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3,028,525

INCANDESCENT LAMP LIGHT SWITCH ARRANGEMENT

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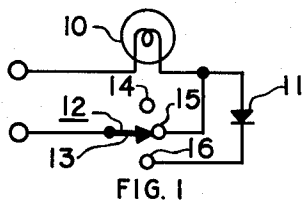


FIG. 1

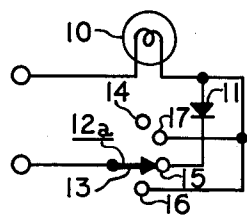


FIG. 2

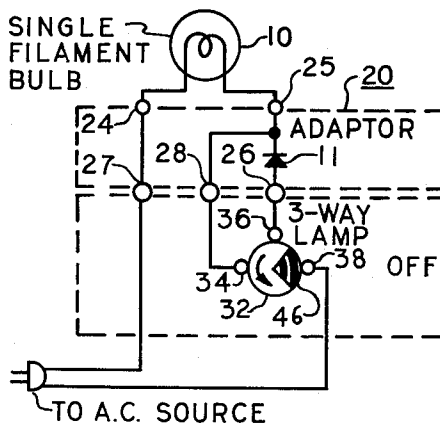


FIG. 4a

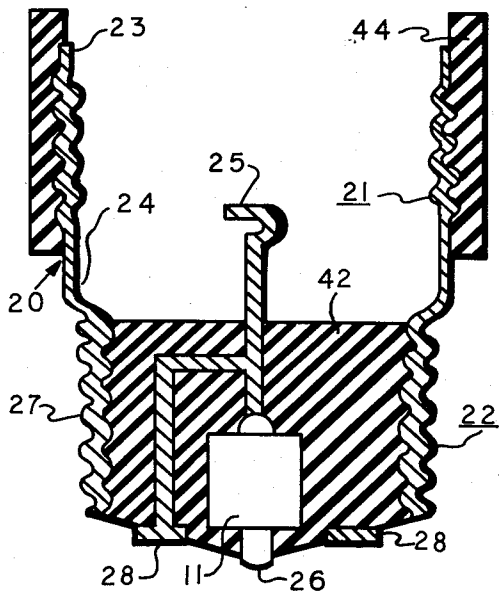


FIG. 3

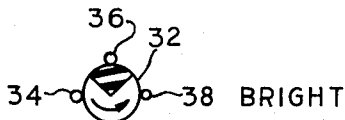


FIG. 4b

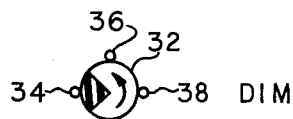


FIG. 4c

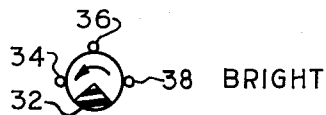


FIG. 4d

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3,028,525
INCANDESCENT LAMP LIGHT SWITCH
ARRANGEMENT

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This invention relates to the incandescent bulb light dimming art wherein half-wave rectification is used to effect light dimming.

This invention is predicated upon the use of half-wave rectification for selectively controlling the light output from an incandescent bulb—a brighter illumination level is provided by connecting the bulb directly to an alternating current source, while a dimmer illumination level is provided by connecting a half-wave rectifier in series with the bulb so as to energize the bulb with pulsating direct current. Such bulb dimming control is described in greater detail in my U.S. Patent 2,896,125, entitled "Electric Lamp Switch Mechanism," and in the co-pending patent application of Eugene Seid, Serial No. 29,879, filed simultaneously with this application, and entitled "Light Dimming Adaptor for Three-Way Incandescent Lamps," and assigned to the same assignee as the present invention.

When half-wave rectifiers, for example crystal diodes, are used to reduce the illumination level of an incandescent bulb by energizing it with pulsating direct current instead of by alternating current, the required rectifier rating has heretofore been such as to enable the rectifier to carry from about 10 to about 40 times the current normally drawn by the bulb. The reason for this appears to be that when a cold incandescent bulb is first turned on, the attendant low resistance of the cold bulb filament causes the bulb to draw an appreciably greater current than during normal bulb operation (when the hot bulb filament exhibits a relatively high resistance). For example, the surge current attendant the turning on of a cold 100 watt (.9 amp.) bulb may be over 20 amperes. Since an incandescent bulb normally heats to its normal operating temperature in a very small fraction of a second, such surge currents do not normally affect the normal equipment associated with supplying current to the bulb. However, half-wave rectifiers, especially germanium or silicon crystal diodes, are adversely affected by such surge currents even though the surge duration is small. The usual effect of such surge currents on the rectifiers is to shorten their life. Consequently, the half-wave rectifiers heretofore used in such light dimming applications have been larger and more costly than would be dictated by the value of the normal operating current to the bulb.

Accordingly, one of the more important objects of this invention is the provision of an arrangement for reducing the required current handling capabilities of a half-wave rectifier used in incandescent bulb light dimming applications.

The foregoing and related objects are realized by interconnecting the bulb to be energized and the current source in a manner such that the bulb is always heated to normal operating temperature prior to subjection of a light dimming rectifier to the bulb current. In one embodiment, for example, the switch arrangement used to operate the bulb is connected to momentarily by-pass the rectifier, and subject the bulb to normal bulb heating, prior to subjection of the bulb to current flow through the rectifier. Thus, in a residential type three-position switch where the desired bulb control sequence is off-dim-bright, the switch is provided with a momentary bright position intermediate the off and dim positions.

In this way the bulb is momentarily warmed up prior to subjecting the rectifier to the bulb current.

In the accompany single sheet of drawings, where like reference characters refer to like or corresponding parts:

FIG. 1 is a schematic illustration of a light dimming switch arrangement wherein the switching sequence is off-bright-dim;

FIG. 2 is a schematic representation of an incandescent bulb switch arrangement wherein the switching sequence is off-dim-bright;

FIG. 3 is a sectional view of an incandescent bulb adaptor arrangement useful in practicing the invention; and

FIGS. 4a through 4d are schematic representations of circuits embodying the invention and depicting, respectively, successive positions of a switch arrangement for controlling the energization of the adaptor shown in FIG. 3.

Referring to FIG. 1, as has been indicated above the illumination level of an incandescent bulb 10 can be reduced to an appreciably lower than normal, or dim level, by connecting a half-wave rectifier 11 in electrical series with the incandescent bulb. Since, according to the invention, it is desirable to avoid subjecting the rectifier 11 to bulb current until after the bulb filament has been heated to its steady-state or normal illumination level, the energization of the bulb is controlled by a pre-determined switch arrangement 12. In this switch arrangement 12 the switch element 13 of the arrangement is movable to any one of three positions. While not shown in the diagram of FIG. 1, the switch arrangement 12 is preferably provided with position-defining detents to prevent the element 13 from more than momentarily assuming any orientation other than those defined by the three positions. In a first position the element 13 is at rest against a first contact 14; in this position no current flows to the bulb 10 and it remains off. In a second position the element 13 is connected to a second contact 15; in this position the alternating current from an alternating current source is connected to pass through the bulb 10, energizing it to its normal, full illumination level. In a third position of the switch element 13, the element is oriented to pass current to a third contact 16; in this third position current flow to the bulb 10 is intercepted by the serially connected rectifier 11 so that the pulsating direct current reaching the bulb causes it to glow at an appreciably lower than full illumination level.

It will be noted that in the arrangement of FIG. 1 the switch sequence is off-bright-dim. Consequently, the filament of the bulb 10 is always heated to a high resistance value prior to subjection of the rectifier 11 to current flow through the bulb. Thus, the rectifier 11 is never subjected to the surge current attendant the turning on of a cold bulb.

FIG. 2 illustrates a switch arrangement according to the invention for providing an off-dim-bright switch sequence while still preserving the rectifier 11 from cold bulb surge currents. The switch arrangement 12a of FIG. 2 is generally similar to the arrangement of FIG. 1. However, in the arrangement of FIG. 2 a momentary contact 17 is provided in addition to the three switch position contacts 14, 15, and 16. The bulb is off when the element 13 is positioned on the first contact 14, the bulb provides a dim illumination level when the element is connected to the second position-determining contact 15, and the bulb is energized at a full brilliancy level when the element 13 is connected to the third position-determining contact 16. In the arrangement of FIG. 2 the fourth or momentary contact 17, intermediate the first two switch position-determining contacts 14 and 15, is connected to by-pass the rectifier 11, for heating the bulb 10 to normal operating temperatures. This con-

tact 17 is arranged so that the element 13 brushes against the contact 17, making momentary electrical connection with it, when the switch element 13 is changed from the off position (contact 14) to the dim position (contact 15). Since the bulb 10 is always heated to normal operating temperature prior to a subjection of the rectifier 11 to bulb current (by virtue of the dim position-defining contact 15 being flanked by two bulb-heating contacts 17 and 16) the rectifier 11 is preserved from surge currents and may thus have a current handling rating that is dictated by only the bulb steady-state requirements.

FIG. 3 is a sectional view of an incandescent bulb adaptor 20 useful in practicing the invention. As discussed in the co-pending patent application referred to above, there are many occasions where it is desirable to reduce the illumination level provided by floor or table lamps. In residential environments this is usually accomplished by the use of three-way lamps, lamps that are constructed to accommodate a special incandescent bulb having two filaments. In this special two-filament bulb, one of the two filaments provides an appreciably higher illumination level than the other filament. Thus, a selection of the filament to be energized effects a selection of the illumination level provided by the bulb. (This selection of illumination level is usually accomplished by means of a rotary switch built into the lamp socket that accommodates the bulb.) While two appreciably different illumination levels are all that are normally required in residential environments, the presence of two filaments in a single bulb has made possible the simultaneous energization of both filaments to provide a third illumination level. Hence, such two-filament bulbs are usually referred to as three-way bulbs. One typical bulb, for example, has a 50 watt filament to provide a low illumination level and a 200 watt filament to provide a high illumination level; the simultaneous energization of both filaments provides a 250 watt illumination level that is almost imperceptibly brighter than the 200 watt illumination level.

In the use of the adaptor 20, by way of comparison, a single filament, 200 watt bulb can be energized to provide an effective 200 watt illumination level, and can also be energized at a second position to provide an illumination level corresponding to of the order of about 75 watts. As will be explained, the adaptor 20 is constructed in a manner such that the single filament incandescent bulb used in the adaptor is always switched to a bright position prior to being switched to a dim position for preserving the rectifier in the adaptor from surge currents attendant the energization of a cold incandescent bulb.

In FIG. 3 the adaptor 20 takes an elongated form, and is made up of a male base member 22, a female bulb-receiving member 21, and the half-wave rectifier 11. The male member 22 is threaded for insertion into the bulb receiving socket (not shown) of the three-way lamp (not shown) to be adapted. To this end the male member 22 is provided with an array of three coaxial terminals; an outermost terminal 27, an intermediate terminal 28, and an innermost terminal 26. These terminals correspond in location to the three terminals of the conventional three-way bulb whose place is to be taken by the adaptor 20.

The female or bulb-receiving member 21 is threaded to receive a common, single-filament bulb (depicted schematically in FIG. 4a by the numeral 10). To this end the female member 21 has two coaxial terminals, an inner terminal 25 and an outer terminal 23.

The outermost terminals 27 and 23 of the male and female members are electrically connected to each other, and as indicated in FIG. 3, are integral with each other at location indicated by numeral 24. In the device of FIG. 3 the inner terminal 25 of the female member 21 is electrically connected to the intermediate terminal 28 of the male member 22. The half-wave rectifier 11 is

electrically connected in series between the inner terminal 25 of the female member and the innermost terminal 26 of the male member 22. At least a portion of the region within the outermost terminal 27 of the male member, and containing the rectifier 11, is preferably filled with an insulating material 42 in order to fix the rectifier and the male member terminals against movement, and at the same time to impart a greater rigidity to the overall adaptor structure.

A band of insulating material 44 is fixed around the outer terminal 23 of the female member 21 in order to assure that no metallic portions of the adaptor 20 will be normally contacted during insertion of the adaptor into a lamp.

FIGS. 4a, 4b, 4c, and 4d will now be referred to in connection with a description of the operation of the adaptor 20. FIG. 4a schematically depicts the adaptor 20 described above, the single filament bulb 10 whose illumination level is to be controlled, and the three-way lamp to be converted for reception of single filament bulbs. The three-way lamp to be converted normally includes a rotary switch having a rotor 32, and three rotor terminals 34, 36, and 38. Alternating current is received by the lamp by means of a conventional two-wire cord. One current supply wire is connected to directly energize the device now in the lamp (the wire terminating at the terminal 27). The other current supply wire is connected to one terminal 38 of the rotary switch.

The rotor 32 of the rotary switch has a circumferential extant that is integral and electrically conductive along approximately 270 degrees of its circumference, and that is insulating along approximately 90 degrees of its circumference (the portion of the rotor indicated at numeral 46 in FIG. 4a). The angular position of the rotor 32 determines whether current may be passed from terminal 38 to terminal 36, from terminal 38 to terminal 34, or whether no current shall flow through the lamp. In the position of the rotor 32 illustrated in FIG. 4a, the insulating portion 42 of the rotor is adjacent to terminal 38; hence, no current flows through the lamp. In a successive position of the rotor 32 depicted in FIG. 4b, the insulating portion of the rotor 32 insulates terminal 36, but directly connects terminals 38 and 34; hence current passes from terminal 38, through terminal 34, and to the other terminal 28 of the device connected to the lamp. It should be noted that in this successive position of the rotor depicted in FIG. 4b, the position immediately following the off position, the electric connections to the bulb 10 are such as to illuminate it to its bright level, warming it to its high resistance operating level.

In a successive position of the rotor 32, depicted in the view of FIG. 4c, the insulating portion of the rotor 32 is positioned adjacent to terminal 34, and terminals 38 and 36 are electrically connected to each other through the rotor; thus, current passes from terminal 38 to terminal 36 and to a third terminal 26 of the device connected to the lamp. In this position of the rotor the bulb 10 is energized at its dim level since the rectifier 11 is serially connected in the circuit to the bulb 10.

In a further successive position of the switch illustrated in FIG. 4d, the terminal 38 is electrically connected to both terminals 34 and 36; current thus passes from terminal 38 to both of the device terminals 28 and 26. In this position of the switch the bulb 10 is again illuminated at its bright level. From the foregoing it is noted that during successive switching operations the adaptor 20 will control the illumination of the single-filament bulb 10 to off, bright, dim, and bright as the lamp switch takes the positions represented in, respectively, FIGS. 4a through 4d. These successive positions represent, respectively, a condition where no current flows through the bulb 10, a condition where the full source alternating current is passed to the bulb to effect its illumination at a full brilliancy level, a condition where a pulsating direct current is passed to the bulb 10 by virtue of the connection of the

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rectifier 11 in series with the bulb (whereupon the bulb is illuminated at the appreciably lower than full brilliancy level), and another condition where the full source alternating current is passed to the bulb to again effect its illumination at a full brilliancy level.

In the arrangement depicted in FIGS. 3 through 4d, the bulb is always subjected to full brilliancy energization prior to a subjection to low level illumination. Hence, the bulb is always heated to its normal, high electric resistance level prior to the subjection of the rectifier to bulb intercepting current flow. Consequently, this adapter arrangement obviates the need for heavy duty rectifiers in the use of the adaptor.

From the foregoing it is seen that the light switch arrangement of the invention provides for the reduction of the required current handling capability of half-wave rectifiers used in incandescent bulb light dimming arrangements, and thus contributes to the low-cost manufacture of such dimming arrangements.

What is claimed is:

1. In combination: means connectable to an incandescent bulb to be selectively energized by alternating current and by direct current from a single alternating current source for controlling the bulb illumination level to, respectively, a high illumination level and a dim illumination level; a half-wave rectifier; and switch means connected to the rectifier and to the bulb connectable means for selectively subjecting the bulb to alternating current from the current source in a first switch position of the switch means, and to direct current in a second switch position of the switch means by means of a serial connection of the rectifier between the bulb and the alternating current source; the switch means being connected to always pass through the first switch position prior to passing through the second switch position, and being free of an off position intermediate the first and second switch positions.

2. In combination: means connectable to an incandescent bulb to be selectively energized by alternating current and by direct current from a single alternating current source for controlling the bulb illumination level to, respectively, a high illumination level and a dim illumination level; a half-wave rectifier; and switch means connected to the rectifier and to the bulb connectable means for selectively first momentarily only subjecting the bulb to alternating current from the current source in a first switch position of the switch means, then subjecting the bulb to direct current in a second switch position of the switch means by means of a serial connection of the rectifier between the bulb and the alternating current source, and then subjecting the bulb to alternating current from the current source in a third switch position of the switch means; the switch means being connected to always pass through the first switch position prior to passing through the second switch position, and being free of off positions intermediate the first and second switch positions and intermediate the second and third switch positions.

3. In combination: a three-way lamp having three-way lamp switching means and a socket receptive of a three-way incandescent bulb; and an adaptor for converting the three-way bulb socket for the receipt of a single-

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filament bulb, while enabling the single-filament bulb to provide two uniquely different levels of illumination during normal operation of the three-way lamp; the switching means comprising a switching member having four switching positions wherein a first of the switching positions comprises an off position, and the other three switching positions comprise different combinations of on positions; the adaptor comprising a male member having three terminals and adapted to mate with the three-way bulb socket; a female member fixed to the male member, and having two terminals receptive of a single-filament bulb and a half-wave rectifier connected between one of the male terminals and one of the female terminals, whereby the adaptor is adapted to pass alternating current from the male portion thereof to the female portion thereof in one path through the adaptor, and to convert alternating current to pulsating direct current by means of current flow in another path between the male member and the female member; the switching means and the adaptor being connectable to provide a switching sequence through the three on positions of the switching means such that the adaptor is always switched to pass alternating current to the female member thereof prior to the passage of direct current to the female member; whereby a single-filament incandescent bulb is always switched to a bright position prior to being switched to a dim position for preserving the rectifier from surge currents attendant the energization of a cold incandescent bulb through the rectifier.

4. An adaptor arrangement for converting a three-way incandescent bulb socket for the receipt of a single-filament bulb, while enabling the single-filament bulb to provide two uniquely different levels of illumination during normal operation of the socket, comprising: a male member; a female member fixed to said male member; and a rectifier electrically connected between said members; said male member having three mutually insulated electrical terminals with said terminals arranged to mate with corresponding terminals in a normal three-way lamp socket during insertion of said male member into said socket; said female member having two mutually insulated terminals arranged to mate with corresponding terminals of a normal single-filament bulb; a first of said male terminals being connected to a first of said female terminals, a second of said male terminals being connected to the second of said female terminals, and said rectifier connected between the third of said male terminals and said second female terminal; said third male terminal being positioned to accommodate the normal switching sequence of a three-way lamp such that passage of current between said third male terminal and said second female terminal is preceded by the passage of current between said second male terminal and said second female terminal, thereby to preserve said rectifier from cold incandescent bulb surge currents.

References Cited in the file of this patent

UNITED STATES PATENTS

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