

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 December 2006 (28.12.2006)

PCT

(10) International Publication Number  
**WO 2006/136026 A1**

(51) International Patent Classification:

**H01J 5/50** (2006.01) **A61L 2/10** (2006.01)  
**F21V 23/06** (2006.01) **H01J 61/36** (2006.01)

(21) International Application Number:

PCT/CA2006/001040

(22) International Filing Date: 27 June 2006 (27.06.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/693,502 24 June 2005 (24.06.2005) US

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

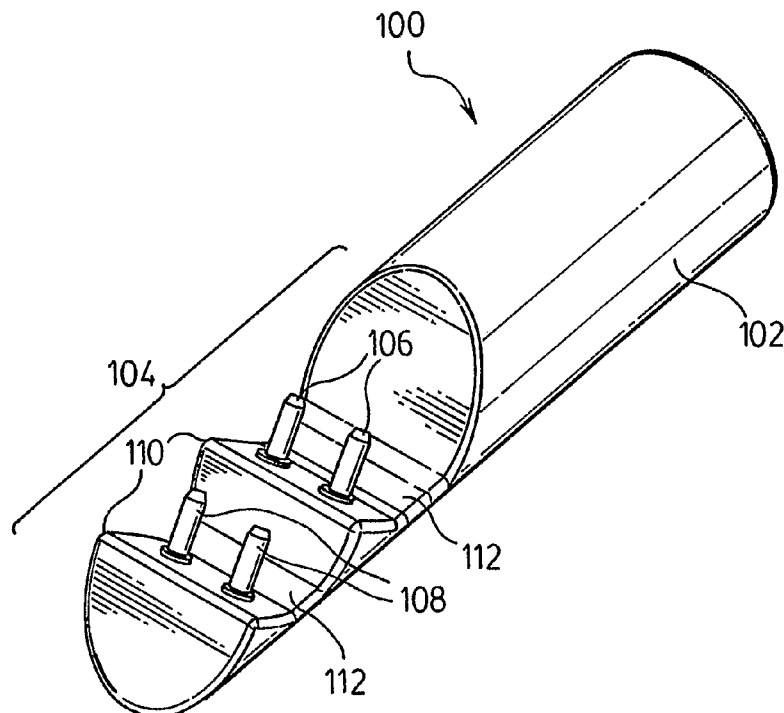
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: RADIATION LAMP AND RADIATION SOURCE MODULE INCORPORATING SAME



(57) Abstract: There is disclosed a lamp device comprising a longitudinal axis, a first elongate electrical connector and a second elongate electrical connector, each of the first elongate electrical connector and the second elongate connector being non- parallel with respect to the longitudinal axis. The present lamp device provides a reliable electric connection on the one hand, yet is relatively inexpensive, uncomplicated and simple to implement on the other hand.



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RADIATION LAMP AND RADIATION SOURCE MODULE  
INCORPORATING SAME

FIELD OF THE INVENTION

In one of its aspects, the present invention relates to a lamp device. In  
5 another of its aspects, the present invention relates to a radiation lamp. In yet another  
of its aspects, the present invention relates to a radiation source assembly. In yet  
another of its aspects, the present invention relates to a radiation source module. In  
yet another of its aspects, the present invention relates to a fluid treatment system. In  
yet another of its aspects, the present invention relates to a water disinfection system.

10 DESCRIPTION OF THE PRIOR ART

Fluid treatment systems such as water disinfection systems are generally  
known in the art.

See, for example, one or more of the following United States patents:

Re36,896,  
15 3,418,370,  
4,482,809,  
4,872,980,  
5,006,244,  
5,471,063,  
20 5,504,355,  
5,538,210,  
6,342,188,  
6,500,346,  
6,507,028,  
25 6,646,269,  
6,674,084,  
6,803,586, and

6,863,078.

Many of the above-identified United States patents teach fluid treatment systems that employ ultraviolet (UV) radiation to kill, sterilize and/or prevent replication of microorganisms (bacteria, viruses, pathogens and the like) that may be present in the fluid.

Generally, such prior art fluid treatment systems employ an ultraviolet radiation lamp to emit radiation of a particular wavelength or range of wavelengths (usually between 185 and 400 nm) to kill, sterilize and/or prevent replication of microorganisms (bacteria, viruses, pathogens and the like) that may be present in the fluid.

Conventional ultraviolet radiation lamps include low pressure lamps, medium pressure lamps, low pressure high output lamps and the like.

In more recent years, it has become conventional to use such ultraviolet lamps configured to have all of the electrical connections disposed at one end of the lamp. See, for example, Figures 2-8 of United States patent 4,700,101 [Ellner et al. (Ellner)] and Figures 1, 2 and 4 of United States patent 5,166,527 [Solymer].

As can be seen from the prior art radiation lamps taught by Ellner and Solymer, the electrical connection pins are elongate and are disposed such that the axes of the pins are parallel with the longitudinal axes of radiation lamp. In other words, the electrical connection is made by pushing an end cap or other connection base on to the pins in a direction parallel to the longitudinal axis of the radiation lamp.

The problem with this approach is that in many applications, the radiation lamp is immersed in a flow of water and turbulence created within that water treatment system invariably imparts a vibratory motion to the lamps which frequently results in lamps being vibrated or shaken loose of its electrical connection base or socket thereby causing the lamps to be rendered completely or intermittently inoperative. When such an event occurs, the water being treated may not be fully disinfected.

More recently, the prior art has attempted to address this problem by using a relatively complicated mechanical connection (e.g., a so-called “push-and-twist” connection) to secure the lamp to the connection base. See, for example, United States patent 5,422,487 [Sauska et al (Sauska)] and United States patent 6,884,103 [Kovacs]. The problem with these approaches is the complexity of the mechanical connection between the lamp and the base unit requiring the use of springs, specialized connection lugs and the like. Further, a connection system which is predicated on a dual motion system such that pushing and twisting gives rise to a higher incidents of lamp breakage and other damage to the module by field personal.

Accordingly, there remains the need in the art for a lamp device, particularly a radiation lamp, which will provide a reliable electric connection on the one hand, yet be relatively inexpensive, uncomplicated and simple to implement on the other hand.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to obviate or mitigate at least one of the above-mentioned disadvantages of the prior art.

Accordingly, in one of its aspects, the present invention provides a lamp device comprising a longitudinal axis, a first elongate electrical connector and a second elongate electrical connector, each of the first elongate electrical connector and the second elongate connector being non-parallel with respect to the longitudinal axis.

In another of its aspects, the present invention relates to a radiation source assembly comprising such a lamp device, together with a radiation transparent protective sleeve.

In another of its aspects, the present invention provides a radiation lamp comprising: an elongate radiation-emitting cavity having a longitudinal axis; a first electrical connection base disposed at a first end of the elongate radiation-emitting cavity; a pair of first elongate electrical connectors and a pair of second elongate electrical connectors disposed in the first electrical connection base; each of the first

elongate electrical connector and the second elongate connector being non-parallel with respect to the longitudinal axis.

In yet another of its aspects, the present invention provides a radiation source module comprising such a radiation lamp and a first support member for supporting the radiation lamp, the first support member comprising a second electrical connection base for engagement with the first electrical connection base and connection to a power supply.

Other aspects of the present invention relate to fluid treatment systems and water disinfection systems incorporating the above lamp device, radiation source assembly, radiation lamp and radiation source module, respectively.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will be described with reference to the accompanying drawings, wherein like reference numerals denote like parts, and in which:

Figures 1-4 illustrate components of a first preferred embodiment of the present lamp device; and

Figures 5-8 illustrate portions of a second preferred embodiment of the present lamp device.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described below with reference to Figures 1-8. In Figures 1-8, there is shown in detail the electrical connection portion of a radiation lamp and/or the connection thereof to a complementary base unit. The remaining detail of the lamp is not shown for easier understanding. However, those of skill in the art will readily recognize how the specific connection shown in the Figures can be implemented in a lamp design by reference to the various prior art patents referred to above.

With reference to Figures 1-4, there is illustrated a first electrical base unit 100 and a second electrical base unit 150.

First electrical connection base unit 100 comprises a housing 102. An end portion 104 of unit 100 comprises a first pair of electrical connectors 106 and a second pair of electrical connectors 108.

5 In portion 104 comprises an undulating shape having a series of peaks 110 and valleys 112. Electrical connectors 106,108 are connected to wire or other suitable electrical conveyance (not shown) disposed within housing 102 which is then connected to the radiation-emitting cavity of a lamp in a conventional manner.

With particular reference to Figure 2, there is illustrated an enlarged view of base unit 150. As shown, base unit 150 comprises a first pair of electrical receptacles 152 and a second pair of electrical receptacles 154. These receptacles are  
10 disposed at a first end portion 156 of base unit 150. Disposed at another end portion 158 of base unit 150 is a sealing system which functions in a manner similar to that described in United States patents 4,872,980 and 5,006,244 referred to above. Specifically, end portion 158 comprises a pair of annular seals 160 that serve to seal  
15 the interior of a radiation transparent protective sleeve (Figure 4) placed over the radiation lamp.

Also disposed on end portion 158 is a stop portion 162 that serves as stop for the open end of protective sleeves surrounding the lamp.

Portion 158 further comprises a pair of annular seals 164 that serve to seal  
20 against water ingress into the frame of a module in which the lamp is placed (again, reference can be made to United States patent 4,872,980 and 5,006,244 for further details on the function of the seals).

Electrical receptacles 152,154 are wired in a conventional manner with the electrical wires or other electrical conveyance emerging from an aperture 166 in end  
25 portion 158 connection unit 150.

With particular reference to Figure 3, it will be seen that when base unit 100 is connected to the remaining components of the radiation lamp, there will be a longitudinal axes shown at line A through base unit 100 and the remainder of the lamp. Further, it will be seen that electrical connector 106,108 are elongate and have  
30 a longitudinal axis through line B. An important feature of this preferred embodiment

is that line B is non-parallel with respect to line A. In other words, the longitudinal axes through electrical connectors 106,108 is in a non-parallel relationship with the longitudinal axes through base unit 100 and the remainder of the radiation lamp. In the specific embodiment shown, electrical connectors 106,108 are disposed at an acute angle  $\alpha$  toward the radiation-emitting cavity (not shown) of the lamp.

When it is desired to engage base unit 100 with base unit 150, the base units are aligned as shown in Figure 3 and moved with respect to one another in the direction of arrow C. The engaged components are shown in Figure 4 and a radiation transparent protective sleeve 170 encases the connected units 100 and 150. As will be appreciated by those of skill in the art, once the connection is shown as made in Figure 4, the connection will withstand vibration forces conveyed to the radiation lamp. Specifically, base unit 100 will not separate from base unit 150 in a direction of arrow D, particularly when radiation transparent protective sleeve 170 is disposed over the connection.

With reference to Figures 5-8, there is illustrated a second embodiment of the preferred invention. In the description of Figures 5-8, reference numerals will be used wherein the last two digits correspond to the same relevance appearing in Figures 1-4 and the first numeral will be "2" in Figures 5-8 instead of "1" in Figures 1-4. Thus, it will be seen that a first major difference between the two embodiments is that the embodiment illustrated in Figures 5-8 comprises electrical connectors 206,208 that are angled away ( $\beta$ ) from the radiation-emitting cavity. Another difference is that the cross-sectional shape base unit 200 in Figures 5-8 comprises a single valley 212 instead of the pair of valleys 112 in the embodiment illustrated in Figures 1-4. Yet another difference is that the cross-sectional shape base unit 200 in Figures 5-8 comprises a single peak 210 instead of the pair of valleys 110 in the embodiment illustrated in Figures 1-4. Otherwise, the embodiment shown in Figures 5-8 may be used in a manner similar to that described above with respect to Figures 1-4.

While this invention has been described with reference to illustrative embodiments and examples, the description is not intended to be construed in a limiting sense. Thus, various modifications of the illustrative embodiments, as well as other embodiments of the invention, will be apparent to persons skilled in the art

upon reference to this description. For example, it is possible to reverse the arrangement of electrical connectors and electrical receptacles in the illustrated embodiments – i.e., the electrical connectors would be disposed in electrical connection base unit 150,250 and the electrical receptacles would be disposed in electrical connection base unit 100,200. Also, it is possible to have a mixture of electrical connectors and electrical receptacles on electrical connection base unit 100,200 and a complementary mixture of electrical connectors and electrical receptacles on electrical connection base unit 150,250. Yet another possible modification of the illustrated embodiments relates to disposed the electrical connectors such that the longitudinal axis thereof is substantially orthogonal to the longitudinal axis of the radiation lamp (i.e.,  $\alpha \approx 90^\circ$  and  $\beta \approx 90^\circ$ ). Yet another modification of the illustrated embodiments relates to the use of electrical connection bases that, in cross-section contain no peaks or valleys. It is therefore contemplated that the appended claims will cover any such modifications or embodiments.

All publications, patents and patent applications referred to herein are incorporated by reference in their entirety to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated by reference in its entirety.

What is claimed is:

1. A lamp device comprising a longitudinal axis, a first elongate electrical connector and a second elongate electrical connector, each of the first elongate electrical connector and the second elongate connector being non-parallel with respect  
5 to the longitudinal axis.
2. The lamp device defined in Claim 2, wherein the first elongate electrical connector and the second elongate electrical connector are substantially parallel with respect to one another.
3. The lamp device defined in any one of Claims 1-2, wherein the first elongate  
10 electrical connector and the second elongate connector are in a spaced relationship along the longitudinal axis.
4. The lamp device defined in any one of Claims 1-2, wherein the first elongate electrical connector and the second elongate electrical connector are aligned in a spaced relationship along the longitudinal axis.
- 15 5. The lamp device defined in any one of Claims 1-4, wherein the first elongate electrical connector and the second elongate connector are disposed in a base portion at one end of the lamp device.
6. The lamp device defined in Claim 4, wherein a cross-section of the base portion containing the longitudinal axis comprises an undulating shape.
- 20 7. The lamp device defined in Claim 4, wherein a cross-section of the base portion containing the longitudinal axis comprises at least one peak and at least one valley.
8. The lamp device defined in Claim 7, wherein the first elongate electrical connector and the second elongate electrical connector are offset with regard to the at  
25 least one peak or the at least one valley.

9. The lamp device defined in Claim 7, wherein the first elongate electrical connector and the second elongate electrical connector are offset with regard to both of the at least one peak and the at least one valley.
10. The lamp device defined in Claim 4, wherein a cross-section of the base  
5 portion containing the longitudinal axis comprises a single peak and a single valley.
11. The lamp device defined in Claim 10, wherein the first elongate electrical connector and the second elongate electrical connector are offset with regard to the single peak or the single valley.
12. The lamp device defined in Claim 10, wherein the first elongate electrical  
10 connector and the second elongate electrical connector are offset with regard to both of the single peak and the single valley.
13. The lamp device defined in Claim 4, wherein a cross-section of the base portion containing the longitudinal axis comprises at a plurality of peaks and a plurality of valleys.
14. The lamp device defined in Claim 13, wherein the first elongate electrical  
15 connector and the second elongate electrical connector are offset with regard to the plurality of peaks or the plurality of valleys.
15. The lamp device defined in Claim 13, wherein the first elongate electrical connector and the second elongate electrical connector are offset with regard to both  
20 of the plurality of peaks and the plurality of valleys.
16. The lamp device defined in any one of Claims 1-15, further comprising an elongate radiation emitting cavity comprising the longitudinal axis.
17. The lamp device defined in Claim 16, wherein the first elongate electrical connector and the second elongate connector are angled toward the elongate radiation  
25 emitting cavity.

18. The lamp device defined in Claim 16, wherein the first elongate electrical connector and the second elongate connector are angled away from the elongate radiation emitting cavity.
19. The lamp device defined in Claim 16, wherein the first elongate electrical  
5 connector and the second elongate connector are disposed in an orthogonal relationship with respect to the longitudinal axis.
20. The lamp device defined in any one of Claims 1-19, wherein at least one of the first elongate electrical connector and the second elongate electrical connector comprises a male portion of a male-female connection system.
- 10 21. The lamp device defined in any one of Claims 1-19, wherein both of the first elongate electrical connector and the second elongate electrical connector comprises a male portion of a male-female connection system.
22. The lamp device defined in any one of Claims 1-19, wherein at one of the first elongate electrical connector and the second elongate electrical connector comprises a  
15 male portion of a male-female connection system and the other of the first elongate electrical connector and the second elongate electrical connector comprises a female portion of a male-female connection system.
23. The lamp device defined in any one of Claims 1-19, wherein both of the first elongate electrical connector and the second elongate electrical connector comprises a  
20 female portion of a male-female connection system.
24. The lamp device defined in any one of Claims 1-24, comprising a pair of first elongate electrical connectors and a pair of second elongate electrical connectors.
25. The lamp device defined in Claim 24, wherein the pair of first elongate electrical connectors are in substantial alignment along a line orthogonal to the  
25 longitudinal axis.

26. The lamp device defined in Claim 24, wherein the pair of second elongate electrical connectors are in substantial alignment along a line orthogonal to the longitudinal axis.

27. The lamp device defined in Claim 24, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are in substantial alignment along a line orthogonal to the longitudinal axis.

28. A radiation lamp comprising: an elongate radiation-emitting cavity having a longitudinal axis; a first electrical connection base disposed at a first end of the elongate radiation-emitting cavity; a pair of first elongate electrical connectors and a pair of second elongate electrical connectors disposed in the first electrical connection base; each of the first elongate electrical connector and the second elongate connector being non-parallel with respect to the longitudinal axis.

29. The radiation lamp defined in Claim 28, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are substantially parallel with respect to one another.

30. The radiation lamp defined in any one of Claims 28-29, wherein the pair of first elongate electrical connectors and the pair of second elongate connectors are in a spaced relationship along the longitudinal axis.

31. The radiation lamp defined in any one of Claims 28-29, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are aligned in a spaced relationship along the longitudinal axis.

32. The radiation lamp defined in any one of Claims 28-31, wherein a cross-section of the first electrical connection base portion containing the longitudinal axis comprises an undulating shape.

33. The radiation lamp defined in any one of Claims 28-31, wherein a cross-section of the first electrical connection base portion containing the longitudinal axis comprises at least one peak and at least one valley.

34. The radiation lamp defined in Claim 33, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to the at least one peak or the at least one valley.

35. The radiation lamp defined in Claim 33, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to both of the at least one peak and the at least one valley.

36. The radiation lamp defined in any one of Claims 28-31, wherein a cross-section of the first electrical connection base portion containing the longitudinal axis comprises a single peak and a single valley.

37. The radiation lamp defined in Claim 36, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to the single peak or the single valley.

38. The radiation lamp defined in Claim 36, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to both of the single peak and the single valley.

39. The radiation lamp defined in any one of Claims 28-31, wherein a cross-section of the first electrical connection base portion containing the longitudinal axis comprises a plurality of peaks and a plurality of valleys.

40. The radiation lamp defined in Claim 39, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to the plurality of peaks or the plurality of valleys.

41. The radiation lamp defined in Claim 39, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are offset with regard to both of the plurality of peaks and the plurality of valleys.

42. The radiation lamp defined in any one of Claims 28-41, wherein the elongate radiation emitting cavity comprises an ultraviolet radiation-emitting cavity.

43. The radiation lamp defined in any one of Claims 28-42, wherein the pair of first elongate electrical connectors and the pair of second elongate connectors are angled toward the elongate radiation emitting cavity.

44. The radiation lamp defined in any one of Claims 28-42, wherein the pair of first elongate electrical connectors and the pair of second elongate connectors are angled away from the elongate radiation emitting cavity.

45. The radiation lamp defined in any one of Claims 28-42, wherein the pair of first elongate electrical connectors and the pair of second elongate connectors are disposed in an orthogonal relationship with respect to the longitudinal axis.

46. The radiation lamp defined in any one of Claims 28-45, wherein at least one of the pair of first elongate electrical connectors comprises a male portion of a male-female connection system.

47. The radiation lamp defined in any one of Claims 28-45, wherein each of the pair of first elongate electrical connectors comprises a male portion or a female portion of a male-female connection system.

48. The radiation lamp defined in any one of Claims 28-45, wherein at least one of the pair of second elongate electrical connectors comprises a male portion of a male-female connection system.

49. The radiation lamp defined in any one of Claims 28-45, wherein each of the pair of second elongate electrical connectors comprises a male portion of a male-female connection system.

50. The radiation lamp defined in any one of Claims 28-45, wherein the pair of the first elongate electrical connectors and the pair of the second elongate electrical connector each comprises a male portion of a male-female connection system.

51. The radiation lamp defined in any one of Claims 28-45, wherein one of the pair of first elongate electrical connectors and the pair of second elongate electrical connectors comprises a male portion of a male-female connection system and the

other of the pair of first elongate electrical connectors and the pair of second elongate electrical connectors comprises a female portion of a male-female connection system.

52. The radiation lamp defined in any one of Claims 28-45, wherein at least one of the pair of second elongate electrical connectors comprises a female portion of a male-female connection system.

53. The radiation lamp defined in any one of Claims 28-45, wherein each of the pair of second elongate electrical connectors comprises a female portion of a male-female connection system.

54. The radiation lamp defined in any one of Claims 28-45, wherein the pair of the first elongate electrical connectors and the pair of the second elongate electrical connector each comprises a female portion of a male-female connection system.

55. The radiation lamp defined in Claim 28-54, wherein the pair of first elongate electrical connectors are in substantial alignment along a line orthogonal to the longitudinal axis.

56. The radiation lamp defined in Claim 28-54, wherein the pair of second elongate electrical connectors are in substantial alignment along a line orthogonal to the longitudinal axis.

57. The radiation lamp defined in Claim 28-54, wherein the pair of first elongate electrical connectors and the pair of second elongate electrical connectors are in substantial alignment along a line orthogonal to the longitudinal axis.

58. A radiation source assembly comprising the lamp device defined in any one of Claims 1-27, together with a radiation transparent protective sleeve.

59. A radiation source assembly comprising the radiation lamp defined in any one of Claims 28-57, together with a radiation transparent protective sleeve.

60. The radiation source assembly defined in Claim 59, further comprising a second electrical connection base for engagement with the first electrical connection base and connection to a power supply.

61. The radiation source assembly defined in Claim 60, wherein the first electrical connection base and the second electrical connection base have a substantially complementary shape.

62. The radiation source assembly defined in any one of Claims 60-61, wherein the first electrical connection base and the second electrical connection base are reversibly engageable.

63. The radiation source assembly defined in any one of Claims 60-61, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a direction transverse to the longitudinal axis of the radiation lamp.

64. The radiation source assembly defined in any one of Claims 60-61, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a non-rotational direction transverse to the longitudinal axis of the radiation lamp.

65. The radiation source assembly defined in any one of Claims 60-61, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an acutely angled direction with respect to the longitudinal axis of the radiation lamp.

66. The radiation source assembly defined in any one of Claims 60-61, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an orthogonal direction with respect to the longitudinal axis of the radiation lamp.

67. A radiation source module comprising the radiation lamp defined in any one of Claims 28-54 and a first support member for supporting the radiation lamp, the first

support member comprising a second electrical connection base for engagement with the first electrical connection base and connection to a power supply.

68. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base have a substantially complementary shape.

69. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base are reversibly engageable.

70. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a direction transverse to the longitudinal axis of the radiation lamp.

71. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a non-rotational direction transverse to the longitudinal axis of the radiation lamp.

72. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an acutely angled direction with respect to the longitudinal axis of the radiation lamp.

73. The radiation source module defined in Claim 67, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an orthogonal direction with respect to the longitudinal axis of the radiation lamp.

74. The radiation source module defined in any one of Claims 67-73, comprising a plurality of said radiation lamps.

75. The radiation source module defined in any one of Claims 67-74, further comprising a second support member for supporting a second end of the radiation lamp.

76. The radiation source module defined in Claim 75, further comprising a third support member interconnecting the first support member and the second support member.

77. A radiation source module comprising the radiation source assembly defined in any one of Claims 59-66 and a first support member for supporting a first end of the radiation transparent protective sleeve.

78. A radiation source module comprising the radiation lamp defined in any one of Claims 28-58, a radiation transparent protective sleeve surrounding the elongate radiation-emitting cavity, a first support member for supporting a first end of the protective sleeve and a second electrical connection base for engagement with the first electrical connection base and connection to a power supply.

79. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base have a substantially complementary shape.

80. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base are reversibly engageable.

81. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a direction transverse to the longitudinal axis of the radiation lamp.

82. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in a non-rotational direction transverse to the longitudinal axis of the radiation lamp.

83. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an acutely angled direction with respect to the longitudinal axis of the radiation lamp.

84. The radiation source module defined in Claim 78, wherein the first electrical connection base and the second electrical connection base are reversibly disengageable in an orthogonal direction with respect to the longitudinal axis of the radiation lamp.

5 85. The radiation source module defined in any one of Claims 78-84, comprising a plurality of pairs of radiation lamps and radiation transparent protective sleeves.

86. The radiation source module defined in any one of Claims 78-85, further comprising a second support member for supporting a second end of the radiation transparent protective sleeve.

10 87. The radiation source module defined in Claim 86, further comprising a third support member interconnecting the first support member and the second support member.

88. A fluid treatment system comprising the lamp device defined in any one of Claims 1-27.

15 89. A fluid treatment system comprising the radiation lamp defined in any one of Claims 28-57.

90. A fluid treatment system comprising the radiation source assembly defined in any one of Claims 58-66.

20 91. A fluid treatment system comprising the radiation source module defined in any one of Claims 67-89.

92. A water disinfection system comprising the lamp device defined in any one of Claims 1-27.

93. A water disinfection system comprising the radiation lamp defined in any one of Claims 28-57.

94. A water disinfection system comprising the radiation source assembly defined in any one of Claims 58-66.

95. A water disinfection system comprising the radiation source module defined in any one of Claims 67-89.

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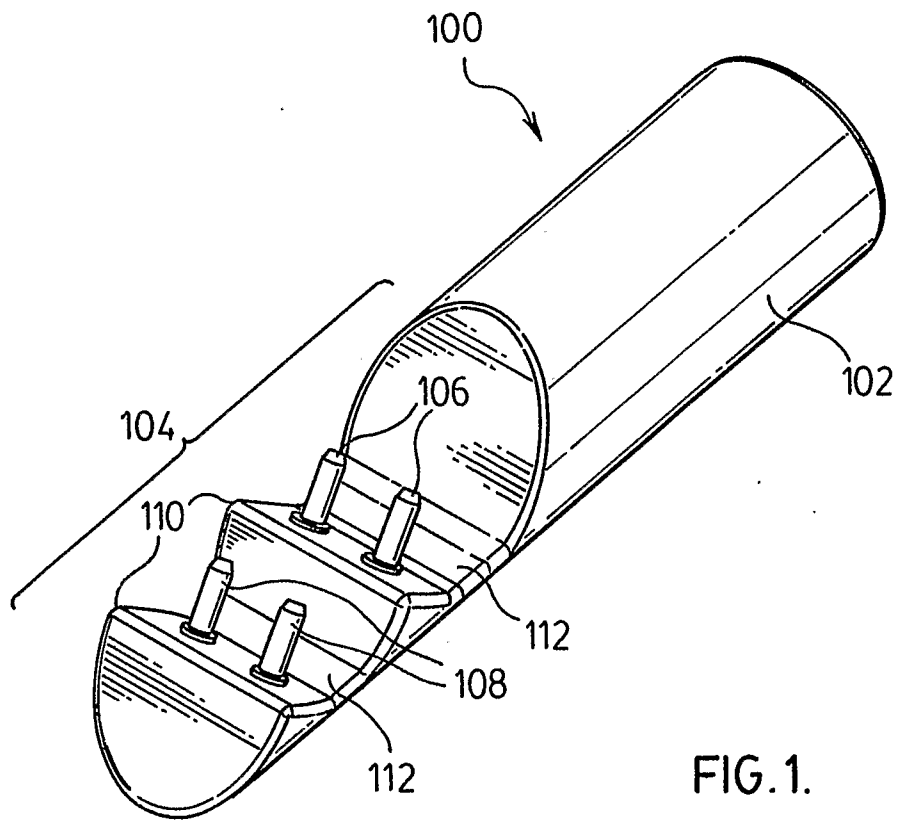
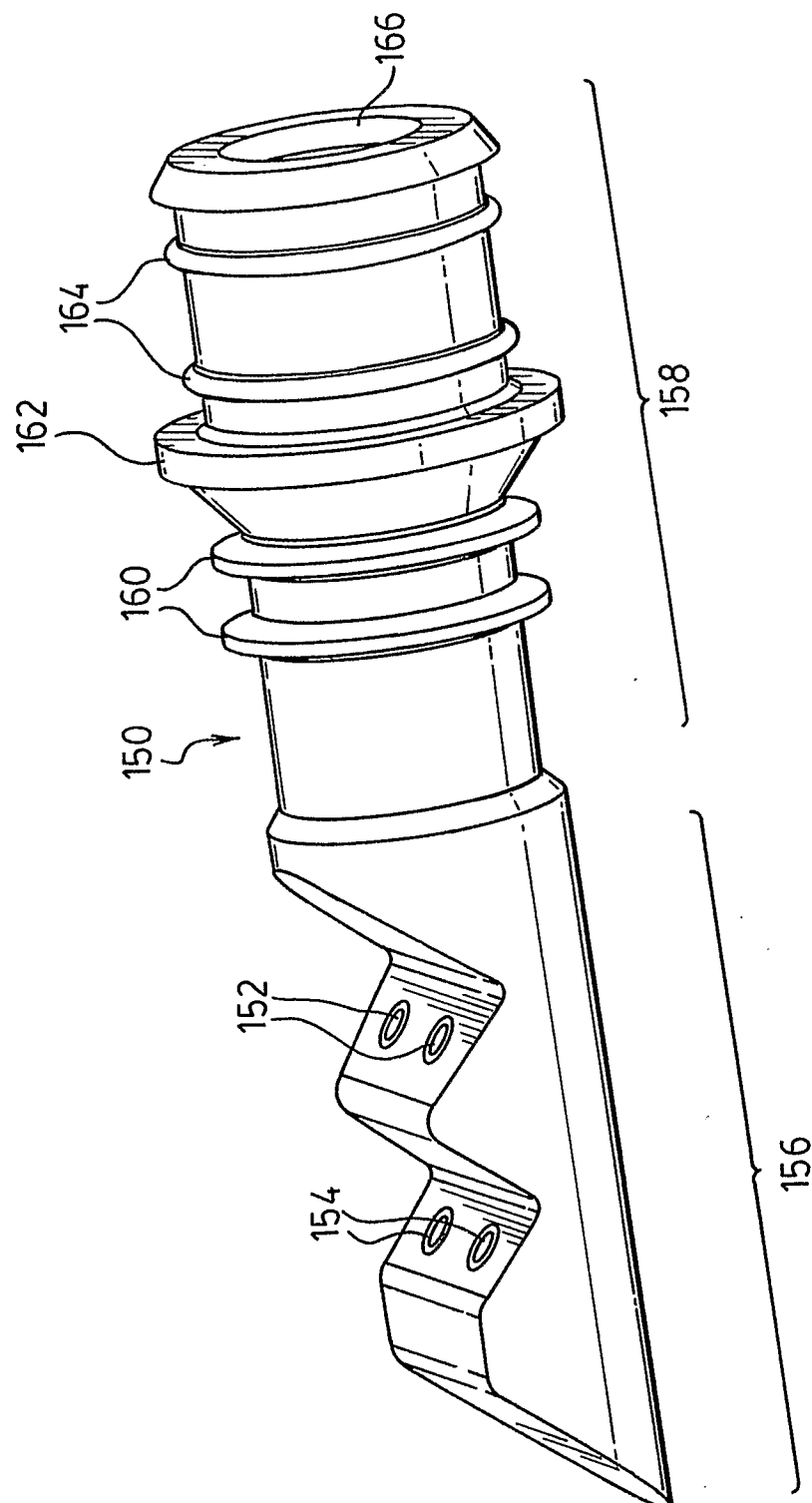


FIG.1.

2/8



3/8

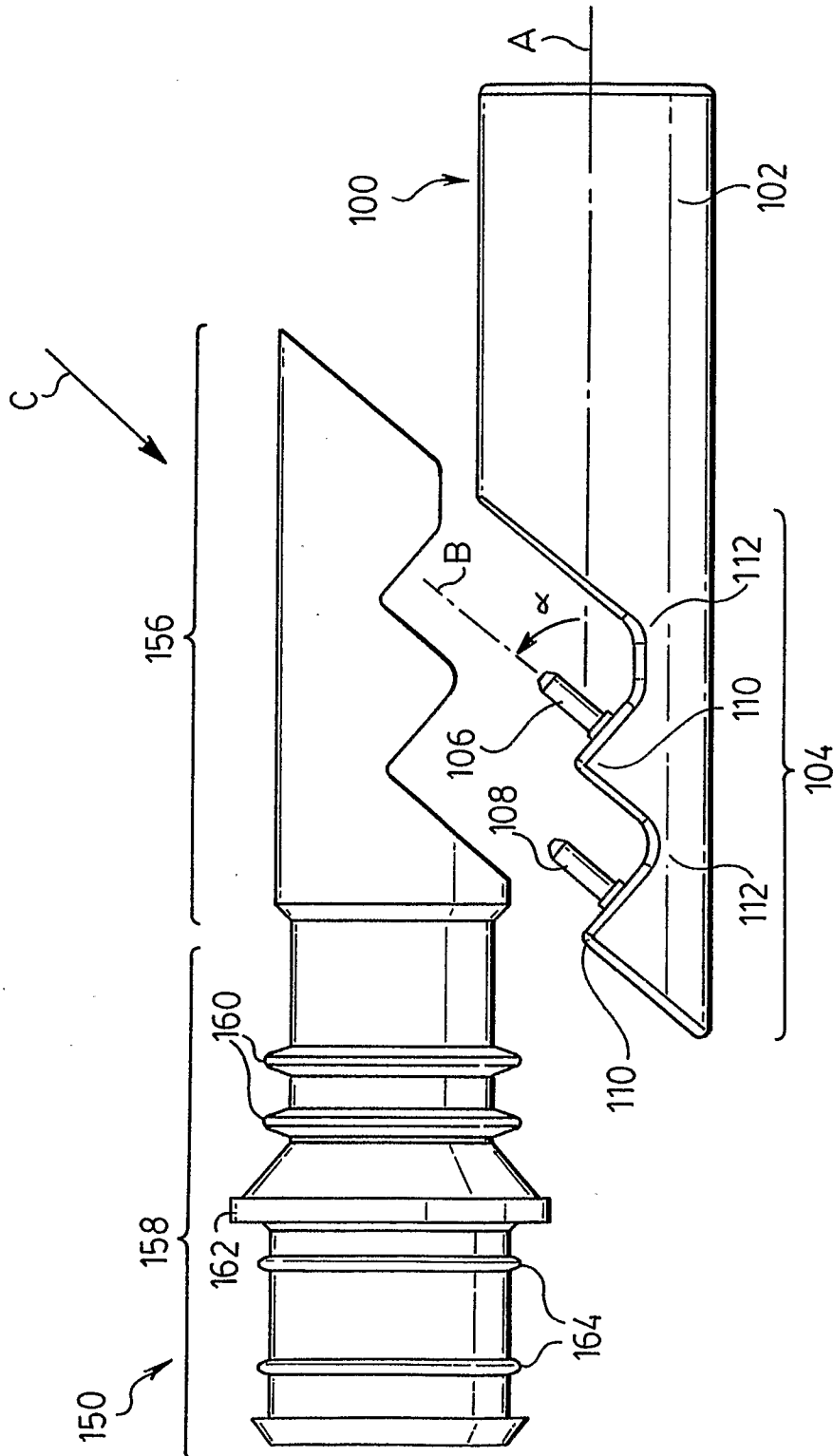
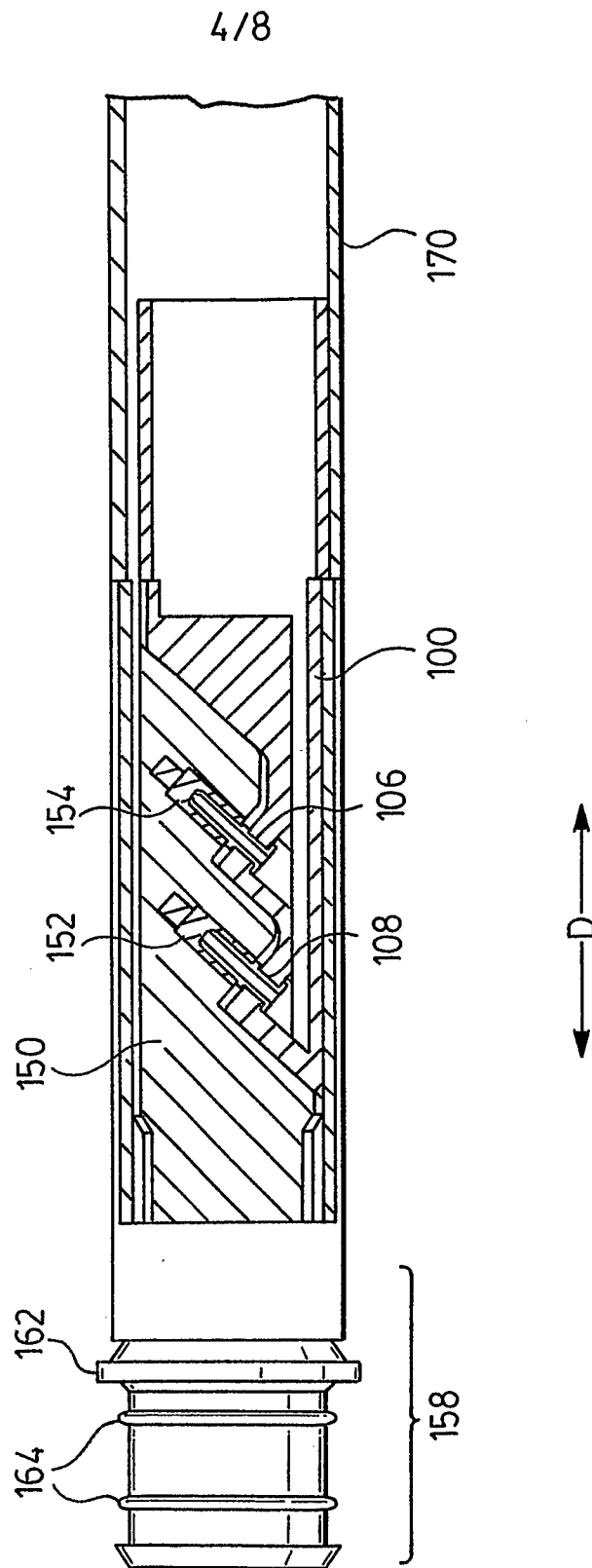
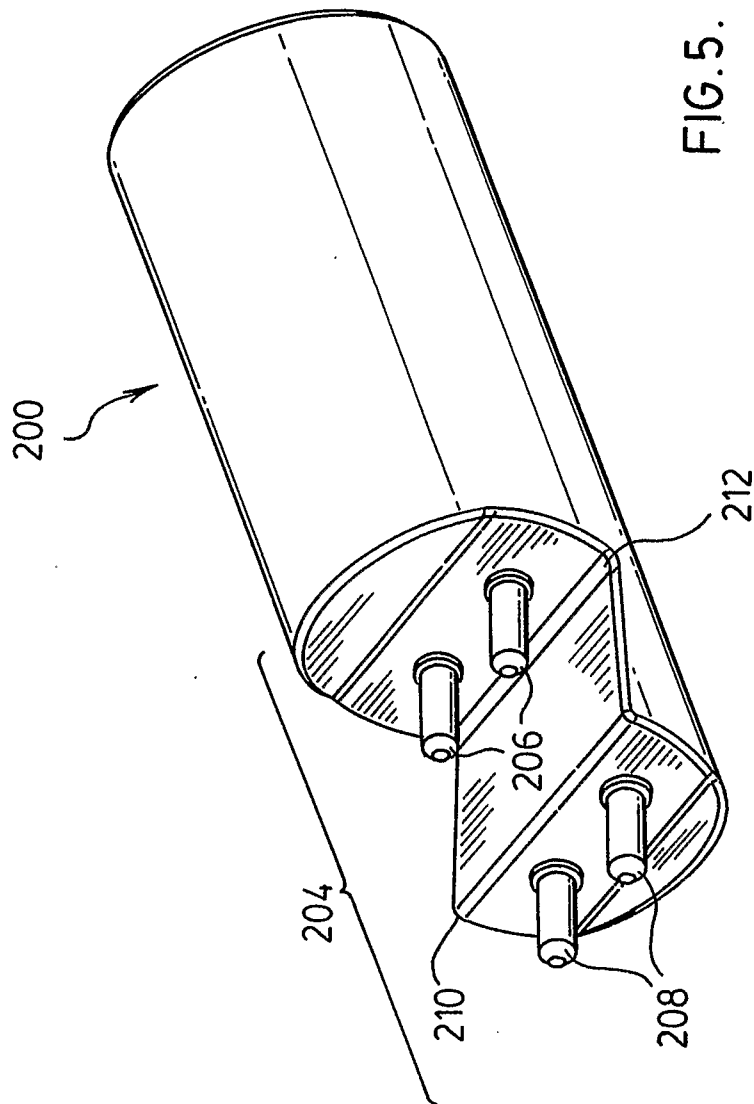


FIG. 3.

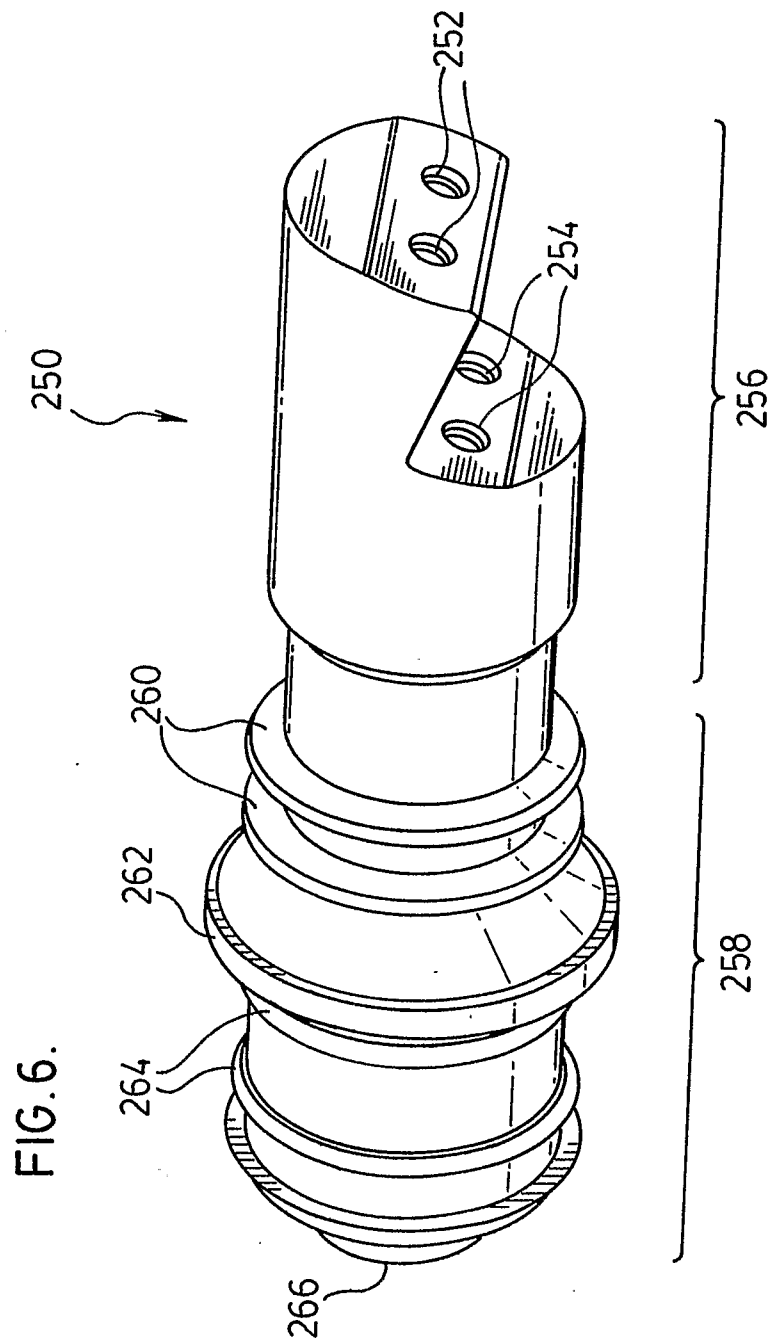
FIG. 4.

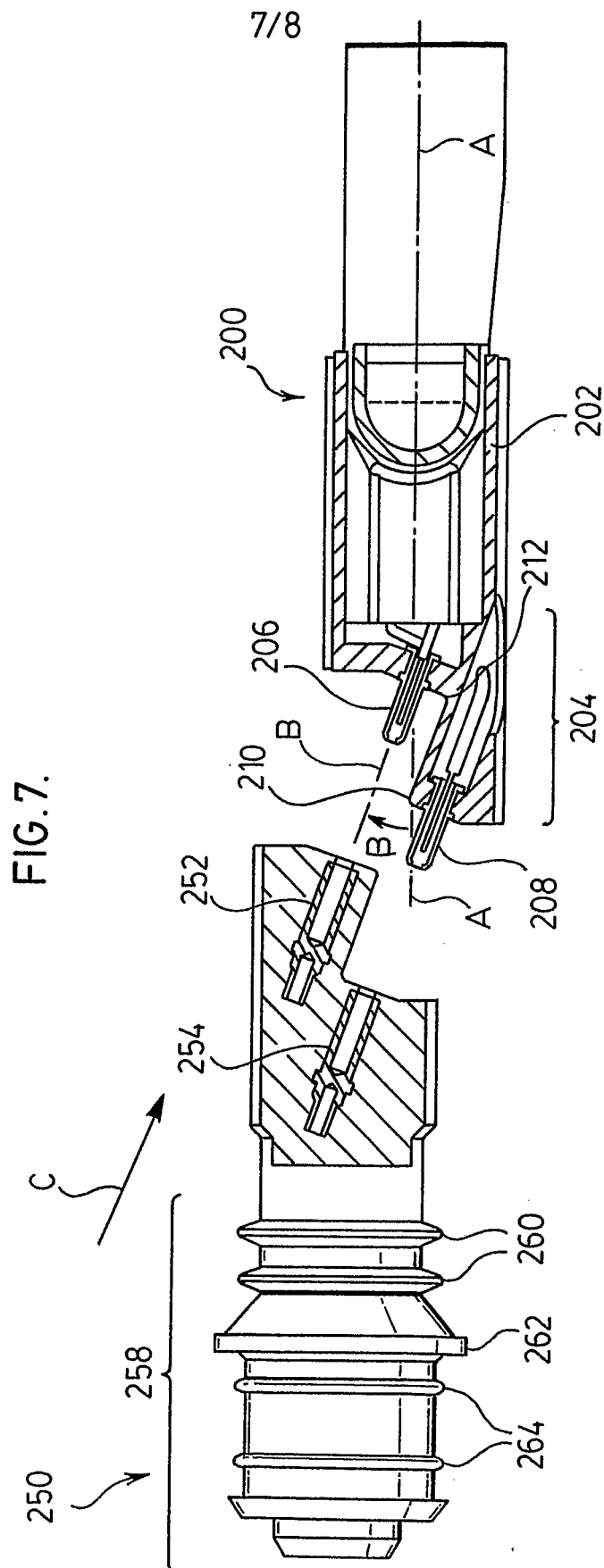


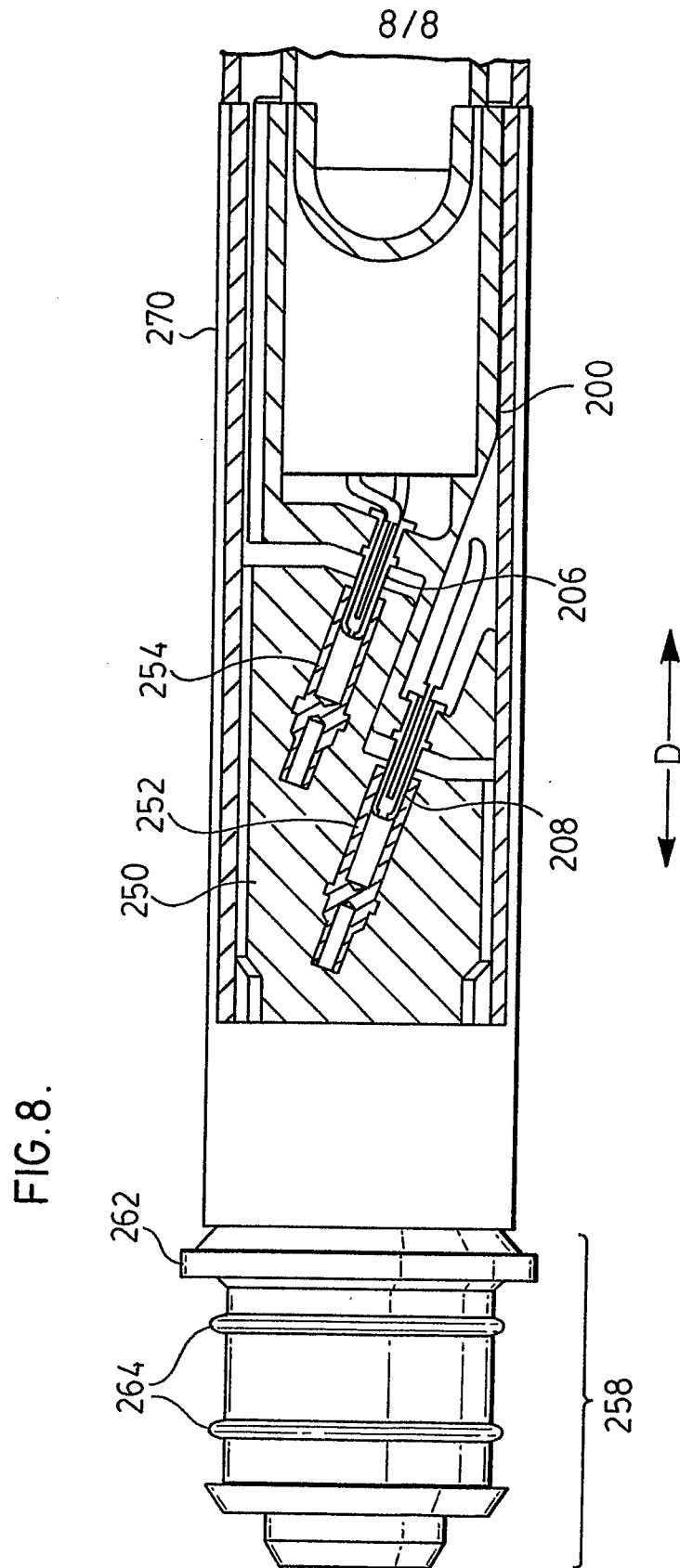
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CA2006/001040

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: **H01J 5/50** (2006.01) , **F21V 23/06** (2006.01) , **A61L 2/10** (2006.01) , **H01J 61/36** (2006.01)

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: H01J 5/50 (2006.01) , F21V 23/06 (2006.01) , A61L 2/10 (2006.01) , H01J 61/36 (2006.01)

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

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

Canadian Patent Database, Delphion, Inspec, USPTO West. Search terms: lamp connector, wall lamp, longitudinal axis, electrical connector, parallel connectors, fluid treatment.

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                             | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | US 6254252 (COUSHAIN ET AL)<br>03 Jul 2001 (03-07-2001). Abstract, col. 3, lines 14 to 35 and Figs. 1-2.                                       | 1-7, 16, 19-21.       |
| X         | US 6488510 (LI)<br>03 Dec 2002 (03-12-2002). Col. 2, line 63 to col. 3, line 8, Figs. 1-2.                                                     | 1-7, 10, 16, 19-21.   |
| X         | US 2002/0168881 (HWANG ET AL)<br>14 Nov 2002 (14-11-2002). Abstract, paragraph [0011], page 1, to paragraph [0017], page 2, Figs. 3, 4A to 4H. | 1-7, 16, 19-21.       |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
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| * Special categories of cited documents :                                                                                                                               | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                                              |
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| "E" earlier application or patent but published on or after the international filing date                                                                               | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
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| "O" document referring to an oral disclosure, use, exhibition or other means                                                                                            |                                                                                                                                                                                                                                                  |
| "P" document published prior to the international filing date but later than the priority date claimed                                                                  |                                                                                                                                                                                                                                                  |

Date of the actual completion of the international search

16 October 2006 (16-10-2006)

Date of mailing of the international search report

7 November 2006 (07-11-2006)

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/CA2006/001040**

| Patent Document<br>Cited in Search Report | Publication<br>Date | Patent Family<br>Member(s)                     | Publication<br>Date                    |
|-------------------------------------------|---------------------|------------------------------------------------|----------------------------------------|
| US6254252                                 | 03-07-2001          | DE10023428 A1<br>NL1015176 A1<br>NL1015176C C2 | 01-02-2001<br>20-11-2000<br>08-10-2001 |
| US6488510                                 | 03-12-2002          | NONE                                           |                                        |
| US2002168881                              | 14-11-2002          | US6843656 B2                                   | 18-01-2005                             |