

AN LED LIGHTING DEVICE HAVING ELASTICALLY BIASED ROTATIONAL END CAPS

TECHNICAL FIELD

[0001] The present invention relates to the field of light emitting diode ("LED") lighting devices. In particular, it relates to an LED lighting device having spring-biased rotational end-caps that is capable
5 of being used with pre-existing fluorescent lighting fixtures.

BACKGROUND

[0002] Fluorescent lighting devices (i.e., fluorescent light bulbs or fluorescent light tubes) have been commercially available since 1938. By 1951, over 51% of lighting devices in use were fluorescent
10 lighting devices (refer to <http://edisontechcenter.org/foourescentlampdev.html>). Use of fluorescent lighting devices as an alternative to incandescent lighting devices has grown rapidly since then. While fluorescent lighting devices are advantageous over incandescent lighting devices in that they consume less electrical energy for any given light output and operate at lower temperatures, fluorescent lighting devices are not without their drawbacks. As set out at column 1, lines 50 – 54 of
15 United States Patent 6,936,968 B2 ("the '968 Patent"), fluorescent lighting devices suffer from the following disadvantages:-

- a. The ionisable material and fill gases used to generate the illumination pattern are hazardous materials;
- b. Fluorescent lighting devices rely on ballast transformers, which tend to fail frequently
20 and thus result in the fluorescent lighting device requiring frequent replacement; and
- c. The energy efficiency, which relates to the energy costs, of operating a fluorescent lighting device has not improved over decades despite increasing energy costs, which makes fluorescent lighting devices a less cost-efficient lighting solution.

[0003] In view of the above-mentioned disadvantages, it was recognised that there was a need to
25 find an alternative to the fluorescent lighting device. It is in this context that LED lighting devices began to gain prominence. The history of commercially useful LEDs, began in the 1960s with the creation of gallium-arsenic-phosphorus LEDs that produced a characteristic red light used as indicators in a number of electronic devices. In the 1970s, several significant advances in LED lighting

technology were achieved; by using different elements and wavelengths. However, it was only in the 1980s, however, did LED lighting truly come into its own. with the creation of the gallium-aluminum-arsenide LED. The gallium-aluminum-arsenide LED lighting device was capable of being manipulated to display red, yellow, orange, and green light and was ten times brighter than previous LED models.

5 With the development of indium-gallium-aluminum-phosphide LEDs in the latter part of the 1980s, the LED lighting field became one of the dominant commercial lighting solutions for all sorts of applications (refer to <http://www.extremetacticaldynamics.com/history-led-lighting.php>).

[0004] Today, LED lighting devices are considered to be one of the most innovative and cost effective means of providing lighting. LED lighting devices require less energy and produce less

10 ambient heat than other light sources. LED lighting devices also last longer than traditional incandescent, fluorescent and halogen bulbs, which results in cost savings on repairs and replacement costs (refer to <http://www.extremetacticaldynamics.com/history-led-lighting.php>). Given the advantages of LED lighting devices over prevalent fluorescent lighting devices, there has been an increasing shift towards phasing out existing fluorescent lighting devices and to replace them with

15 LED lighting devices.

[0005] An embodiment of a typical LED lighting device is described in the '968 Patent at column 2, lines 11 – 22. The LED light tube described in the '968 Patent comprises an elongated, cylindrical tube, a base (or end) cap at each end, wherein the end cap includes a first and second prong extending from the base cap such that LEDs within the cylindrical tube are in electrical connection

20 with regular AC power sources.

[0006] Although there are several benefits in embracing LED lighting devices, the shift towards using LED lighting devices faces a widespread problem. Due to the use of fluorescent lighting devices being so prevalent and widespread globally, existing lighting fittings, such as troffer fixtures, for example, are catered towards fluorescent lighting devices and not for LED lighting devices. A troffer fixture is

25 described in the '968 Patent as follows:-

"...a housing and a tube holder. The tube holder comprises electrical sockets in electrical communication with the LED light tube. The electrical sockets are adapted to receive a first and second prong in the end cap of the LED tube..." (see column 2, lines 25 – 29 of the '968 Patent).

Although the troffer fixture described in the '968 Patent is with respect to an LED lighting device, generally, most typical troffer fixtures serve the dual purpose of supporting or holding a fluorescent lighting device, and providing an electrical connection between the fluorescent lighting device and the AC power supply.

5 **[0007]** The costs for replacing florescent lighting fixtures, such as the troffer lighting fixture, for example, will be significant due to their widespread implementation and use. As such, there have been attempts to adapt LED lighting devices such that those LED lighting devices can be used with existing fluorescent lighting fixtures as a means to reduce the costs involved when shifting over from a fluorescent lighting device to an LED lighting device.

10 **[0008]** An example of such an attempt is disclosed in United States Patent 8,066,411 B1 ("the '**411 Patent**'). The '**411 Patent**' discloses an LED lighting tube having an elongated cylindrical housing with apertures along the cylindrical housing. The apertures contain a reflector. The cylindrical housing also houses a circuit board mounted with an LED. The LED aligns with the aperture such that when light is emitted by the LED, the emitted light passes through the aperture thereby providing illumination to the
15 environment outside the cylindrical housing.

[0009] The invention of the '**411 Patent**' also includes a rotatable electrical coupling connected to the ends of the cylindrical housing. The rotatable electrical coupling includes a limiter that limits the extent of the rotation of the cylindrical housing relative to the rotatable electrical coupling to a maximum angle of rotation of about 190 degrees (see column 3, lines 45 – 46 of the '**411 Patent**'). The rotatable
20 electrical coupling is in electrical connection with the circuit board includes a first and second prong capable of being in electrical connection with existing fluorescent lighting fixtures and AC power supply (see column 1, lines 20 – 22, and Figures 9 and 10 of the '**411 Patent**').

[0010] Thus the device of the '**411 Patent**' permits an LED lighting tube to be capable of integration into existing standard linear fluorescent fixtures.

25 **[0011]** Nevertheless, there is still a need for an LED lighting device that is retrofitted to be compatible with existing lighting fixtures, especially lighting fixtures intended for fluorescent lighting devices. There is also a need for such an LED lighting device to be capable of easy (i) assembly and/or manufacture, and (ii) installation in a cost – effective manner. In this respect, an LED lighting device as described below, and as defined in the claims appended hereto, meets the aforesaid objectives.

DESCRIPTION OF THE INVENTION

[0012] A first aspect of the present invention relates to an end cap for a lighting device. The end cap includes a housing. The housing has a first portion and a second portion. The first portion is adapted to be capable of being coupled to an end of a lighting device. The lighting device may be a fluorescent tube lighting device, a halogen tube lighting device or an LED tube lighting device, for example. The first portion is also in electrical connection with said lighting device.

[0013] The second portion of the housing is adapted to be capable of being coupled to an electrical socket of a lighting fixture. When coupled to the electrical socket, the second portion is in electrical connection with a power supply.

[0014] The end cap also includes at least two independent electrical leads in each portion of the housing. In one embodiment, a pair of electrical leads may extend from the second portion of the housing to contact at least two corresponding electrical leads that extend from the first portion of the housing. In so doing, the power supply and the lighting device will be placed in an electrical connection.

[0015] The end cap also includes at least one elastic member. The elastic member is coupled to the first and second portions of the housing along a common central axis of rotation of the first and second portions. The coupling of the first and second portions of the housing to each other is such that the second portion is elastically coupled to and biased against the first portion. The elastically biased coupling of the second portion of the housing to the first portion of the housing is such that the second portion is capable of a restricted linear movement in a direction that is against the elastic bias. Further, the elastic bias coupling is also such that the second portion of the housing is capable of a rotational movement about the central axis relative to the first portion.

[0016] In one embodiment, the first portion of the housing includes a substantially circular planar surface. The substantially circular planar surface has a first at least substantially cylindrical wall that extends from the circumference of the substantially circular planar surface. The first at least substantially cylindrical wall extends in a first direction that is at least substantially perpendicular to the circular planar surface. The first cylindrical wall is adapted to be capable of coupling to the end of the lighting device. In a specific exemplary embodiment, the first portion of the housing may be

coupled to the end of the lighting device using screws such that the first at least substantially cylindrical wall may be inserted into the end of the lighting device. Alternatively, the first at least substantially cylindrical wall of the first portion of the housing may have screw threads such that it may be screwed into the end of the lighting device, which itself may have complementary threading to receive the first at least cylindrical wall of the first portion.

[0017] In another embodiment, the first portion of the housing may also include a second at least substantially cylindrical wall. The second at least substantially cylindrical wall also extends from the circular planar surface, however, in a second direction. The second direction is also perpendicular to the circular planar surface but opposite to the first direction.

[0018] In a further embodiment, the second portion of the housing also includes a substantially circular planar surface. In one exemplary embodiment, the size (diameter and circumference) of the substantially circular planar surface of the second portion of the housing may be similar or identical to the size of the substantially circular planar surface of the first housing portion. The substantially circular planar surface of the second portion may also have an at least substantially cylindrical wall that extends from the circumference of the substantially circular planar surface of the second portion. The at least substantially cylindrical wall of the second portion of the housing extends from the circumference of the substantially circular planar surface of the second portion and in the first direction such that it is of a perpendicular orientation with respect to the circular planar surface of the second portion. In this embodiment, the at least substantially cylindrical wall of the second portion may be adapted to be capable of being either rigidly or non-rigidly coupled to the second at least substantially cylindrical wall of the first portion.

[0019] In yet another embodiment, the first portion of the housing may be capable of being coupled to the end of the lighting device via at least two substantially parallel prongs that extend in a substantially perpendicularly manner from the circular planar surface of the first portion. The direction of extension of the two substantially parallel prongs is essentially in the first direction. One prong is adapted such that it is in electrical connection with a positive terminal of the lighting device and the other prong is adapted such that it is in electrical connection with a negative terminal of the lighting device. In all embodiments of the present invention, the two at least substantially parallel prongs of the first portion are in electrical connection with the at least two independent electrical leads of the first portion.

[0020] In another embodiment, the second portion of the housing is capable of being coupled to the electrical socket of the lighting fixture. This is achieved via the second portion having at least two substantially parallel prongs extending perpendicularly from its substantially circular planar surface in the second direction, which is opposite to the first direction. In this embodiment, the prongs are adapted to electrically connect with the power supply via the electrical socket of the lighting fixture. Specifically, one prong will be in electrical connection with a positive terminal of the electrical socket of the lighting fixture, and the other prong will be in electrical connection with a negative terminal of the electrical socket of the lighting fixture. As with the first portion, the two at least substantially parallel prongs of the second portion are also electrically connected to the at least two independent electrical leads of the second portion.

[0021] In one exemplary embodiment of the invention, each of the at least two independent electrical leads of the first portion may be at least a substantially semi-circular wall that extends perpendicularly in the second direction from the circular planar surface of the first portion. In this exemplary embodiment, the at least two independent electrical leads of the second portion may be a prong that extends perpendicularly from the circular planar surface of the second portion in the first direction such that each electrical lead of the second portion, i.e., the prong, contacts a corresponding electrical lead of the first portion, i.e., the substantially semi-circular wall. Although in this exemplary embodiment, the two semi-circular wall electrical leads of the first portion are positioned such that they almost form a complete conductive circular wall, there is no actual contact between the two semi-circular leads. Instead, each of the two prongs contacts a corresponding semi-circular electrical lead. As the second portion is rotated relative to the first portion, each electrical lead prong of the second portion follows the semi-circular shape of the corresponding semi-circular electrical lead thereby ensuring that electrical connectivity between the prongs and the semi-circular wall is maintained even after the rotation is completed.

[0022] In another embodiment, the second at least substantially cylindrical wall of the first portion includes at least one plurality of grooves. In an exemplary embodiment, second at least substantially cylindrical wall of the first portion may have two, three or four pluralities of grooves. In such exemplary embodiments, each plurality of grooves may be arranged in a symmetrical arrangement with respect to each other along. The grooves may be arranged along a peripheral edge of a distal end of the second at least substantially cylindrical wall of the first portion. In all the embodiments of the invention

having grooves, each groove is adapted to receive therein a protrusion that at least substantially corresponds to the dimension and/or the shape of the groove itself.

[0023] In a further embodiment, the at least substantially circular planar surface of the second portion may include at least one protrusion. The at least one protrusion may extend perpendicularly
5 from the circular planar surface in the first direction and along the second at least substantially cylindrical wall's inner surface. As such, the protrusion may be located at the circumference of the substantially circular planar surface of the second portion. The at least one protrusion is of a suitable shape and dimension such that it is at least partially receivable by any one of the plurality of grooves at the distal end of the second at least substantially cylindrical wall of the first portion. When the
10 protrusion is received by the groove, the second portion of the housing becomes rotationally locked with respect to the first portion of the housing.

[0024] In yet another embodiment, the at least substantially cylindrical wall of the second portion has indications along its outer surface to indicate various positions that correspond to incremental angles of rotation of the second portion with respect to the first portion. In an exemplary embodiment, the at
15 least substantially cylindrical wall of the second portion may have indications '0', '1', '2', '3' and '4' along the outer surface. The markings on the outer surface or external surface of the second portion may correspond to grooves described above that are on the periphery of the second substantially cylindrical wall of the first portion, which may not be visible when the second portion is coupled to the first portion. As such, the marking '0' may correspond to a first groove, the marking '1' may
20 correspond to a second groove, the marking '2' may correspond to a third groove, the marking '3' may correspond to a fourth groove and the marking '4' may correspond to a fifth groove. In this exemplary embodiment, each plurality of grooves may include up to five grooves.

[0025] When the protrusion of the second portion is engaged with the first groove, the indication that corresponds to the first groove is marking '0'. When the second portion is rotated from indication
25 marking '0' to indication marking '1', the protrusion moves to the second groove. Prior to moving to the second groove, the protrusion has to be disengaged from the first groove. The second portion, being resiliently biased against the first portion is thus pulled against the direction of the bias. In so doing, the protrusion disengages from the first groove, i.e., the second portion is now in a withdrawn position.

[0026] While the second portion is held in its withdrawn position, the second portion is rotated relative to the first portion to the next marking indication '1'. In so doing, the second portion is rotated about an angle of 22.5 degrees. The overall effect of the rotation of the second portion is that the electrical conducting prongs that are capable of being coupled to the electrical socket of the lighting fixture are themselves rotated by the same angle. In this particular embodiment the total angle of rotation that is possible (α) is given by $[22.5 \times 4(\text{grooves})]$, which gives a total of 90 degrees. This allows the electrical conducting prongs that are capable of being coupled to the electrical socket of the lighting fixture in the present exemplary embodiment of being capable of rotations of up to 90 degrees to adapt to the orientation of the electrical sockets of the lighting fixture.

10 [0027] In yet another embodiment, the first and second portions of the housing may be separate and discrete parts. Alternatively, the first and second portions may be formed as a single part. Where the first and second portions are formed as separate parts, the first portion may be coupled to the second portion. In this regard, any coupling means described herein, in particular coupling means between the first portion and the lighting device, first portion and second portion and second portion and lighting fixture, may be achieved by coupling means selected from the group including, but not limited to, snap-fit means, tight-fit means screw-fit means.

[0028] In any of the embodiments described herein, the elastic member is a spring. The type of spring that may be used may be selected from the group including, but not limited to, a compression spring, a conical compression spring, a torsion spring, an extension spring or a helical spring, for example.

20 [0029] A second aspect of the invention relates to a lighting device end cap having a housing. The housing includes a first portion and a second portion. The first portion is adapted to be capable of being coupled to an end of a lighting device, and the second portion is adapted to be capable of being coupled to an electrical socket of a lighting fixture. The second portion is in electrical connection with the lighting fixture such that the second portion is in electrical connection with a power supply. The end cap according to the second aspect of the invention also includes at least one fuse located within the second portion. The fuse is in electrical connection with the power supply.

[0030] The end cap according to the second aspect of the invention also includes at least one elastic member. The elastic member is coupled to the first and second portions of the housing along a

common central axis of rotation of the first and second portions. The coupling of the elastic member to the first and second portions is such that the second portion is elastically coupled to and biased against the first portion. This effectively provides the second portion with restricted linear movement in a direction against the elastic bias. The second portion of the housing is also provided with a
5 rotational movement about the central axis relative to the first portion as a result of the coupling.

[0031] It should be noted that all the various embodiments described above in relation to the first aspect of the invention are also applicable to the second aspect of the invention insofar as the features of the second aspect of the invention are to be found in the various embodiments of the first aspect of the invention.

10 **[0032]** A third aspect of the invention relates to an LED lighting tube. In this aspect of the invention, the LED lighting tube includes an elongated hollow cylindrical body having a first end and a second end. Within the elongated cylindrical body there is at least one circuit board having at least one LED in electrical connection with the at least one circuit board. The LED lighting tube includes an end cap as described in any of the above-mentioned embodiments of the first aspect of the invention. The
15 lighting device end cap is affixed at the first end of the elongated hollow cylindrical body and is in electrical connection with the at least one circuit board. The LED lighting device also includes a lighting device end cap according to the second aspect of the invention. The lighting device end cap according to the second aspect of the invention is affixed at the second end of the elongated hollow cylindrical body.

20 **[0033]** The lighting device end cap according to the first aspect of the invention, and the lighting device end cap according to the second aspect of the invention, are both capable of being in electrical connection with an electrical socket of a lighting fixture and a power supply. By so doing, the LED lighting tube is thus supported and held in position with respect to the lighting fixture. Furthermore, by providing electrical connection from the power supply to the circuit board, the end caps according to
25 the first and second aspects of the invention enable the LED to be capable of providing illumination.

[0034] Again, it should be noted that all the various embodiments described above in relation to the first and second aspects of the invention are also applicable to the third aspect of the invention insofar as the features of the third aspect of the invention are to be found in the various embodiments of the first and second aspects of the invention.

[0035] Although various aspects and embodiments of the present invention have been described above, the following illustrations of exemplary embodiments and accompanying description serve to further aid in the understanding and clarity of those various embodiments of the invention. However, it should be noted that the scope of the invention is by no means limited to the exemplary embodiments described and illustrated hereafter, but rather, as set out in the claims that are appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] FIGURE 1 is an exploded isometric view of an exemplary embodiment of a first aspect of the present invention;

10 [0037] FIGURE 2 is another exploded isometric view of the embodiment of Figure 1;

[0038] FIGURE 3A is an exploded isometric view of an exemplary embodiment of a second aspect of the present invention;

[0039] FIGURE 3B is another exploded isometric view of the embodiment of Figure 3A;

[0040] FIGURE 4A is an illustration of an exemplary embodiment of a third aspect of the present invention;

[0041] FIGURE 4B is another illustration of the embodiment of Figure 4A in a withdrawn position;

[0042] FIGURE 5A is an illustration of the embodiment of Figure 4A as it is being rotated; and

[0043] FIGURE 5B is an illustration of the embodiment of Figure 4A in a rotated position.

20 **DETAILED DESCRIPTION OF THE DRAWINGS**

[0044] FIGURE 1 is an exploded isometric view of an exemplary embodiment of a first aspect of the present invention. In this exemplary embodiment, the end cap's housing has two separate and distinct portions, i.e., a first portion 2 and a second portion 3. Both the first and second portions are cylindrical in shape. The first portion 2 as a first cylindrical wall 6 extending in a first direction from a central circular planar surface 2A. The first portion also has a second cylindrical wall 4 extending from the circumference of the central circular planar surface 2A in a second direction, which is opposite the first direction. The first cylindrical wall 6 is adapted to be connected to an end of a lighting tube both

physically and electrically. In this exemplary embodiment, the physical coupling of the first portion 2 to the end of the lighting tube is achieved by screws 8A and 8B. As for the electrical connection, this is explained later below.

[0045] In this exemplary embodiment, the first portion includes a cavity defined by the circular planar surface 2A as a base and the second cylindrical wall 4. Within this cavity is a pair of independent electrical leads 10. The electrical leads 10 are substantially semi-circular in shape and are also formed in the form of a wall that extends perpendicularly from the base, i.e., the circular planar surface 2A. The electrical leads 10 are affixed to the circular planar surface 2A. The second cylindrical wall 4 has at its peripheral edge, which is distal from the circular planar surface 2A, at least one plurality of grooves 12. Each groove 12 is adapted to receive, as least partially, a corresponding protrusion from the second portion 3.

[0046] The second portion 3 also has a circular planar surface 3A from which a cylindrical wall 1 extends. The cylindrical wall 1 extends from the circumference of the circular planar surface 3A. In the centre of the circular planar surface 2A is a hole 5A. The hole 5A extends inwards in the form of a tube 5C and is adapted to accommodate therein an elastic member, in this example, a coil spring 9A. The coil spring 9A is secured to the second portion 3 and indirectly to the first portion 2 at a corresponding hole 5B by screw 9B, which is partially threaded. This permits the second portion to be capable of sliding along the non-threaded portion of the screw 9B when the first and second portions 2, 3 are coupled together. The second portion also has a pair of electrical conducting prongs 7A and 7B arranged in an equidistant manner.

[0047] FIGURE 2 is another exploded isometric view of the embodiment of Figure 1. In this view, the cavity as defined by the circular planar surface and the first cylindrical wall 6 can be seen. The first portion 2 has two electrical conducting prongs 23A and 23B extending from the cavity defined by the circular planar surface 6A and the first cylindrical wall 6. The electrical prongs 23A and 23B are in electrical connection with the electrical leads 10. As mentioned earlier, the first portion 2 is secured to the end of the lighting tube by screws 8A and 8B. The circular planar surface is of a given thickness. The indicator arrow 24 is located on the width (or thickness) of the circular planar surface 2A.

[0048] Turning to the second portion 3, the circular planar surface 3A and cylindrical wall 1 define a cavity within the second portion 3. Within this cavity, there is another pair of electrical conducting

prongs **21A** and **21B** that extends vertically from the circular planar surface **3A**. The prongs **23A** and **23B** are in electrical connection with the prongs **21A** and **21B**. The prongs **21A** and **21B** are of sufficient length such that they contact the electrical leads **10** when the first and second portions **2,3** are assembled together.

5 **[0049]** **FIGURE 3A** is an exploded isometric view of an exemplary embodiment of a second aspect of the present invention. This aspect of the invention refers to an end cap containing a fuse therein. With regard to the first portion **2**, the same description as provided above applies. However, the first portion **2** does not include any electrical leads or electrical conducting prongs.

[0050] **FIGURE 3B** is another exploded isometric view of the embodiment of **Figure 3A**. In this
10 illustration, a fuse **31** is shown to be secured to the circular planar surface **3A** of the second portion. The fuse **31** is in electrical connection to the prongs **7A** and **7B** (not visible).

[0051] **FIGURE 4A** is an illustration of an exemplary embodiment of a third aspect of the present invention. In this aspect of the invention, the first portion **2** of the housing of the end cap is affixed to an LED lighting tube **44**. On the surface of the first portion is an arrow indicator **42**.

15 **[0052]** The second portion **3** of the housing also has indicator markings '0', '1', '2', '3' and '4' along the cylindrical wall **1** of the second portion **3**. In **Figure 4A** the arrow indicator **42** is positioned such that it is aligned to marking indication '0'. The second portion **3** is coupled to the first portion **2** about the central axis of rotation **5A** of the first portion **2** and the second portion **3**. In this position, the second portion **3** is elastically biased against the first portion **2**. The second portion **2** also has two
20 independent electrical prongs **7A** and **7B** that are adapted for connecting with an electrical socket of a lighting fixture.

[0053] **FIGURE 4B** is another illustration of the embodiment of **Figure 4A** in a withdrawn position. To enter the withdrawn position, the second portion **3** is capable of being translated in a linear direction as indicated by the arrows. This is done by pulling the second portion **3** against the direction of the
25 elastic bias. This results in the elastic member **9B**, which in this exemplary embodiment is a coil spring, to stretch within its elastic limit. Concurrently, when the second portion **3** is pulled, within the housing a protrusion (not shown) affixed to the inner surface of cylindrical wall **1** of the second portion **3**, and that is engaged with a groove **12** of the second cylindrical wall **4** of the first portion **2**

disengages from said groove 12. The second portion 3 is now able to rotate in a clockwise direction with respect to the first portion 2.

[0054] FIGURE 5A is an illustration of the embodiment of Figure 4A as it is being rotated. As shown, the second portion 3 is rotated in a clockwise direction (as indicated by the arrow) with respect to the first portion 2. As can be seen, the second portion 3 has been rotated such that indicator 42 points to indicator marking '3'. In this exemplary embodiment, each interval between the indicator markings corresponds to an angular rotation of about 22.5 degrees. As such, in rotating the second portion 3 up to indicator marking '3', results in an angular rotation of about 67.5 degrees. This results in the prongs 7A and 7B also being rotated by the same angle of rotation with respect to the first portion. During the entire withdrawal and rotation phases, the first portion remains static and fixed to an end of the lighting tube 44.

[0055] FIGURE 5B is an illustration of the embodiment of Figure 4A in a rotated position. With the rotation complete, the indicator marking '3' is aligned with the indicator arrow 42. The second portion 3 is then released and slides linearly towards the first portion 2 due to the second portion 3 being elastically biased against the first portion 2. Within the housing, when the second portion 3 is released, concurrently the protrusion (not shown) that is affixed to the inner surface of cylindrical wall 1 of the second portion 3, also slides towards the first portion 2 and re-engages with the groove 12 of the second cylindrical wall 4 of the first portion 2. The second portion 3 is now able locked and no longer able to rotate with respect to the first portion 2.

[0056] As mentioned earlier, the above description of the exemplary embodiments of the present invention merely serve to aid in the understanding of the underlying principle behind the invention. The present invention is not to be construed as being limited to the illustrated embodiments but rather, to the extent as defined in the claims that follow.

CLAIMS

What is claimed is:

1. A lighting device end cap comprising:-

a housing, said housing having a first portion and a second portion,
wherein the first portion is adapted to be capable of being coupled to an end of a lighting device such that the first portion is in electrical connection with said lighting device, and wherein the second portion is adapted to be capable of being coupled to an electrical socket of a lighting fixture such that the second portion is in electrical connection with a power supply;

at least two independent electrical leads extending from the second portion to contact at least two corresponding electrical leads extending from the first portion such that the power supply and the lighting device are in electrical connection; and

at least one elastic member, said elastic member being coupled to the first and second portions along a common central axis of rotation of the first and second portions such that the second portion is elastically coupled to and biased against the first portion, thereby providing the second portion with restricted linear movement in a direction against the elastic bias and with rotational movement about the central axis relative to the first portion.

2. The device according to claim 1, wherein the first portion comprises:

a substantially circular planar surface;

a first at least substantially cylindrical wall that extends from the circumference of the substantially circular planar surface in a first direction perpendicular to the circular planar surface, wherein the first cylindrical wall is adapted to be capable of coupling to the end of the lighting device; and

a second at least substantially cylindrical wall that extends from the circular planar surface in a second direction that is also perpendicular to the circular planar surface but opposite the first direction.

3. The device according to claim 2, wherein the second portion comprises:

a substantially circular planar surface; and

an at least substantially cylindrical wall that extends from the circumference of the substantially circular planar surface in the first direction perpendicular to the circular planar surface; wherein the at least substantially cylindrical wall of the second portion is adapted to be capable of non-rigidly coupling to the second at least substantially cylindrical wall of the first portion.

4. The device according to claim 2, wherein the first portion is capable of being coupled to the end of the lighting device via at least two substantially parallel prongs extending perpendicularly from the circular planar surface in the first direction, wherein one prong is in electrical connection with a positive terminal of the lighting device and the other prong is in electrical connection with a negative terminal of the lighting device.
5. The device according to claim 3, wherein the second portion is capable of being coupled to the electrical socket of the lighting fixture via at least two substantially parallel prongs extending perpendicularly from its substantially circular planar surface in a second direction opposite to the first direction, said prongs being adapted to electrically connect with the power supply via the electrical socket of the lighting fixture such that one prong is in electrical connection with a positive terminal of the electrical socket of the lighting fixture and the other prong is in electrical connection with a negative terminal of the electrical socket.
6. The device according to claim 4, wherein the two at least substantially parallel prongs of the first portion are in electrical connection with the at least two independent electrical leads of the first portion.
7. The device according to claim 5, wherein the two at least substantially parallel prongs of the second portion are electrically connected to the at least two independent electrical leads of the second portion.
8. The device according to any of claims 1 – 7, wherein each of the at least two independent electrical leads of the first portion is a substantially semi-circular wall that extends perpendicularly in the second direction from the circular planar surface of the first portion.
9. The device according to any of claims 1 – 8, wherein each of the at least two independent electrical leads of the second portion is a prong that extends perpendicularly from the circular

- planar surface of the second portion in the first direction such that each electrical lead the second portion contacts a corresponding electrical lead of the first portion.
10. The device according to any of claims 2 – 9, wherein the second at least substantially cylindrical wall of the first portion comprises at least one plurality of grooves,
 11. The device according to any of claim 10 wherein each of the at least one plurality of grooves is in a symmetrical arrangement from each other along a peripheral edge of the distal end of the second at least substantially cylindrical wall of the first portion.
 12. The device according to any of claims 10 or 11, wherein each groove of the plurality of grooves is adapted to receive therein a protrusion that at least substantially corresponds to the shape of the groove.
 13. The device according to any of claims 3 – 12, wherein the at least substantially circular planar surface of the second portion comprises at least one protrusion extending perpendicularly therefrom in the first direction and along the second at least substantially cylindrical wall's inner surface, said at least one protrusion being at least partly receivable by any one of the plurality of grooves at the distal end of the second at least substantially cylindrical wall of the first portion such that the second portion is rotationally locked with respect to the first portion.
 14. The device according to any of claims 3 – 13, wherein the at least substantially cylindrical wall of the second portion has indications along its outer surface to indicate various positions that correspond to incremental angles of rotation of the second portion with respect to the first portion.
 15. The device according to claim 14, wherein each incremental angle of rotation of the second portion with respect to the first portion is between 0 degrees to 90 degrees.
 16. The device according to any of claims 1 – 15, wherein the first and second portions of the housing are separate and discrete parts.
 17. The device according to any of claims 1 – 16, wherein the first portion is coupled to the second portion.
 18. The device according to any of claims 1 – 17, wherein the coupling means between the first portion and the lighting device, first portion and second portion and second portion and lighting

fixture is selected from the group consisting of snap-fit means, tight-fit means or screw-fit means.

19. The device according to any of claims 1 – 18, wherein the elastic member is a spring selected from the group consisting of a compression spring, a conical compression spring, a torsion spring, an extension spring or a helical spring.
20. The device according to any of claims 1 – 19, wherein the lighting device is a light emitting diode (LED) lighting device.
21. A lighting device end cap comprising:-

a housing, said housing having a first portion and a second portion, wherein the first portion is adapted to be capable of being coupled to an end of a lighting device, and the second portion is adapted to be capable of being coupled to an electrical socket of a lighting fixture such that the second portion is in electrical connection with the lighting fixture such that the second portion is in electrical connection with a power supply;

at least one fuse located within the second portion and in electrical connection with the power supply; and

at least one elastic member, said elastic member being coupled to the first and second portions along a common central axis of rotation of the first and second portions such that the second portion is elastically coupled to and biased against the first portion, thereby providing the second portion with restricted linear movement in a direction against the elastic bias, and with rotational movement about the central axis relative to the first portion.

22. An LED lighting tube comprising:-

an elongated hollow cylindrical body having a first end and a second end;

at least one circuit board within the cylindrical body having at least one LED in electrical connection with the at least one circuit board;

a lighting device end cap according to any of claims 1 – 19, said lighting device end cap affixed at the first end of the elongated hollow cylindrical body and in electrical connection with the at least one circuit board; and

a lighting device end cap according to claim 20, said lighting device end cap affixed at the second end of the elongated hollow cylindrical body,

wherein the lighting device end cap according to any of claims 1 – 18, and the lighting device end cap according to claim 20, are capable of being in electrical connection with an electrical socket of a lighting fixture and a power supply, thereby supporting the LED lighting tube in position with respect to the lighting fixture, and providing electrical connection from the lighting fixture to the LED such that the LED is capable of providing illumination.