

[54] **ELECTRONIC COMPONENT**

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[51] Int. Cl. **H01j 7/44**

[58] Field of Search 215/32; 338/219, 220, 221; 315/71, 200 R, 205

[56] **References Cited**

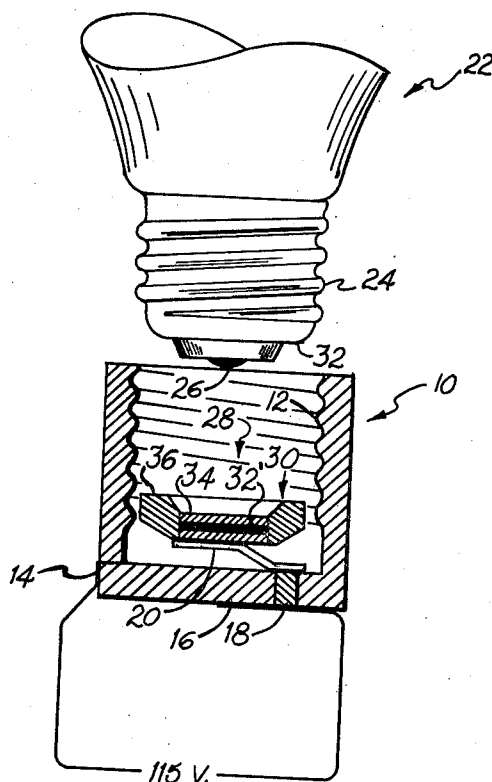
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[57] **ABSTRACT**

Devices for prolonging the life of an electric light bulb adapted to fit into a light socket between the central contact of the light socket and the central contact of the light bulb. Disclosed are combinations of rectifying and resistive elements, preferably temperature responsive resistive elements which function to reduce turn-on surges and lower the operating temperature of the bulb filament. Also disclosed is a method of utilizing a printed circuit board to provide physical and electrical mounting as well as component encapsulation for the rectifying and/or resistive elements.

12 Claims, 9 Drawing Figures



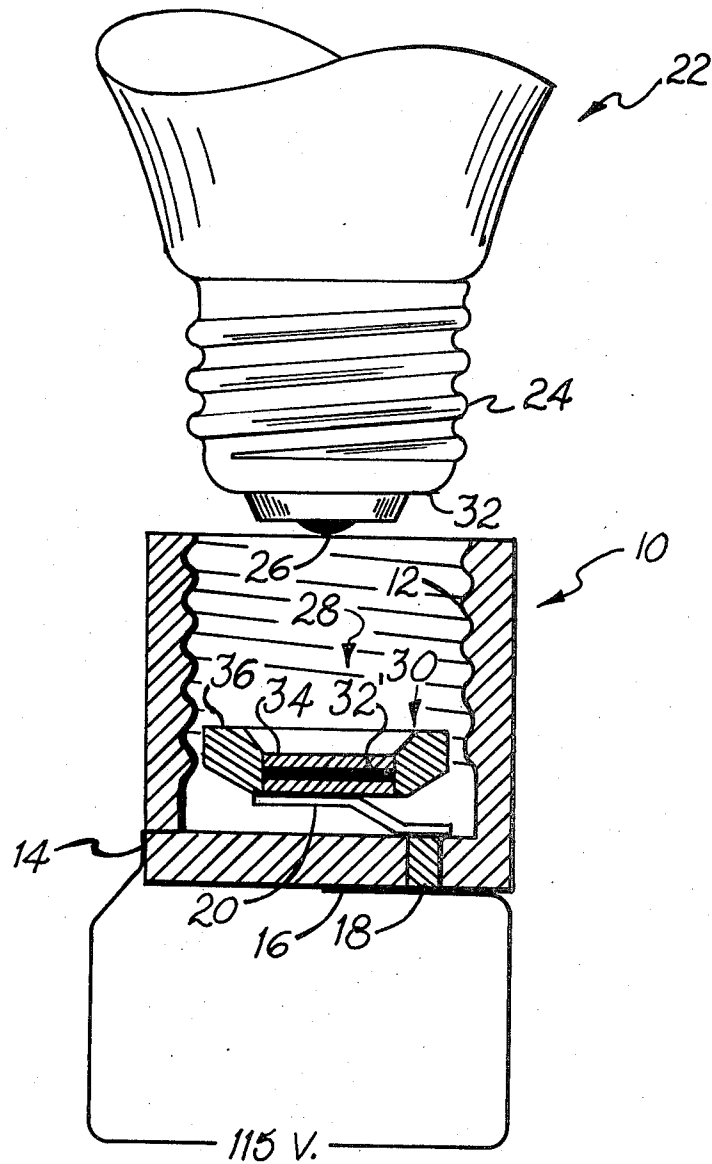


FIG. 1.

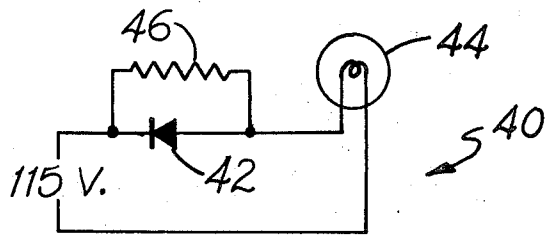


FIG. 2.

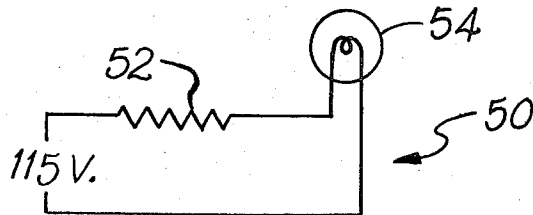


FIG. 3.

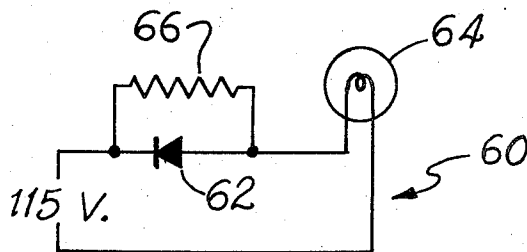


FIG. 4.

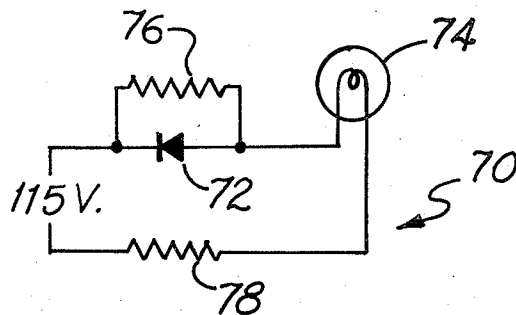


FIG. 5.

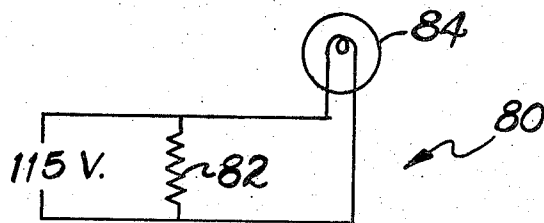


FIG. 6.

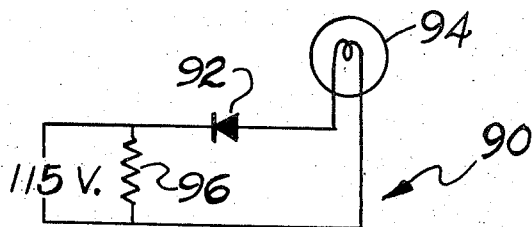


FIG. 7.

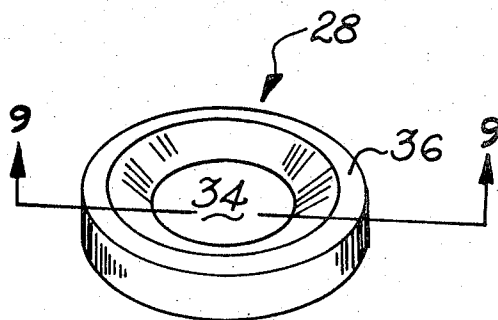


FIG. 8.

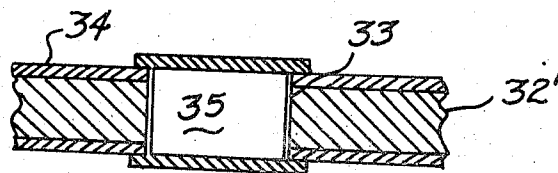


FIG. 9.

ELECTRONIC COMPONENT

BACKGROUND OF THE INVENTION

This invention relates to improved electric light saving devices and deals particularly with both simple and effective means for increasing the life of incandescent electric light bulbs and a method for mounting and encapsulating said means.

Various devices have heretofore been suggested for increasing the life of incandescent light bulbs. For example, resistance units which function to materially reduce the voltage of the circuit. While such devices do increase the bulb life, they have the attendant disadvantage of also decreasing the amount of light emanating from the bulb. More recently, it has been suggested to utilize a diode rectifier, the purpose being to transform the alternating current normally supplied to the light socket to a pulsating current. While here too, the overall result is a reduction in the voltage supplied to the bulb and a corresponding increase in effective life, this arrangement also has several critical disadvantages; most notably a reduction in the intensity of light produced by the bulb and an objectionable color shift toward the red end of the spectrum.

It has been found that the reliability of an incandescent light bulb is subject to two major forms of attack. The first relates to the "turn-on" surges experienced by the bulb at the instant when voltage is first impressed across the bulb circuit. In point of fact, the overwhelming majority of bulb failures occurs during this instant of electrical/thermal turn-on surge. The second most prevalent form of failure for incandescent light bulbs is due to thermally caused deterioration of the filament. As is well known, both the number of turn-on surges a lamp filament can withstand and the total steady state burning time are directly correlatable to the operating temperature of the filament. That is, the rate of degradation of a bulb filament and the number of turn-on surges that the filament can withstand are effected by the operating temperature of the filament.

Most of these prior art devices utilize separate component parts to provide (a) a pair of contacts to interconnect the resistive or rectifying element with the lamp base and socket; (b) rigid mounting for the resistive or rectifying element; and (c) encapsulation for the resistive or rectifying element to protect it from airborne dirt and moisture, etc., all of which transform a relatively simple device into a complex and expensive device. For example, contacts with the lamp base and socket are usually provided by external metal stampings; mounting for the element is accomplished through a discreet pair of component leads or wires which travel from the element to the contacts; and, environmental integrity is provided by separate encapsulation.

BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention resides in the provision of devices which are of proper size to fit within a conventional light socket between the central contact of the socket and the central terminal of the light bulb. Preferably the devices are provided with a contact on one surface designed to engage the central contact of the light socket and a contact on its opposite surface designed to engage the central terminal of the light bulb. A combination of rectifying and resistive elements, preferably thermally responsive resistive ele-

ments are electrically connected between the two contacts. When current is supplied to the light bulb, the rectifier transforms the alternating current into a pulsating current, cutting down the time when the light filament is energized and causing a corresponding increase in the life of the light bulb. Concomitantly the resistive elements overcome the inherent disadvantage of the diode by permitting a portion of the current to by-pass the diode thereby increasing the effective voltage across the filament to correspondingly increase light output. In the most preferred embodiments, as will be explained in greater detail hereinafter, the resistive elements are thermally responsive and function, during the turn-on sequence, to assist the diode rectifier in minimizing turn-off surge.

It is another object of the present inventor to provide a method of mounting and encapsulating the resistive and/or rectifying elements obviates the above disadvantages. More specifically, according to the present invention, a through hole of appropriate configuration is made in a printed circuit board, an unencapsulated resistive and/or rectifying element is inserted in the hole and then top and bottom terminals are soldered, preferably with a positive meniscus, onto the element to join the element to the circuit board. In this manner the element is both mounted and encapsulated by the insulated portion of the printed circuit board and the solder seals at either end; the solder seals further serving as contacts for electrical connection to the lamp base and socket.

The subject matter which applicant regards as his invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as its organization and method of operation together with further objects and advantages thereof will best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a sectional view through a conventional light socket and through the device comprising the present invention showing the manner in which said device is positioned intermediate the central contact of the socket and the central contact of an incandescent light bulb, partially shown in full view;

FIGS. 2-7 are schematic representations of various possible circuit embodiments of the present invention;

FIG. 8 is a perspective representation of an embodiment for encapsulating the circuit of the present invention; and,

FIG. 9 is an enlarged partial side elevational view taken along the line 9-9 of FIG. 8, through a printed circuit board showing a preferred embodiment for mounting and encapsulating the circuit of the present invention.

Referring now to the drawings, FIG. 1 depicts the environment of use of the present invention. A conventional light socket 10 having an internally threaded shell 12 has a first contact 14 and a second contact 16 interconnecting the socket to an external source of electrical energy (not shown); the second contact 16 is a further connected through conductor 18 to a spring biased member 20 which forms the central contact of the socket 10. A standard incandescent light bulb having a lower portion 22, an externally threaded body 24 and a central contact 26, is adapted to be screwed into position in the socket 10. As will be more fully ex-

plained hereinafter, the device 28 of the present invention is removably positioned in the socket 10 intermediate the central contact 20 of the socket and the central contact 26 of the bulb. Preferably, the upper position 30 of the device 28 is designed such that it substantially conforms to the shape of the bottom plate 32 of the light bulb, thereby facilitating proper positioning in the socket 10.

The device 28 comprises a printed circuit board 32' containing the circuitry to be presently detailed, a copper or other conductive metal face 34 on both surfaces and an epoxy or other suitable non-conductive base 36 circumscribing the printed circuit board and conductive metal faces.

The circuitry, to be presently detailed, can be attached onto the printed circuit board 32' in a manner well known to the art; or, preferably, the circuitry or elements thereof can be inserted into the printed circuit board 32'. That is, as best shown in FIG. 9, a through hole 33 is drilled in the printed circuit board 32' and the circuitry, or elements thereof, represented by the block 35 are inserted into the hole. The hole is then sealed, either by solder contact points 37 or by solder and a copper foil contact points now shown, but well known in the art. If solder contact points are used they preferably will have a positive meniscus to facilitate contact with external circuitry. In this manner the circuitry 35 is both mounted and encapsulated, i.e., protected against moisture and dirt, and interconnected, by the solder contact points 37 to the lamp base and socket. It is of course understood that certain elements may be so encapsulated and the remaining elements attached to the printed circuit board in the known manner.

It is known in the art to prolong the useful life of an incandescent light bulb by interposing either a resistive element or a rectifying element in series with the filament of the bulb. Both such expedients have the effect of reducing the voltage being transmitted to the filament thereby permitting the filament to operate at a lower temperature, which in turn, correspondingly extends its useful life. While each such device has been found to result in a noticeable improvement in the life of the filament, the deleterious side effects intimately associated with each device has proscribed any practical application thereof. With resistive elements, for example, there is a sharp reduction in the amount of illumination emanating from the bulb; with rectifiers, on the other hand, there is, in addition to reduction in the intensity of the light, an objectionable color shift in the light toward the red end of the spectrum. Thus, notwithstanding the proposed solutions of the prior art there still existed the need for a practical apparatus which can inexpensively and effectively prolong the useful life of an incandescent light bulb.

With the devices of the present invention, quite to the contrary of the prior art, not only is the effective life of the light bulb measurably increased but the, heretofore, overwhelming damage to the quality and quantity of the light generated by the bulb is contained within readily acceptable limits. Referring now to FIGS. 2-7 the preferred embodiments of the present invention will be described in detail; it being understood that the circuit elements shown in each of FIGS. 2-7 are incorporated into the device 28 by attachment to printed circuit board 32'.

The device 40 shown in FIG. 2 comprises a diode rectifier 42 in series with an incandescent light bulb 44; and, a resistor 46 in parallel with the diode rectifier 42. Resistor 46 functions to channel a portion of the current past the diode rectifier 42, thereby substantially improving the quantity of light provided and substantially eliminating any shift in the color of the light toward the red end of the spectrum. In this manner, the effective life of the filament is increased without the attendant disadvantages of dimming and color shift.

In FIG. 3, the device 50 comprises a negative temperature coefficient resistor 52 in series with an incandescent light bulb 54. A negative temperature coefficient resistor is one whose absolute resistance value varies with temperature such that as the temperature of the element increases its electrical resistance decreases. With this arrangement the deleterious surge of electrical and thermal energy normally impressed upon the incandescent lamp filament at the instant of "turn-on" is kept to a minimum. i.e., at that instant the negative temperature coefficient resistor has a relatively high electrical resistance value and, thus, the flow of current to the lamp filament is constrained to a relatively low level. Subsequent to "turn-on" the resistor element begins to dissipate heat rapidly, increasing the internal temperature of the device. This temperature increase, in turn, causes a reduction in the resistance of the element and allows the lamp filament to receive more electrical energy. In the final stages of operation, the resistor element reaches a high ambient operating temperature and, correspondingly, displays a relatively low resistance, resulting in the illumination from the bulb almost approaching full value. Since, however, the resistance value never reaches zero the effective life of the bulb is increased because the operating temperature of the lamp filament is always less than it would be in the absence of device 50. Most importantly though, device 50 substantially eliminates the extremely deleterious effects heretofore associated with "turn-on" surges, thereby further enhancing and prolonging the effective life of the incandescent light bulb.

Looking now to FIG. 4, device 60 comprises a diode rectifier 62 in series with an incandescent light bulb 64; and, a negative temperature coefficient resistor 66 in shunt arrangement across the series diode rectifier. Preferably, the room temperature resistance value of the resistor 66 is relatively high, on the order of from about 300 to 3 meg ohms. In this particular embodiment the diode rectifier functions to reduce the objectionable turn-on surges and the resistor permits filament temperature to increase beyond that which would be possible with the diode alone thereby substantially eliminating deleterious reductions in light output. At the moment of initial switch-on, the resistance value of the negative temperature coefficient resistor is relatively high, thus having no measurable electrical effect on the incandescent filament. As heat is dissipated by the filament the resistance value correspondingly decreases permitting a portion of the current normally blocked by the diode to by-pass the diode. In this preferred manner, a higher effective filament voltage is realized with an attendant increase in filament temperature and light intensity, thereby eliminating objectionable light levels and color changes while still substantially increasing useful life of the light bulb.

In FIG. 5, the device 70 comprises a diode rectifier 72 in series with an incandescent light filament 74 and

a first negative temperature coefficient resistor 76; a second negative temperature coefficient resistor 78 is positioned in shunt arrangement with the series diode rectifier 72. The initial turn-on sequence for this preferred arrangement is particularly advantageous in that it reduces associated surges to an absolute minimum. This is because the series negative temperature coefficient resistor 76 is at a relative high value at the instant of turn-on thereby reducing the surge of current associated with turn-on. Another advantage of this particular embodiment is that once the warm-up sequence is completed the series resistor and the shunt resistor have been reduced to a minimum value permitting normally blocked current flow to bypass the diode. Thus both optimum reduction in turn-on surge and elimination of objectionable color and light intensity changes can be realized.

A further method of reducing turn-on surges and thereby increasing the effective life of an incandescent bulb is shown in FIG. 6 wherein the device 80 comprises a positive temperature coefficient resistor 82 in parallel relationship with an incandescent filament 84. A positive temperature coefficient resistor functions as does a negative temperature coefficient resistor in that both adjust their resistance value relative to their temperature. However, with the former, the resistance increases as temperature increases; whereas with a negative temperature coefficient resistor, the resistance value decreases with increase temperature. In this embodiment during the turn-on sequence the positive temperature coefficient resistor 82 has a relatively low resistance value and thus absorbs most of the turn-on surge. As the relatively high current flow courses through the resistor, energy is created, increasing the temperature thereof and, correspondingly increasing resistance. This, in turn, causes the greater portion of current to flow through the incandescent bulb 84. Once a steady state is reached between the heat generated by resistor 82 and bulb 84, the resistance value of the resistor approaches an almost infinite value and most of the current flows to the bulb 84. Thus, the bulb burns at substantially full brightness and turn-on surges are reduced to an absolute minimum.

Applicants final embodiment for increasing the effective life of an incandescent light bulb is shown in FIG. 7 wherein the device 90 comprises a diode rectifier 92 in series with an incandescent light bulb 94 and a positive temperature coefficient resistor 96 in parallel across the light bulb 94. In this arrangement, turn-on surges the absorbed by the relatively low initial resistance of resistor 96. As above, after warm-up the relatively high resistance value assumed by the resistor, responsive to the concurrent increase in temperature causes the current to flow in the series circuit described by the diode rectifier 92 and the bulb 94. Thus, in this embodiment turn-on surges are reduced to an acceptable minimum; and, at the same time, the steady state filament temperature is reduced through the utilization of the diode.

As this invention may be embodied in several forms without departing from the spirit or essential character thereof, the present embodiments are illustrative and not restrictive. The scope of the invention is defined by the appended claims rather than by the description preceding them and all embodiments which fall within the meaning and range of equivalency of the claims are,

therefore, intended to be embraced by those claims.

What is claimed:

1. A device for prolonging the life of an electric light bulb and adapted to fit in the bulb socket between the central contact of the socket and the central contact of the bulb, the device having an electrical circuit comprising a diode rectifier in series electrical arrangement with the bulb, a first resistor in parallel electrical arrangement with the diode rectifier, the first resistor permitting a portion of the current to by-pass said diode rectifier when the device is in operation and at least one additional resistor in series electrical arrangement with the bulb filament in said electrical circuit.

2. A device as in claim 1 wherein the absolute resistance value of said resistor is temperature responsive, changing said resistance value responsive to changes in temperature conditions in said electrical circuit.

3. A device as in claim 2 wherein said resistor is a negative temperature coefficient resistor.

4. A device as in claim 1 wherein said at least one additional resistor is temperature responsive, changing its absolute resistance value relative to changes in temperature in said electrical circuit.

5. A device as in claim 4 wherein said at least one additional resistor is a negative temperature coefficient resistor.

6. A device for prolonging the life of an incandescent electric light bulb, said device being adapted to fit in the lamp socket intermediate the central contact of the socket and the central contact of the bulb, the device having an electrical circuit comprising at least one temperature responsive resistive element, said element changing its absolute resistance value to temperature changes in said electrical circuit and a diode rectifier in parallel electrical relationship with the resistive element.

7. A device as in claim 6 wherein said electrical circuit further contains at least one additional resistive element in series electrical arrangement with the bulb filament.

8. A device as in claim 6 wherein said temperature responsive resistive element is a negative temperature coefficient resistor.

9. A device as in claim 6 wherein said temperature responsive resistance element is a positive temperature coefficient resistor.

10. A device as in claim 9 wherein said positive temperature coefficient resistor is in parallel electrical arrangement with the electric light bulb.

11. A device as in claim 10 wherein said electrical circuit also contains a diode rectifier in series electrical arrangement with the electric light bulb.

12. A device for prolonging the life of an electric light bulb and adopted to fit in the bulb socket between the central contact of the socket and the central contact of the bulb the device having an electrical circuit interconnected with a printed circuit board; the electrical circuit comprising a diode rectifier in series electrical arrangement with the bulb and a resistor in parallel electrical arrangement with the diode rectifier; the printed circuit board having a hole therethrough with at least one of the elements in said electrical circuit being positioned in said hole, the hole being sealed at either end by a solder seal having a positive meniscus.

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