Jan. 24, 1967 E. T. DUNCAN 3,300,711

LAMP DIMMER

Filed Feb. 13, 1963

Fig. 2.

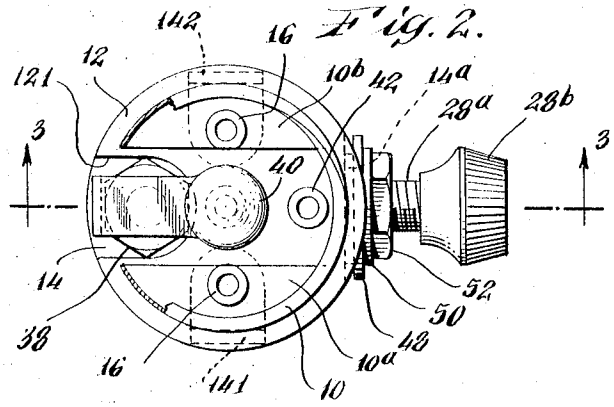


Fig. 1.

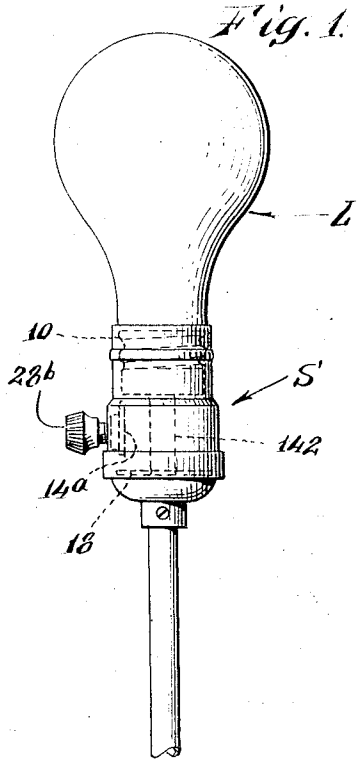


Fig. 3.

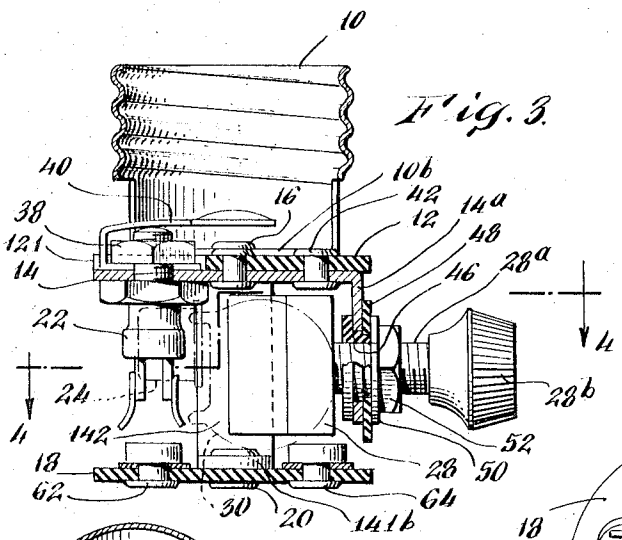


Fig. 4.

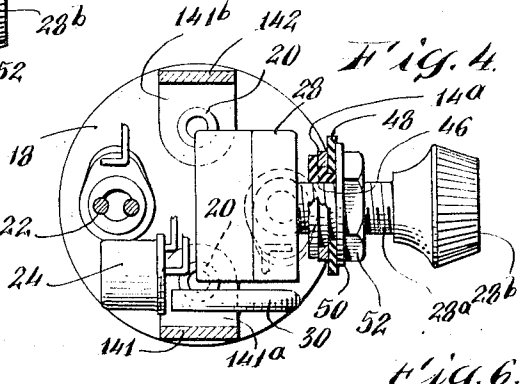


Fig. 5.

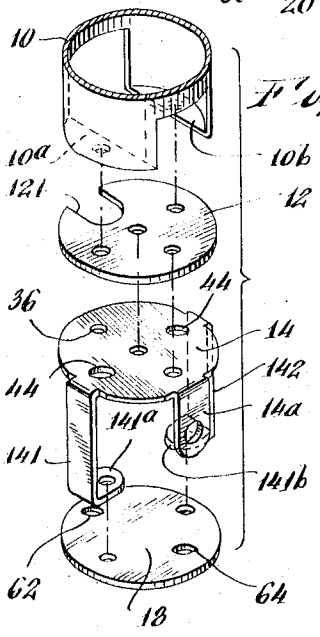
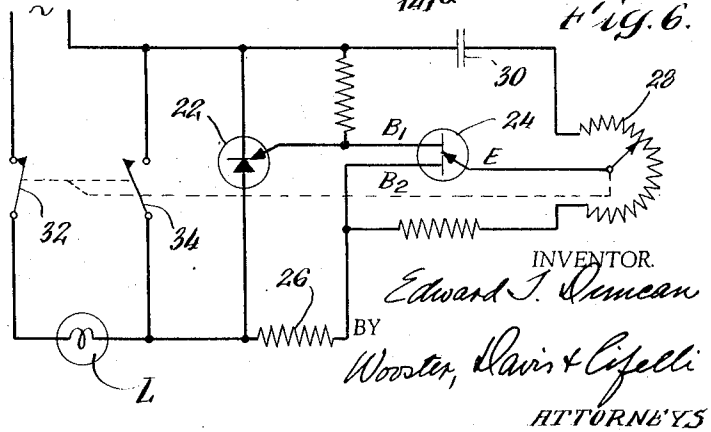


Fig. 6.



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LAMP DIMMER

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8 Claims. (Cl. 323—22)

This invention relates to a lamp dimmer, and, more particularly, to such a dimmer adapted for enclosure in a standard incandescent lamp socket.

In the past, a number of attempts have been made to produce commercially successful dimmers for home light dimming. However, each of these prior art devices has faced a number of practical difficulties. Primarily, these difficulties have arisen due to the large sizes required, their high power consumption, the large amount of heat generated, and the high temperatures created. It will be readily appreciated that under many circumstances these problems are interrelated so that one cannot be attacked without adversely affecting others.

The advent of solid state electronics has brought forth a concerted effort in all fields of electronics to reduce the size of components and of apparatus employing such components. The silicon-controlled rectifier, for example, and the unijunction transistor promise to effect a revolution in many fields of electronics. However, the problems so well known to the prior art have not yet been eliminated. This is due to the fact that many solid state devices, for example the silicon-controlled rectifier, are themselves producers of heat. Consequently, although component size may be reduced, there are still many problems inherent in using solid state devices, particularly in the vicinity of other heat-producing sources. In fact, size reduction is often detrimental, due solely to loss of heat capacity.

A dimmer suitable for incorporation directly into an incandescent lamp socket has long been desired and sought. This will be apparent when one considers the unsatisfactory alternative methods heretofore employed for achieving a poor limitation of lamp dimming. One of the most common alternatives has been the use of a three-way switch in combination with a special lamp bulb having three illumination levels. The problems with this type of apparatus will be immediately apparent to anyone who has used such devices. The frustration of having one of the filaments of the incandescent bulb burn out is well known. Also, the illumination levels produced by such a socket and lamp combination are fixed and invariable. No levels of illumination between the three rated levels can be obtained. Other methods of dimming require special installation, such as wall mounting, because of the size factor. Individual lamp dimmers are also available which are wired to the controlled lamp but placed in separate control boxes.

Accordingly, it would be desirable to enclose a lamp dimmer directly within a standard sized lamp socket. However, this is not easily accomplished due to the heat problems encountered. To begin with, the interior of a lamp socket is a closely confined space well adapted to trap heat. Furthermore, it is in close proximity to a heat source, namely, the incandescent lamp bulb. A small lamp socket which totally encloses a heat-producing solid state device and is also placed in close proximity to a heat source would normally result in a device which would overheat seriously, even to the point of being hazardous to the user.

Accordingly, it is the primary object of this invention to provide an improved housing for a lamp socket dimmer which overcomes the foregoing objections. Other objects are to provide a dimmer which does not overheat,

which provides a continuously variable dimming range, which is reliable, and which is relatively inexpensive.

The manner in which the foregoing objects are achieved will be more apparent from the following description, the appended claims, and the figures of the attached drawing, wherein:

FIG. 1 is an illustration of an incandescent lamp socket embodying the apparatus of this invention;

FIG. 2 is a plan view of the apparatus of the invention;

FIG. 3 is a cross sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a cross section taken along the line 4—4 of FIG. 3;

FIG. 5 is an exploded perspective view showing the manner in which various elements of the apparatus are assembled; and

FIG. 6 is a schematic diagram of a circuit usable in this invention.

FIG. 1 illustrates the manner in which the dimmer of this invention may be installed in a lamp socket S of standard design which is also adapted to receive a standard incandescent lamp L. The manner in which this is achieved will be more apparent from the illustrations of FIGS. 2, 3 and 4, illustrating the dimmer construction. It will be seen that a screw shell **10** is secured to an upper insulating disc **12** and a copper chassis disc **14** by means of suitable rivets **16** passing through inwardly projecting flanges **10***a*, **10***b* on the screw shell **10**. Depending from chassis disc **14** are a pair of vertical side frames **141**, **142** and a support bar **14***a*. The lower end of each of side frames **141**, **142** is bent inwardly to form a corresponding support flange **141***a*, **141***b* which is then secured to a lower insulating disc **18** by means of rivets **20**. It will be seen that the assembly of the screw shell **10**, the upper and lower insulating discs **12** and **18** and the chassis disc **14**, as illustrated in FIG. 5, results in the formation of a standard lamp screw shell positioned directly above an enclosure well suited for the installation of electronic components.

An understanding of the components utilized in one embodiment of this invention may be best achieved by reference to the schematic diagram of FIG. 6. In FIG. 6 there is illustrated a lamp L which has its applied voltage controlled by a silicon-controlled rectifier **22** which is fired by a unijunction transistor firing circuit. The firing circuit includes a unijunction transistor **24** having its base two and emitter timing circuit supplied directly from the line through dropping resistor **26**. The emitter of the unijunction transistor is connected to a potentiometer **28** and a capacitor **30**. The voltage across the capacitor **30** rises to a value which is determined by the time constant of the circuit. When it reaches the peak point voltage the unijunction transistor **24** will fire and this, in turn, triggers the silicon-controlled rectifier **22** into the conducting state.

Mechanically connected to the potentiometer **28** are a pair of electrical switches **32**, **34**. These switches are integrally connected with the potentiometer **28** and are alternatively actuated as the potentiometer control reaches either end of its travel. Switch **32** is connected in series with the load and functions as an on-off switch for both the lamp and dimmer circuits. As the potentiometer control (**28***b*, FIG. 1) is turned clockwise from its "off" position, this switch first closes. The potentiometer then gradually increases the timing constant of the timing circuit, causing the silicon-controlled rectifier **22** to conduct through a greater and greater portion of its conducting half cycle. As the potentiometer reaches the point of maximum clockwise rotation, switch **34** closes, bypassing the entire dimming circuit and placing the lamp L directly across the line voltage for 100% illumination. It will be readily understood that the circuit illustrated in FIG. 6 is a half-wave rectification circuit. Accordingly, the

maximum brightness achieved by the dimming circuit alone is a function of the half-wave power. In one embodiment of this invention, dimming is achieved throughout the region of 0 to 38% of the lamp wattage. After the 38% point is reached, the switch **34** closes and places the lamp across the load for 100% operation. The result is that the brightness of a 150 watt lamp may be set at a controlled level anywhere between 0 and approximately 60 watts. For higher illumination levels, switch **34** closes and places the lamp directly across the line for 150 watts illumination.

As has been previously pointed out, both an incandescent lamp L and the silicon-controlled rectifier **22** are heat-producing devices. Accordingly, the protection of closely spaced electronic components is a difficult matter. The screw shell **10** receives heat from the bulb L. In order to prevent this heat from being conducted to the silicon-controlled rectifier, it is important to minimize as much as possible heat flow between the screw shell **10** and the silicon-controlled rectifier **22**. This objective has been achieved in this invention by a novel mechanical and electrical configuration which provides a separate heat sink for the silicon-controlled rectifier and also provides a high impedance heat path between the screw shell and the rectifier. In addition to these important features, the heat sink also serves as a structural member enclosing the solid state electronics and serves as an electrical conductor. By employing this single component for these multiple uses, the objectives of small size, sturdiness and reliability are also achieved.

The heat sink which serves as the basis for the structure of this invention is most clearly illustrated in FIG. 5. The heat sink chassis is constructed of relatively heavy copper or other good heat-conducting medium and includes a chassis disc **14**, downwardly depending side frames **141**, **142**, and a downwardly depending support bar **14***a*. The anode stud of the silicon-controlled rectifier **22** is connected directly to the chassis disc **14** as shown in FIG. 3 by inserting it through an opening **36** provided therein and securing it by means of a suitable nut **38**. Also connected to the stud of the silicon-controlled rectifier and beneath the nut **38** is a springing contact arm **40** for contacting the central terminal of lamp L to provide electrical connection to the stud. The insulating disc **12** is positioned between the chassis disc **14** and the screw shell **10** and is provided with a suitable cut-out portion **121** to provide clearance for the stud and the springing contact arm. The insulating disc **12** is secured to the chassis disc **14** by means of the rivet **42**. It is important to note that rivet **42** is centered in the opening between the flanges **10***a*, **10***b* of the screw shell **10** so that no heat-conducting path is formed therewith. The screw shell **10** is further connected to the insulating disc **12** by means of rivets **16** which are isolated from the upper chassis disc **14** by virtue of the enlarged openings **44** provided in the chassis disc. It will thus be apparent that no direct low-impedance heat path exists between the screw shell **10** and the base of the silicon-controlled rectifier **22**. Any heat which passes between these two must pass through portions of the insulating disc **12** or through the insulating portions of the lamp base.

As the chassis disc **14** is connected with the center lamp terminal through contact arm **40**, it may be energized at greater than ground potential. Accordingly, the potentiometer shaft **28***a* is electrically isolated from support bar **14***a* by means of an insulating washer-bushing **46** and an insulating disc washer **48**. These elements, the potentiometer **28**, and its contained switches **32**, **34** are secured by means of a lock washer **50** and a nut **52**. Electrical connections to the dimmer socket are provided by the internally threaded terminal bushings **62**, **64**.

It will now be apparent that with the novel construction of this invention, the chassis **14** serves as a heat sink for the silicon-controlled rectifier but is substantially isolated from the heat conducted to the screw shell **10** by

the incandescent lamp. Furthermore, it will be apparent that the heat sink also serves efficiently as a sturdy enclosure for protecting the solid state elements and as an electrical conductor. In one embodiment of this invention, temperature tests were conducted utilizing thermocouples applied to the stud of the silicon-controlled rectifier. When tested with a 200 watt bulb, which is the largest bulb that will fit in the average harp used in lamp appliances, a maximum heat rise of only 54° F. above ambient was recorded with the device hanging in the bulb-downward position which provides the most severe test of heating. With the bulb pointing upward, the rise over ambient was 25° F.

Accordingly, it will be apparent to those skilled in the art that the apparatus of this invention provides a compact, sturdy and reliable dimmer which successfully solves the many heat conduction problems normally to be expected by the simultaneous use of incandescent lamps and solid state controlled rectifiers. Furthermore, these problems have been solved in such a manner that the entire lamp dimmer is contained within a normal sized socket.

Many variations and modifications of this invention will be apparent to those skilled in the art which do not depart from the spirit and scope thereof. For example, although a standard shell socket has been illustrated as enclosing the dimmer of the invention, it may also be mounted within a socket having a screw-type lamp base. This would allow simple conversion of any existing lamp to a dimming lamp. Accordingly, it is to be understood that this specification is illustrative only rather than limiting. This invention is limited only by the scope of the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A lamp dimmer socket which comprises a planar first member having a plurality of support members depending therefrom in a first direction perpendicular thereto, said first and support members being formed of heat and electrically conductive material; insulating means on said first member on the side opposite said depending support members; a lamp contact shell positioned on said insulating means; center contact means within and insulated from said screw shell, positioned to engage the center contact of an incandescent bulb and electrically connected to said first member; dimming circuit means enclosed within said first member and said side members, said dimming circuit means including a solid state phase-controllable current controlling element mounted in heat conducting relationship with said first member; and externally controllable knob means in actuating relationship with said dimming circuit means.

2. The socket of claim **1** wherein said dimming circuit means comprises a solid state controlled rectifier having its base connected to said first member in heat and electrically conducting relationship thereto; and circuit parameter varying means arranged to vary the half cycle conducting time of said rectifier, said knob means being connected in actuating relationship to said circuit parameter varying means.

3. The socket of claim **2** wherein said circuit parameter varying means comprises a unijunction transistor having an emitter timing circuit with a variable time constant adjustable from said knob means.

4. The socket of claim **3** wherein said knob means is connected in actuating relationship to a potentiometer.

5. A lamp dimmer socket which comprises: a first disc member having a plurality of side members depending from the edge thereof in a first direction perpendicular to the plane of said disc, said disc and side members being formed of heat and electrically conductive material; an insulating second disc positioned on said first disc on the side opposite said depending side members; a lamp screw shell positioned on said insulating second disc on the side opposite said first disc member; contact means within and insulated from said screw shell adapted

to engage the center contact of an incandescent bulb and electrically connected to said first disc member; dimming circuit means within said side members comprising a solid state controlled rectifier having its base connected to said first disc member in heat and electrically conducting relationship thereto, and circuit parameter varying means arranged to selectively vary the half cycle conducting time of said rectifier; and externally controllable knob means in actuating relationship with said circuit parameter varying means.

6. The socket of claim 5 wherein said screw shell is riveted to said second disc by a plurality of first rivets, wherein said first disc member defines a plurality of first openings therethrough, each of said first openings being positioned to encircle one of said first rivets to prevent conduction of heat and electricity between said rivets and said first disc member, and wherein said second disc defines a second opening surrounding said contact means.

7. The socket of claim 6 wherein an insulating third disc is supported by said side members parallel to said first and second discs whereby said dimming circuit means is substantially completely contained between said first and third discs.

8. The socket of claim 7 wherein all of said first, second, and third discs, screw shell, and dimming circuit means are positioned within a lamp socket body and wherein said knob means protrudes therefrom.

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