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Ciancanelli et al.

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(54) **ULTRAVIOLET LAMP FOR USE IN WATER PURIFIERS**

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(51) **Int. Cl.**
H01J 9/03 (2006.01)
(52) **U.S. Cl.** **439/617**; 439/677; 439/934;
250/436; 313/318.06
(58) **Field of Classification Search** 439/617,
439/677, 934; 313/318.02, 318.06; 250/436,
250/504 R

See application file for complete search history.

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(57) **ABSTRACT**

A lamp is provided having terminal pins mounted on and extending outwardly along a longitudinal axis of an end cap of the lamp. The pins are offset relative to one another along the longitudinal axis. The end cap has semi-circular, parallel surfaces at one end, and the pins extend outwardly from the respective semi-circular, parallel surfaces. A barrier wall extends substantially perpendicularly between the semi-circular surfaces. In a first embodiment, a male extension member extends outwardly from the barrier wall along at least a portion of the lower semi-circular surface. This male extension is coextensive with the upper semi-circular surface. Alternatively, in a second embodiment, a female recess is provided through the boundary wall. This recess again extends between the upper and lower semi-circular surfaces.

22 Claims, 5 Drawing Sheets

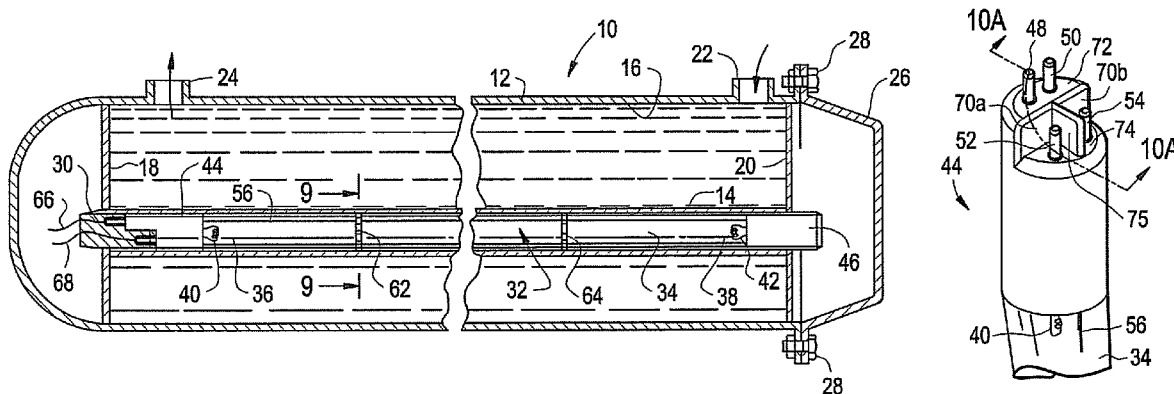


FIG. 1
PRIOR ART

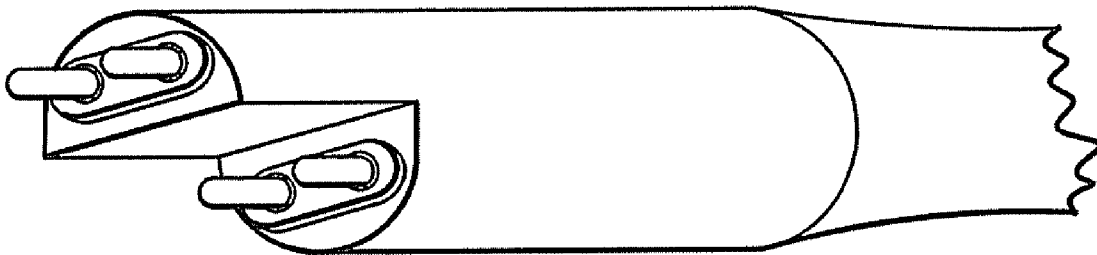


FIG. 2
PRIOR ART

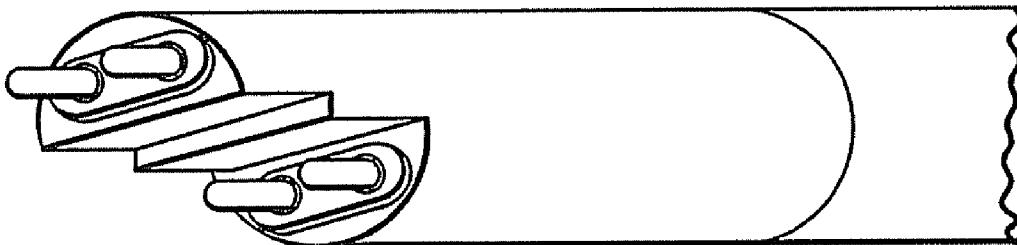


FIG. 7
PRIOR ART

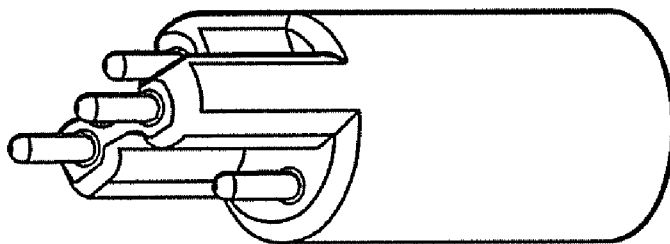


FIG. 6
PRIOR ART

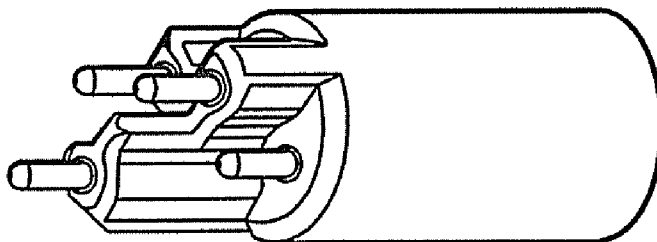


FIG. 5
PRIOR ART

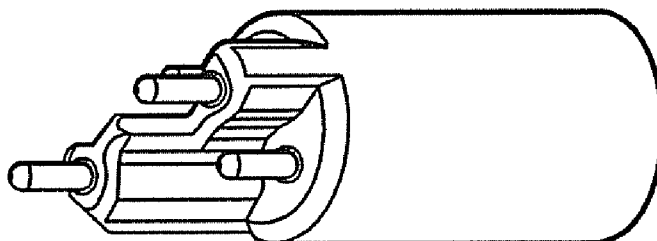


FIG. 4
PRIOR ART

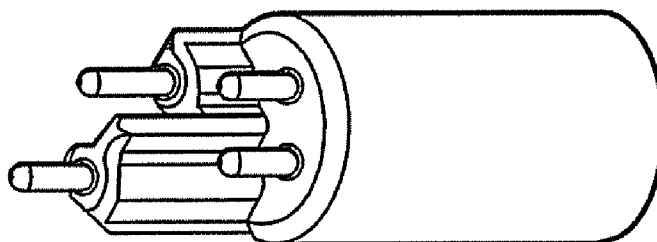


FIG. 3
PRIOR ART

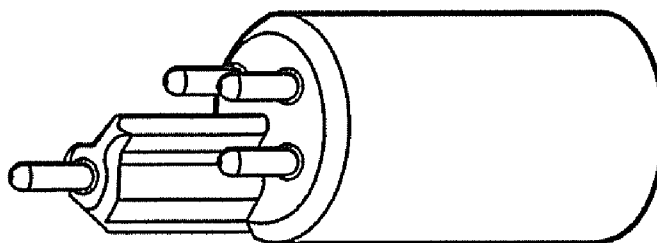


FIG. 8

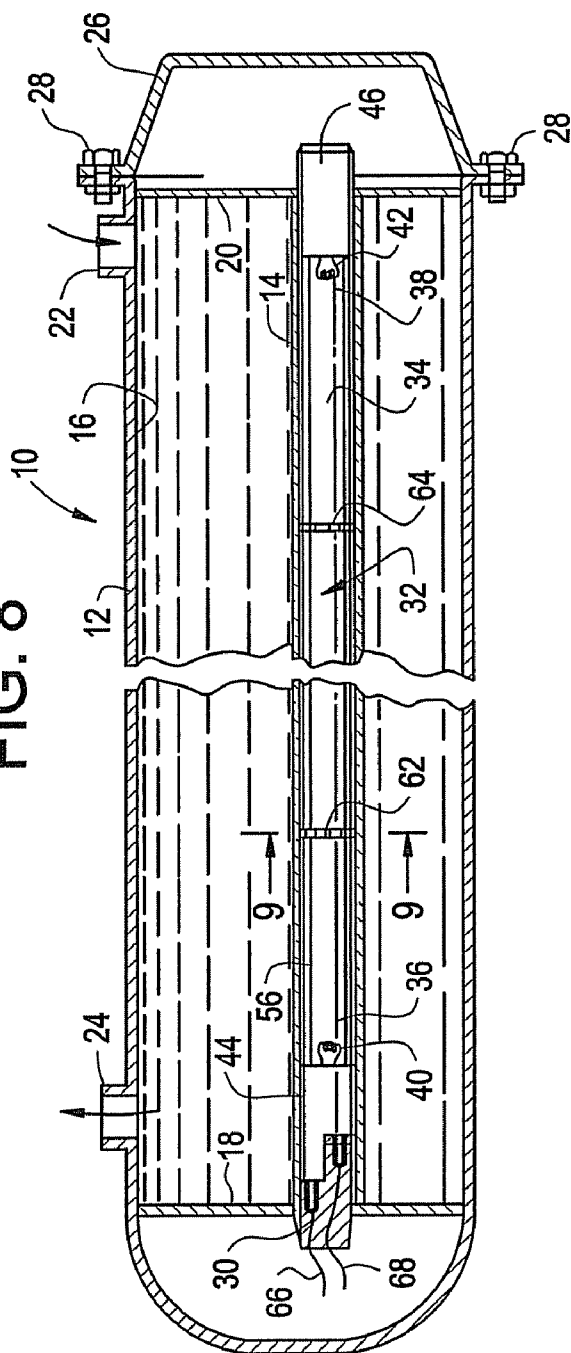


FIG. 9

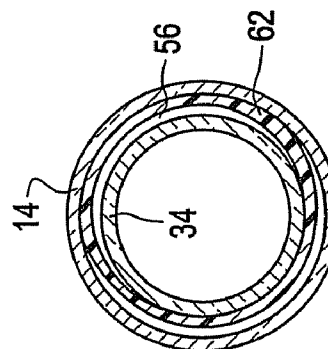


FIG. 10A

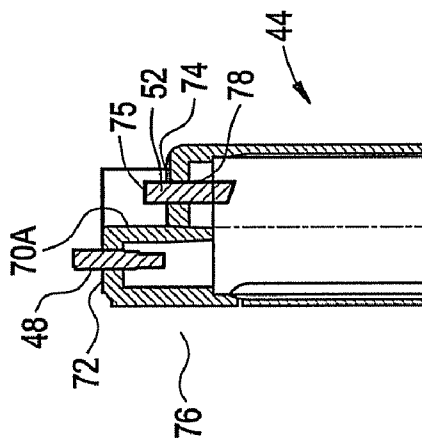


FIG. 10

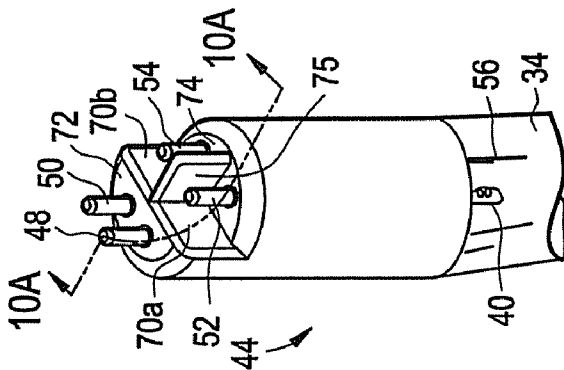


FIG. 11

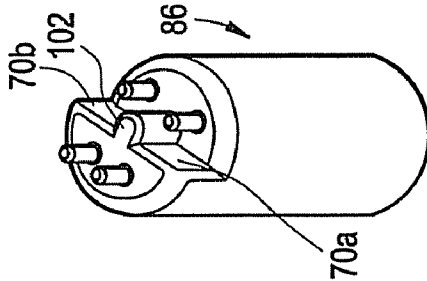


FIG. 12

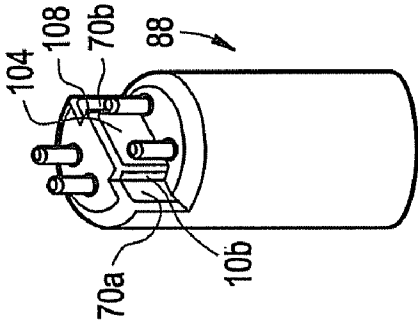


FIG. 13

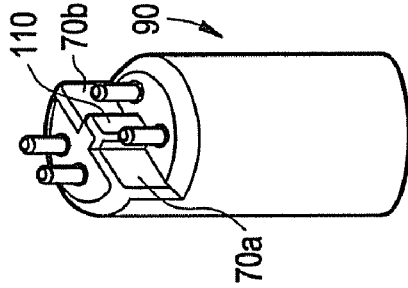


FIG. 14

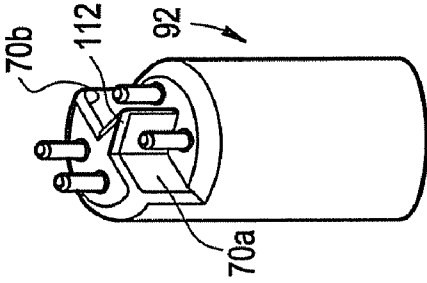


FIG. 15

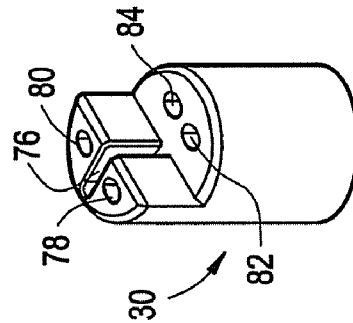


FIG. 16

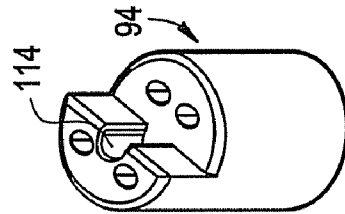


FIG. 17

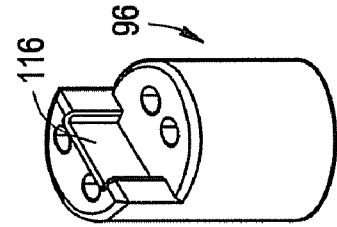


FIG. 18

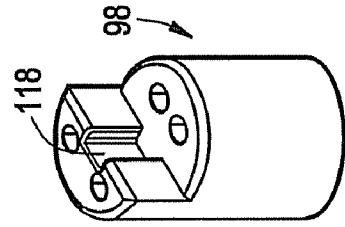


FIG. 19

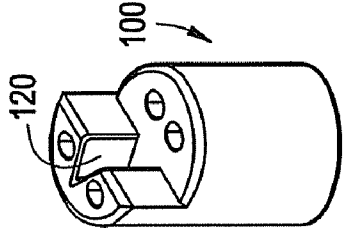


FIG. 20

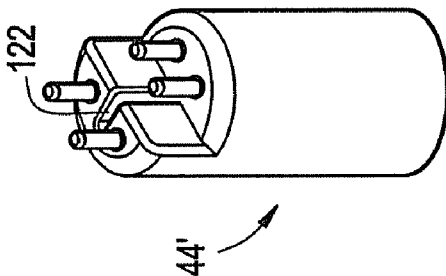


FIG. 21

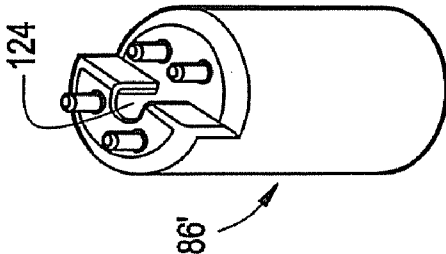


FIG. 22

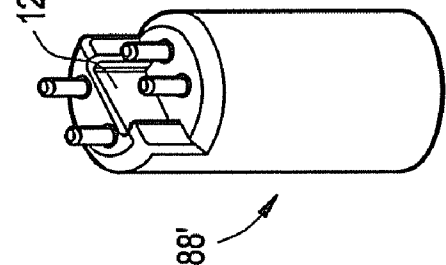


FIG. 23

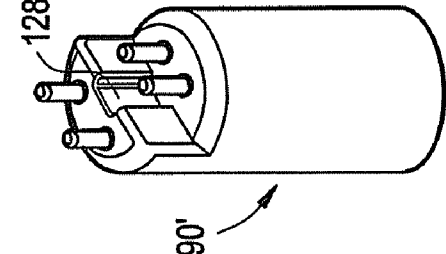


FIG. 24

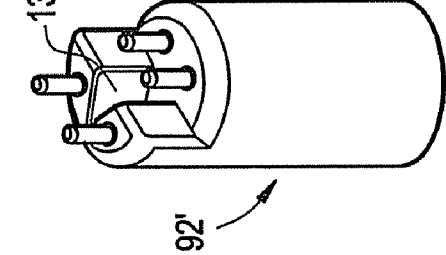


FIG. 25

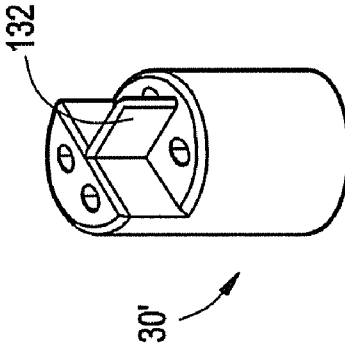


FIG. 26

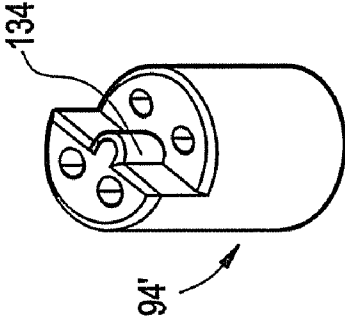


FIG. 27

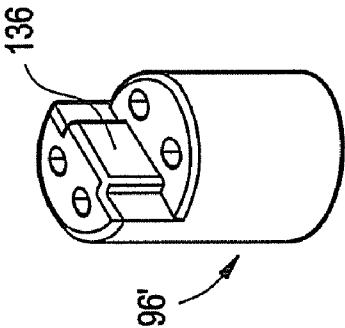


FIG. 28

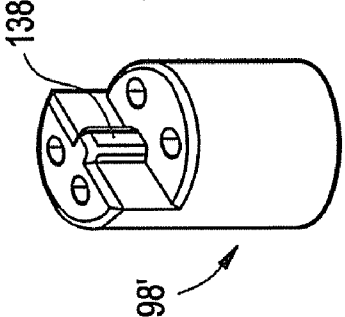
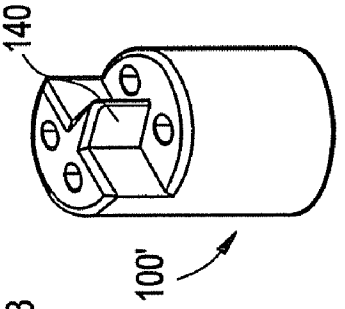


FIG. 29



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ULTRAVIOLET LAMP FOR USE IN WATER PURIFIERS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of the date of the earlier filed provisional application, U.S. Provisional Application No. 60/777,213, filed on Feb. 27, 2006, the contents of which are incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to improvements in lamps, especially ultraviolet lamps used in air and water purifiers.

2. Description of Related Art

Ultraviolet air and water or other liquid purifiers are known for disinfecting contaminated air or water or other liquid for domestic or commercial use. Such purifiers include at least one lamp for emitting ultraviolet radiation into a chamber filled with contaminated air or water or other liquid to kill microorganisms therein. In conventional manner, the lamp includes two electrodes spaced apart within an elongated arc tube containing a gas, particularly mercury vapor with or without additives. A pair of end caps are mounted at the ends of the tube. Each electrode contains two lead wires from the lamp seal each of which, or in some instances only one, are electrically connected to respective contact(s) or terminal pin(s). The lamp is typically inserted endwise into a sleeve installed in the water, other liquid or air purifier with or without the sleeve. To simplify insertion and electrical connection, the pins are conveniently mounted on one of the end caps. When the electrodes are energized by voltage from an electrical power supply, an electrical discharge is initiated in the gas between the electrodes. This discharge reacts with a layer of a radiation-emitting material coated on an interior surface of the arc tube and causes ultraviolet radiation to be emitted from the lamp in a manner well known in the art.

An example of an ultraviolet lamp of the type described above is disclosed in U.S. Pat. No. 5,166,527 ('527), all of the contents of which are incorporated herein by reference. The '527 patent discloses a lamp, especially useful as an ultraviolet lamp for use in a water purifier, comprising an elongated, hollow arc tube extending along a longitudinal axis between opposite end regions. The tube contains a gas, preferably mercury vapor with or without additives. A pair of electrodes is spaced apart along the longitudinal axis. The electrodes are respectively mounted within the arc tube at the end regions thereof. A pair of end caps is respectively mounted at the end regions of the arc tube. A first electrical contact or pair of electrical contacts or terminal pins extends in mutual parallelism along the longitudinal axis and is electrically connected to one or both of the electrode lead wires. A second electrical contact or pair of electrical contacts or terminal pins extends in mutual parallelism along the longitudinal axis and is electrically connected to one or both of the other of the electrode lead wires. Both pairs of pins are mounted on, and extend outwardly along the longitudinal axis of, one of the end caps. A wire conductor is, or two wire conductors are, located exteriorly of the tube and electrically connected to one pin or one pair of pins at one end region of the tube, as well as to the electrode at the other end region of the tube.

Two embodiments, of the lamp disclosed in the '527 patent are shown in prior art FIGS. 1 and 2. As shown in FIGS. 1 and 2, the pairs of pins are offset relative to each other along the longitudinal axis. This offset resists the formation of an elec-

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trical arc between the pairs of pins exteriorly of the arc tube, especially in the presence of the moisture-laden, humid environment of the water purifier.

Still referring to prior art FIGS. 1 and 2, the one end cap has a stepped outer end wall having a pair of wall portions lying in mutual parallelism in planes generally perpendicular to the longitudinal axis. The first pair of pins is supported on, and extends through, one of the end wall portions for a predetermined distance, and the second pair of pins is supported on, and extends through, the other of the end wall portions for the same predetermined distance. The planes of the end wall portions are spaced apart by a predetermined spacing larger than said predetermined distance in order to still further prevent electrical arcing between the pairs of pins exteriorly of the arc tube. A barrier wall internally of the one end cap physically separates the electrical connections to the two pairs of pins to resist the formation of an electrical arc between the pairs of pins interiorly of the one end cap. The barrier wall is advantageously made of the same non-conductive material as the one end cap.

In addition to the two-tiered stepped bases of the '527 patent, other multi-tiered bases have been manufactured including those bases shown in prior art FIGS. 3-7.

Although well-suited for their intended purposes, there continues to be a need for improved lamp base designs, particularly ultraviolet lamps.

SUMMARY OF THE INVENTION

In accordance with the present invention, a lamp is provided having terminal pins mounted on and extending outwardly along a longitudinal axis of an end cap of the lamp. The pins are offset relative to one another along the longitudinal axis. The end cap has semi-circular, parallel surfaces at one end, and the pins extend outwardly from the respective semi-circular, parallel surfaces. A barrier wall extends substantially perpendicularly between the semi-circular surfaces. In a first embodiment, a male extension member extends outwardly from the barrier wall along at least a portion of the lower semi-circular surface. This male extension is coextensive with the upper semi-circular surface. Alternatively, in a second embodiment, a female recess is provided through the boundary wall. This recess again extends between the upper and lower semi-circular surfaces.

The above-described end cap configuration for the lamp of this invention may be mated to a complimentary shaped receptacle. It will be appreciated that if the male member embodiment is used in the end cap of the lamp, a complimentary shaped receptacle will be the inverse (that is, a female configuration). Similarly, if the female type end cap is utilized as the lamp end cap, the complimentary receptacle will have a male extension.

The utilization of the male or female configuration along the boundary wall in accordance with the present invention leads to improved lamp configurations in that polarization between the pairs of pins are more easily ensured; and the mating of the end cap and receptacle may be stronger. The designs will further allow for matching of the lamp and connector to a specific power supply to reduce the chances of connecting an ultraviolet lamp into an improperly matched power supply.

The lamp of this invention is preferably an ultraviolet lamp and finds particular application for use in a water, other liquid, or air purifier.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

FIGS. 1-7 are respective views of end caps used in ultraviolet lamps in accordance with the prior art;

FIG. 8 is a cross-sectional view along the longitudinal axis of a water purifier employing the ultraviolet lamp in accordance with the present invention;

FIG. 9 is a cross-sectional elevation view along the line 9-9 of FIG. 8;

FIG. 10 is a perspective elevation view of a first embodiment of an end cap for a lamp in accordance with the present invention;

FIG. 10A is a cross-sectional elevation view along the line 10A-10A of FIG. 10;

FIGS. 11-14 are perspective elevation views of second, third, fourth and fifth embodiments of end caps in accordance with the present invention;

FIGS. 15-19 are perspective elevation views of receptacles for the end caps of FIGS. 10-14, respectively;

FIGS. 20-24 are perspective elevation views of additional embodiments of end caps having female recesses in accordance with yet other embodiments of the present invention; and

FIGS. 25-29 are perspective elevation views of receptacles for the end caps of FIGS. 20-24, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 8 of the drawings, reference numeral 10 generally identifies a water purifier having a cylindrical housing 12 extending along a longitudinal axis. A hollow, axially-extending sleeve 14 is centrally mounted within the housing 12 between apertured support walls 18, 20 spaced apart along the longitudinal axis. The support walls 18, 20, together with the interior wall of the housing 12 and the exterior wall of the sleeve 14, bound an interior space 16. A water inlet 22 admits pressurized water to be purified into the space 16. A water outlet 24 discharges the purified water from the space 16. The space 16 serves as a flow-through passage for the water contained therein which, during the course of its flow, is exposed to ultraviolet radiation as described below.

A removable cover 26 overlies the support wall 18 at one end of the housing 12. The cover 26 is detachably coupled to the housing 12 by a set of threaded fasteners 28 to permit access to the interior of the sleeve 14 through the aperture of the support wall 18. An electrical socket 30 is removably mounted within the aperture of the support wall 18. An ultraviolet lamp 32 in accordance with this invention is slidably inserted into the interior of the sleeve 14 through the aperture of the support wall 18. An electrical connection, as described below, is made with the socket 30. In operation, the lamp 32 emits ultraviolet radiation of sufficient intensity to kill micro-organisms in the water, other liquid or air contained in the space 16 to purify the same for domestic and commercial applications.

The lamp 32 includes an elongated, hollow, sealed, arc tube 34 constituted of a light-transmissive material, e.g. silica quartz or other ultraviolet transmitting glass tube. The tube 34 has opposite end regions 36, 38 spaced apart along the longitudinal axis. A gas, preferably mercury vapor with or without additives, is sealingly contained within the tube.

A pair of electrodes 40, 42 is respectively mounted within the tube at the end regions 36, 38. A pair of end caps 44, 46 constituted of a non-conducting material, e.g. ceramic, is

respectively mounted at the end regions 36, 38 over the sealed end regions of the tube. Each end cap has a bore having a closed base against which a sealed end region of the tube abuts when the sealed end region is inserted fully into a respective end cap. End cap 44 (best shown in FIGS. 10 and 10A) also has a barrier wall 70a, 70b, extending between semi-circular bases 72, 74 such that bases 72, 74 are stepped with base 72 being the upper or distal base and base 74 being the lower or proximal base. In accordance with an important feature of this invention, a male member 75 extends laterally from barrier wall 70a, 70b, along lower base 74. Member 75 is centrally positioned along wall 70a, 70b thus splitting the wall into the two sections 70a and 70b. Member 75 has a height which is equal to the distance between respective bases 72 and 74. Member 75 also acts to divide lower base 74 into two symmetrical sections (each comprising an approximately 90 degree quadrant).

Still referring to FIG. 10, a first pair of electrical contacts or terminal pins 48, 50 extends in mutual parallelism along the longitudinal axis, and is mounted on, and extends outwardly of, the end cap 44 (through base 72). A second pair of electrical contacts or terminal pins 52, 54 also extends in mutual parallelism along the longitudinal axis, and is also mounted on, and extends outwardly of, the same end cap 44 (through base 74). Pins 52 and 54 are separated from one another by member 75. The pins 48, 50 extend into interior compartment 76, and the pins 52, 54 extend into compartment 78 (see FIG. 10A).

The pins 48, 50 are electrically connected within end cap 44 to one end of a wire conductor 56. The conductor 56 is located exteriorly of the tube 34, and extends along the longitudinal axis to the opposite end cap 46 wherein the other end of the conductor 56 is connected to the electrode 42. The pins 52, 54 are electrically connected within the end cap 44 to the electrode 40. The barrier wall 70a, 70b physically separates the pairs of pins.

Thus, as shown in FIG. 10, the end cap 44 has a stepped, outer end wall having a pair of semi-circular end wall portions 72, 74 lying in mutual parallelism in planes generally perpendicular to the longitudinal axis. As best shown in FIG. 15, the socket 30 has a complementary stepped, outer end wall together with a centrally located recess 76. During mating, the pins 48, 50, 52, 54 will be received into respective sockets 78, 80, 82, 84 while member 75 is received into mating recess 76.

A set of centering rings 62, 64, preferably constituted of a synthetic plastic material, is located on tube 34, being placed thereon before the end caps are attached to the end regions of the tube 34. The rings 62, 64 coaxially surround the tube 34 and frictionally engage and support the tube, and assist in centering the tube within sleeve 14.

Referring now to FIGS. 11-14, additional embodiments of the end cap depicted in FIG. 10 are shown. All of these end caps have a similar configuration to that shown in FIG. 10 including a pair of parallel but longitudinally displaced semi-circular bases 72, 74 having a barrier wall 70a, 70b, extending therebetween so as to form a stepped base. In addition and in accordance with the present invention, a male member or extension extends centrally outwardly from barrier wall 70a, 70b. While this male extension was in the form of a relatively thin wall 75 in the end cap 44 of FIG. 10, the male extension takes on a differing geometric shape in the various embodiments shown in FIGS. 11-14. More specifically, the end cap 86 in FIG. 11 has a rounded arcuate shape (e.g., V-shaped, semi-circular shaped) extension 102 extending between barrier wall sections 70a and 70b. The end cap 88 in FIG. 12 has an extension 104 in the shape of a rectangular box which

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includes a pair of opposed sidewalls **106**, **108** which extend outwardly from and perpendicularly to respective barrier wall sections **70a** and **70b**. The end cap **90** of FIG. **13** also has a box like extension **110** which is similar to extension **104** (in FIG. **12**); however, extension **112** has a more square cross-section relative to the rectangular cross-section of extension **104**. Thus, the barrier wall sections **70a** and **70b** in FIG. **13** are relatively larger than the respective barrier wall sections **70a** and **70b** in FIG. **12**. End cap **92** in FIG. **14** is a V-shaped triangular shape extension member **112** which forms the divider between barrier wall sections **70a** and **70b**.

Significantly, all of the additional embodiments of FIGS. **11-14** have in common the feature of FIG. **10** wherein a male member extends outwardly from barrier wall **70a**, **70b**, and is coextensive with stepped (that is longitudinally displaced) base sections **72**, **74**. It will be appreciated that in accordance with this invention, the male member may have any suitable configuration besides those shown in FIGS. **10-14** and that such configuration may be symmetrical, asymmetrical, spherical, conical, aspheric or any other desired shapes.

As in the receptacle **30** shown in FIG. **15** which receives the end cap **44** in FIG. **10**, the end caps of the embodiments of FIGS. **11-14** have similarly complimentary shaped respective receptacles **94**, **96**, **98** and **100** as shown in FIGS. **16-19**, respectively. Thus, receptacle **94** of FIG. **16** has a rounded arcuate shaped recess **114** for receiving and mating with rounded or U-shaped extension **102** in FIG. **11**. Similarly, receptacle **96** has a rectangular shaped recess **116** which is sized and configured to mate with and be received by rectangular extension **104** in FIG. **12**. Receptacle **98** in FIG. **18** has a square shaped recess **118** for mating with and being received by square shaped extension **110** in FIG. **13** while receptacle **100** of FIG. **19** has a V-shaped recess **120** for mating with and being received by V-shaped extension **112** in FIG. **14**. Again, it will be appreciated that the receptacles of FIGS. **15-19** may include a recess having any desired shape, so long as the shape is complimentary to, and can be received by, the shape of the extensions in the mating end cap.

In still another alternative embodiment of the present invention, it will be appreciated that the male extension in the plug ended lamp and the female recess in the complimentary receptacle may be reversed such that the lamp cap will exhibit the recess while the receptacle will exhibit the complimentary male extension for mating with the recess in the cap. Such alternative configurations are shown in the end caps of FIGS. **20-24**. The end caps of FIGS. **20-24** are similar to the respective end caps shown in FIGS. **10-14** with the only difference being that the male extension has been substituted with the female recess in FIGS. **20-24**. Thus, end cap **44'** includes a narrow recess **122** (similar to the recess **76** shown in FIG. **15**), end cap **86'** includes an arcuate shaped recess **124** (similar to the recess **114** in FIG. **16**), end cap **88'** includes a rectangularly shaped recess **126** (similar to the recess **116** in FIG. **17**), end cap **90'** of FIG. **23** includes a square shaped recess **128** (similar to the recess **118** in FIG. **18**) and end cap **92'** of FIG. **24** includes a V-shaped recess **130** (similar to the V-shaped recess **120** of FIG. **19**).

Similarly, with reference to FIGS. **25-29**, receptacles are shown which are configured to mate with the end caps of FIGS. **20-24**, respectively. Thus, receptacle **30'** of FIG. **25** includes male extension **132** which is sized and configured to be received by recess **122** in FIG. **20**. Receptacle **94'** of FIG. **26** includes arcuate shaped male extension **134** which is sized and configured to be received by arcuate recess **124** in FIG. **21**. Similarly, receptacle **96'** of FIG. **27** includes a rectangular extension **136** which is sized and configured to be received by rectangular recess **126** of FIG. **22**, receptacle **98'** of FIG. **28**

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includes a square shaped extension **138** which is sized and configured to be received by squared shaped recess **128** in FIG. **23** and receptacle **100'** of FIG. **29** includes a triangular shaped extension **140** which is sized and configured to be received by rectangular shaped recess **130** in FIG. **24**.

It will be appreciated that all of the embodiments of the present invention represent an advance over the stepped cap configuration of the aforementioned '527 patent in that the use of the extension (or alternatively the recess) positioned centrally along the barrier wall will provide improved interlocking between the lamp and the receptacle and will also ensure proper orientation of the respective pins within the recesses of the receptacle.

In operation, the cover **26** is removed, and a lamp **32** is inserted into the interior of the sleeve **14** via the aperture in the support wall **18**. After insertion, the socket **30** is connected to the pins **48**, **50**, **52**, **54**. Then the cover **26** is installed on the housing **12**. Electrical wires **66,68** extend exteriorly of the socket to a non-illustrated electrical power supply. A voltage difference across the wires **66,68** is applied to both electrodes **40**, **42** causing an electrical discharge within the tube. This discharge causes ultraviolet radiation to be emitted. This radiation passes through the light-transmissive wall of the sleeve **14** to irradiate the water contained in the space **16**.

The aforementioned barrier wall **70a**, **70b** prevents arcing interiorly of the end cap **44** by physically separating the electrical connections between the pins **48**, **50** and the wire conductor, on the one hand, and the electrical connections between the pins **52**, **54** and the electrode **40**, on the other hand. The pairs of pins are thus effectively isolated.

It will be understood that each of the elements described above, or two or more together, also may find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an ultraviolet lamp for use in water or other liquid or air purifiers, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention. Thus, the lamp of this invention need not be limited to lamps that emit ultraviolet radiation, nor be limited to use in a water purifier.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described way of illustrations and not limitation.

What is claimed is:

1. A lamp, comprising:

- an elongated, hollow, arc tube extending along a longitudinal axis between opposite end regions and containing a gas;
- a pair of electrodes spaced apart along the longitudinal axis and respectively mounted within the arc tube at the end regions thereof;
- a pair of end caps respectively mounted at the end regions of the arc tube;
- a first pair of electrical pins electrically connected to one of the electrodes;
- a second pair of electrical pins electrically connected to the other of the electrodes; and
- said pins being mounted on one of the end caps, and being offset relative to each other along the longitudinal axis, said one end cap including a mutually parallel distal semi-circular base and a proximal semi-circular base with a barrier wall extending between said distal and

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proximal bases, said barrier wall including either an extension extending outwardly therefrom along said proximal base or a recess extending inwardly therefrom along said distal base, said extension or said recess being coextensive with said distal and proximal bases, said first pair of pins extending through said distal base and said second pair of pins extending through said proximal base.

2. The lamp according to claim 1, wherein the first pair of pins is electrically connected to said one electrode along a conductor that rests exteriorly on, and extends along the longitudinal axis of the arc tube.

3. The lamp according to claim 1, wherein said one end cap has an interior; and further comprising a wall extending between the pins within the interior of said one end cap.

4. The lamp according to claim 1, further comprising a socket having a first pair of openings for the first pair of pins, and a second pair of openings for the second pair of pins wherein the openings are offset relative to each other along the longitudinal axis and wherein the socket includes a recess or extension configured to be mated with the respective extension or recess of said end cap.

5. The lamp of claim 1 wherein said barrier wall includes an extension and wherein the extension has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

6. The lamp of claim 1 wherein said barrier wall includes a recess and wherein the recess has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

7. The lamp of claim 1 wherein the extension or recess is centrally positioned along said barrier wall.

8. The lamp of claim 1 wherein said lamp comprises an ultraviolet lamp.

9. A water purifier apparatus comprising:

a hollow housing extending along a longitudinal axis, and having a hollow, sleeve mounted therein and bounding a flow-through passage, said housing having an inlet for admitting water to be purified into the passage and an outlet for discharging purified water from the passage; an elongated, hollow axially-extending arc tube mounted within the sleeve, said arc tube containing a gas;

a pair of electrodes spaced apart along the longitudinal axis and respectively mounted within the arc tube at end regions thereof;

a pair of end caps, respectively mounted at the end regions of the arc tube;

a first pair of electrical pins electrically connected to one of the electrodes;

a second pair of electrical pins, electrically connected to the other of the electrodes; and

said pins being mounted on one of the end caps, and being offset relative to each other along the longitudinal axis, said one end cap including a mutually parallel distal semi-circular base and a proximal semi-circular base with a barrier wall extending between said distal and proximal bases, said barrier wall including either an extension extending outwardly therefrom along said proximal base or a recess extending inwardly therefrom along said distal base, said extension or said recess being coextensive with said distal and proximal bases, said first pair of pins extending through said distal base and said second pair of pins extending through said proximal base.

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10. The apparatus according to claim 9, wherein the first pair of pins is electrically connected to said one electrode along a conductor that rests exteriorly on, and extends along the longitudinal axis of the arc tube.

11. The apparatus according to claim 9, wherein said one end cap has an interior; and further comprising a wall extending between the pins within the interior of said one end cap.

12. The apparatus according to claim 9, further comprising a socket having a first pair of openings for the first pair of pins, and a second pair of openings for the second pair of pins wherein the openings are offset relative to each other along the longitudinal axis and wherein the socket includes a recess or extension configured to be mated with the respective extension or recess of said end cap.

13. The apparatus of claim 9 wherein said barrier wall includes an extension and wherein the extension has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

14. The apparatus of claim 9 wherein said barrier wall includes a recess and wherein the recess has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

15. The apparatus of claim 9 wherein the extension or recess is centrally positioned along said barrier wall.

16. The apparatus of claim 9 wherein said lamp comprises an ultraviolet lamp.

17. An end cap for a lamp, comprising:

a tubular housing having pins mounted on one end thereof, said pins being offset relative to each other along the longitudinal axis of the housing, said one end including a mutually parallel distal semi-circular base and a proximal semi-circular base with a barrier wall extending between said distal and proximal bases, said barrier wall including either an extension extending outwardly therefrom along said proximal base or a recess extending inwardly therefrom along said distal base, said extension or said recess being coextensive with said distal and proximal bases, said first pair of pins extending through said distal base and said second pair of pins extending through said proximal base.

18. The end cap according to claim 17, wherein said housing has an interior; and further comprising a wall extending between the pins within the interior of said housing.

19. The end cap according to claim 17, further comprising a socket having a first pair of openings for the first pair of pins, and a second pair of openings for the second pair of pins wherein the openings are offset relative to each other along the longitudinal axis and wherein the socket includes a recess or extension configured to be mated with the respective extension or recess of said end cap.

20. The end cap of claim 17 wherein said barrier wall includes an extension and wherein the extension has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

21. The end cap of claim 17 wherein said barrier wall includes an extension and wherein the extension has a cross-sectional shape with respect to the longitudinal direction, which is selected from the group of arcuate, rectangular, square and V-shaped.

22. The end cap of claim 17 wherein the extension or recess is centrally positioned along said barrier wall.

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