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24113
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FILING RECEIPT

Date Mailed: 01/18/2007

Receipt is acknowledged of this provisional Patent Application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please mail to the Commissioner for Patents P.O. Box 1450 Alexandria Va 22313-1450. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

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If Required, Foreign Filing License Granted: 01/16/2007

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is
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Early Publication Request: No

** SMALL ENTITY **

Title

Resistive bypass for series lighting circuit

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PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 C.F.R. § 1.53(b)(2).

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TITLE OF INVENTION (280 characters max)

RESISTIVE BYPASS FOR SERIES LIGHTING CIRCUIT

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ENCLOSED APPLICATION PARTS (check all that apply)

- ☒ Specification Number of Pages: 18 ☐ CD-ROM or CD-R in duplicate,
☒ Drawings 14 Sheets, Figs. 1-14 and Compact Disc Transmittal
☒ Applicant(s) is/are entitled to small ☐
entity status in accordance with 37 CFR 1.27.

METHOD OF PAYMENT

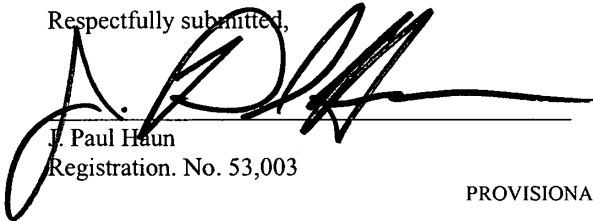
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- ☒ A check in the amount of \$100 is enclosed to cover the provisional application filing fee. The Commissioner is hereby authorized to charge any additional filing fees and/or to credit any overpayment to our Deposit Account Number 16-0631.

The invention was made by an agency of the U.S. Government or under a contract with an agency of the U.S. Government.

[X] No. [] Yes. The name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,


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Registration. No. 53,003

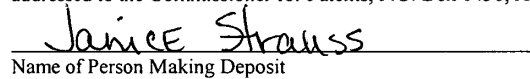
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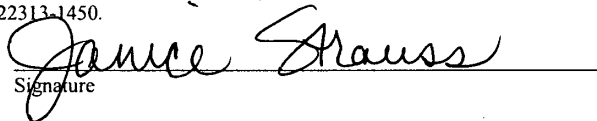
12/22/06

PROVISIONAL APPLICATION FILING ONLY

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RESISTIVE BYPASS FOR SERIES LIGHTING CIRCUIT

Technical Field of the Invention

The present invention is generally related to an improved light circuit for series circuits or series-parallel circuits utilizing incandescent, LED, or other types of lighting sources, and more particularly, the present invention relates to a resistive bypass element that will continue to conduct electricity and keep the remainder of the series circuit of lights lit even when one or more individual lighting elements are burnt out, defective, broken, have a loose connection or a broken connection in the series circuit, including series parallel circuits.

Background of the Invention

Series connected circuits containing lighting sources are well known especially in lighting strings and flexible lighting (Rope Lights) around the holidays when such light strings are used for decorative purposes. More recently, series connected lighting sources are becoming popular in task lighting, general illumination, automotive lighting, and specialty lighting utilizing LEDs. Generally, the lights in these lighting circuits are electrically in series rather than in parallel. One particular drawback to these types of lighting circuits is that when a lighting source is removed from the circuit, is burnt out, defective, or has a loose connection, the entire lighting circuit is rendered inoperable. Each lighting element within the circuit completes the electrical circuit, so when a light source is removed (for a replaceable type), a connection becomes loose, or the lighting element burns out or other lighting component within the light source, a gap is created in the circuit and electricity is unable to continue to flow through the circuit. When a "good" light source is inserted into the circuit or socket, it completes the circuit, thus allowing electricity to flow uninterrupted.

While previous mechanical and electrical circuit configurations have been used in an attempt to address the problems described above, none do so with the reliability, simplicity, and low cost of the present invention. The difficulties and drawbacks of previous lighting series

circuit configurations are overcome by the resistive bypass for a series light circuit of the present invention.

Summary of the Invention

5 The systems and methods of the invention have several features, no single one of which is solely responsible for its desirable attributes. Without limiting the scope of the invention as expressed by the claims which follow, its more prominent features will now be discussed briefly. After considering this discussion, and particularly after reading the section entitled "Detailed Description of the Drawings" one will understand how the features of the light unit for a light string provide several advantages over traditional series light circuit.

10 Accordingly, it is an object of the present invention to provide a novel and improved bypass circuit for a series light circuit configuration capable of keeping uninterrupted current flow on condition that a light source of the circuit is removed, becomes loose, fails to conduct, or lighting element or other lighting device of the light source burns out, or becomes defective within the light source.

15 Another object of the present invention is to provide the ability to allow for semiconductor light sources, such as light emitting diodes (LEDs), to provide a twinkling effect, by utilizing LED packages that incorporate integrated circuits (ICs) or other types of electronic circuits that control the flashing rate of the light source, which would only effect the individual lighting element as the resistive bypass would allow current to continue to flow in remaining
20 lighting elements in the series circuit. In another embodiment of the invention, one or more semiconductor light sources with each with a flashing circuit, but without an associated bypass element in parallel, can be located in the lighting circuit in order to flash all the remaining light sources in the series circuit.

25 In yet another embodiment of the invention, one or more incandescent light sources, each with a flashing device, but without an associated bypass element in parallel, can be located in the lighting circuit in order to flash all the remaining light sources in the circuit.

Yet another object of the present invention is to provide the ability to allow for semiconductor light sources, such as LEDs, to provide color changing characteristics by utilizing LED packages that incorporate two or more LED chips, and an IC, or other electronic circuit, that controls each LED chip in the LED package independently, while the electronic circuit or IC
5 controls the current and/or voltage to the individual LEDs in the LED package, allowing for the mixing of the LED chip colors to get various resultant colors, which would only effect the individual lighting element as the resistive bypass would allow current to continue to flow in remaining lighting elements in the series circuit. Those skilled in the art would also recognize that a zener diode could be used in parallel to the light source and bypass circuit to help regulate
10 the voltage across the light source.

Further objects and features of the invention will be readily apparent to those skilled in the art from the following specification which includes the appended claims and drawings.

To achieve the above objects and in accordance with the purpose of the invention, as embodied and broadly described herein, one embodiment of a light circuit for a series lighting
15 circuit of the present invention comprises lighting sources connected in series with each other, where each lighting source has a resistive bypass element connected in parallel across it.

The embodiment of this device is to provide a low cost resistive bypass element for series connected light sources. The current movement towards low energy incandescent bulbs, LEDs, and other energy saving light sources allows for a simple resistor to be utilized without creating
20 the heating issues previously faced if such a device was attempted. Now with these low power consuming lighting sources, a resistive bypass element becomes the forefront of products, providing a low-cost bypass circuit.

In addition, the use of the resistive bypass element in series connected lighting circuits enables longevity and durability to continue without effect from the failure of any single light
25 source due to defect, or connection issues.

In another embodiment of the present invention, the resistive bypass element may be connected in parallel with more than one light source, where the failure of one bulb would then

only affect a limited amount of light sources in the lighting circuit, further saving the cost of bypass resistive elements across each lighting source.

In another embodiment of the present invention, a resistive bypass circuit allows for other types of lighting effects, such as twinkle type products where a semiconductor light source can
5 utilize miniature ICs inside a lighting package, and will only affect that lighting source, allowing the remaining light sources to function independently. Also, more than one light package may have the twinkling effect. For this embodiment, the resistive bypass may only be used across those twinkling effect light sources, as an additional embodiment, or may be used across all lighting sources.

10 One more embodiment of the resistive bypass circuit is that it also allows for the use of color changing LED packages, that utilize more than one LED chip inside, and may consist of an IC controlled mixing of the LED chips to create other resultant colors, and will only effect that lighting source, allowing the remaining light sources to function independently. Also, more than one light package may have this color changing effect. For this embodiment, the resistive bypass
15 may only be used across those color changing light sources, as an additional embodiment, or may be used across all lighting sources.

The series circuits above with bypass resistors, can also be employed in series – parallel circuits, and be employed in products with or without lampholders, including directly connected to printed circuit boards, as other embodiments of the invention.

20 The present invention has numerous features and advantages associated therewith.

The bypass circuit of the present invention herein described has an advantage of keeping the remainder of lights within a series lighting circuit lit when a light source is missing from, or becomes loose in, one or more light source sockets or circuits, or becomes defective. This is accomplished by continuing to conduct electricity through the series light circuit even when a
25 light source is broken, loose, poor connection, or defective light source.

The bypass circuit can be utilized in AC or DC circuits powered by batteries, step down transformers, AC utility power, or converters from AC to DC or DC to AC power, pulsed DC, and filtered or unfiltered DC.

As will be realized, the invention is capable of other and different embodiments and its several details are capable of modifications in various respects, all without departing from the invention. Accordingly, the drawing and description are to be regarded as illustrative and not restrictive.

5 Other objects, advantages and novel features of the present invention will be drawn from the following detailed description of preferred embodiment of the present invention with the attached drawings. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the
10 principles of the invention, in which:

Brief Description of the Drawings

Fig. 1 is a circuit diagram of one embodiment of the present invention where the lighting sources are incandescent bulbs;

15 Fig. 2 is a circuit diagram of one embodiment of the present invention where the lighting sources include LEDs;

 Figs. 2a – 2c show various configurations and locations of the current limiting resistor and series and series-parallel configurations of Fig. 2;

 Fig. 2D shows a circuit diagram of one embodiment using a full wave rectifier with an optional filter capacitor;

20 Fig. 3 is a diagram of a light string embodiment of the present invention where the lighting sources are incandescent bulbs and the lighting element is a filament;

 Fig. 4a is a front and side view of a light source assembly where the light source is an incandescent bulb;

25 Fig. 4b is a front and side view of a light source assembly that includes an incandescent light bulb and a resistor;

 Fig. 4c is a front and side view of a light source assembly that includes an incandescent light bulb, a resistor, and a large-diameter lamp holder;

Fig. 4d is a front and side view of a light source assembly showing the brass contacts of the light source assembly and an alternate resistor mounting position;

Fig. 5 is a diagram of a light string embodiment of the present invention where the light sources LEDs and the lighting element is an LED semiconductor chip;

5 Fig. 6 is a front view of a light source assembly where the light source includes an LED encased in an epoxy lens;

Fig. 7 is a diagram of one embodiment of the present invention that produces a twinkling effect and includes a split construction of a full wave rectifier;

Fig. 8 is diagram of another embodiment of the present invention that produces a
10 twinkling effect and includes traditional full-wave rectification;

Fig. 9 is a front and close-up view of the present invention embodied in a wire tree branch;

Fig. 10 is a front view of a needleless artificial tree as used in a lighted green goods system of the present invention;

15 Fig. 11 is a front view of an artificial tree with needles as used in a lighted green goods system of the present invention;

Fig. 12 is a front view of one embodiment of a lighted green goods system using bypass circuit light strings;

Fig. 13. is a view of a flexible lighting system with a bypass circuit using incandescent
20 light sources; and

Fig. 14. is a view of a flexible lighting system with a bypass circuit using LED light sources.

Detailed Description of the Drawings

The resistive bypass circuit 10 as shown in Fig. 1 includes a power source 12, light
25 sources 14, and bypass resistors 16. Power source 12 is shown in Fig. 1 is a 120 volt alternating current (AC) power source, power source can be any voltage AC, direct current (DC), AC converted to DC, or DC converted to AC, both filtered or unfiltered DC, and pulsating DC.

Light sources 14 may include incandescent bulbs, LEDs, or other lighting devices. Light sources 14 of Fig. 1 are incandescent bulbs.

Bypass resistors 16 are configured in parallel with light sources 14, and combinations of bypass resistors 16 and light sources 14 are configured in series. Light sources 14 and bypass
5 resistors 16 may be packaged together into light source assemblies 18. When all light sources 14 are operating properly, a portion of the total current flowing through bypass circuit 10 flows through light source 14, while the remainder flows through bypass resistor 16.

In the event that a light source 14 ceases to conduct, and current flow is interrupted through that light source 14, the total current will flow through its corresponding bypass resistor
10 16. A missing, broken, or improperly connected light source 14 may cause a light source 14 to fail to conduct. In the case where light source 14 is an incandescent bulb, filament failure, or burnout, may be the cause of a light source failing to conduct. Without bypass resistors 16 operating in parallel with light sources 14, any failure in a light source 14 would interrupt power to all other light sources 14. The values of bypass resistors 16 are typically the same, and are
15 chosen such that an appropriate current flows through light sources 14 when all light sources are operating properly.

Fig. 2 illustrates another embodiment of the present invention that uses LEDs as a light source. Resistive bypass circuit 20 includes power source 12, light sources 26, optional current limiting resistors 24, bypass resistor 28. Light sources 26, optional current limiting resistors 24,
20 and bypass resistors 28 may be packaged together into light source assemblies 22. In the embodiment shown in Fig. 2, light source 26 is a single LED. In other embodiments, light source 26 may be an LED chip that includes more than one LED. Those skilled-in-the-art will appreciate that the value of current limiting resistors 24 will be chosen based on the type of light source 26, the number of light sources 26, the number of bypass resistors 24, and the number and
25 value of bypass resistors 28.

In the embodiment shown in Fig. 2, power source 12 provides power to bypass circuit 20. When all light sources 26 are operable, current flows through the circuit, with a portion of the total current flows through the path containing current limiting resistor 24 and light source 26,

while the remainder flows through bypass resistor 28. When current flow is interrupted through a light source 26, total current flows through the corresponding bypass resistor 28, allowing the remaining light sources 26 to operate.

Resistive bypass circuits 10 and 20 may be used with any series, or series-parallel
5 connected lighting device where failure of the bulb or its connection will turn off some or all of the bulbs. This includes mini-bulb lighting strings used for Christmas and other holiday decorative lighting, rope lights (also known as flexible lighting) and other general lighting applications that use series connected lamps or LEDs, such as a LED desk lamp, or under-counter light.

10 Power source 12 is shown in Fig. 2 is a 120 volt alternating current (AC) power source, power source can be any voltage AC, direct current (DC), AC converted to DC, or DC converted to AC, both filtered or unfiltered DC, and pulsating DC.

Figs. 2a – 2c show various configurations and locations of the current limiting resistor and series and series-parallel configurations of Fig. 2. Figures 2a and 2b, show light source
15 assemblies, 22, that contain only the light source, 26, and the bypass resistor, 28, with the current limiting resistor located outside of the light source assembly 22.

Fig. 2D shows a circuit diagram utilizing a filtered full wave rectifier, 82 with an optional filter capacitor 84. The full wave rectifier could be replaced by a single rectifier diode, 76, to produce ½ wave rectification, and can be optionally filtered by capacitor 84. If a large enough
20 capacitor 84 is selected, utilizing a single diode, 76, it could simulate full wave rectification to the circuit.

Fig. 3 is an embodiment of the present invention in the form of a series-connected decorative light string 30. Decorative light string 30 includes power plug 32, optional light source assemblies 34, incandescent bulbs 36 and bypass resistors 16. Power plug 32 may
25 directly plug into utility power (120V, 208V, 220V, 240V, 280V, etc), connect to a step down power supply (such as a Class 2 power supply) or may be omitted for direct connection to a power source. As shown in Fig. 3, incandescent bulbs 36 may be a miniature bulb-type (mini bulb) operating on 2.5 VAC at 70-120 mA, or some other low current draw bulb. Resistors 16

may be in the range of 30 ohms to 60 ohms, though the value of resistors 16 will vary according to the total current flow desired, as well as according to other factors mentioned above. Resistors 16 are configured in parallel with light sources 36. Light source assemblies 34, if provided, are configured electrically in series with each other. As indicated earlier, when a light source
 5 assembly 36 fails, total system current will flow through the corresponding bypass resistor 16, allowing the other light sources 36 to remain lit.

In one embodiment of the decorative light string 30 includes one or more light source assemblies 34 that includes a flashing device, but does not include a bypass element 16 in parallel, causing all of the remaining light source assemblies 34 in the series circuit of decorative
 10 light string 30 to flash.

Some methods of making Light source assemblies 34 are further described in Figs. 4a-d, but the present invention is not limited to the embodiments depicted in the figures. Fig. 4a illustrates a light source assembly 34a including a light source 36a in the form of a mini bulb, and a lamp holder 35a. Fig. 4b illustrates a light source assembly 34b that includes a light source
 15 assembly 34b, a light source 36b in the form of a mini bulb, a bypass resistor 16, and a lamp holder 35b. Lamp holder 35b may be larger than lamp holder 35a to accommodate bypass resistor 16. Bypass resistor 16 is connected across light source 36b in parallel. The connection may be accomplished by soldering, crimping, friction fit, compression fit, or other means, including connecting to a pair of brass contacts (not shown), to the leads of light source 26b, or
 20 to other conductors.

Fig. 4c illustrates yet another light source assembly, light source assembly 34c, which includes a light source assembly 34c, a light source 36c in the form of a mini bulb, a bypass resistor 16, and a lamp holder 35c. In this embodiment, lamp holder 34c is even larger than lamp holder 35b.

25 Fig. 4d illustrates another light source assembly, light source assembly 34d, which includes a light source assembly 34d, a light source 36d in the form of a mini bulb, a bypass resistor 16, and a lamp holder 35d. In this embodiment, lamp holder 34d may be longer than lamp holder 35b. In the embodiment shown in Fig. 4, one lead of bypass resistor 16 can be

crimped to the brass contact. The other lead of bypass resistor 16 may be crimped to a second brass contact 17, or connected by other means, such that it is electrically in parallel with light source 36d. Other means includes being connected to the leads of light source 36. In addition to crimping, soldering, friction fit, compression, and other common connection means may be employed.

In yet another embodiment, light sources 36 may be mini bulbs filled with an inert gas. Since the use of a bypass resistor 16 has the potential to decrease current flow through light sources 36, an inert gas, such as Krypton, can be used in place of a vacuum to allow for the bulb filament to burn whiter and maintaining the same bulb life expected from mini bulbs and get even closer to a standard mini bulb brightness.

Lamp holders 35 of light source assemblies 34 may include molded lamp holders, assembled-on lamp holders, heat-shrink formed lamp holders, and other types of lamp holders. Light sources 36 may be removable, or non-replaceable. In another embodiments, the light source assemblies 34 may be mounted on a rigid or flexible printed circuit board, or connected directly to conductors or wires.

Another embodiment of the present invention is a light string 40 as shown in Fig. 5. Light string 40 includes an optional power plug 42, light sources 26, current-limiting resistors 24, and bypass resistors 28. Light sources 26, current limiting resistors 24, and bypass resistors 28 may be packaged together into light source assemblies 44. The embodiment shown works substantially as described above.

One embodiment of light source 44 is shown in Fig. 6. Lamp holder base 33 houses bypass resistor 28, brass contacts 17, and the ends of wires 45. Bypass resistor 28 is connected to brass contacts 17 or other contact material to create a parallel configuration. Brass contacts 17 may be crimped on to wires 45 or other conductors. The optional lamp holder adapter 48 attaches to epoxy or some other material lens 46. The lens 46 encases light source 26, where light source 26 in this embodiment is an LED.

In another embodiment, the bypass resistor 28, may be located directly across the LED leads 49 outside of any optional lens material, 46.

In an alternate embodiment, the bypass resistor 28 may be located within the LED lens material 46 in parallel with the LED.

Fig. 7 illustrates another embodiment of the present invention, light string 50, that utilizes partial rectification and blinking LEDs inside the epoxy lens. Light string 50 includes a power plug 52, end connect 53, and light source assemblies 54 and 56. Light source assemblies 54 are connected in a series configuration. Light source assemblies 56 are connected to the series-connected light sources 54 as shown in Fig. 7.

Light source assemblies 56 includes a bypass resistor 58, optional current limiting resistor 60, light source 62, which in this embodiment is an LED, and diode 64. Light source assembly 56 may also includes a lamp holder (not shown), similar to the ones described above.

Light source assemblies 54 includes a bypass resistor 58, optional current limiting resistor 60, and light source 62 or light source 66. In this embodiment, light source 62 is an LED chip, and light source 66 is a "blinking" LED that incorporates a chip that turns the LED on and off for a blinking or flashing effect. Operation of light source 66 is independent of the other light sources 62 due to the bypass resistor 58. Light source assembly 54 may also includes a lamp holder (not shown), similar to the ones described above. Circuit 50 may utilize more than one blinking LED 66, per circuit, or may only include blinking LED 66 as its light source.

In this embodiment, diodes 64 provide full-wave rectified power to light source assemblies 54, causing light sources 62 and 66 of light source assemblies 54 to remain lit throughout most of the AC power cycle. Light source assemblies 56 receive partial rectification due to the particular configuration of Fig. 7, causing light sources 62 of light source assemblies 56 to be powered throughout approximately half the AC power cycle.

When light source 66 is a blinking LED chip as shown in Fig. 7, current is periodically interrupted to the LED on the chip. Without bypass resistors 58, this would cause all light sources in light string 50 to lose power due to an interruption of current flowing through the series-connected circuit. However, bypass resistor 28 allows current to continue flowing, maintaining power to other light sources 62 and 66. Under normal operation, light source 66 will cause its LED to blink on and off, creating a twinkling effect, while other light sources 62 remain

powered and lit. The use of multiple light sources 66 in a light string 50 creates a desirable twinkling effect as light sources 66 turn on and off, while light sources 62 remain lit.

In an another embodiment, Light source 66 may be a multi LED chip configuration, programmed to change the light output color of the light source. Alternate embodiments may use
5 a light source 66 where the bypass device 80 is an electronic circuit, or integrated circuit across the LED leads inside or outside of the epoxy housing/lens.

Figure 8 illustrates another embodiment where, a resistive bypass circuit 70 utilizes full-wave rectification to provide power to all light sources 62 and 66. Resistive bypass circuit 70 includes an AC power source 72, full-wave rectifier 74 with optional filter capacitor (not shown),
10 main current limiting resistor 78, bypass resistors 80, light sources 66 and 62. Full-wave rectifier 74 includes four diodes 76. Full wave rectifier 74 may optionally employ one diode 76, and a sufficiently sized filter capacitor to simulate full wave rectification. The AC power source 72 may be any source voltage.

In this embodiment, full-wave rectifier 74 provides DC power for bypass circuit 70.
15 Main current limiting resistor 78 limits the total amount of current flowing through circuit 70 and is sized partially based on the number of light sources 62 and 66. The use of a single current limiting resistor 78 rather than multiple current limiting resistors simplifies design and manufacturing efforts, but may optionally be manufactured with multiple current limiting resistors as described in the embodiments above. Lights source 66 in the form of blinking LED
20 chips, along with bypass resistors 80 create a twinkling effect when embodied in a light string. The size of bypass resistor 80 depends on the electrical characteristics of light source 66, but in one embodiment may be 300 to 600 ohms. In some embodiments, bypass resistor 80 may only be used in conjunction with light sources 66, and not with light sources 60. This configuration would enable the twinkling effect, but would eliminate the bypass function at light sources 62.

25 Another embodiment is the use of circuit 70 in a DC-supplied circuit, such that full wave rectifier 74 is not required. Additional embodiments of circuit 70 are configured in a series-parallel configuration. In another embodiment, light source 66 may be a multi LED chip configuration, programmed to change the light output color of the light source.

Fig. 9 depicts a decorative lighting sculpture 90 that includes an optional power plug 91, wires 98, optional connectors 96, main rod 92, branches 94, wires 100 and light source assemblies 102. Power plug 91 may be connected in one embodiment to a 45 VDC to 50 VDC class II transformer with an output of 1.2 A, though other voltage ranges and power sources may be used. Alternatively, light sculpture 90 may not include power plug 91 and may be directly connected a power source. Light source assemblies 102 may be similar in configuration to the other light source assemblies described above, utilizing incandescent bulbs, LEDs, or other light sources configured in parallel with a bypass resistor.

In alternate embodiments, the bypass resistor may be replaced by bypass circuits utilizing transistors or other electronic active circuits.

The circuits and light strings of the present invention as applied to artificial trees, wreaths, garlands, and other artificial greenery, or alternatively to medium to large decorative products, such as stars, figures, icons and other decorative products provide a number of advantages. Replacing light strings due to light sources that have failed on a light string that is attached to an artificial tree or other decorative product, can be a difficult task since the string is not easily removed from the tree or products and the use of electric testers is not practical due to the fields such products produce with the volumes of wires and optional metal support structures. The bypass circuits and light sets described herein ensure that the light string will continue to remain lit even in the event of a light source failure, meaning that the entire light string does not have to be removed from the tree or decorative product. The combination of circuits, light strings and tree make a reliable, convenient lighted green goods system. Figs. 10-12 depict some of the artificial trees used in such a lighted green goods system.

Fig. 10 shows one version of an artificial tree 140 that includes a tree trunk 148, branches 142, branch mains 144, and sub-branches 146. Artificial tree 140 may be constructed of a combination of many materials as described above. In this embodiment, artificial tree 140 is constructed primarily of painted metal, or in another embodiment made primarily of plastic, or a combination of plastic and metal.

Fig. 11 shows another version of an artificial tree, 140'. Artificial tree 140' includes tree trunk 148', branches 142', branch mains 144', sub-branches 146' and needles 149. Needles 149 are commonly derived from PVC, nylon, and/or PE and may be green in color to make artificial tree 140' appear to be an evergreen or pine tree. In another embodiment it may use white needles and branches for different aesthetics.

FIG. 12 light string, such as light string 30, 40, 50, 70, or a combination thereof, attached to branches 142 of tree 140 to form a pre-lit tree system 200. Light strings 30, 40, 50, 70, or other embodiments of the present invention, may be similarly attached to trees 140'. Light string 30, 40, 50, 70 is shown attached to tree 140 via clips 150. Clip 150 may include but are not limited to C clips, snap lock clips, and wire ties.

Figs. 13 and 14 depict the present invention in the form of flexible lighting, or rope lighting. Flexible lighting 300 as depicted in FIG. 13 includes an outer encasement 302, end cap 304, power cap 306, power cord 308, power plug 310, and one or more bypass circuits 312. Flexible lighting 300 may operate on 120VAC, which is transmitted through power plug 310 and power cord 308, though other voltages may be used, and the input may be rectified or DC. Outer encasement 302 is typically made of a PVC material, and houses bypass circuit 312. Power cap 306 assists in attaching power cord 308 to bypass circuit 312 and may attach to outer encasement 302 by any number of known methods.

Bypass circuits 312 are series circuits and each bypass circuit 312 is connected in parallel with the other. Bypass circuit 312 includes a plurality of light sources 314 electrically connected in parallel with bypass resistors 320. Light sources 318 may be incandescent bulbs, LEDs, or other light sources. As described in previous embodiments, bypass resistor 320 may be replaced with another active circuit device. Bypass circuit 312 may also include conductors 314 and 316 which extend the length of flexible lighting 300 and provide power to the bypass circuits 312 when more than one circuit 312 is employed.

Operation of flexible lighting 300 is similar to those embodiments described above. During normal operation, current flows through both light source 318 and bypass resistors 320.

If light source 318 fails, the entire bypass circuit 312 current flows through bypass resistor 320, allowing flexible lighting 300 to stay lit.

FIG. 14 depicts a similar flexible lighting system that relies on LEDs, rather than incandescent bulbs. Flexible lighting 400 as depicted in FIG. 14 includes an outer encasement 402, end cap 404, power cap 406, power cord 408, power plug 410, and one or more bypass circuits 412. Flexible lighting 400 may operate on 120VAC, which is transmitted through power plug 410 and power cord 408, though other voltages may be used, and the input may be rectified or DC. Outer encasement 402 is typically made of a PVC material, and houses bypass circuit 412. Power cap 406 assists in attaching power cord 408 to bypass circuit 412 and may attach to outer encasement 402 by any number of known methods.

Bypass circuits 412 are series circuits and each bypass circuit 412 is connected in parallel with the other. Bypass circuit 412 includes a plurality of LEDs 414 electrically connected series with resistors 419. Series connected LEDs 414 and resistors 419 are electrically in parallel with bypass resistors 420. Light sources 418 may be LEDs, or other light sources. As described in previous embodiments, bypass resistor 420 may be replaced with another active circuit device. Bypass circuit 412 may also include conductors 414 and 416 which extend the length of flexible lighting 400 and provide power to the bypass circuits 412 when more than one circuit 412 is employed. The number or location of resistors 419 in each circuit 421 may vary based on circuit requirements, with some bypass circuits 412 not including a resistor 419. In other embodiments, resistor 419 may be located external to circuit 421, and in line with circuit Bypass circuit 412.

Operation of flexible lighting 400 is similar to those embodiments described above. During normal operation, current flows through both light source 418 and bypass resistors 420. If light source 418 fails, the entire bypass circuit 412 current flows through bypass resistor 420, allowing flexible lighting 400 to remain lit.

Other embodiments of flexible lighting 300 and 400 may incorporate twinkling, flashing and color changing properties as previously described above.

In addition to decorative lighting, the bypass circuits of the present invention may also be used in general lighting applications including portable lighting, auto lighting, traffic lights and the like.

The invention addresses many of the deficiencies and drawbacks previously identified.

- 5 The invention may be embodied in other specific forms without departing from the essential attributes thereof; therefore, the illustrated embodiments should be considered in all respects as illustrative and not restrictive. The claims provided herein are to ensure adequacy of the present application for establishing foreign priority and for no other purpose.

Claims

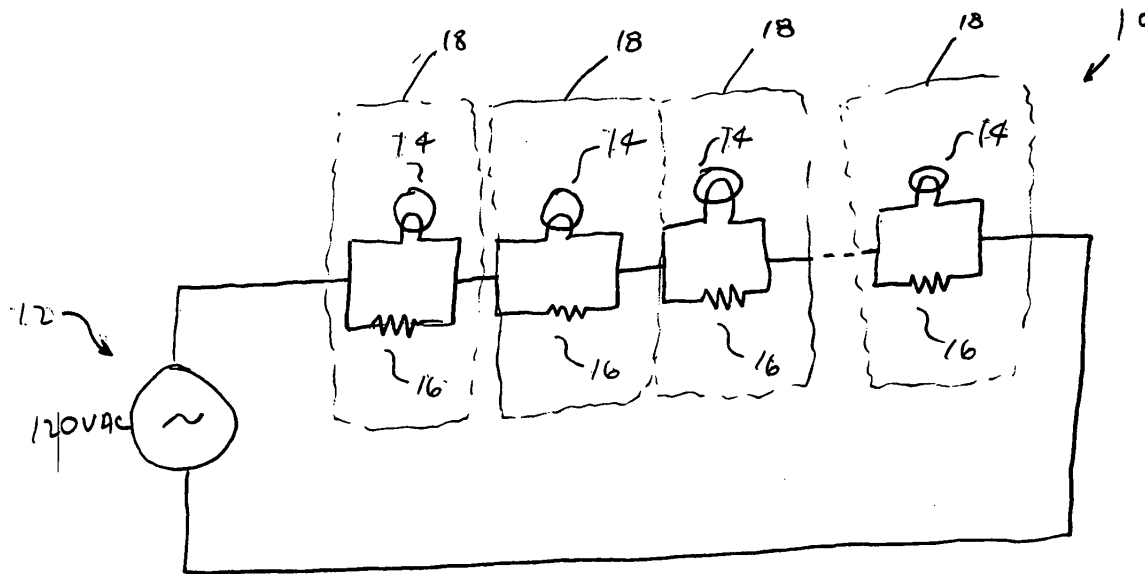
What is claimed is:

1. The bypass circuit for a series lighting circuit as substantially described herein.
2. The resistor bypass circuit as substantially described herein.
- 5 3. A method of maintaining electrical continuity throughout a series connected lighting circuit, or series-parallel lighting circuit as substantially described herein.
4. A system for maintaining electrical continuity throughout a series connected lighting circuit, or series-parallel lighting circuit as substantially described herein.
5. Special lighting effects created by the use of the bypass circuit as substantially described
10 herein.
6. Electronic active bypass circuit as substantially described herein.
7. The flexible lighting system as substantially described herein.
8. The lighted green goods system as substantially described herein.
9. The lighted decorative product system as substantially described herein.

Abstract

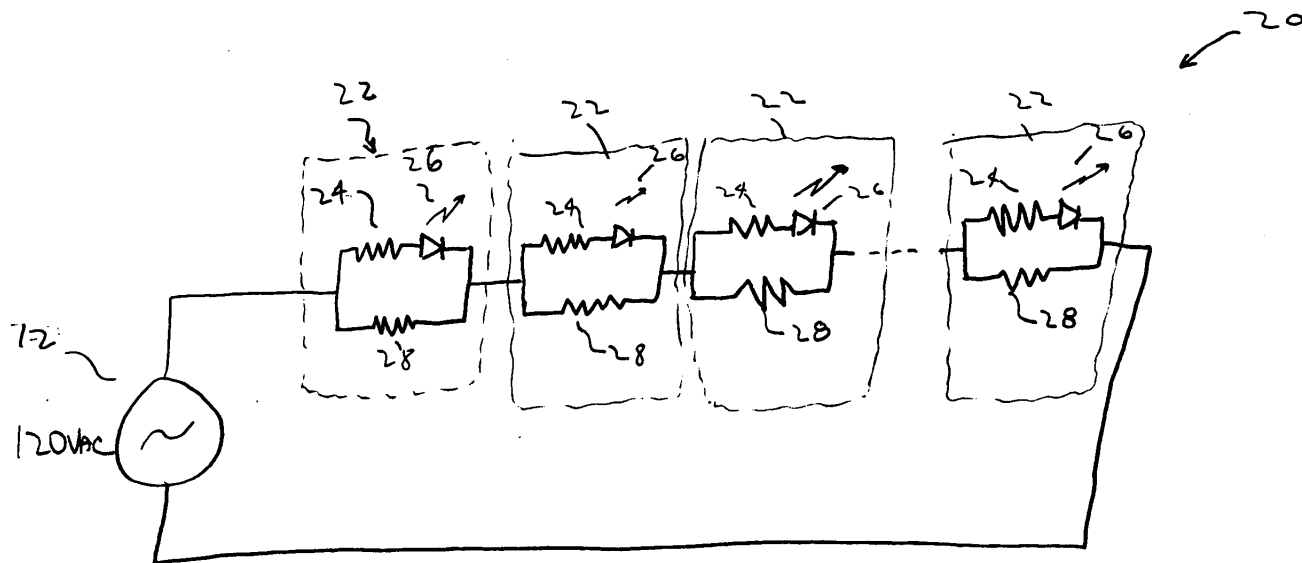
A system for maintaining electrical continuity throughout a series connected lighting circuit, or series-parallel lighting circuit as substantially described herein.

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Key
resistor
Bulb, incandescent

FIG. 1



key
 — Resistor
 — LED

FIG. 2

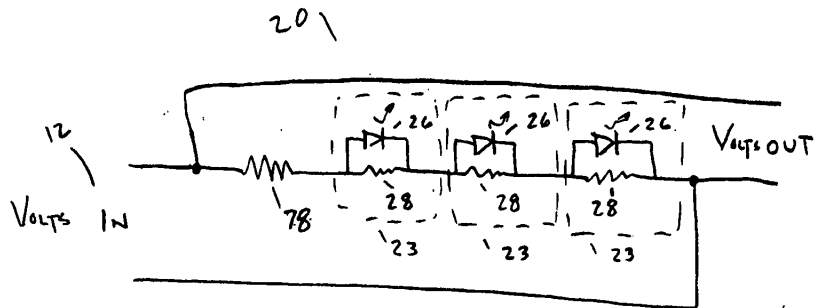


FIG 2a

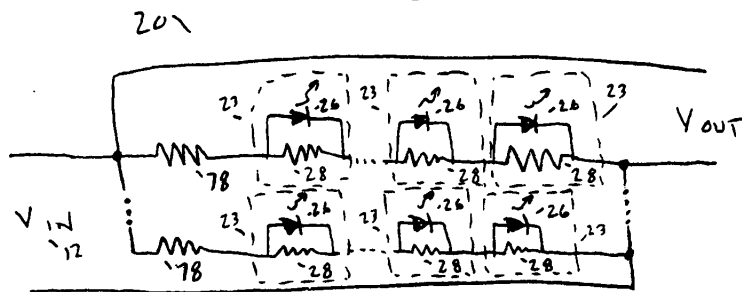


FIG 2b

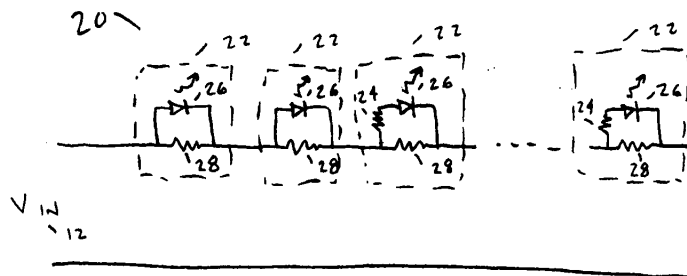


FIG 2c

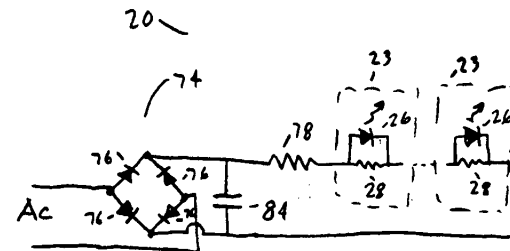


FIG 2d

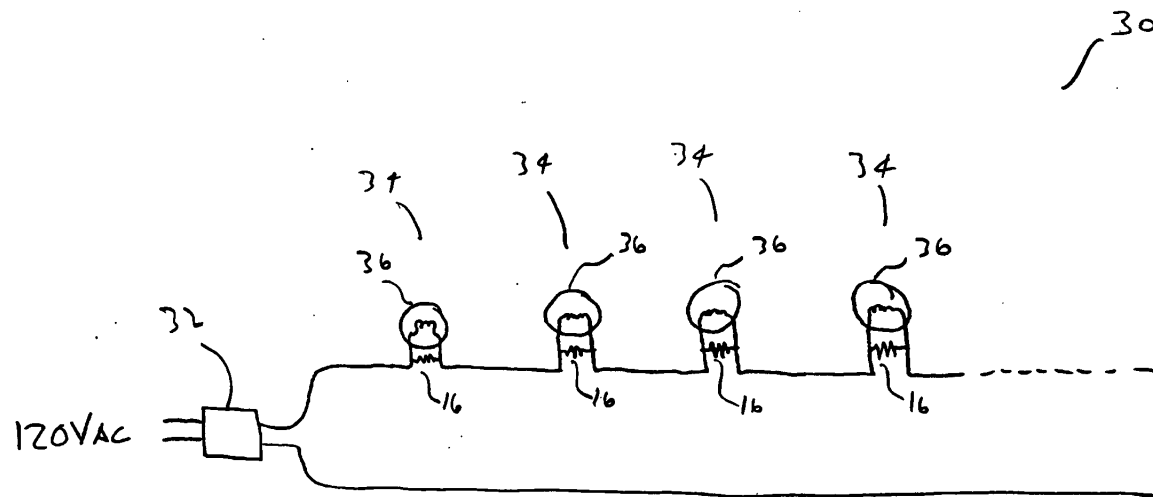
KEY

RESISTOR

76 - DIODE

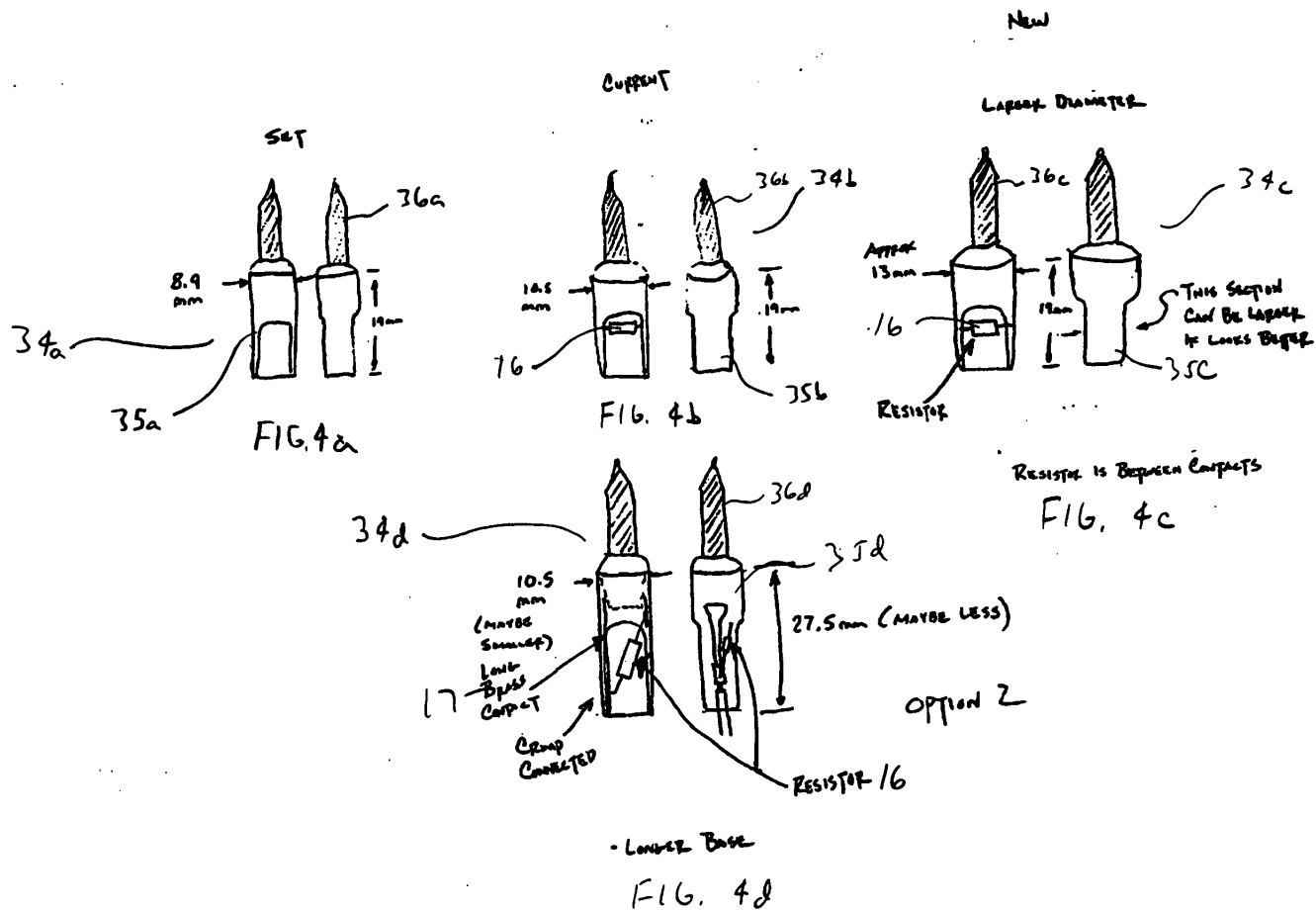
26 - LED

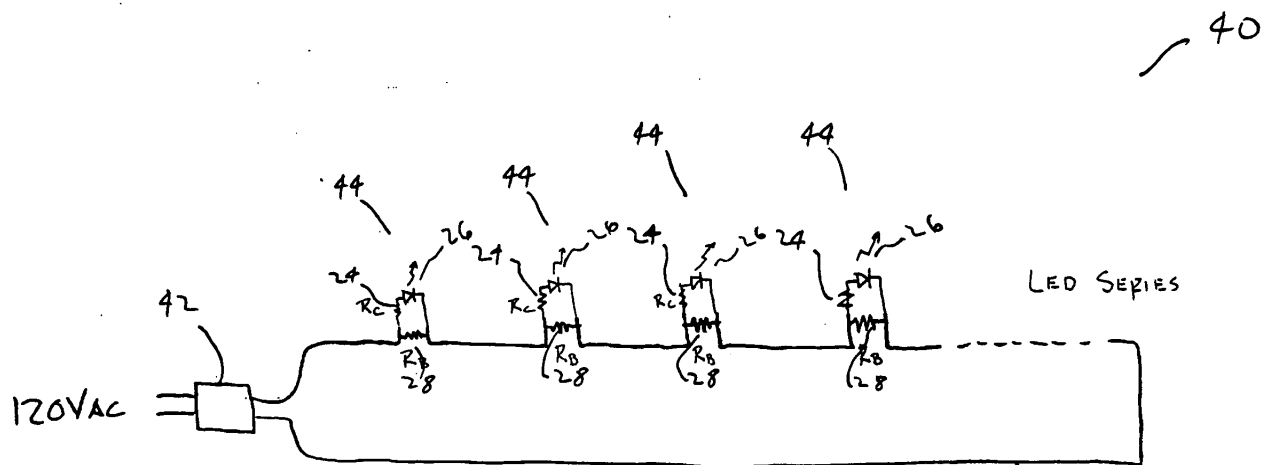
84 - CAPACITOR



KEY
 Ⓞ = MINI BULB 2.5V, 100mA
 —||— = RESISTOR

FIG. 3





KEY

R_B = BYPASS RESISTOR

R_C = CURRENT LIMITING RESISTOR

$\text{---}\text{M}\text{---}$ = RESISTOR

Ω = OHM

$\text{---}\text{X}\text{---}$ = LED

FIG. 5

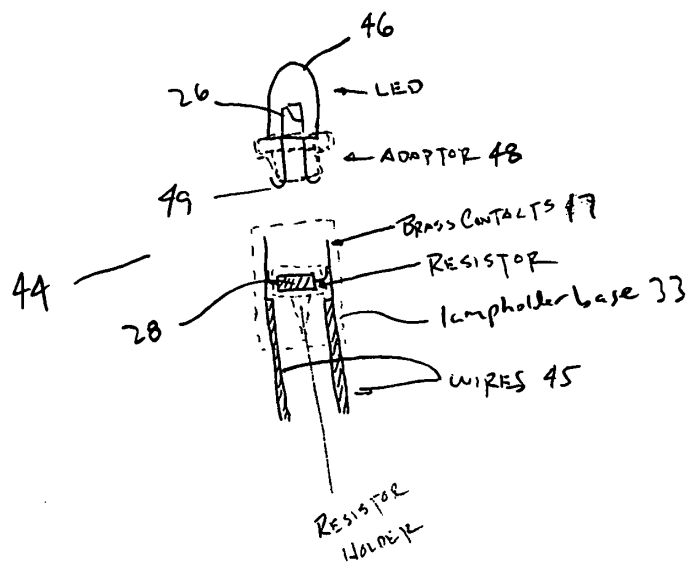
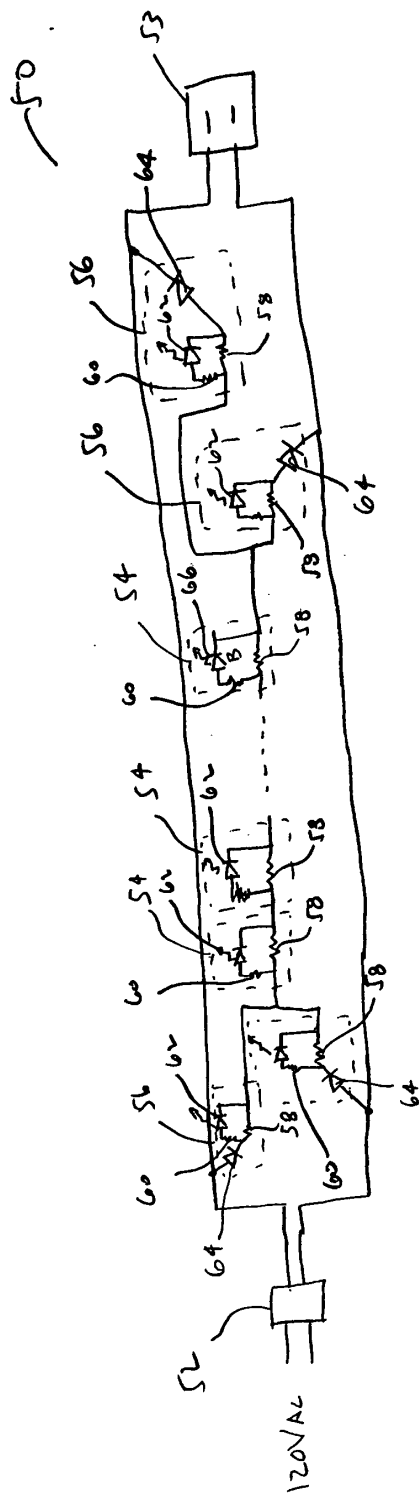


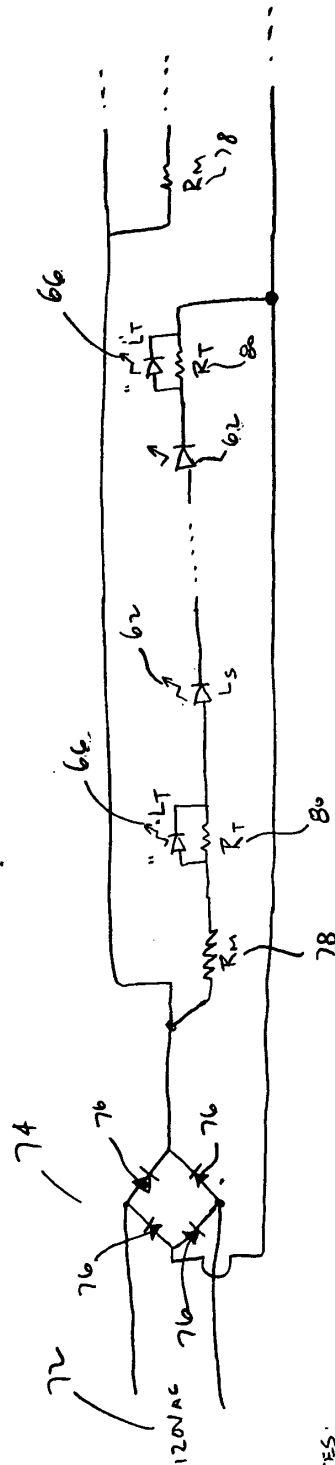
FIG. 6



∇ = Diode
 ∇ = LED

∇ = LED WITH BLINKING IC
 INSIDE EPOXY

FIG. 7



Notes:

$$76 - 1 = 75$$

6 in Δ = STEADY ON LED

66 $\overline{K}$ "G" = BUNKING LED WITH IC
LT INSIDE EPOXY

$$R_M = \frac{\text{MAIN CURRENT LIMITING}}{\text{FOR LEDS}} \text{ RESISTOR} \dots$$

R_T = BYPASS RESISTOR FOR BLINKING LED
APPROX 560Ω

Fig. 8

70

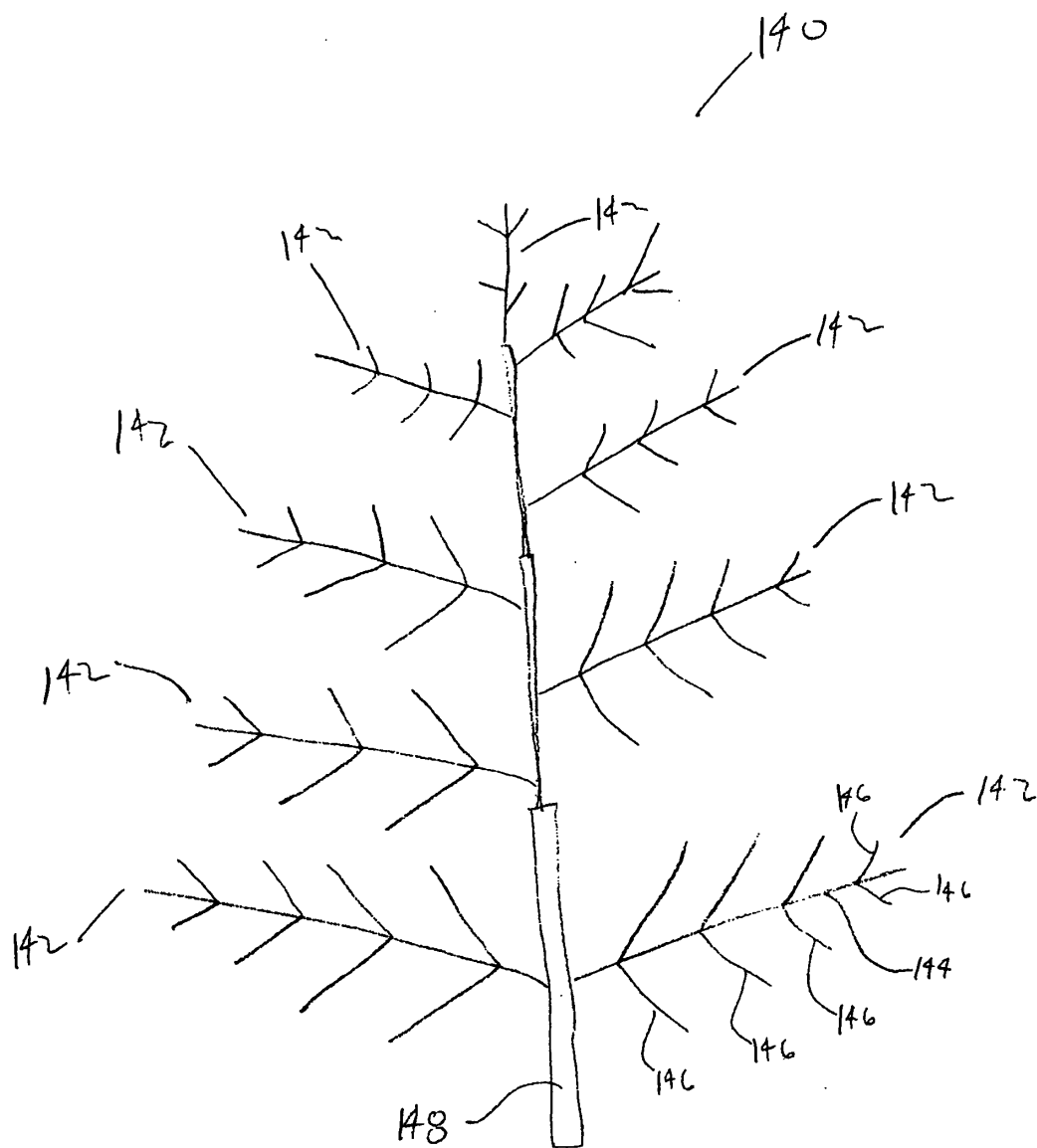


FIG. 10

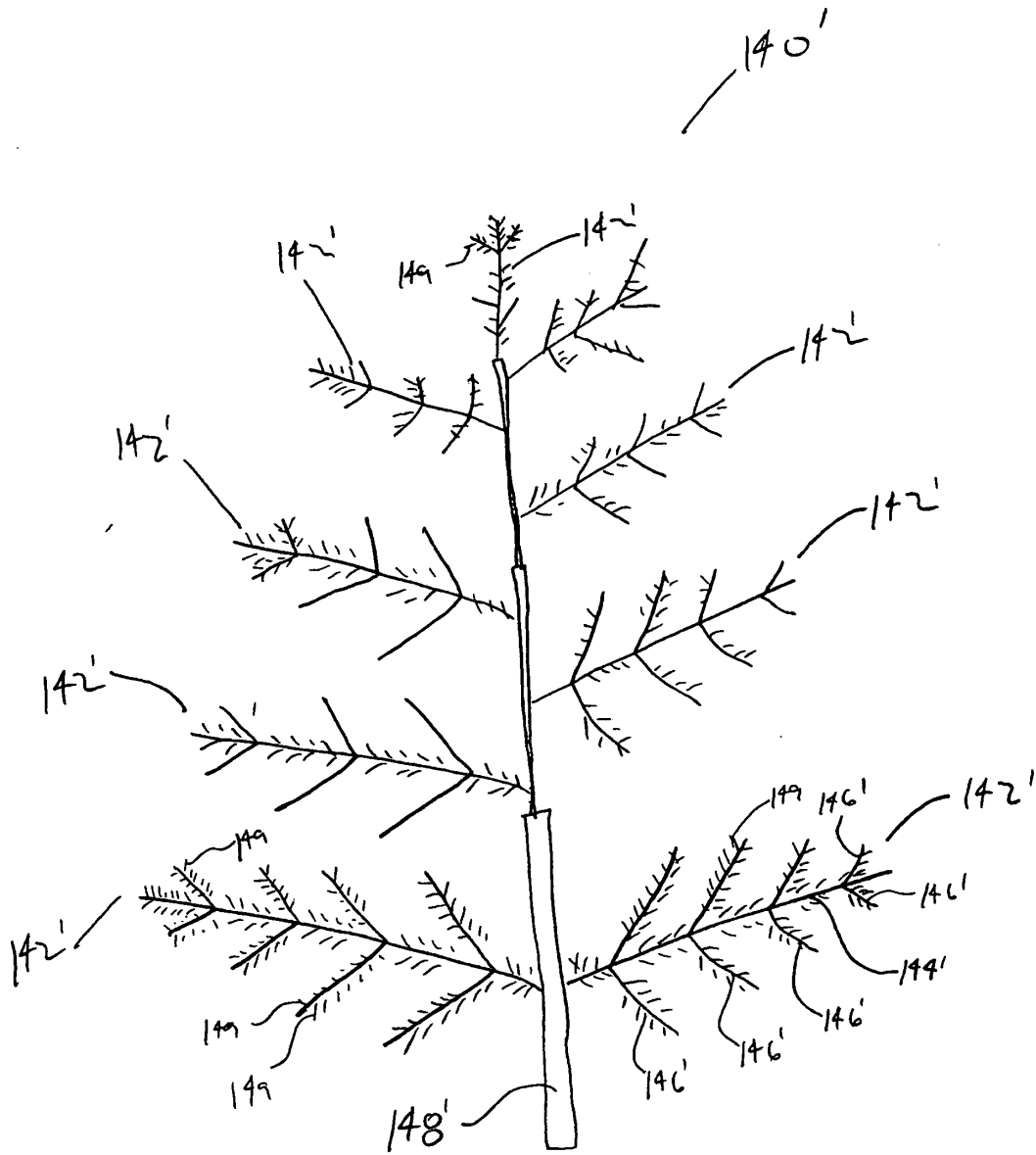


FIG. 11

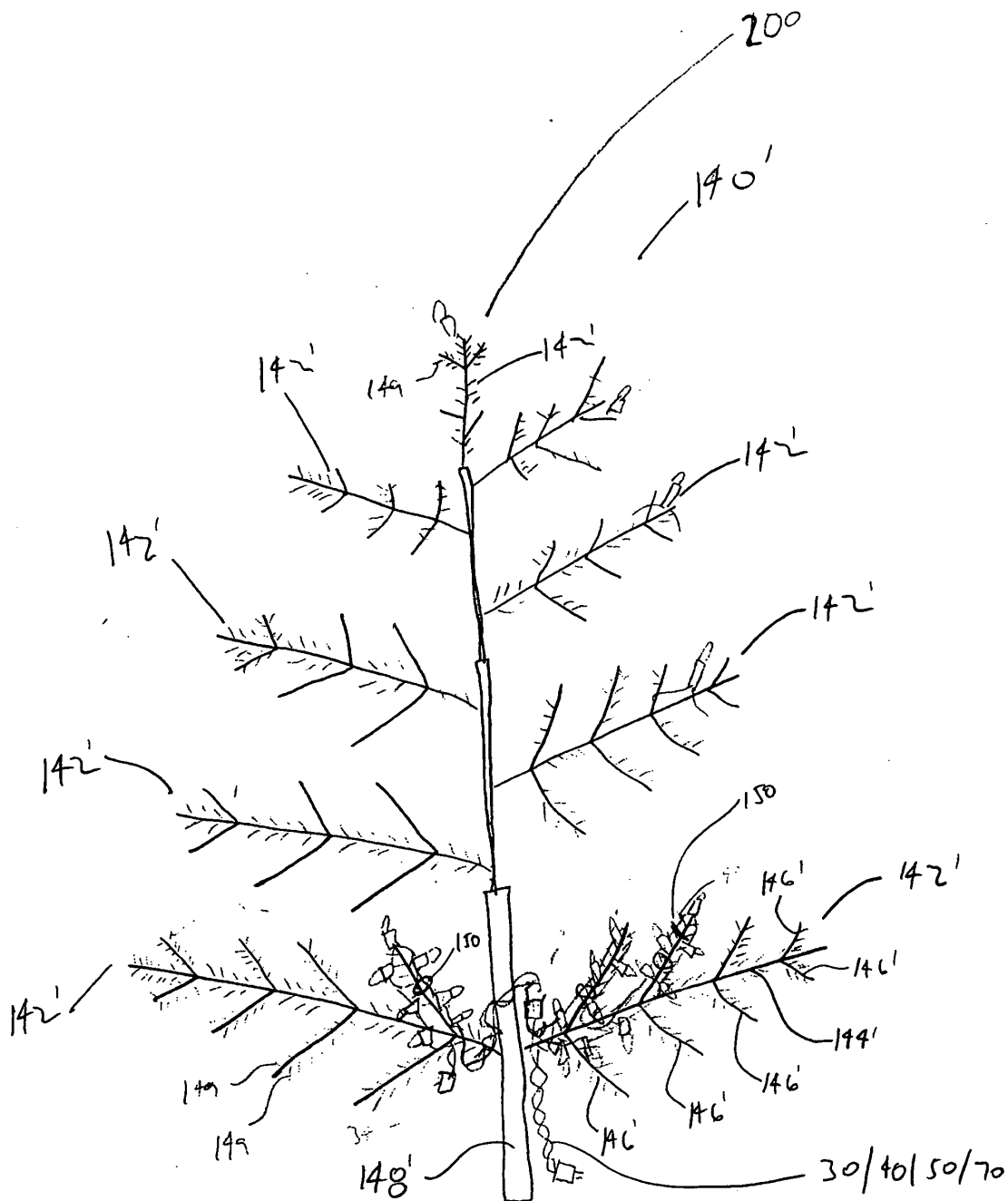


FIG. 12

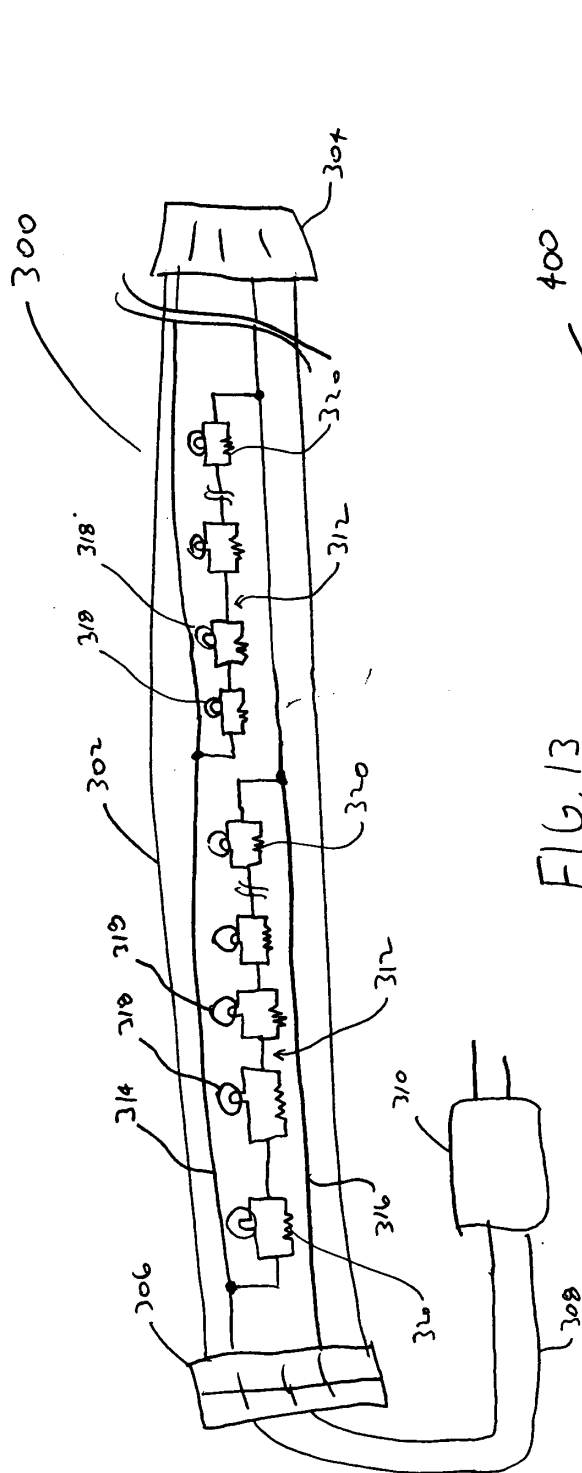


FIG. 13

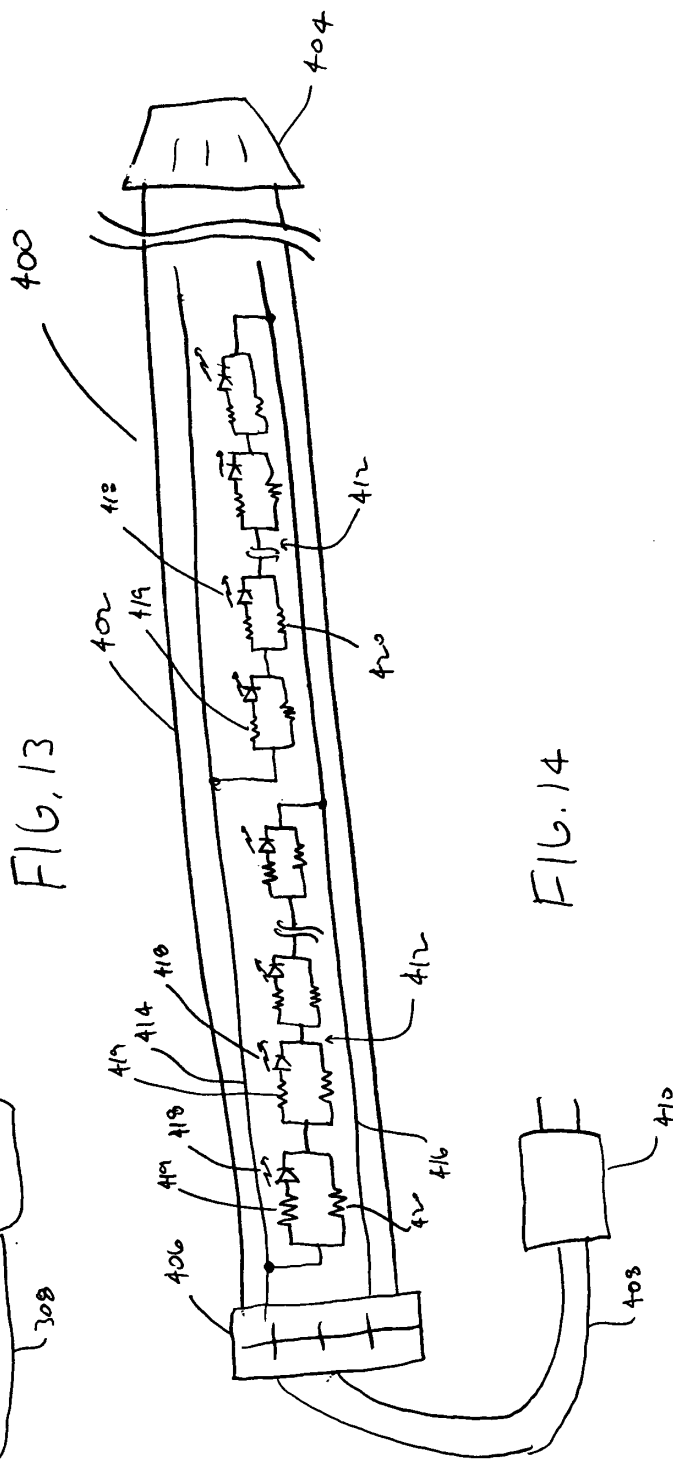


FIG. 14

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