United States Patent

[11] 3,573,543

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[21] Appl. No. **797,882**
[22] Filed **Feb. 10, 1969**
[45] Patented **Apr. 6, 1971**
Continuation-in-part of application Ser. No. 558,784, June 20, 1966, now abandoned.

[54] **VARIABLE LIGHT INTENSITY LAMP SOCKET HAVING SEMICONDUCTOR MOUNTED ON HEAT SINK THERMALLY ISOLATED FROM LAMP BASE**
8 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **315/194,** 315/195, 315/197, 315/200, 315/241, 315/50
[51] **Int. Cl.** **H05b 37/02,** G05f 1/00
[50] **Field of Search** ..... 315/194-—200, 241, 50; 307/297; 317/21, 101

[56] **References Cited**

UNITED STATES PATENTS

3,256,466	6/1966	Trolio et al.	315/200X
3,275,922	9/1966	Meyer et al.	315/200X
3,300,711	1/1967	Duncan	315/194X
3,331,013	7/1967	Cunningham	315/194X
3,346,874	10/1967	Howell	307/297
3,372,302	3/1968	Fasola	315/200X
3,401,265	9/1968	Dotto	317/101X
3,450,941	6/1969	Butts	315/194

OTHER REFERENCES

" Triac Control For A-C Power," By E. K. Howell, General Electric Application note, May, 1964 pages 1 to 6 (and title page)

Using the Triac for control of AC power, General Electric Application note, March, 1966, pages 1— 11 only (and title page)

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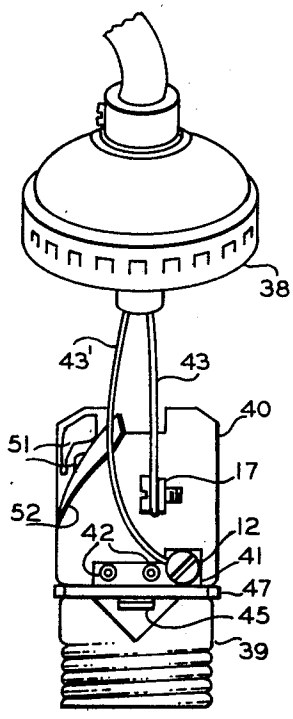
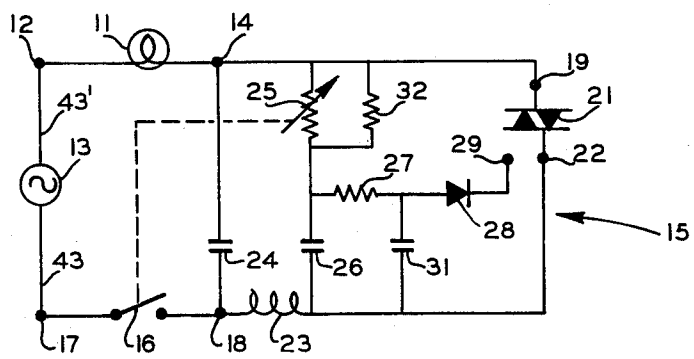
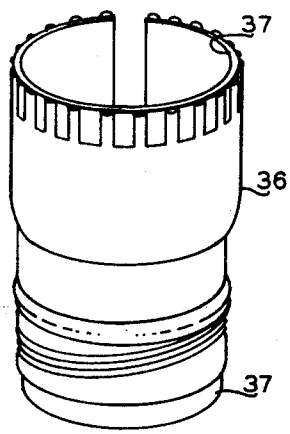
ABSTRACT: A solid state controllable current conducting semiconductor of a variable light intensity control circuit is mounted on a heat sink member which is positioned adjacent one end of an electrically and thermally insulating support member. The opposite end of the support member is secured to the insulating disc at the base of the lamp receiving shell of the lamp socket. The heat sink member is shaped to provide structural support and to increase the surface area thereof.







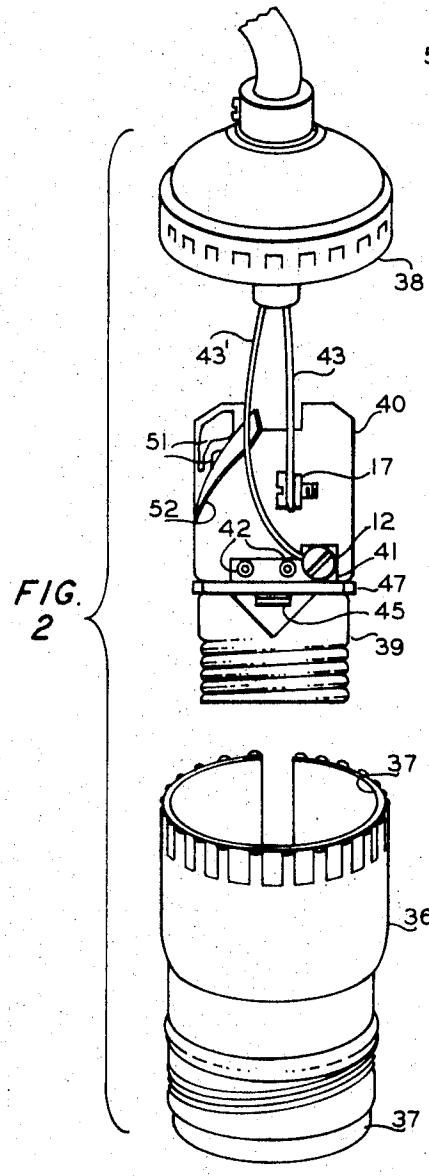


FIG. 2

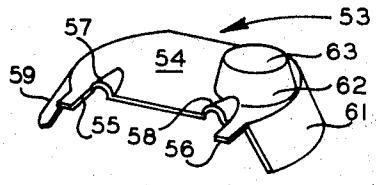


FIG. 6

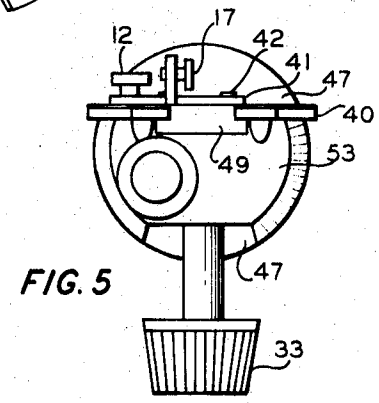


FIG. 5

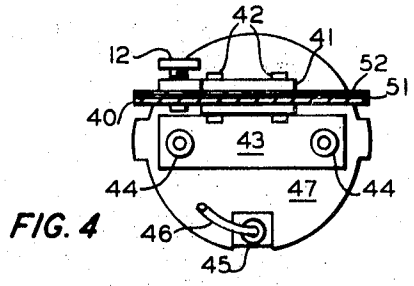


FIG. 4

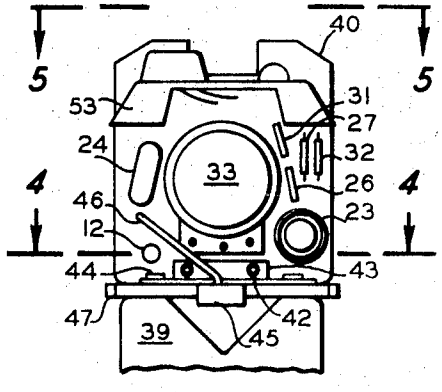


FIG. 3

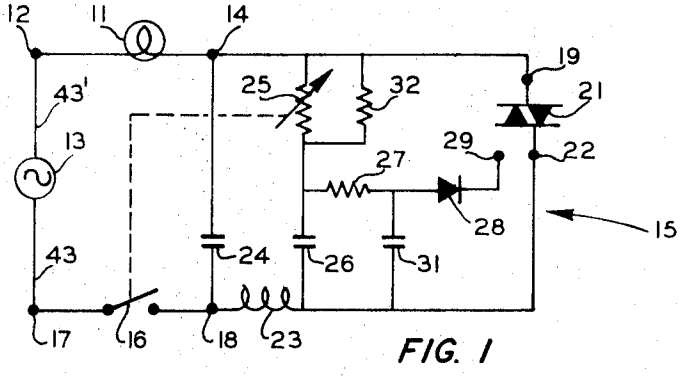


FIG. 1

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BY

VARIABLE LIGHT INTENSITY LAMP SOCKET HAVING SEMICONDUCTOR MOUNTED ON HEAT SINK THERMALLY ISOLATED FROM LAMP BASE

This application is a continuation-in-part of my copending application, Ser. No. 558,784, filed Jun. 20, 1966, now abandoned.

This invention relates to variable light intensity lamp sockets. In one aspect the invention relates to an improved construction of a light dimming socket for avoiding overheating of the components thereof. In another aspect the invention relates to a heat sink for utilization in a variable light intensity control circuit mounted in a standard incandescent lamp socket.

This invention represents an improvement over the prior art lamp dimmers exemplified by Duncan, U.S. Pat. No. 3,300,711. In the structure illustrated in the Duncan patent, the anode stud of the semiconductor in the control circuit is positioned directly against the center contact arm, which in turn is in direct contact with the center contact of the light bulb. Furthermore, the anode stud and a portion of the heat sink chassis are exposed to radiation from the lamp receiving shell. This type of structure permits heat transfer between the lamp and the semiconductor.

In accordance with the present invention, it has been discovered that the thermal isolation of the semiconductor of a variable light intensity control circuit positioned in a lamp socket from the lamp receiving shell can be significantly enhanced by securing the semiconductor on a heat sink positioned on the remote end of an electrically and thermally insulating support member which is mounted substantially perpendicularly to an electrically and thermally insulating base disc positioned on the inner end of the lamp receiving shell.

Accordingly, it is an object of the present invention to provide an improved variable light intensity lamp socket. It is an object of the invention to enhance the thermal isolation of a semiconductor in a variable light intensity control circuit from the heat produced by the lamp. It is an object of the invention to provide an improved heat sink mounting for a semiconductor. It is an object of the invention to provide an improved thermal mounting for a semiconductor at a lower cost. It is an object of the invention to provide a wide range of light intensity control within a standard lamp bulb socket without dimensional modification thereof.

Other objects, aspects and advantages of the invention will be apparent from a study of the specification, the drawings and the appended claims to the invention.

In the drawings, FIG. 1 is a schematic representation of a circuit suitable for utilization with the invention; FIG. 2 is an exploded view, partly in perspective and partly in elevation of a variable light intensity lampholder in accordance with a presently preferred embodiment of the invention, showing the back side of the structural support board; FIG. 3 is a partial view in elevation of the front side of the structural board, showing the structural and spatial relationship of the components; FIG. 4 is a cross-sectional view along line 4–4 in FIG. 3; FIG. 5 is a view along line 5–5 in FIG. 4; and FIG. 6 is a perspective view of the back side of the heat sink element.

Referring now to FIG. 1, one lead of light 11 is connected to a first terminal 12 of an AC power source 13, while the other lead of light 11 is connected to a first terminal 14 of the variable light intensity control circuit 15. A switch 16 is connected between the second terminal 17 of power source 13 and a second terminal 18 of circuit 15. A first main current carrying terminal 19 of a solid state controlled bidirectional current conducting semiconductor, or triac, 21 is connected to terminal 14 while the second main current carrying terminal 22 of semiconductor 21 is connected through inductance 23 to terminal 18. A capacitor 24 is connected between terminals 14 and 18. Capacitor 24 and inductance 23 serve as a radio frequency filter to prevent the pulsing in circuit 15 from affecting A.M. radio reception. The construction and operation of the triac 21 are described by J. H. Galloway in "Using the Triac for Control of AC Power," General Electric Application Note, Mar. 1966. A variable resistor 25 and a capacitor 26 are

connected in series between terminals 14 and 22. A resistor 27 and a bidirectional diode 28 are connected in series between the gate terminal 29 of triac 21 and the junction between resistor 25 and capacitor 26. A capacitor 31 is connected between terminal 22 and the junction of resistor 27 and bidirectional diode 28. A resistor 32 is connected in parallel with variable resistor 25 to provide the desired light level at the low end of the light intensity control range. Resistor 25 is manually varied to adjust the desired light level within the control range. Resistor 25 and switch 16 can be combined in a single unit actuated by knob 33 (FIGS. 3 and 5). In the operation of the circuit, the rotative positioning of knob 33 controls the amount of current through diode 28 to the gate terminal 29 of triac 21 and hence gives complete intensity control over the current supply through standard lamp bulb 11.

Referring now to FIGS. 2—6, the light intensity control circuit is installed in a conventional lamp socket of standard design comprising an outer housing 36, an electrically and thermally insulating liner 37, cap 38, and a threaded screw shell 39 adapted to receive a standard lamp bulb. An electrical conduit having leads 43 and 43' connects screw terminals 12 and 17 to the source of power. Screw terminal 12 is positioned in vertical metal plate 41 which is connected by rivets 42 through vertical support board 40 to the vertical portion of L-shaped metal bar 43. The horizontal portion of bar 43 is connected by rivets 44 through electrically and thermally insulating base disc 47 to the inner end of screw shell 39. Thus, bar 43 serves not only as an electrical connection, but also as the structural mounting bracket for positioning vertical support board 40 substantially perpendicularly to base disc 47 on the side thereof remote from shell 39. The spring contact arm 45 is positioned within screw shell 39 but insulated therefrom, and is connected by lead 46 to terminal 14.

Vertical support board 40 is formed of a suitable electrically and thermally insulating material, for example, fiberglass. Substantially all of the remaining electrical connections are in the form of a printed circuit 51 on the back side of vertical support board 40. An insulating paper sheet 52 is positioned over the printed circuit 51 and secured to board 40 by a layer of a suitable adhesive and by rivets 42. The upper end of board 40 can be provided with a notch 48 to receive a tab 49 of sheet 52. Board 40 also serves as the structural mounting means for resistors 25, 27 and 32, capacitors 24, 26 and 31, switch 16, choke 23, and heat sink member 53. Heat sink member 53 is formed of a suitable conductor of heat and electricity, for example, a metal such as copper. As illustrated in FIGS. 3, 5 and 6, heat sink member 53 comprises a substantially semicircular planar section 54 which is roughly in the shape of a D, mounting lugs 55 and 56 which project rearwardly from section 54 into openings in vertical support board 40, inverted U-shaped ridges 57 and 58 projecting upwardly from section 54, peripheral flange sections 59 and 61 depending downwardly from section 54, and inverted cup-shaped section or depression 62 extending upwardly from section 54. Planar section 54 extends substantially the distance between support board 40 and the adjacent portion of the liner 37. Ridges 57 and 58 are substantially perpendicular to support board 40. Ridges 57 and 58 and flange sections 59 and 61 extend rearwardly into contact with vertical support board 40, thereby rigidly supporting heat sink member 53 substantially perpendicularly to support board 40, preventing bending relative to support board 40. Triac 21 and diode 28 are mounted inside of cup-shaped section 62 conductive heat transfer relationship therewith, one main current carrying terminal being soldered directly to the underside of the planar center section 63 of cup-shaped section 62. Thus, element 53 serves as a structural mounting for triac 21, as a heat sink for triac 21 and as an electrical connection to one terminal of triac 21. Flange sections 59 and 61 and ridges 57 and 58 not only serve as structural mounting elements, their configuration increases the total surface area of the heat sink 53, thereby enhancing the ability of the heat sink 53 to dissipate heat produced by internal heating in triac 21. The center section 63 of cup-shaped

section 62 is planar to prevent flux buildup during soldering as this could cause incomplete surface contact of the terminal of triac 21 with section 63. The cup-shaped section 62 encloses the triac 21 to a greater extent than would be possible with a flat surface and thus provides maximum surface area for the heat sink 53 in the immediate area of triac 21. While flange sections 59 and 61 can form a single continuous flange around the curved periphery of planar section 54, it is presently preferred to omit the center section of the flange to prevent the possibility of contact with the potentiometer 25.

As illustrated in FIG. 3, the heat sink 53 is mounted on heat insulative board 40 is as remotely as possible from the base disc 47 and the screw shell 39. Bar 43 is the only heat conductive material thermally connected to screw shell 39 which is located in the same chamber as heat sink member 53. Unlike many prior art devices which employ a full size metal disc, bar 43 is shaped to present a minimum of exposed surface area in the common chamber, thereby minimizing transfer of heat from screw shell 39 into the chamber. In general the exposed surface area of bar 43 will be less than 50 percent and preferably less than 25 percent of the area of disc 47. The next most significant heat producer is choke 23, which is mounted on thermally insulative board 40 adjacent disc 47 and as far as possible from triac 21. As triac 21 requires only a very low gate current, there is very little heat produced by potentiometer 25. While the problem of the heat production by a triac is particularly acute in the environment of a standard lamp socket structure, the use of a monodirectional solid state current conducting semiconductor also presents significant problems of heat dissipation. The structure of the present invention is applicable to both of these types of semiconductors.

This invention permits control of a standard lamp bulb from off to any desired intensity within the limits of the bulb design. The variable light intensity control circuit, despite the heat sink requirements, has been miniaturized to such an extend that it can be inserted or formed within a standard light bulb socket without modification of its dimensions.

In a presently preferred embodiment of the invention, heat sink member 53 is formed from a sheet of copper having a thickness of approximately 0.025 inch into the generally D shape illustrated in the drawings, having an initial, or unfolded, diameter of about 1½inches, planar section 54 having final dimensions of approximately 1 inch in apparent diameter and approximately five-eighth inch in the direction perpendicular to support board 40. Cup-shaped section 62 has a depth of approximately one-eighth inch deep and smaller and larger diameters of approximately three-eighth inch and one-fourth inch, respectively. The heat sink member 53 is mounted on board 40 so that planar section 54 is approximately one inch from disc member 47.

Reasonable variations and modifications of this invention can be made, or followed, in view of the foregoing disclosure, without departing from the spirit or scope thereof.

I claim:

1. A variable light intensity lamp socket which comprises a lamp socket housing having an electrically and thermally insulating interior surface, a lamp receiving shell positioned in one end of said lamp socket housing, an electrically and thermally insulating base member positioned in said housing and across the inner end of said shell, an electrically and thermally insulating support member positioned within said housing and substantially perpendicularly to said base member on the side thereof remote from said lamp receiving shell, an electrically conductive metal heat sink member mounted substantially perpendicularly to said support member on a portion of said support member remote from said base member so as to be thermally insulated from said shell, said metal member being in the form of a generally semicircular planar member extending substantially the distance from said support member to the adjacent portion of said housing, said planar member having a cup-shaped depression formed therein, center contact means positioned within and insulated from said lamp receiving shell, and variable light intensity control circuit means positioned within said housing, said circuit means including a solid state controllable current conducting semiconductor, said semiconductor being mounted directly on said metal member within said depression in conductive heat transfer relationship therewith.

2. A variable light intensity socket in accordance with claim 1 wherein said metal member further comprises a flange depending from at least the end portions of the curve periphery of said planar member and contacting the adjacent surface of said support member, at least one inverted U-shaped ridge formed in said planar member and extending substantially perpendicularly to said support member and in contact therewith, said at least one ridge being on the surface of said planar member opposite to that of said flange to provide support for said planar member against bending relative to said support member.

3. A variable light intensity socket in accordance with claim 2 further comprising an electrically conductive L-shaped angle bar, means for fastening one side of said angle bar to the end of said support member which is adjacent to said base member, means for fastening the other side of said angle bar through said base member to said shell, the exposed surface area of said angle bar being small compared to the area of said base member.

4. A variable light intensity socket in accordance with claim 3 wherein said semiconductor is a controllable bidirectional current conducting semiconductor.

5. A variable light intensity socket in accordance with claim 1 wherein said circuit means comprises a printed circuit formed on one side of said support member, and circuit elements mounted on said support member.

6. A variable light intensity socket in accordance with claim 5 wherein said circuit means further comprises a radio frequency filter network including an inductance, said inductance being mounted on said support member adjacent said base member and remote from said heat sink member.

7. A variable light intensity socket in accordance with claim 1 further comprising an electrically conductive L-shaped angle bar, means for fastening one side of said angle bar to the end of said support member which is adjacent to said base member, means for fastening the other side of said angle bar through said base member to said shell, the exposed surface area of said angle bar being small compared to the area of said base member.

8. A variable light intensity socket in accordance with claim 1 wherein said semiconductor is a controllable bidirectional current conducting semiconductor.