US008870415B2

(12) **United States Patent**
Ivey

(10) **Patent No.: US 8,870,415 B2**
(45) **Date of Patent: Oct. 28, 2014**

(54) **LED FLUORESCENT TUBE REPLACEMENT LIGHT WITH REDUCED SHOCK HAZARD**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 466 days.

(21) Appl. No.: **13/315,582**

(22) Filed: **Dec. 9, 2011**

(65) **Prior Publication Data**

US 2012/0147598 A1 Jun. 14, 2012

Related U.S. Application Data

(60) Provisional application No. 61/421,343, filed on Dec. 9, 2010.

(51) **Int. Cl.**

F21V 21/00	(2006.01)
F21K 99/00	(2010.01)
F21V 21/005	(2006.01)
F21S 4/00	(2006.01)
F21V 25/02	(2006.01)
H05B 33/08	(2006.01)
F21V 23/02	(2006.01)
F21Y 101/02	(2006.01)

(52) **U.S. Cl.**

CPC ***F21K 9/17*** (2013.01); ***F21V 21/005*** (2013.01); ***F21S 4/008*** (2013.01); ***F21V 25/02*** (2013.01); ***H05B 33/0806*** (2013.01); *F21V 23/02* (2013.01); *F21Y 2101/02* (2013.01); *Y02B 20/386* (2013.01)

USPC .. **362/249.05**; 362/221; 362/225; 362/249.02

(58) **Field of Classification Search**

CPC H05B 33/086; F21K 9/30; F21S 4/008; F21V 21/005; F21V 23/003

USPC ..... 362/23.1, 217.01, 221, 223, 225, 362/249.02, 249.05, 612; 315/185 R, 224

See application file for complete search history.

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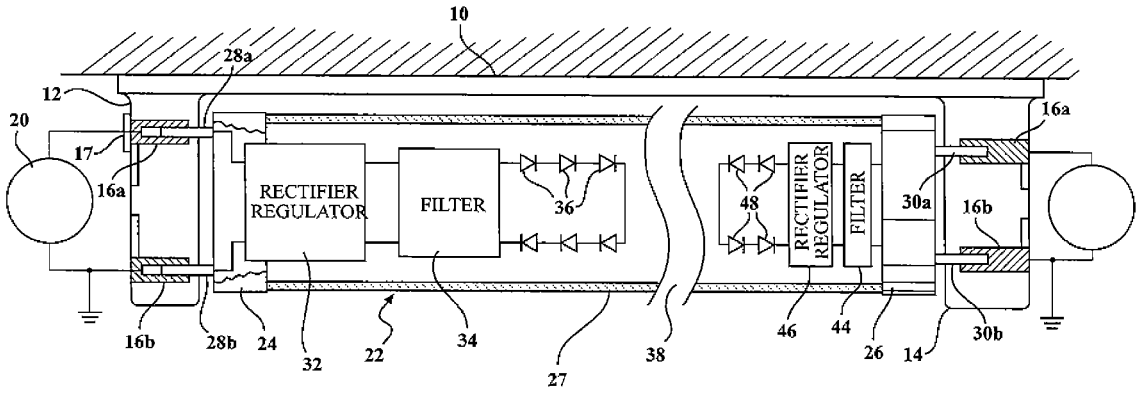
(57) **ABSTRACT**

An LED-based tube light suitable for replacing a conventional 48-inch fluorescent tube light includes LEDs connected into a complete illumination circuit that runs exclusively through connectors at one end of the light. In an alternative embodiment, two LED groups are used, each group being connected exclusively to its own set of end connectors.

5 Claims, 3 Drawing Sheets



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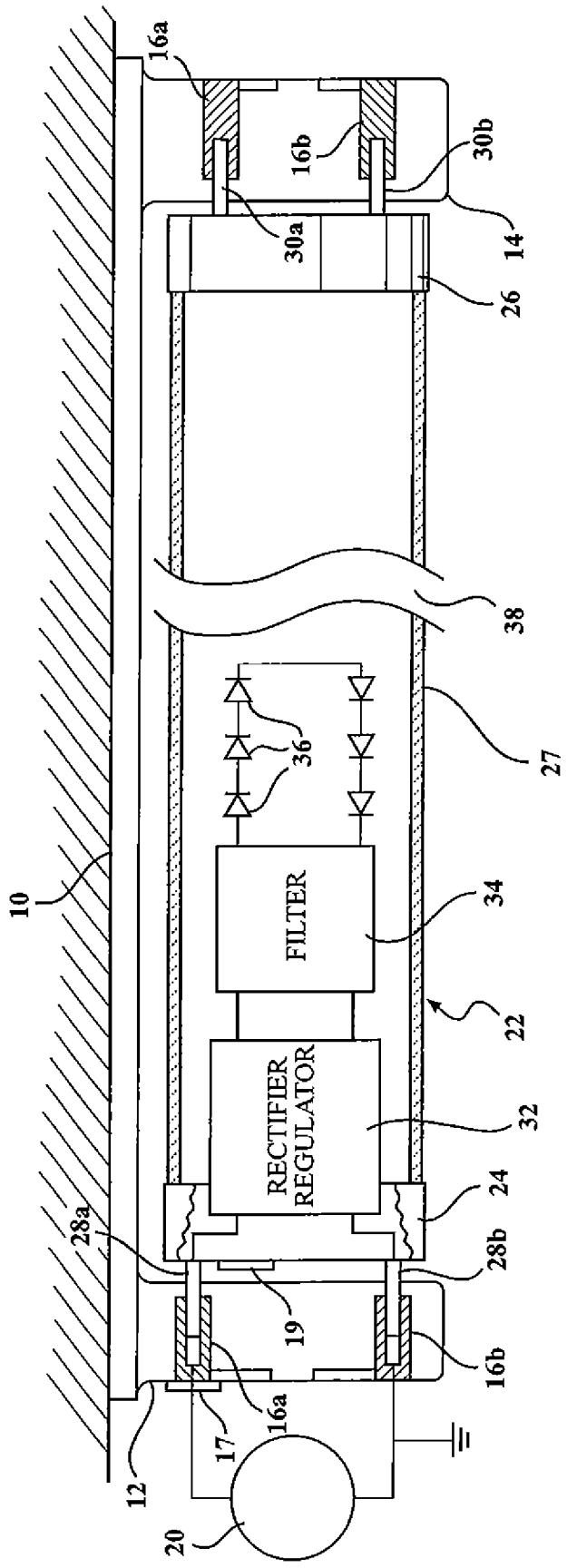
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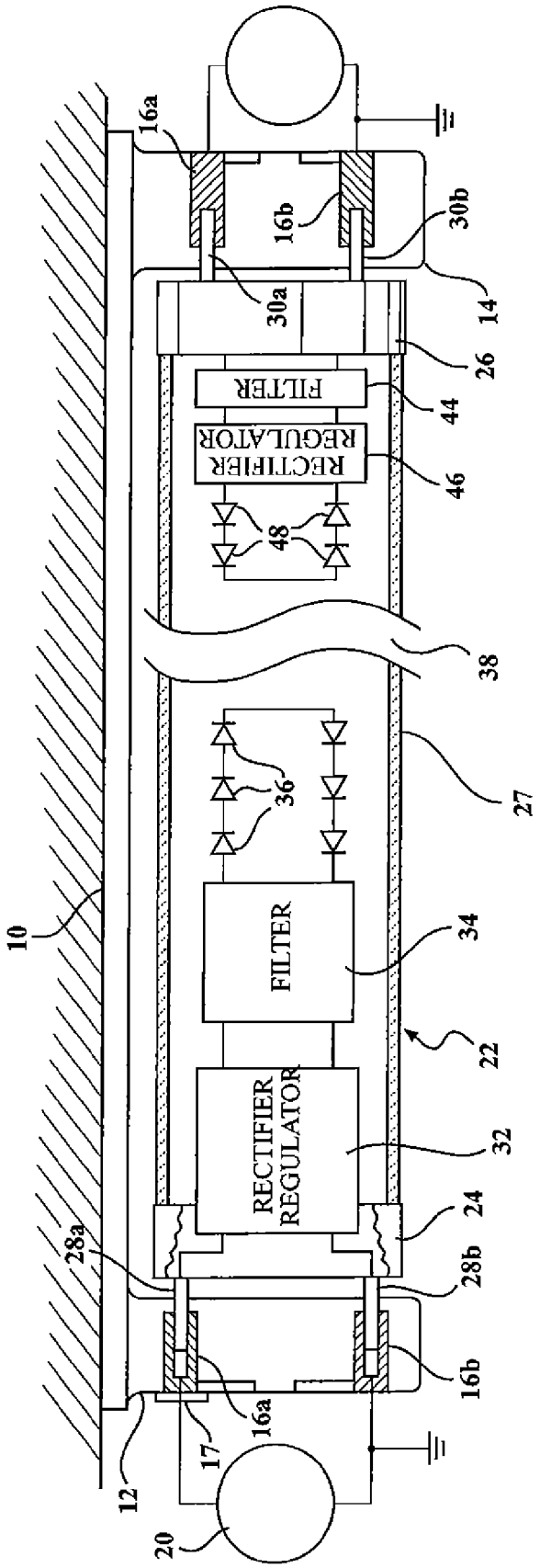
16b
30b
30a
14
26
38
27
36
10
FILTER
34
22
RECTIFIER
REGULATOR
32
24
28a
28b
19
16b
16a
17
12
20

FIG. 1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30b
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FILTER
44
RECTIFIER REGULATOR
46
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38
36
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FILTER
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22
RECTIFIER REGULATOR
32
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28a
28b
16b
16a
17
12
20

FIG. 2

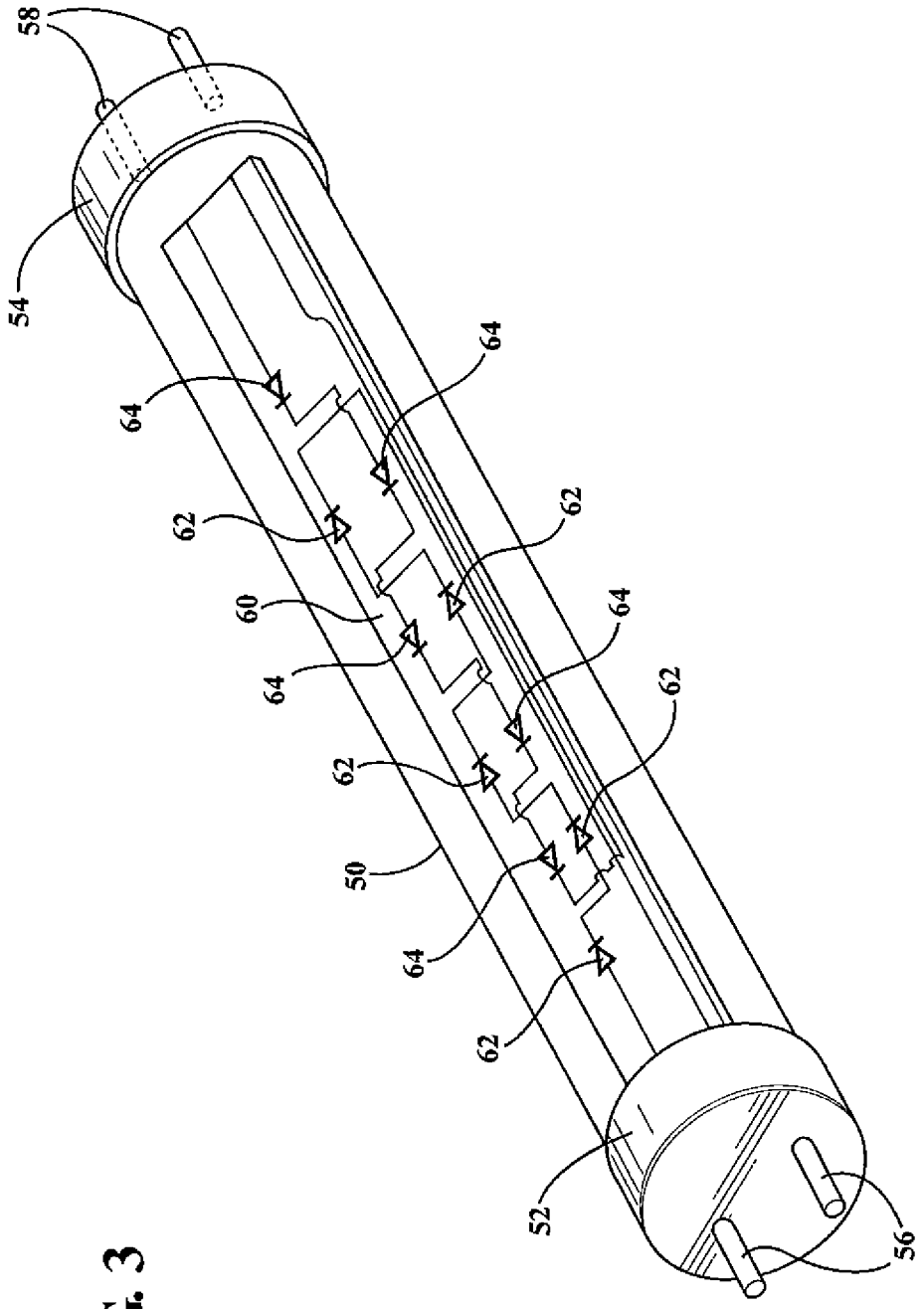

FIG. 3

LED FLUORESCENT TUBE REPLACEMENT LIGHT WITH REDUCED SHOCK HAZARD

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. provisional patent application Ser. No. 61/421,343 filed Dec. 9, 2010

BACKGROUND

Fluorescent tube light fixtures are commonly found in offices, institutions, shops, garages and many other places. A typical fixture includes a reflector accommodating several tube lights in parallel. Each light is mounted between opposed pin-type receptacles spaced, for example, 48" apart to receive electrically joined bi-pin connectors found on opposite ends of conventional fluorescent tube lights. The lights are sometimes installed into the fixture receptacles one end at a time, albeit one can insert both ends of the tube into the fixture receptacles at the same time.

LED-based replacement lights are now available for fluorescent tube lights and can be installed or plugged into fixtures normally intended for conventional fluorescent tube lights, usually after removal of the ballast. Because the LEDs and other components within some LED-based replacement lights provide a complete circuit from the pins on one end of the tube to the pins on the other end of the tube, a shock hazard exists if a person installs such a replacement light in a "hot" feature one end at a time; i.e., after installing the pins at one end into the receptacle of a hot fixture, one can receive a shock if one touches the pins at the other end.

SUMMARY

Disclosed herein is an LED-based, fluorescent tube replacement light that reduces or eliminates the risk of shock in the circumstances described above; i.e., installing an LED-based replacement light into the fixture originally designed for a double-ended fluorescent tube light having pin-type connectors. In general, the lights disclosed herein establish a complete electrical circuit through some or all of the LEDs in the light from only one end of the light, thereby electrically isolating the pins on one end of an LED-based replacement light from the pins on the other end of the replacement light, such that no complete electrical circuit between the two ends exists.

In one form, this can be accomplished by connecting all of the circuit components including the LEDs themselves between the pills at only one end of the light while the pins at the other end of the light serve only to provide a mechanical anchor; i.e., the pins at said other ends are electrically deadened so that they are not in circuit with the pins at the opposite end. The pins that are connected in circuit with the LEDs must, of course, not be directly tied together as they are in conventional bi-pin connector installation.

In another embodiment disclosed herein, the electrical components including the LEDs within a replacement light can be divided into groups, which groups are arranged in their own circuits and have their own end connectors. For example, one LED circuit may have its connectors at the left end of the tube while the other LED circuit has its pins at the right end of the tube.

Variations on these arrangements are possible. For example, one of more pulse-width-modulation power supplies may be incorporated into the light.

BRIEF SUMMARY OF THE DRAWINGS

The description herein makes reference to the accompanying drawings wherein like reference numerals refer to like parts throughout the several views and wherein:

FIG. **1** is a sectional view through a normally ballasted fixture which has been modified to receive an LED-based fluorescent tube replacement light wherein only the left end of the fixture is hot and the right end of the fixture serves only as a mechanical anchor for the tube light;

FIG. **2** is a sectional view of an alternative embodiment in which the electrical circuitry within the LED-based replacement tube light is divided into separate groups, which groups include LED banks which are electrically isolated from one another; and

FIG. **3** is a perspective view of another embodiment representing a variation in the arrangement of LEDs.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENT

Referring to FIG. **1**, there is shown a fixture **10** which is normally ballasted and otherwise configured to receive a fluorescent tube light having bi-pin connectors at opposite ends. Here, a conventional fluorescent tube has been replaced with an LED-based light **22**. The term "bi-pin" connector refers to a set of two small conductive pins arranged in parallel and serving to make electrical contact between a source and a circuit on-board the light. These connectors also serve as mechanical anchors for the light to which they are attached. In a conventional fluorescent light, the two pins at each end are electrically tied together by a metal conductor. In the embodiments disclosed herein, the two side-by-side pins are not electrically tied together.

The fixture **10** comprises opposite end receptacles **12**, **14**, each having conductive pin receivers **16***a*, **16***b* spaced apart to receive the pins **28***a*, **28***b* and **30***a*, **30***b* of the LED-based replacement light **22**. The fixture **10** may be of the twist-to-lock type where the light **22** is turned 90° to lock it into the fixture.

In FIG. **1**, the fixture **10** has been modified by removing the ballast and breaking any electrical tie such as is seen at **18** between the pins **16***a*, **16***b* so that they may be and are electrically isolated from one another. In this configuration, pin **16***a* is the hot pin as connected to the hot side of 110V AC line source **20** while pin receiver **16***b* is grounded. In this embodiment, the pin receivers **16***a*, **16***b* in the right side receptacle **14** are electrically deadened; i.e., they are not wired to any electrical source. A label **17** may be placed on the receptacle **12** to identify the hot pin. A similar label **19** is placed on the light **22** near the hot pin **28***a*.

In FIG. **1**, the LED-based tube light **22** is shown to comprise pins **28***a*, **28***b* on the left side and pins **30***a*, **30***b* on the right side, these pins being configured so as to be virtually identical in size and spacing to the pins found on a conventional fluorescent tube light. The pins are shown in FIG. **1** to be integrated with end caps **24**, **26** which are mounted to and secured over a glass envelope **27** in conventional fashion.

Disposed within the translucent envelope **27** are a rectifier/regulator module **32**, a filter module **34** and a bank of LEDs **36** which, when supplied with current from the rectifier/regulator and filter **34**, produce illumination through at least part of the glass envelope **27**. The envelope **27** may also be made of other translucent materials, including plastic. The LEDs may be distributed along a heat sink or other support. The regulator **32** is preferably a current limiter of the pulse width modulation (PWM) type as described in U.S. Pat. No. 7,049,761 the

entire content of which is incorporated herein by reference. PWM regulators may be used not only for current limiting but also for brightness control and selective dimming.

As seen in FIG. **1**, the LEDs **36** and all associated circuitry are completely isolated from the pins **30***a*, **30***b* in the receptacle **14**. Moreover, pins **30** are electrically dead. A dielectric medium **37**, in this case air, exists between the left and right pin sets **28**, **30**. Accordingly, even if the installation process involves plugging in the pins **28***a*, **28***b* to a hot source first, there is no risk of shock if one installing the tube touches the pins **30***a*, **30***b* in the installation process. The LEDs may be of any of the available types, including soldered lead LEDs and surface mount LEDs.

Looking now to FIG. **2**, there is shown a fixture **40** which is identical to the fixture **10** of FIG. **1** except for the fact that the receptacle **14'** on the right side of the fixture as shown in FIG. **2** is wired to an AC source **21** and both sources have switches S. The pin receivers **16***a*, **16***b* are the same as those found in the receptacle **10** of FIG. **1**; note that any electrical short circuit between the pins on either end which was previously used to tie them together has been eliminated, so pin receiver **16***b* can be grounded while pin **16***a* is hot.

Disposed within the fixture **40** is an LED-based fluorescent replacement tube light **41** which is substantially similar to the light **22** of FIG. **1** except that it is double-ended; i.e., in addition to the LED group or bank **36**, a second LED group or bank **48** is provided in the right side of the tube **42**. The LEDs **48** are wired to the pins **30***a*, **30***b* along with a rectifier circuit **44** and a filter circuit **46**. When supplied with current by the filter **46**, the LEDs **48** produce illumination similar to that produced by LEDs **36**. Again, the left and right sides of the tube light **42** are electrically isolated by a dielectric medium **38**, including air. Again, plugging in one end of the light **42** poses no electrical shock hazard associated with touching the pins at the opposite end of the tube since the left and right pin sets **28**, **30** are electrically isolated from one another.

It will be understood that the embodiments shown here are illustrative and various modifications and additions to them are possible within the spirit and scope of the invention as defined herein. For example, the LED groups **36** and **48** in the embodiment of FIG. **2** need not be arranged left and right as shown, but may be interspersed over the entire available length of the light **22** as shown in FIG. **3**; for example, one group can be illuminated independently of the other, but either group alone will effectively illuminate the entire effective length of the light albeit at a lesser illumination level. Again, the regulators **32** and **46** are preferably PWM type regulators as described above.

FIG. **3** shows a tube light **50** including a cylindrical glass or plastic envelope with end caps **52**, **54** at the opposite ends thereof. End cap **52** provides a mount for conductive pin connectors **56** and end cap **54** provides the same for connectors **58**. A circuit board **60** is mounted within the translucent envelope and extends from one end cap to the other. Although the envelope is described as cylindrical, it is to be understood that the light **50** may also be constructed in the form of an extruded metal half-cylinder to which a half-cylinder glass or plastic lens is attached. In that case, the extrusion receives the board **60** and serves as a heat sink.

Diodes **62** are arranged on the board **60** in staggered fashion and connected in series between pins **56**. Diodes **64** are also arranged in staggered fashion and connected in series between pins **58**. Since the two diode circuits are separate, they may be turned on and off separately by switches S. Alternatively, switches S (FIG. **2**) may be ganged together or otherwise arranged as a single switch so both banks of LEDs go on and off together. Although not shown, PWM regulators may be mounted on board light **50** if desired or be wired off board for dimming purposes. Again, LEDs **62**, **64** may be of any available type but are preferably white for most institutional applications.

What is claimed is:

1. An LED-based tube light for replacing a conventional fluorescent tube light in a fixture designed to receive a conventional tube with bi-pin connectors at each end comprising:

a tubular body having opposite ends;

a first group of LEDs disposed within said body and connected into a first circuit;

a first set of connector pins at one of said opposite ends and connected exclusively into said first circuit;

a second group of LEDs disposed within said body and connected into a second circuit; and

a second set of connector pins at the other of said opposite ends and connected exclusively into said second circuit;

wherein said first and second circuits are electrically isolated from one another.

2. A light as defined in claim **1** wherein said body includes a translucent envelope.

3. A light as defined in claim **1** wherein each of said first and second circuits includes a PWM regulator.

4. A light as defined in claim **1** wherein each of said first and second circuits includes a switch.

5. A light as defined in claim **1** wherein said body is approximately 48 inches long.

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