

[54] **DIODE RECTIFIER SOCKETED
ELECTRICAL DEVICES AND DIODE
RECTIFIERS THEREFOR**

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315/200 R, 315/205**

[51] Int. Cl. **H05b 37/02**

[58] Field of Search **315/49, 63, 64, 69, 71,
315/194, 199, 200 R, 205, 272**

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Assistant Examiner—James B. Mullins

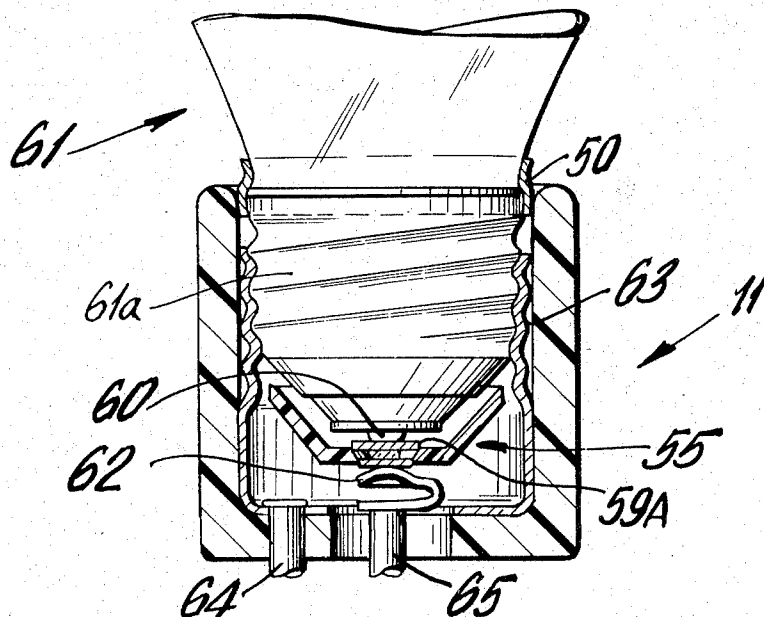
Attorney, Agent, or Firm—Marvin Feldman; J. B. Felshin

[57] **ABSTRACT**

This electrical device comprises an electrically operated article, such as a lamp, which has a base that fits

into a socket. The electrical connection from the socket to the electrically operated article is made through a diode rectifier. The rectifier is a semiconductor. The purpose of the rectifier is to change the voltage of the electrically operated article from A.C. to D.C. current with the top halves of the alternating waves cut off and at the same time to reduce the temperature and extend the life of the article. In case of a lamp, its life is lengthened because the filament will evaporate more slowly and retard darkening of the bulb, thereby reducing replacement costs. To get the same lumens as is normal for a lamp of a predetermined wattage and without the rectifier, the rectified lamp must be of a higher nominal wattage. The rectifier is a chip that comprises a semi-conductor between metal contacts or metalized contacts and with the edges of the semi-conductor protected by insulation material which integrates the parts of the rectifier into a unit. The rectifier is in the socket and between a terminal of the article and a terminal of the socket. Said unit is removable from at least one of them. The unit is in electrical contact with said terminals, and may be fixed either to the article terminal or to the socket terminal, but not to both. In any event, the unit is outside of the conductive systems of the electrically operated article and outside the conductive system of the socket, and serves to connect them in series circuit. In one form of the invention the rectifier unit is fixed to the central bottom contact of a lamp base or to a terminal of the lamp base. In another form of the invention, the rectifier unit is fixed to a pair of terminals of the lamp base connecting a pair of filaments in the lamp in parallel. In yet another form of the invention the unit is on an insulator flange centralized with respect to the socket and removable from the socket and lamp base, and may be dropped into the socket. In still another form of the invention, the rectifier unit is mounted on and fixed to a terminal of the socket, and the lamp base is removable from the socket and out of contact with said unit.

9 Claims, 16 Drawing Figures



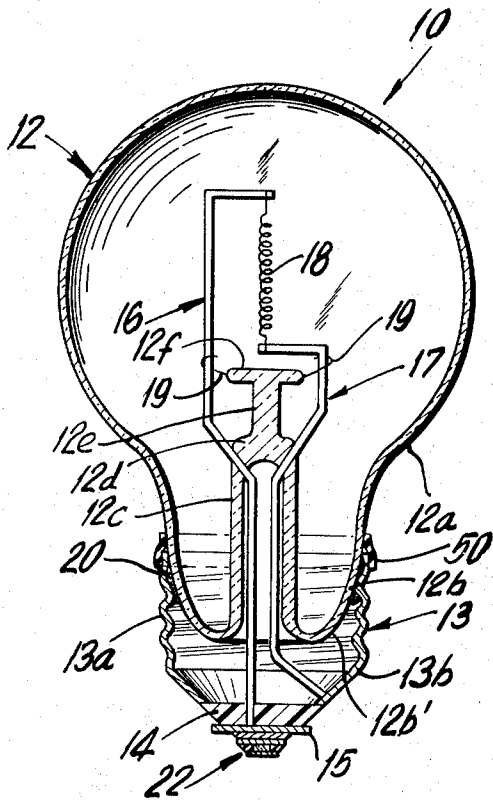


FIG. 1

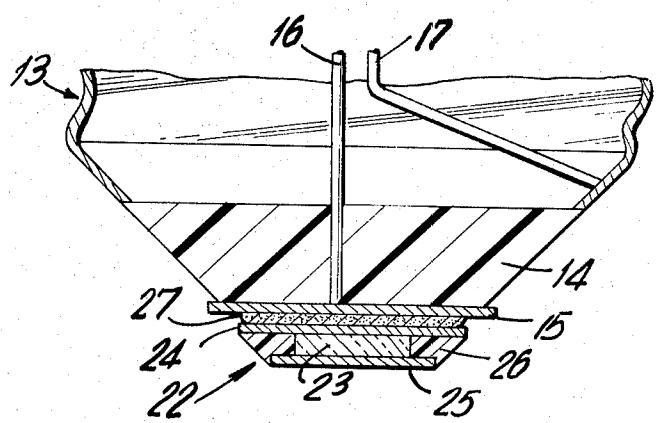


FIG. 2

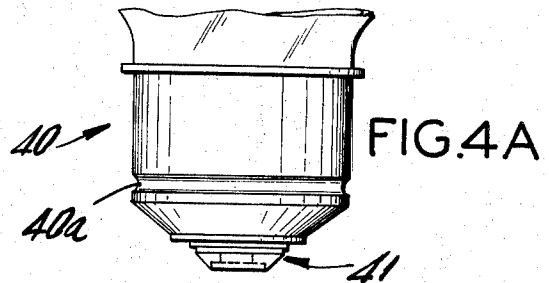


FIG. 4A

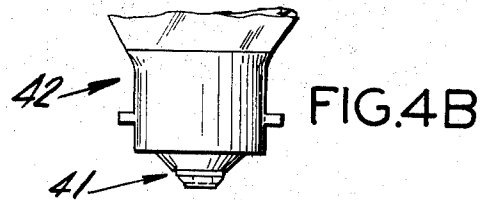


FIG. 4B

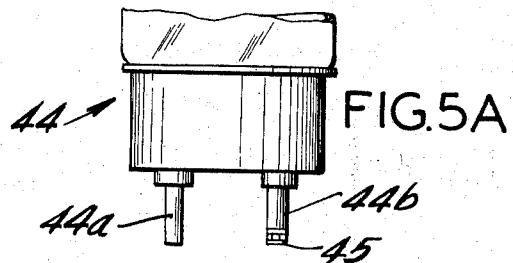


FIG. 5A

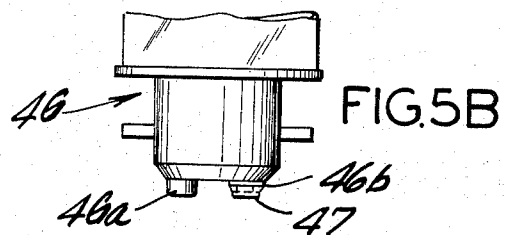


FIG. 5B

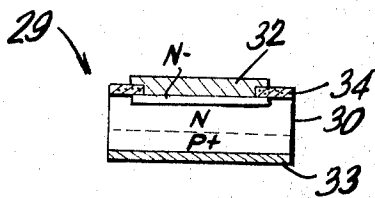


FIG. 3A

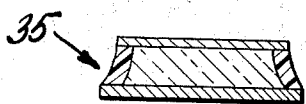


FIG. 3B

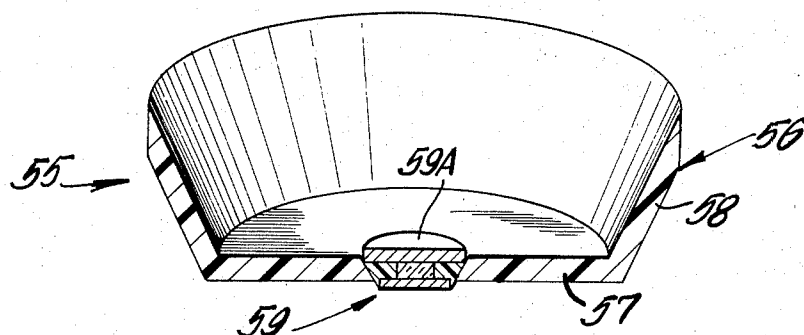


FIG. 6

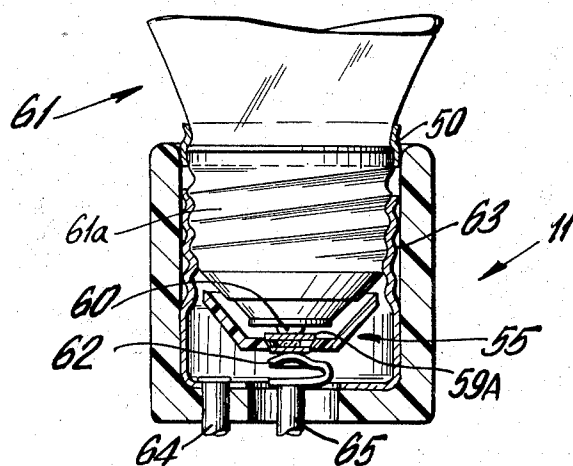


FIG. 7

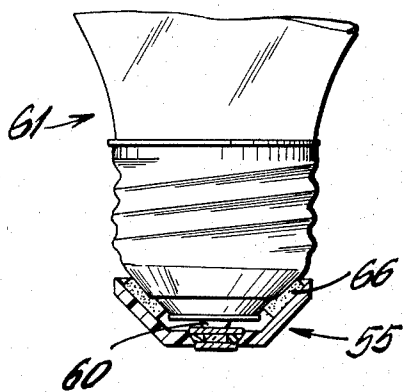


FIG. 8

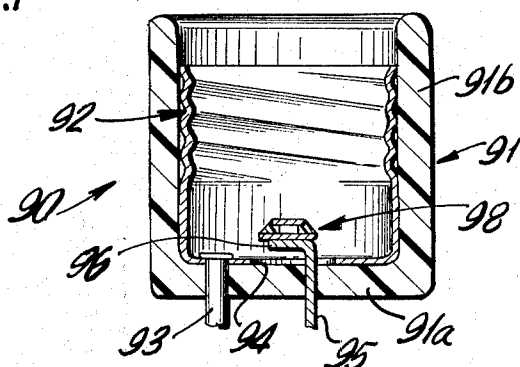


FIG. 12

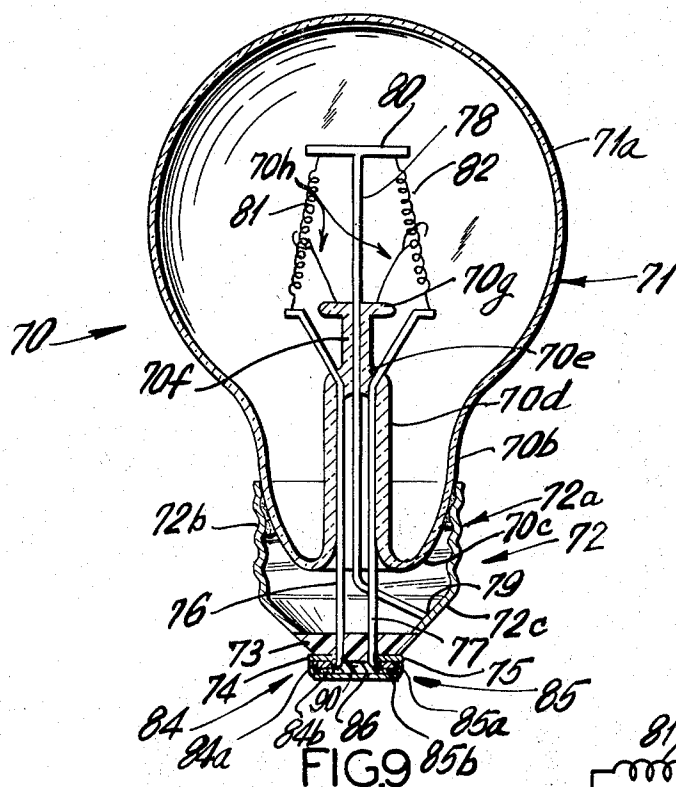
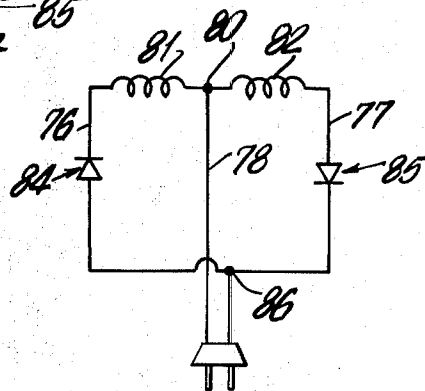


FIG. 11A

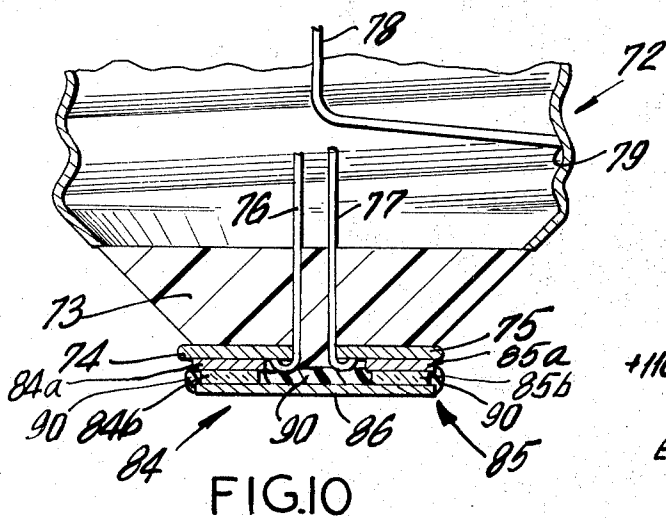


FIG. 10

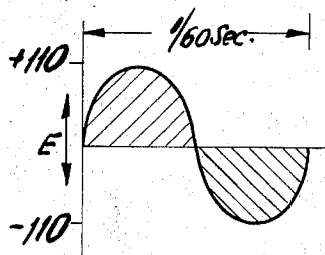


FIG. 11B

DIODE RECTIFIER SOCKETED ELECTRICAL DEVICES AND DIODE RECTIFIERS THEREFOR

This invention relates to rectified socketed electrical devices and to rectifiers therefor.

An object of this invention is to provide a construction of the character described which shall be easy to manufacture, relatively inexpensively, which shall have better heat sinking features than rectifiers now in use and which can be made much thinner than present devices, and which can be applied to standard lamps and sockets.

Another object of this invention is to provide a contact on the outside of the lamp or socket, and a rectifier unit which engages such contact and which is removable from the lamp or from the socket or from both.

This invention also relates generally to electric incandescent lamps, and more particularly to increase in lamp life; still more particularly to increase in lamp life by imposing a rectifier in series with the lamp filament, said rectifier being attached to the bottom central terminal of the lamp. The rectifier so imposed in the filament circuit will change the voltage applied to the lamp from alternating to half wave direct, thus reducing the filament current thereby substantially increasing lamp life.

Previous methods heretofore employed for this purpose had a rectifier wired integrally into the lamp socket in such a way that with a special three way switch it could be put in series with the filament or be by-passed. Other methods employed a rectifier enclosed in a package that could be screwed in or dropped into the lamp socket. These methods required alterations in the lamp socket during manufacture of the lamp or the making of special devices to be used in conjunction with the lamp and its socket. In some cases they also required special switches to be used to put the diode in and out of the filament circuit.

According to the present invention the placing of the rectifier element into the filament circuit is accomplished by simply attaching a small thin diode rectifier button directly to the central bottom contact of the lamp base.

This invention still further relates to a rectifier comprised of a semiconductor diode chip or sandwich mounted in an insulating material in the form of a small flat or saucer shape which can either be dropped into the lamp socket or adhered to the lamp base, in either case this being so done that the rectifier diode is placed in series with the lamp filament when the lamp is screwed into the lamp socket. The rectifier so positioned will act to alter or rectify a source of alternating current, thus reducing the filament temperature and consequently significantly increasing lamp life.

Previous methods heretofore employed for this purpose have used finished rectifier diodes with leads that have been wired directly into lamp sockets, or devices that are then screwed into lamp sockets or placed in the socket, or in one case, a lead mounted rectifier diode that is wired internally into the lamp base. All these methods used a finished rectifier device with leads attached and are fairly complex to make, consequently also being fairly expensive to manufacture.

According to the present invention, the rectifier diode is used in essentially its most basic form, that being a simple semiconductor chip or chip sandwich;

this basic rectifier chip then being mounted centrally in the bottom of a saucer shaped insulator.

It has long been known in the art, that the placing of a rectifier in series with the filament of a standard light bulb would increase its useful life by a factor of ten or more. Such rectified lamps, however, have suffered from a marked reduction of the light output, and created a "flickering" which with some applications, is undesirable, especially in those areas that use other than a 60 cycle/second A.C. voltage supply.

In normal operation, at 60 cycle A.C. supply, an incandescent lamp goes on and off 120 times each second, once for the positive excursion of voltage, one for the negative. In previous inventions, a diode is placed in the circuit, effectively blocking one of those excursions, so the temperature of the filament is considerably reduced. This filament temperature reduction eliminates the rapid evaporation of tungsten, and the life of the filament and hence the lamp, is extended many times. Indeed in tests, the common 100 watt lamp bulb, whose normal life is around 600 hours, has lasted in excess of 5,000 hours on several bulbs without a single failure. This is more than double the so-called "long life" bulbs currently on the market, whose advertised life is less than 2,500 hours. Extrapolation on accelerated testing has indicated the rectified lamps will last over 10,000 hours, or 5 years of normal household use.

The difficulties of this approach however, as mentioned above, are that the light output is less (because of the reduced filament temperature) and a flickering effect (because the filament is "on" 60 times a second, rather than 120). The contemplated device circumvents these problems by the following:

a. There are two filaments, each supplied through a diode, one the reverse of the other. That is, one filament is on during one half of the cycle, the other is on during the other half, so light pulses are being produced at 120 cycles per second, and there is no noticable flickering.

b. Because there is a finite decay time of the filament glow, one filament is still glowing while the other is on, so this residual glow adds to the light output. This in addition to the obvious light output increase by using both halves of the wave form, improves the intensity of the bulb.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described and of which the scope of invention will be indicated in the following claims.

In the drawings:

FIG. 1 is an elevation of the lamp with rectifier attached comprising the invention.

FIG. 2 is an elevation on an enlarged scale in section of a form of the semiconductor rectifier attached to the lamp base.

FIGS. 3A, 3B, are elevations on an enlarged scale in section of several forms of semi-conductor rectifiers that can be used for attachment to the lamp base contact.

FIGS. 4A, 4B, 5A, 5B show bases for lamp other than the screw base shown in FIG. 1, and embodying the invention.

FIG. 6 is a perspective view, partly in cross-section of a modified rectifier unit embodying the invention;

FIG. 7 is an axial cross-section of a lamp base and socket employing the rectifier unit of FIG. 6;

FIG. 8 is a vertical view of a lamp and rectifier in cross-section and illustrating a modified form of rectifier;

FIG. 9 is an axial cross-section view of a lamp with two filaments and embodying the invention;

FIG. 10 is an enlarged partial view of the structure of FIG. 9;

FIG. 11A, shows schematically, the electric circuit for the lamp of FIG. 9;

FIG. 11B, illustrates the alternating wave for the two filaments of the lamp illustrated in FIG. 9.

FIG. 12 is a vertical view of a socket with a rectifier embodying the invention and in which the rectifier is fixed to a terminal of the socket.

Referring now in detail to the drawing and particularly to FIGS. 1 to 5B numeral 10 designates an electric single filament lamp to be screwed into any usual lamp socket such as lamp base socket 11 shown in FIG. 7. Said lamp 10 comprises a glass envelope or bulb 12. Said bulb 12 comprises a part spherical portion 12a from which a neck 12b extends downwardly. Said neck 12b has an inwardly and upwardly turned lower end portion 12b' from which a central tubular press seal portion 12c extends upwardly. The tubular portion 12c is closed, as at 12d, at its upper end. Extending up from closed end 12d is a stem 12e having a flat flange portion 12f at its upper end. Fixed to the lower end of neck 12b, in conventional manner, is a screw base 13 of conductive metal. Said screw base 13 comprises an upper screw threaded shell portion 13a having a downwardly extending frusto-conical portion 13b to which is fixed an insulating web 14. Said screw shell 13a constitutes a terminal of the lamp. Fixed to the underside of web 14 is a centrally located terminal or eyelet 15. Connected to eyelet 15 is a lead 16 which passes upwardly through web 14 and into the interior of portion 12c, through said portion 12c, and upwardly to a point spaced above flange 12f. A second lead 17 is connected to the frusto-conical portion 13b and passes into the interior of press-seal portion 12c, in spaced relation to lead 16, then passes through said press-seal portion and upwardly to a point just above flange 12f, but below the upper end of lead 16. Said leads 16, 17 are interconnected by a filament 18 which may comprise tungsten. A filament support 19 of usual construction supports the leads 16, 17, and sometimes the filament itself. The attachment of the screw base 13 to the neck 12b of the bulb 12 may be accomplished by conventional cement as at 20. The insulating web 14 may consist of glass or organic plastic as is well known in the art.

To the underside of the terminal 15 is attached an integrated rectifier diode unit 22. The unit 22 comprises a thin wafer, disc or chip 23 which may comprise a rectifying semi-conductor such as germanium or silicon sandwiched between thin contacts or discs 24, 25 of conductive metal or metalized contacts, extending beyond the periphery of the chip or disc 23, and the unit is integrated and the chip protected at its edges by a ring 26 of insulating material, as for example glass, ceramic or organic material. The ring 26 bridges the contacts or discs 24, 25 all around.

Attachment of the diode unit 22 to the contact 15 is made by any suitable means such as soldering, brazing or conductive cement, as shown at 27.

In accordance with the invention, the lamp thus has a diode rectifier in series with the lamp filament 18. This lamp, when connected to an alternating current supply, will therefore have half wave rectified current supplied to the filament 18. This half wave current will cause the filament to operate at a reduced temperature as well as at reduced illumination, and by this means will substantially increase the life of the lamp.

The metal discs 24, 25 may each be about 0.010 inch in thickness and the semi-conductor chip 23 may be about 0.005 inch in thickness, thus making the diode about 0.025 inch in thickness.

In FIG. 3A there is shown a semi-conductor diode 29 of the passivated type, which consists of the doped silicon semi-conductor chip 30 containing a passivated rectifying junction, with metal or metalized contacts 32, 33 top and bottom. A passivating layer of oxide (non-conductor) 34 is interposed between outer edges of the silicon chip 30 and the top metal contact 32. This may be made very thin, of the order of 0.008 to 0.010 inch. The passivated chip 30 in itself is well known in the art.

In FIG. 3B, there is shown a mesa passivated type rectifier 35, again passivated at its edges with some material as shown in FIGS. 1 and 2.

These are just examples, since the rectifier may consist of most and suitable type structure so long as it has the current and voltage handling capability required for the particular lamp, and is small in size and thickness so as not to cause the lamp to be raised out of its socket in such manner that any significant part of the screw shell of the lamp base is exposed when the lamp is screwed into the socket. If this does occur, and/or it is desirable to protect against this potential hazard, the upper portion of the metal base may be provided with an insulative "guard-ring" as shown at 50 in FIG. 1. Said insulative guard ring is more fully described herein.

A feature of the invention is that it requires only a small button rectifying diode to be added to the base of a standard commercial lamp. The rectifier changes the appearance of the lamp so slightly that to the normal eye the lamp appears unchanged from its original form. A further feature is the low cost of the rectifier and the process for its attachment to the lamp. A further feature is that the height of the lamp with button attached is essentially the same as it would be in its normal state with only a solder bump taking the place of the button. A further feature is that the lamp can be used as is, in any socket for which it was normally intended.

The invention is not just limited to the standard screw base lamps, but can be adapted to most any type of lamp base that is manufactured by attaching the rectifier diode button to a contact to the filament lead wire coming through the bottom of the lamp base. Examples of other bases for which the button lamp rectifier is adaptable are shown in FIGS. 4A, 4B, 5A and 5B.

In FIG. 4A, the base 40 of the lamp is smooth and has an annular groove 40a into which spring pressed members of the socket may snap for attaching the lamp to the socket. At the lower end of base 40 is a rectifier 41 similar to rectifier 22 and attached to the bottom contact, like contact 15.

In FIG. 4B there is shown a lamp base 42 of the bayonet type, also with a rectifier 41 similar to rectifier 22, attached to its bottom contact, like contact 15.

In FIG. 5A is shown a lamp base 44 with two jack terminals 44a, 44b. Attached to the lower end of one jack terminal 44b is a rectifier diode 45 similar to diode 22.

In FIG. 5B there is shown a lamp base 46 of the bayonet type with two terminals 46a, 46b. Attached to one terminal 46b is a diode rectifier 47 similar to rectifier 22.

The rectifier requirement is that it operate at a current of about half or greater than that required for operation of the lamp without the rectifier. For example, for a 100 watt lamp the rectifier current should be about 0.8 amp. The rectifier must also have capability to block in its non conducting state the maximum a.c. voltage normally applied to the lamp.

By using this invention it is expected to increase lamp life by a significant factor, estimated to be at least tenfold, this estimate being made from available data from lamp manufacturers through extrapolation, and corroborated through actual life tests on the invention.

A combination socket and plug screwed to a base of a lamp, with a rectifier in the plug part of the combination socket and plug, is old, but it is too large and increases the height by about 1 1/4 inches.

Our rectifier is separate and removable from either the lamp or its socket or both, but is not permanently fixed to both.

As shown in FIG. 1, an insulating guard ring 50 surrounds the upper part of the screw shell 13a and overlaps a portion of the neck 12a of the bulb 12. The guard ring is preferably made of elastic insulating material. It can be stretched into shape to constrict against the base and bulb neck and may be a normally tubular ring or an O-ring to fit on the upper end of the base of the lamp. In any event it should prevent the fingers of the user from contacting the upper end of the base of the lamp when the lamp is in a socket as an extra precaution against getting an electric shock and for the sake of safety. The ring can have an inwardly extending lip at one end and may also be conical in shape or of any other suitable shape.

Referring now to FIGS. 6, 7 and 8, numeral 55 designates a saucer shaped lamp rectifier button or member shown in enlarged sectional view in FIG. 6. Said button member 55 comprises a saucer shaped shell or flange 56 to conform generally to the bottom of the base of a lamp. Shell 56 is made of insulating material such as nylon or other suitable plastic. Said shell 56 has a bottom wall 57 and an annular conical wall 58. Fixed within a suitable through opening at the center of bottom wall 57 is a rectifier unit 59 which may be like rectifier unit 22 of FIGS. 1 and 2, or rectifier unit 29 of FIG. 3A, or rectifier unit 35 of FIG. 3B or other designs known in the state-of-the-art. In any event the rectifier unit is attached or fixedly mounted in the bottom center of the saucer shell either through the use of some adhesive such as epoxy, or through a process such as molding or plastic casting.

FIG. 7 is a cross-sectional view of a conventional lamp base socket 11 and through the lamp rectifier button 55 showing the manner in which the saucer rectifier 55 may be interposed between the usual bottom contact 60 of a conventional lamp 61 and the contact 62 of the lamp base socket. As shown in FIG. 7, the

socket 11 has a screw shell 63 into which is screwed the lamp base 61a of the lamp 61. A terminal 64 of the socket is connected to shell 63. A second terminal 65 connects in conventional manner to the contact 62. Contact 62 is a spring contact and as the lamp is screwed to the socket, the spring contact 62 is depressed sufficiently for the entire lamp base to be substantially received in the socket, without protrusion.

The separate lamp button rectifier 55 is so thin that the bulb is raised only slightly. It can be inserted into any socket in which a bulb base is screwed. Again, however, if this protrusion is detrimental, protection therefrom may be obtained by the use of a "guard-ring" as shown at 50 in FIG. 7.

Where the semi-conductor rectifier is incorporated into the base of the bulb, it increases the height only slightly, which will not effect the screwing of the bulb to a socket. If the diode rectifier is in button form and inserted into the socket there is no increase in height. When the rectifier is placed on the bottom of the bottom contact of the lamp base, there is very little if any increase in height because the semi-conductor essentially replaces the solder that is usually applied to the bottom contact of the base, to engage the central contact of the socket, which is usually spring-pressed.

FIG. 8 is a conventional lamp 61 with the saucer rectifier 55 attached to the lamp base by means of a layer 66 of adhesive.

The saucer shaped rectifier is so positioned in the lamp socket, that the lamp when screwed into the socket, automatically centers the rectifier chip so that it is interposed between and contacted by the lamp base connection on one side and the socket spring contact on the other side. In this manner the rectifier diode is placed in series with the filament of the lamp. The saucer rectifier is of such a diameter to slide through the internally threaded portion of the base, and because of the saucer nature of its shape, position itself in the bottom of the socket so that it is centrally located. In the case where the lamp socket is mounted with its open side down, as is the case many times for ceiling fixtures, the saucer rectifier is so shaped as to set easily over the lamp base in an upside down position while the lamp is being screwed into the socket.

To remove the need to drop the saucer rectifier into the socket or balance it on the lamp base while screwing the lamp into the socket, the lamp button may be attached to the lamp base through the use of an adhesive or an adhesive-coated plastic or rubber form between the rectifier supporting shell, and the sides of the lamp base, as illustrated in FIG. 8. The adhesive system is applied between the rectifier insulating member and the lamp base so as to hold the rectifier diode in contact with the bottom central contact of the lamp base. Use of such a system substantially reduces the potential shock hazard that could occur if one were to try to remove the rectifier from the lamp socket with the fingers or some metal probe and the current source were on. Another means of accomplishing this could be the provision of a low-melting solder coating on the interior contacting surface of the device at 59a of FIG. 6, such that in use, the mating surfaces of 60 and 59a in FIG. 7 become fused, and the saucer-rectifier thereby becomes attached to the lamp.

Reference is now made to FIGS. 9, 10, 11A and 11B. In said figures, a lamp 70 illustrates a modified form of

the invention. Lamp 70 comprises a bulb 71 having an upper part-spherical portion 71a from which a neck 70b extends downwardly. Extending from neck 70b is an inwardly and upwardly turned back portion 70c from which a tubular press-seal portion 70d extends upwardly, closed at its upper end, as at 70e. A central stem 70f extends up from closed end 70e. At the upper end of stem 70f is a flat flange 70g. Fixed to the lower end of the neck 70b is a base 72 comprising a conductive metal shell 72a having an upper screw threaded portion 72b and a lower downwardly converging frusto-conical portion 72c. Fixed to the lower end of frusto-conical portion 72b is an insulator 73. Attached to the underside of the insulator 73 are a pair of spaced contact plates 74, 75. Connected to said contact plates 74, 75 are leads 76, 77, respectively, passing through the insulator 73, and within tube 70d, in spaced relation to each other, and through the closed end 70e to the level of flange 70g and disposed on opposite sides thereof. Extending through the stem 70f is a common lead 78. The lead 78 passes through tubular portion 70d in spaced relation to leads 76, 77. One end of lead 78 is connected to screw shell 72, at 79. At the upper end of lead 78 is a cross-head 80. One filament 81 connects cross-head 80 with the upper end of lead 76. A second filament 82 connects cross-head 80 with the upper end of lead 77.

Attached to the undersides of contacts 74, 75 are diode rectifiers 84, 85. Diodes 84, 85 comprise spaced metal discs or plates 84a, 85a at the undersides of contacts 74, 75 respectively, and semi-conductor chips 84b, 85b at the undersides of plate 84a, 85a and a common bottom metal conductor plate 86 bridging the undersides of said chips 84b, 85b. The semi-conductors are protected circumferentially at their edges by insulation 90. Although these contacts 74, 75 are shown as spaced discs, they could just as easily be concentric rings.

Thus the junctions are so arranged as to allow current to pass in one direction through filament 81 and in the opposite direction through filament 82. Contacts 84a, 85a maybe eliminated if desired, but make the manufacture easier.

To get alternate lighting of each filament, the diodes are of opposite polarity on each contact 74 and 75 with respect to the bottom plate 86 or the common filament lead 80. If they are of the same polarity the units would work but one would not get the alternate lighting of each filament.

The electrical operation can be more readily comprehended by reference to FIGS. 11A, 11B. FIG. 11A shows the equivalent circuit and FIG. 11B shows graphically, the voltage excursions seen at the usual 110 Volt, 60 Cycle A.C. common in the U.S.A. During the first 1/120th of a second, the voltage builds to 110 Volts, and drops to zero. During the second 1/120th of a second, the voltage drops to minus 110 Volts, and rises back to zero. This represents one cycle and this is repeated 60 times each second. This is what the bottom contact 86 "sees" relative to the screw shell 72a, or in terms of the circuit is what junction 86 "sees" relative to junction 80, as seen in FIG. 11A. Now the rectifier allows current to pass in one direction but prevents it from passing in the other direction and this arrangement allows the current induced by the positive voltage to light filament 81, and the current induced by the negative portion to light the filament 82. Thus, as is in-

indicated in the shaded portion of FIG. 11B, each half of the cycle lights only one of the filaments.

In FIG. 12 there is shown a lamp base socket 90 comprising an outer socket 91 of insulating material, having a bottom wall 91a from which a cylindrical wall 91b extends upwardly. Within the socket 91 is a screw shell 92 into which the base of a conventional lamp may be screwed. The shell 92 is fixed to the socket 91 and connected to a lead 93. The bottom wall of the shell 92 has a central opening 94. A second lead 95 passes through wall 91a and hole 94 and has at its upper end, an offset finger 96. Fixed to the top of finger 96 is a rectifier unit 98 similar to the diode rectifiers 22 (FIG. 1) or 29 (FIG. 3A) or 35 (FIG. 3B), and comprising a semi-conductor chip sandwiched between a pair of metal contacts or discs with the edges of the chip protected by an encircling insulator.

The upper end of lead 95 could be in form of a spring, as is shown at 62 in FIG. 7.

When a conventional lamp is screwed to the socket of FIG. 12, the diode rectifier operates like the diode rectifiers of FIGS. 1, 3A, 3B.

It will thus be seen that there is provided an article in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings, is to be interpreted as illustrative only.

We claim:

1. A diode rectifier unit and lamp combination, said combination comprising; a diode rectifier unit, said unit comprising a semi-conductor chip sandwiched between a pair of metal disc contacts, and a ring of insulating material extending around the periphery of said chip and bridging said contacts, said insulating material integrating said chip and contacts so as to form said unit; a lamp comprising a bulb having a base and an about centrally disposed contact at the bottom of said base, a filament in the bulb, a pair of terminals on the base, one of said terminals comprising said central bulb contact, conductive means to connect the opposite ends of the filament to said terminals, respectively; and a socket for receiving said base and providing electrical contact with said other terminal, said socket having a centrally disposed contact; and means to hold said unit in about axial disposition with and below, and one of said disc contacts thereof in conductivity with, said central bulb contact, and in about axial disposition with and above, and the other of said disc contacts thereof in conductivity with, said central socket contact, without any significant part of the base being exposed with the unit so held in place.

2. The combination of claim 1, and a flange of insulating material attached to said unit and extending radially beyond said unit.

3. The combination of claim 2, said flange being annular, said unit and flange forming a button.

4. The combination of claim 3, said flange having a central flat portion and an outer, annular upwardly divergent portion, and said unit being located at the center of said central flat portion.

5. The combination of claim 4, means to attach said button to the lower end of said base with a contact of

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said unit engaging the center contact of said base, and the upwardly divergent portion of the flange of said button surrounding the lower end of said base.

6. The combination of claim 5, said means for attaching said button to said base comprising adhesive between said flange and said base.

7. The combination of claim 5, said attach means comprising conductive solder between said center contact and said one contact of said unit.

8. The combination of claim 1, a second filament, a second terminal at about the center of said base, means to connect one end of each of said filaments to one of

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said first and second center terminals, respectively, means to connect the opposite ends of said filaments to said other terminal, one contact of said unit being electrically connected to one of said first and second center terminals, a second unit, means to conductively connect one of said contacts of said second unit to the other of said first and second center terminals, and means to conductively connect the other of said contacts of said first and second units to each other.

9. The combination of claim 1, said lamp comprising a screw base and a screw socket.

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