the aperture 19.

At the opposite end of the housing 11, the lamp 17 is supported by and sealed to the end cap 14. For this purpose, a second support member 21 is provided, the member 21 having an annular disc-like flange 22 and an integrally formed central boss 23 on one side. An aperture 24 extends centrally through the boss 23 and flange 22, the aperture 24 having a reducing diameter through the boss 23 to the flange 22 so as to be of a frustoconical configuration. The support member 20 is formed of a resilient plastics material such as polyurethane. The support member 18 is also formed of a similar material.

The support member 21 is positioned relative to the end cap 14 such that the flange 22 is on the outside of the end cap 14 with the boss 23 projecting through a central aperture 25 in the end cap 14. The flange 22 is secured to the cap 14 by spaced fasteners 26 for example screws or rivets.

The end 27 of the lamp 17 opposite the end 20 carries the electrical terminals 28 for connection to a power supply. The end 27 of the lamp 17 is forced into the frustoconical aperture 24 so as to effectively wedged in position with the terminals 28

located beyond the flange 21. The end cap 14 may then be engaged with the threaded end of the housing 11 and rotated to a closed position to seal the housing 11. During rotation of the end cap 14 in tightening, the lamp 17 and support member 18 frictionally engaged with the lamp 17 will also rotate in the housing 11 until the cap 14 is fully tightened.

In use power is supplied to the lamp 17 via the terminals 28 and air containing oxygen (or pure oxygen) is pumped by any air pump into the inlet 15 as indicated by the arrow X in Fig. 1. Air passing into and along the housing 11 towards the outlet 16 is exposed to the ultraviolet light emitted by the lamp 17 along its length. This converts oxygen in the air into ozone which passes through the outlet 16 as indicated by the arrow Y in Fig. 1. The generated ozone may be used for any purpose but typically may be used for bubbling through water to be treated for sterilization purposes.

Referring now to Figs. 6 to 11, there is illustrated a second embodiment of ozone generator 28 according to the present invention comprising an elongated hollow tubular housing 30 which has an integrally formed end wall 31 at one end and an end cap 32 at its opposite open end which is releasably engaged with the housing 30. The housing 30 supports four elongated ultraviolet lamps 33 which extend longitudinally of the housing 29 and which are arranged at equi-spaced positions relative to, and at a common radius around, the central axis of the housing 30. The lamps 33 are of similar form to the lamp 17 of the embodiment of Figs. 1 to 4 and have electrical terminals 34 at one end 35.

The end wall 30 is formed with four integrally formed blind hollow circular sockets 36 which are of a diameter to match the respective ends 37 of the lamps 33 opposite the ends 35. The ends 37 are neatly received within the sockets 36 to be supported at the end wall 31 of the housing 30.

The end cap 32 is provided with four hollow tubular holders 38 corresponding to the sockets 36 and at a similar spacing and radius to the sockets 36 relative to the central axis of the housing 30. The holders 38 comprise hollow tubular members of an internal diameter slightly greater than the lamp ends 35 whereby the holders 38 can neatly receive the terminal ends 35 of the ultraviolet lamps 33 such that the lamps 33 are supported to the end cap 32 with the terminals 34 projecting out of the holders 38 as is apparent in Fig. 10. Annular seals (not shown) are provided around the lamp ends 35 to seal the ends 35 to the holders 38.

An inlet 39 to the housing 30 is also provided in the end cap 32, the inlet 39

including a tubular inlet spigot 40 and being positioned towards the outer periphery of the end cap 32. In addition, the inlet spigot 40 is angled to the longitudinal axis of the housing 30 and arranged in a tangential orientation relative to the central axis of the housing 30. The outlet 41 for ozone is provided in the end wall 31 of the housing 30 and is similar to the inlet 39 and includes a tubular outlet spigot 42 which is also angled to the longitudinal axis of the housing 30 but arranged in an opposite direction to the inlet spigot 40.

As in the embodiment of Figs. 1 to 5, air containing oxygen (or pure oxygen) is pumped into the inlet spigot 40 to flow into the housing 30. The orientation of the spigot 40 ensures that the air (or oxygen) enters in a tangential direction and at an acute angle to longitudinal axis of the housing 30. The incoming air or oxygen on striking the curved inner wall of the housing 30 will be caused to be deflected and move in a spiral manner through the housing 30 towards the outlet spigot 42. Power is also supplied to the ultraviolet lamps 33 through the terminals 34 such that oxygen exposed to the lamps 33 is converted into ozone. The generated ozone then passes through the outlet spigot 42. As the air or oxygen moves spirally through the housing 30, it is exposed for an extended period of time to the ultraviolet lamps 33 to thereby increase the conversion of oxygen into ozone.

Referring now to Figs. 12 to 15, there is illustrated a further embodiment of ozone generator 43 according to the invention which is similar to the embodiment of Figs. 6 to 11 and includes an elongated tubular housing 44 which houses four elongated ultraviolet lamps 45. The housing 44 has an end wall 46 having an axially extending inlet spigot 47 connected thereto for supply of air or oxygen to the housing 44. The opposite end of the housing 44 is threaded for threaded engagement by an end cap 48. Annular support members 49 of similar configuration of the support members 21 of Fig. 5 are fixed to the end cap 48 and extend therethrough for engagement by the terminal ends 50 of the lamps 45 so that the terminals 51 of the lamps 45 extend beyond the end cap 48.

The opposite ends of the lamps 45 are supported by a spacer 52 which is provided with apertures 53 through which the lamps 45 pass, the apertures 53 being of similar diameter to the diameter of the lamps 45. The spacer 52 however has a transverse dimension less than the internal diameter of the housing 45 and is curved on its outer periphery. This enables the spacer 52 to rotate freely within the housing 11 with the lamps 44 during for example rotation and tightening of the cap 48. The spacers

52 have indented portions or apertures 54 to allow free flow of air and/or ozone therepast. The cap 48 also includes a plurality of outlets 55 in the form of spigots for outward flow of ozone.

The generator 43 is connected to an air pump or blower through the inlet spigot 47 and power applied to the lamps 45 via the terminals 51. Oxygen in the air flowing from the inlet 47 towards the outlets 55 is converted into ozone for flow through the outlets 55. The outlets 55 may be connected to a distribution manifold for distribution of the ozone where required.

The embodiments described above show that the ozone generators are provided with a single ultraviolet lamp or four ultraviolet lamps. It will be appreciated however that the housings may include any number of lamps. Further the inlets and outlets to the housings of the ultraviolet lamps may be considerably varied from that shown an illustrated. For example, the single inlets may be replaced by a plurality of inlets for air or oxygen. Similarly the multiple outlets of the generator of the embodiment of Figs. 12 to 15 may be replaced by a single outlet.

The terms "comprising" or "comprise" or derivatives thereof as used throughout the specification and claims are taken to specify the presence of the stated features, integers and components referred to but not preclude the presence or addition of one or more other feature/s, integer/s, component/s or group thereof.

Whilst the above has been given by way of illustrative embodiment of the invention, all such variations and modifications thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as described in the appended claims

Claims

1. An ozone generator comprising a hollow elongated housing, at least one ozone producing ultraviolet light source in said housing and extending therealong, an inlet at one end of said housing and an outlet at the opposite end of said housing whereby air containing oxygen flowing into said inlet is exposed to ultraviolet light and converted into ozone for exit through said outlet.

2. An ozone generator as claimed in claim 1 wherein said housing comprises a tubular housing and wherein said at least one ultraviolet light source comprises at least one elongated ultraviolet lamp.

3. An ozone generator as claimed in claim 2 wherein said at least one ultraviolet lamp comprises a single ultraviolet lamp located coaxially within the housing.

4. An ozone generator as claimed in claim 2 wherein said at least one ultraviolet lamp includes more than one ultraviolet lamp and wherein the respective said lamps are arranged at spaced locations within the housing

5. An ozone generator as claimed in claims 3 or claim 4 wherein housing is closed at one end by a removable end cap to permit placement of the ultraviolet lamp or lamps within the housing or removal of the lamp or lamps from the housing.

6. An ozone generator as claimed in claim 5 wherein one end of the at least one ultraviolet lamp carries terminals and wherein said end cap supports said one end or ends of said ultraviolet lamp or lamps such that said terminals are arranged externally of the housing.

7. An ozone generator as claimed in claim 6 wherein said end cap includes at least one holder for receiving said one end or ends of said lamp or lamps.

8. An ozone generator as claimed in claim 6 and including a support member or members for supporting said one end of an ultraviolet lamp or lamps, said support member being secured to the end cap.

9. An ozone generator as claimed in claim 8 wherein said support member comprise an annular flange secured to the end cap, said flange having a central aperture to receive said one end of the lamp therethrough.

10. An ozone generator as claimed in claim 9 wherein said support member includes a support boss having a bore therein for receiving said one end of the lamp, said bore being of a frustoconical configuration for sealing engagement with said one end of said lamp.

11. An ozone generator as claimed in any one of claims 2 to 10 wherein said at least one lamp is supported by one or more spacers which support the lamp or lamps at a position or positions along its or their length.

12. An ozone generator as claimed in claim 11 wherein said spacer includes one or more openings therethrough or indentations therein for the passage of air and/or ozone.

13. An ozone generator as claimed in claim 11 or claim 12 wherein said spacer is free for rotation within the housing.

14. An ozone generator as claimed in any one of claims 5 to 10 wherein the end of said housing opposite said one end is closed by an end cap or by an integrally formed end wall, said end cap or end wall including at least one socket for receiving an end or ends of the lamp or lamps.

15. An ozone generator as claimed in any one of claims 2 to 14 wherein said inlet and outlet are provided in a side wall of the tubular housing.

16. An ozone generator as claimed in any one of claims 5 to 14 wherein a said inlet or outlet is provided in an end caps or end wall of the housing.

17. An ozone generator as claimed in claim 16 wherein said inlet is angled to the longitudinal axis of the housing whereby air or oxygen flowing into the housing is caused to undergo a spiraling or swirling path around the lamp or lamps from one end

of the housing to the other end thereof.

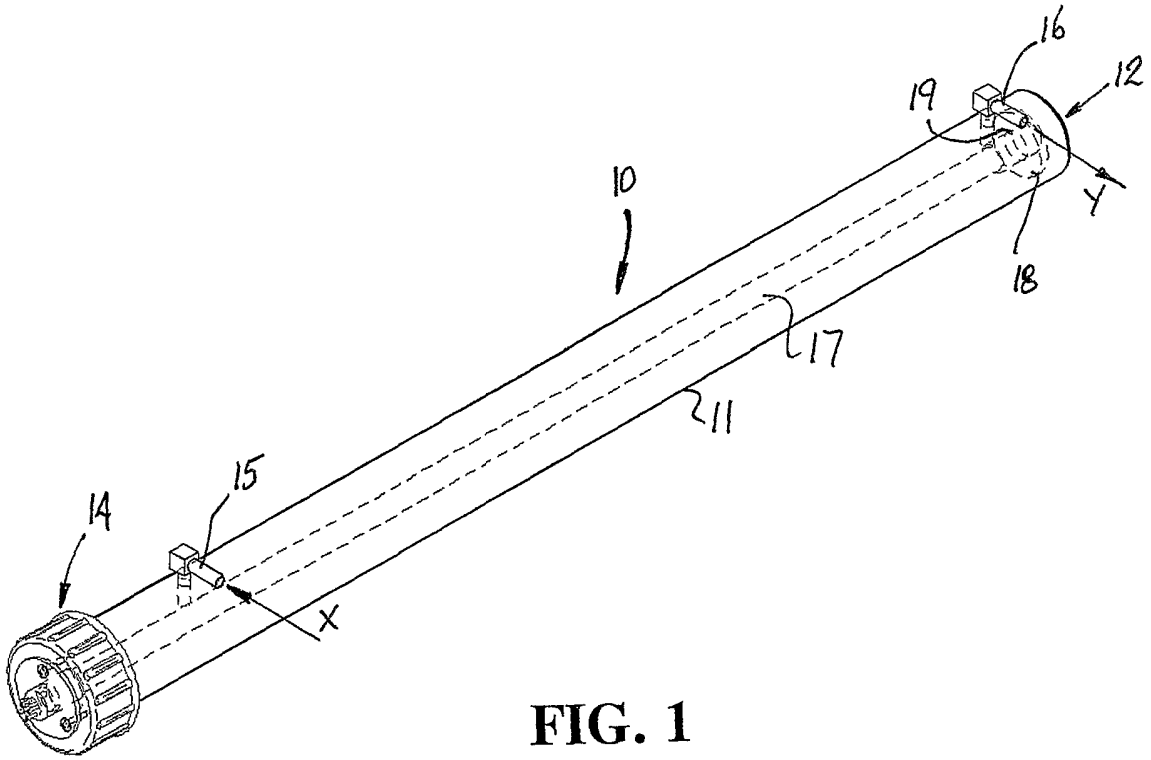


FIG. 1

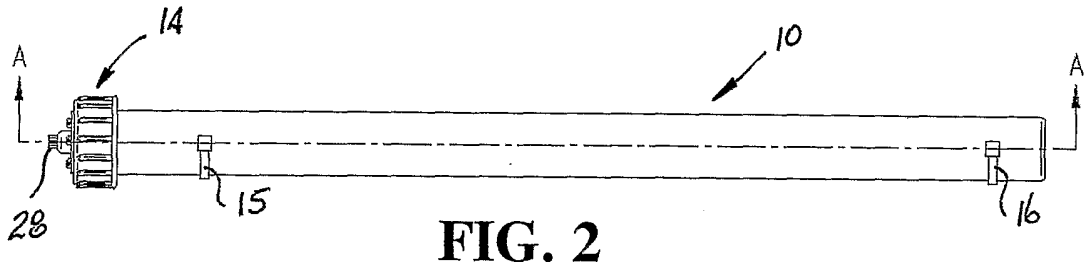


FIG. 2

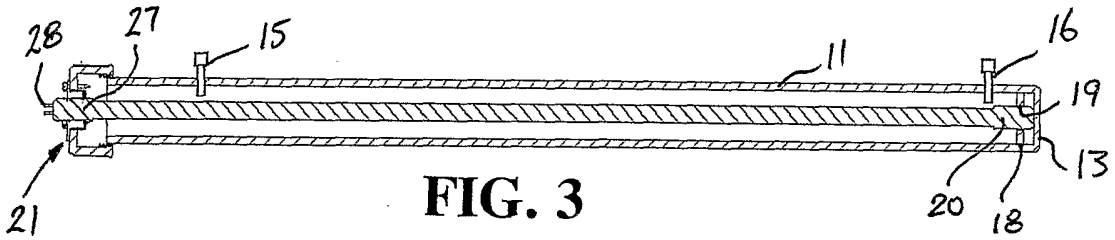


FIG. 3

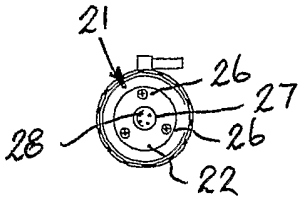


FIG. 4

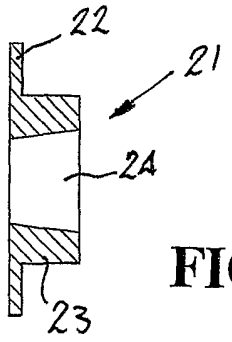


FIG. 5

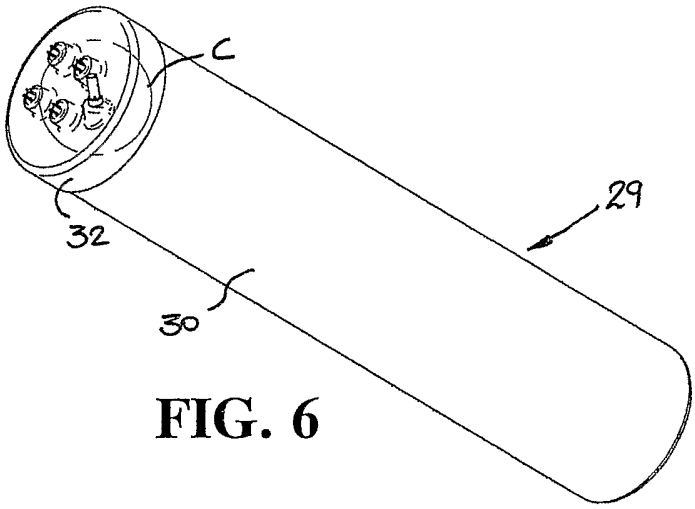


FIG. 6

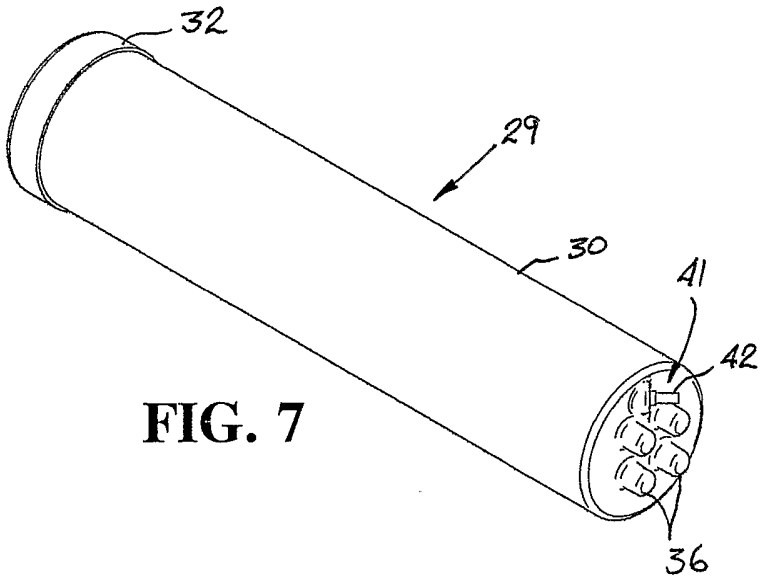


FIG. 7

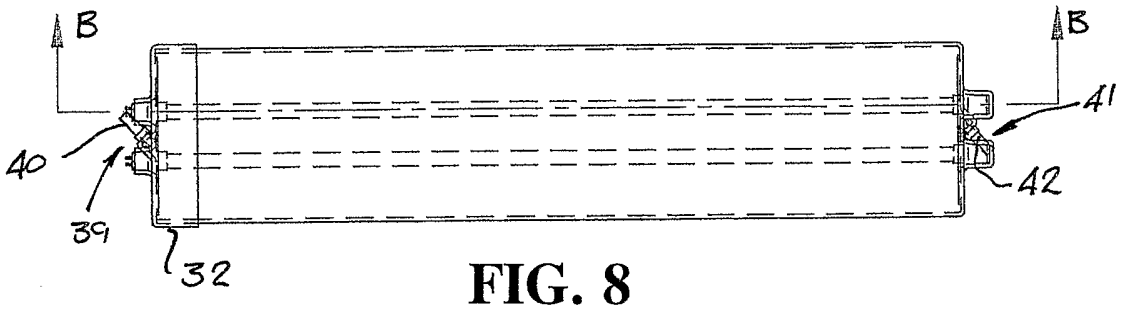


FIG. 8

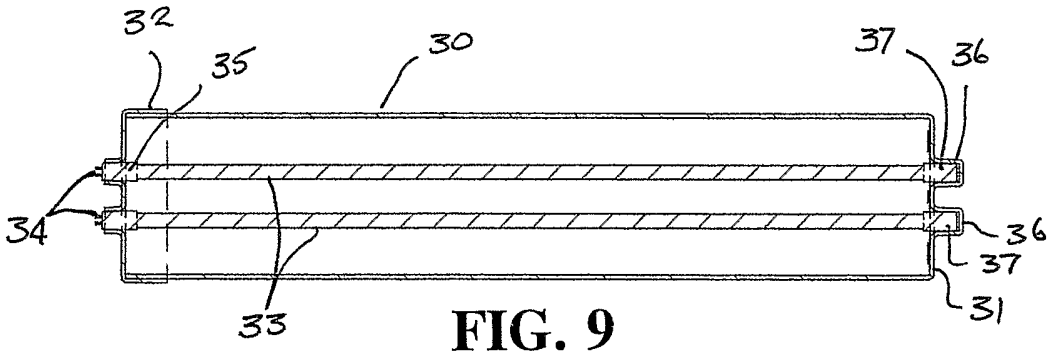
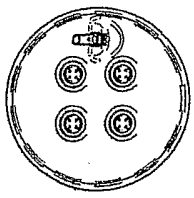


FIG. 9

FIG. 10



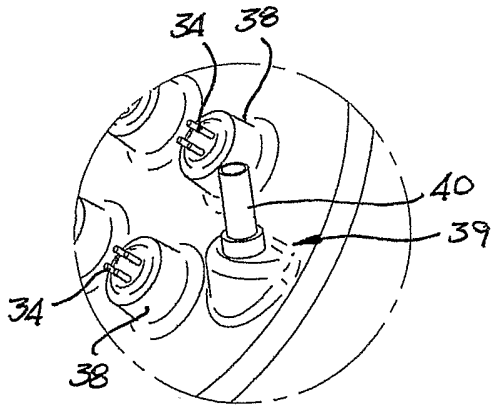


FIG. 11

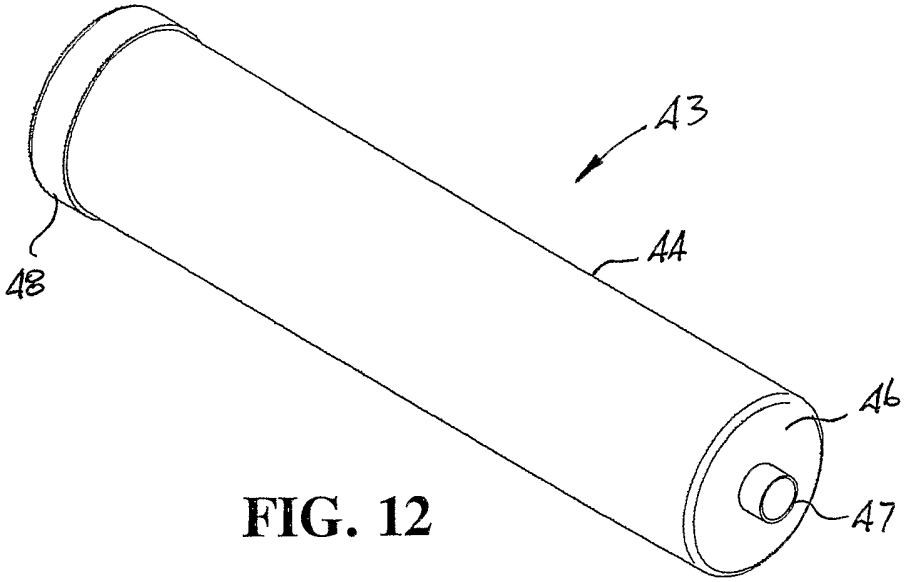


FIG. 12

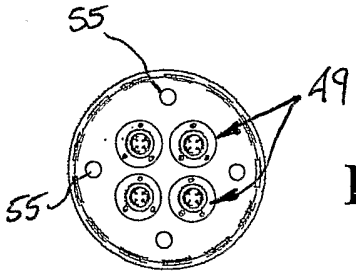


FIG. 14

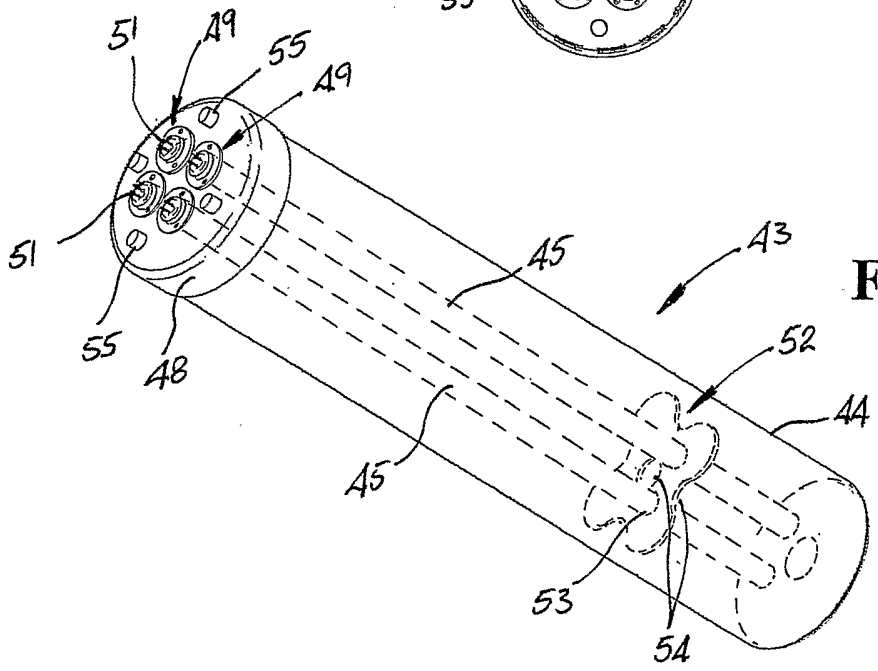


FIG. 13

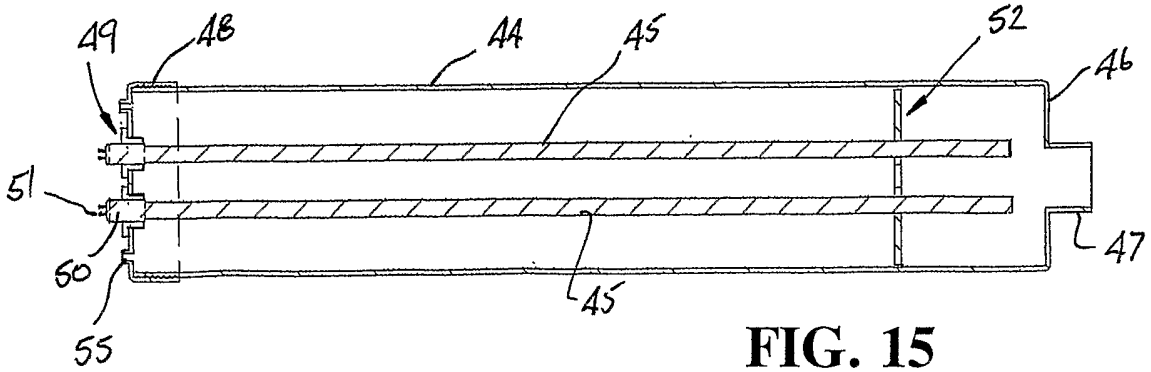


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001259

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: C01B 13/10; C02F 1/78; A61L 9/015

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: C01B 13/10; C02F 1/78; A61L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: WPAT, JAPIO; Key Words: ozone, ultraviolet, generator, apparatus, device

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 1992/010429 A1 (KLAUSEN, LAURITZ) 25 June 1992 See page 4 line 15 – page 5 line 14, Fig.1	1-15
X	EP 1362828 A1 (LIGHT SOURCES, INC.) 19 November 2003 See abstract, Fig.2	1-3, 5-14, 16
X	US 6428756 B1 (BARNES) 6 August 2002 See column 2 lines 26-57, Fig.1	1-14, 16, 17

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
17 October 2005	20 OCT 2005
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **ALBERT YONG** Telephone No : (02) 6283 2160

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001259

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/033376 A1 (BENRAD AB) 22 April 2004 See abstract	1-3, 5-14, 16
X	FR 2835517 A (RENAUD JEAN LUC-FR) 8 August 2003 See abstract, page 2 line 31-page 3 line 20, Fig.1	1-3, 5-15, 17
X	WO 2000/006209 A2 (ECO-AIRE COMPANY, INC.) 10 February 2000 See abstract, page 23 line 21-page 24 line 15, Figs. 3 and 14	1-3, 5-15
X	Patent Abstracts of Japan JP 10-045401 A (HORIBA LTD) 17 February 1998 See abstract; see also paragraph 22 of machine translation obtained from JPO website, Fig.4	1-3, 4-15
X	Patent Abstracts of Japan JP 04-272763 A (IWASAKI ELECTRIC CO LTD) 29 September 1992 See abstract	1-14, 16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2005/001259

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9210429	AU	90495/91				
EP	1362828	US	6824693				
US	6428756	NONE					
WO	2004033376	AU	2003267916	EP	1549589	SE	0202978
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		CA	2304070	CA	2309215	CA	2311386
		US	2002098109	US	2003039577	US	2005175498
		WO	9913922	WO	9913956	WO	9922777
		WO	9926668				
JP	10045401	NONE					
JP	4272763	NONE					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX