

[54] **LIGHTING CONTROL SYSTEM FOR INCANDESCENT LAMPS**

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[51] Int. Cl. **H05b 39/02**

[58] Field of Search 307/93, 157, 202, 293; 315/49, 50, 94, 97, 101, 102, 104-107, 119, 127, 194, 199, 208, 309, 311, 360, DIG. 4; 317/40 R, 41, 130, 33 SC; 323/68; 328/3, 8, 11, 259, 270

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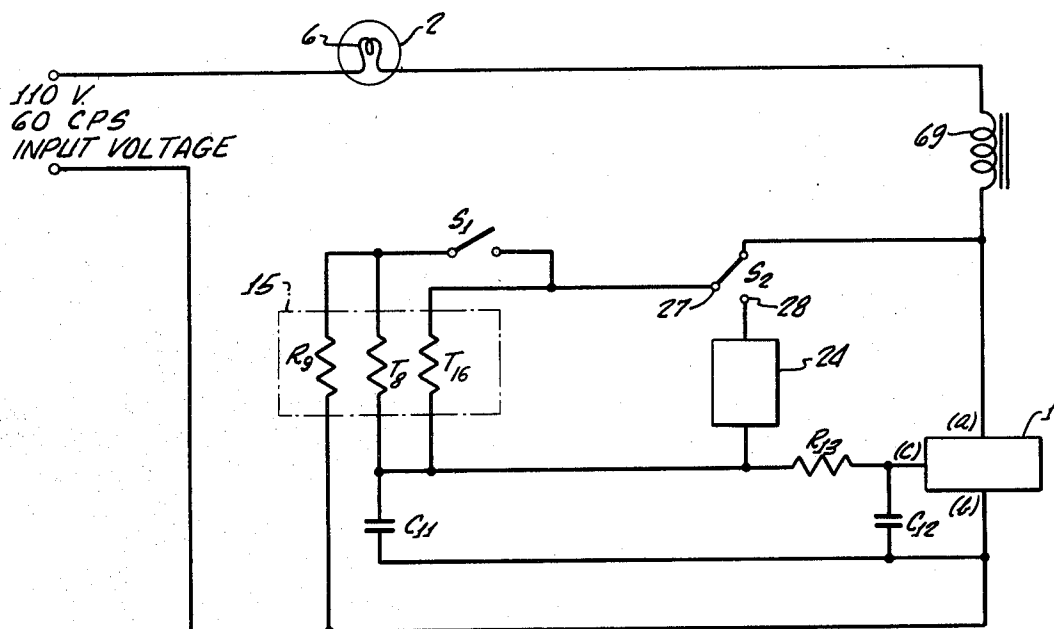
Primary Examiner—R. V. Rolinec

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[57] ABSTRACT

The specification discloses a dual mode light switch arrangement. In one mode the switch operates to progressively increase power when "turned on", and progressively decreases power when "turned off". In the other mode, the switch functions as a proportional light dimmer.

11 Claims, 12 Drawing Figures



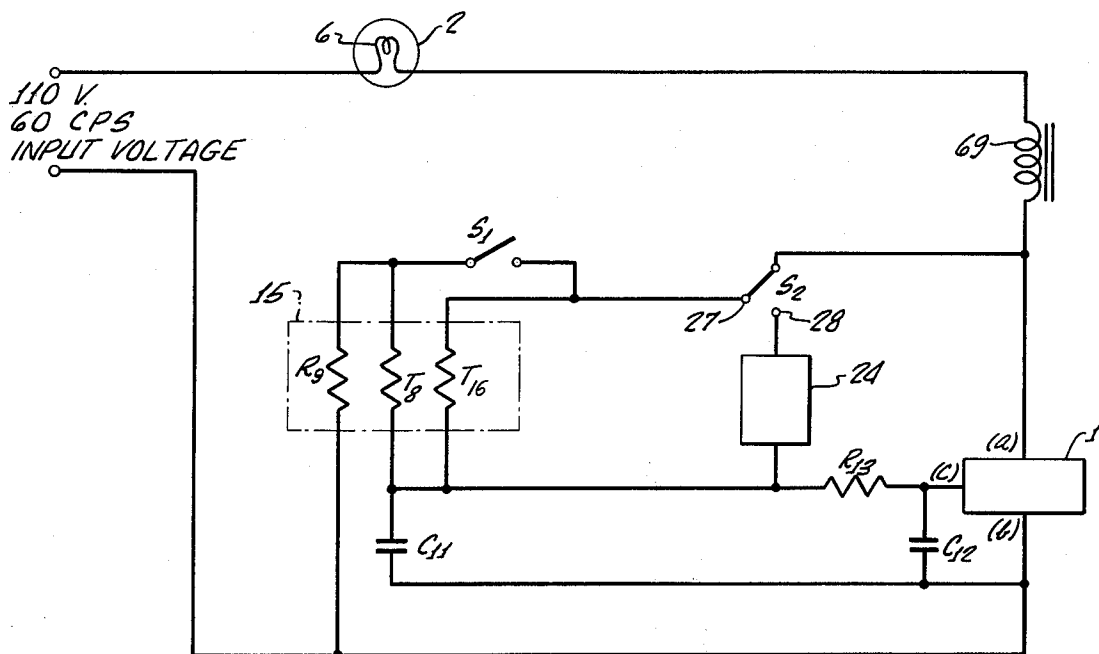
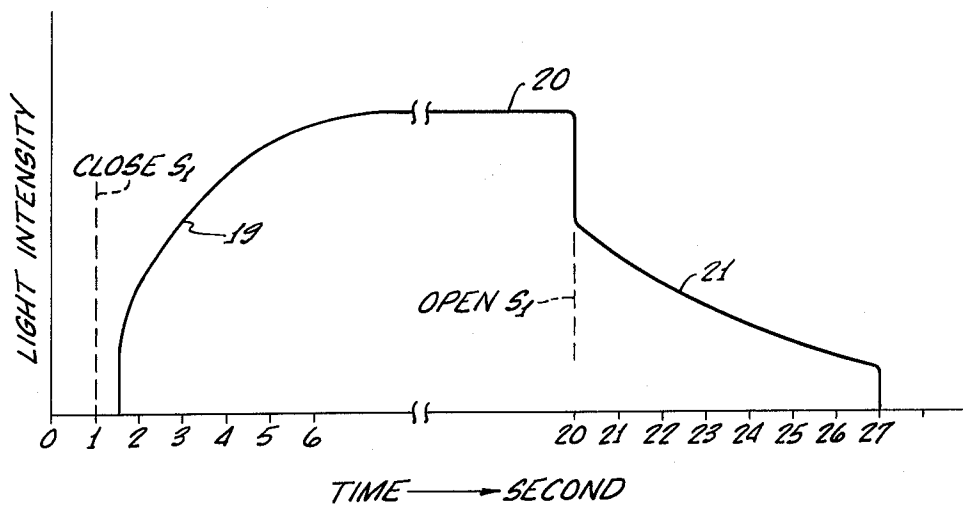


FIG. 1.

FIG. 2.



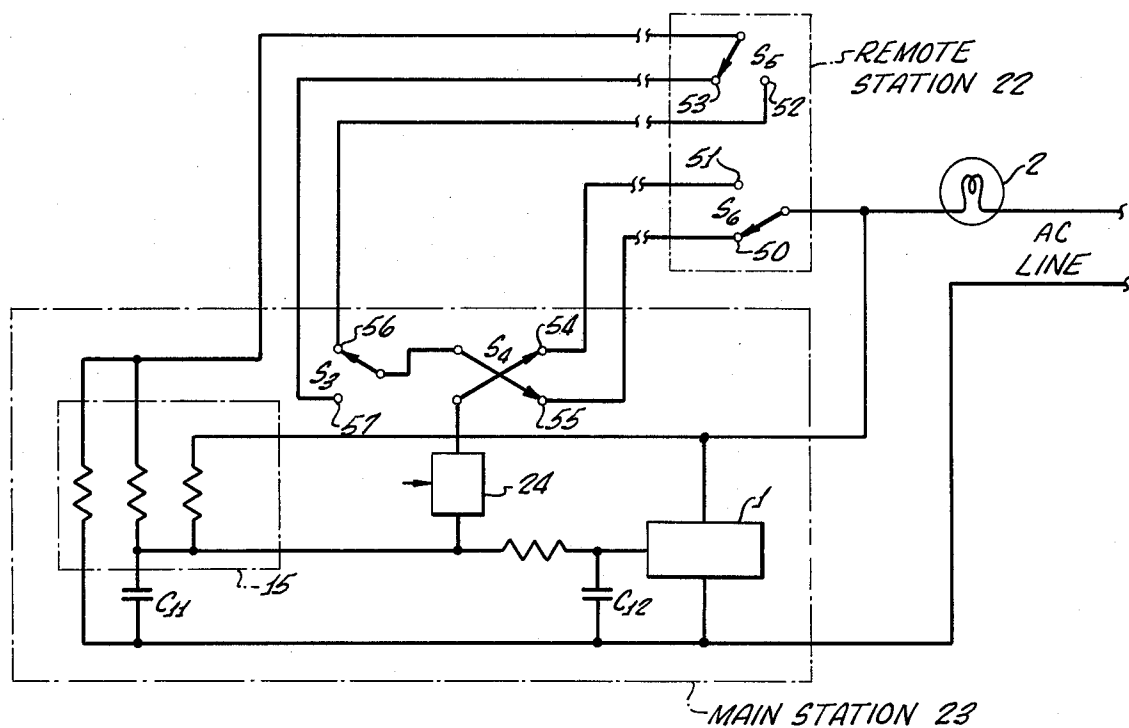


FIG. 3.

FIG. 4.

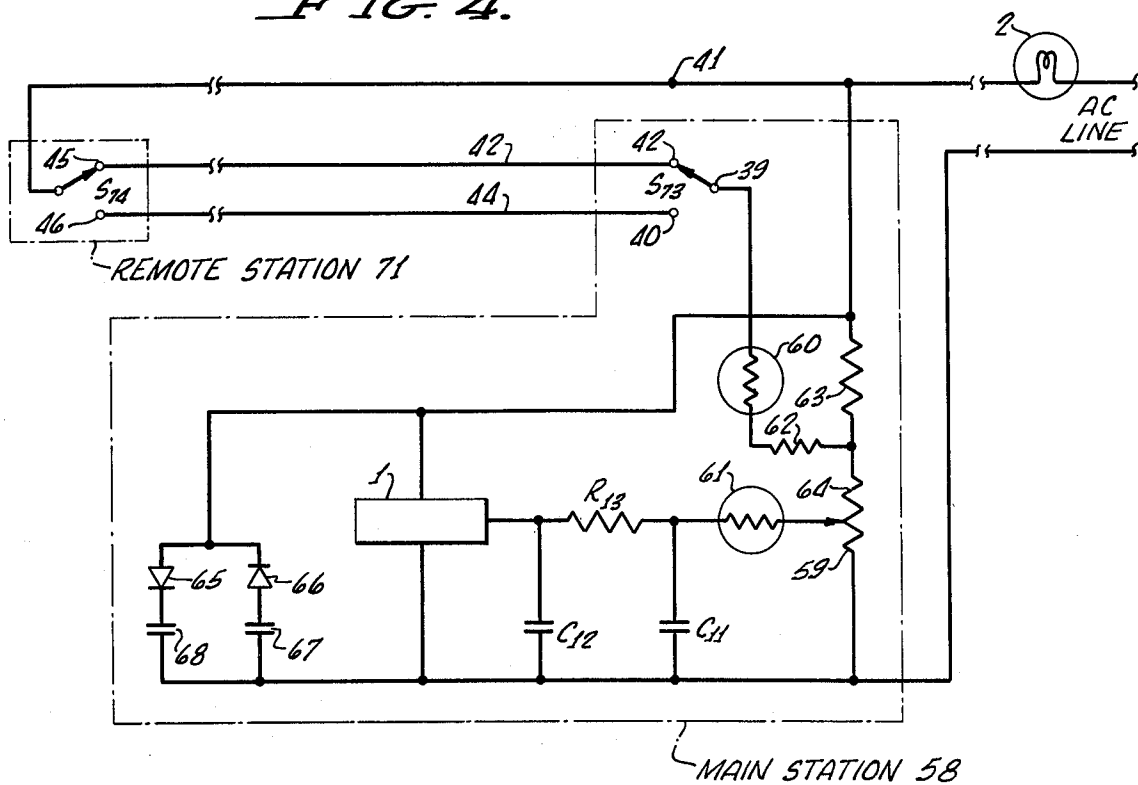


FIG. 5.

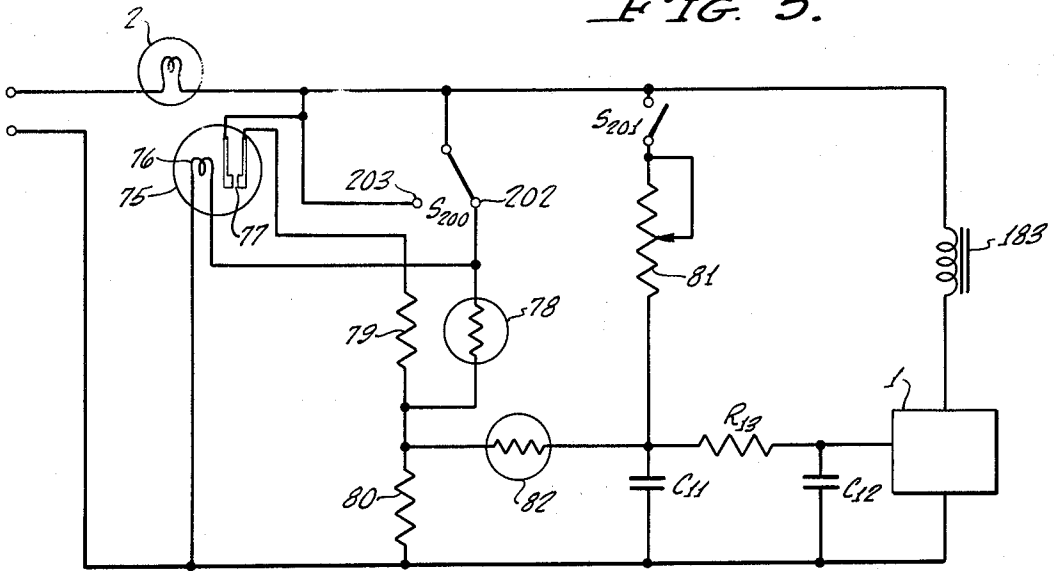


FIG. 6.

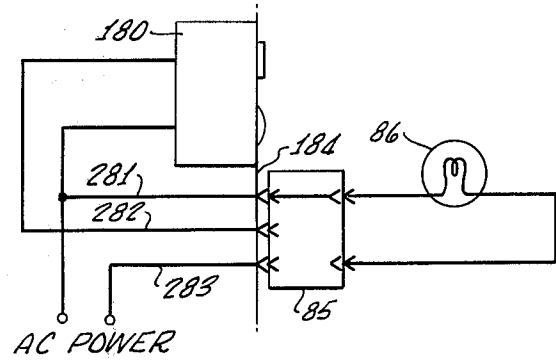
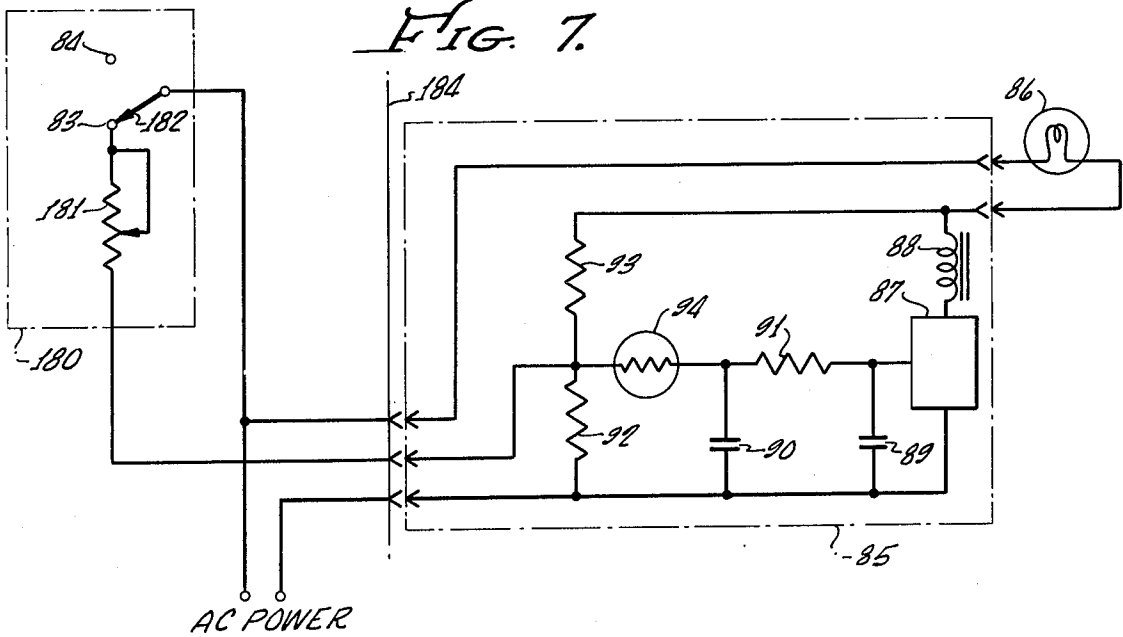


FIG. 7.



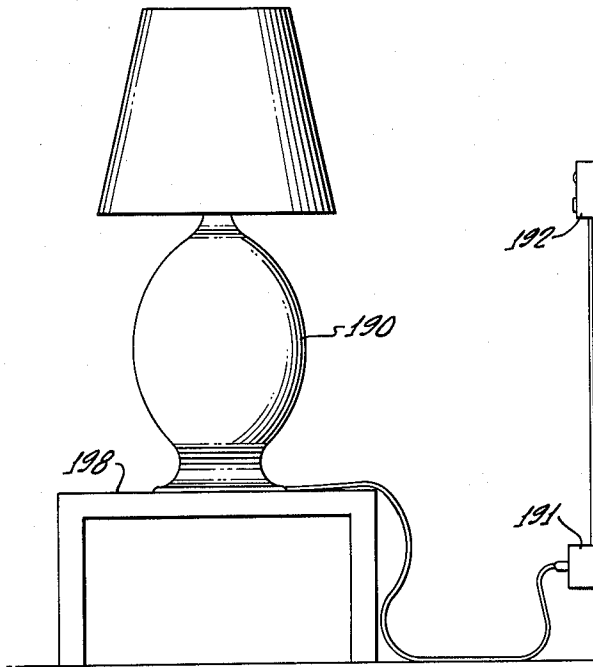


FIG. 11.

FIG. 8.

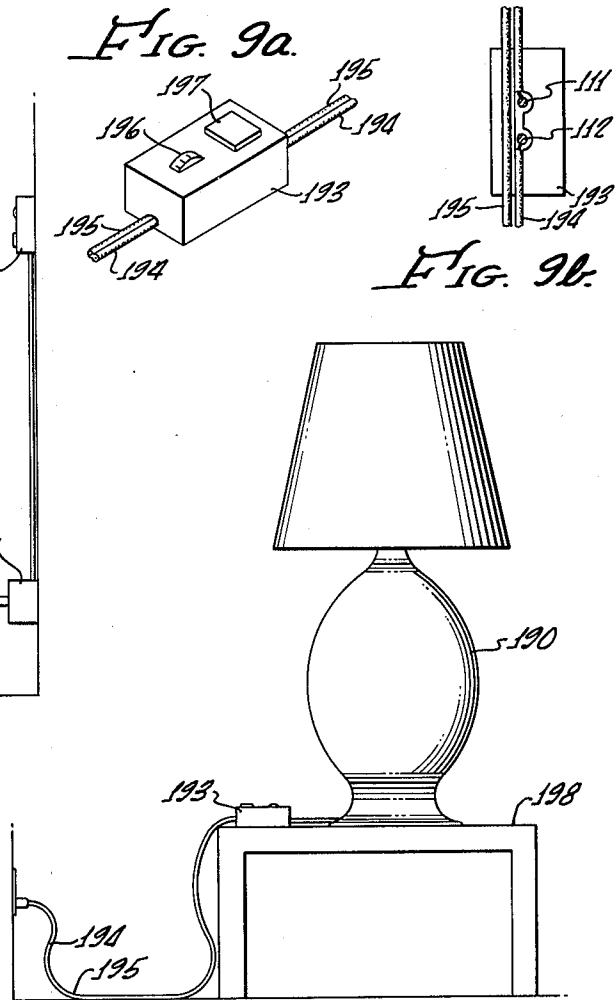
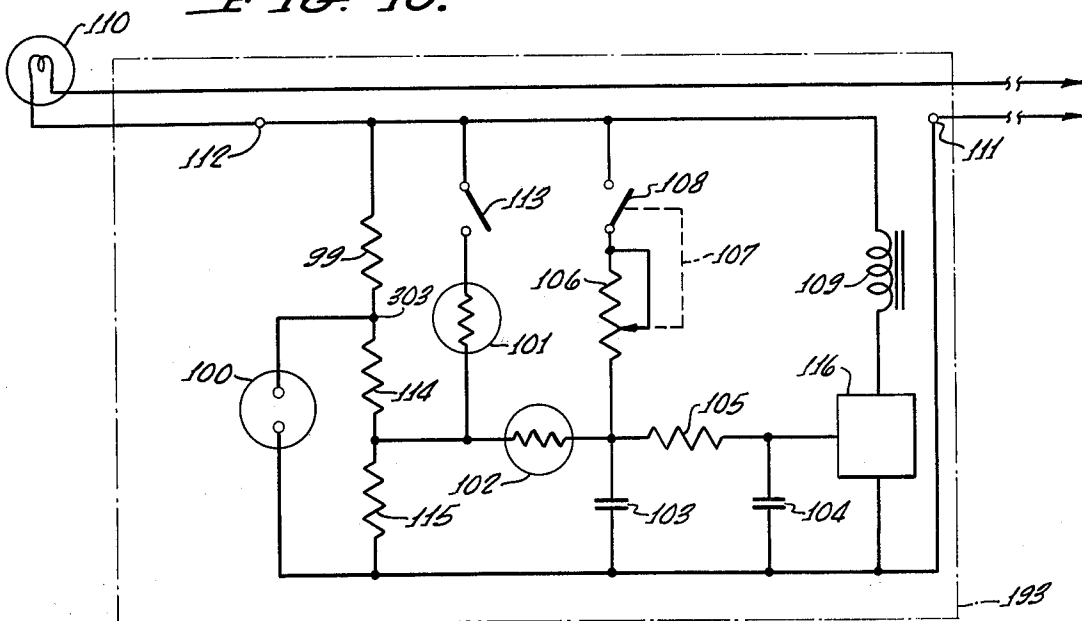


FIG. 10.



LIGHTING CONTROL SYSTEM FOR INCANDESCENT LAMPS

BACKGROUND OF THE INVENTION

Conventional household light switches are binary in character. They are either totally "on" or totally "off". When they are switched to the on state the full line voltage is instantaneously applied to the load. If the load is an incandescent bulb the low resistance of the cold filament can result in a surge current which is eight to twelve times greater than the nominal operating current. Almost all bulb failures occur when the light is turned on. In addition to its pernicious effect upon bulb lifetime, the abrupt change in light intensity can be unpleasant, and may even cause temporary pain and damage to sensitive eyes.

Other inadequacies of the common light switch become obvious when switching from the on position to the off position. Depending upon the location of the switch and the light available from other sources, one may be left in the dark. At the very least, the abrupt decrease in light intensity is psychologically displeasing.

In addition to their binary character, many conventional light switches are noisy, and require a fairly large mechanical "throw" in order to make and break the heavy contacts. Furthermore except for the expensive relay operated touch switch arrangements, the making and breaking of the contacts occur in the main power circuit.

What is actually desired is a household wall switch which will operate in a 1st mode to simulate touch plate control so as to progressively increase the intensity when touched "once" and progressively decrease the intensity when touched a second time. In addition, it is desirable that the switch function in a second mode to dim the light intensity to any desired level.

Accordingly, a primary object of the present invention is to provide a switch which, when switched to the on position will cause the light intensity to increase progressively rather than abruptly.

A further object of the present invention is to provide a switch, which when switched to the off position, will cause the light intensity to decrease progressively, rather than abruptly.

Another object of the present invention is to provide a Household Wall Switch which may be actuated by a light touch.

Another object of the present invention is to provide a Household Wall Switch having a progressive intensity mode and a manually adjustable dimming mode.

Another object of the present invention is to provide a light switch for effecting a psychologically cheerful rate of change in the intensity of a light which is switched on or off.

Another object of the invention is to provide a light switch which will provide power gradually to the bulb.

Another object of the present invention is to provide an arrangement for controlling a light so as to cause the light to gradually change from one state to another when operated from either of two remote locations.

Another object of the present invention is to provide an arrangement for protecting a control element from being destroyed by high voltage spikes which could result if a reactive load were accidentally applied.

Another object of the present invention is to provide an arrangement for dimming a lamp which is plugged into an outlet that is not controlled by a wall switch.

Another object of the invention is to provide a minute light to illuminate the switch panel when the switch is off.

Another object of the present invention is to provide a control unit for a lamp (which is plugged into a standard wall outlet) having a progressive intensity mode and an adjustable dimming mode.

It is another object of the present invention to provide a light control unit having an on-off push button for effecting a progressive intensity change from the off to the on state and vice versa, and a partially exposed thumb wheel for manually adjusting the dimming level.

It is another object of the present invention to provide a switch for an incandescent lamp which will give the illusion of a gaslight when turned on or off.

Other objects and advantages of the present invention will be obvious from the detailed description of a preferred embodiment given herein below.

SUMMARY OF THE INVENTION

The aforementioned objects are realized by the present invention which, in its most generic sense includes an AC power control element such as a semiconductor bidirectional triode thyristor (commonly known as a triac) which is connected in series with the load (herein an incandescent lamp), to vary the point at which current begins to flow during each half cycle of the applied AC power in accordance with a component whose value varies so as to gradually increase the conduction angle after turn-on and gradually decrease the conduction angle after turn-off. Specific embodiments include externally and self heated thermister combinations which, in conjunction with resistive and capacitive networks, function to vary the impedance of the gating circuitry after turn-on and turn-off. The circuitry can be incorporated in a wall or cord switch. Additional components can be included to effect proportional dimming, panel lighting and in the case of a wall switch, "three-way" operation from two different locations.

DESCRIPTION OF THE DRAWINGS:

FIG. 1 shows the circuitry for a progressive intensity turn-on and decreasing intensity turn-off switch employing an externally heated temperature sensitive element.

FIG. 2 is a typical curve showing how the intensity of the light shown in FIG. 1 varies after the switch S_1 is closed and opened.

FIG. 3 shows how the basic circuitry shown in FIG. 1 can be modified to operate the light from two different stations.

FIG. 4 shows a preferred embodiment of the invention employing a self-heating element to effect progressive turn-on and turn-off from two different stations.

FIG. 5 shows a circuit employing a self-heated temperature sensitive element in combination with an externally heated time delay relay.

FIG. 6 shows a block diagram of a wall switch utilizing a progressive intensity circuit which is built into a box having a 3 prong wall connector for plugging into a wall outlet and a 2 jack female connector for an external lamp.

FIG. 7 shows the corresponding circuitry for the block diagram shown in FIG. 6.

FIG. 8 shows a side view of a light control unit adapted to attach to a lamp cord which is plugged into a standard wall outlet.

FIG. 9a shows a perspective view of the control unit.

FIG. 9b shows a view from the underside of the control unit illustrating how the connection is made to the lamp cord.

FIG. 10 shows a preferred embodiment of the circuitry contained in the control unit shown in FIGS. 9a and 9b.

FIG. 11 shows an alternative embodiment of a control unit which plugs into a wall outlet.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT:

FIGS. 1 and 2 illustrate the basic concept and characteristics which underlie the various embodiments of the invention. The heart of the structure lies in a network which will function to vary the triggering time of a bistable device as a function of time. The bistable device 1 has its main terminals (a) and (b) connected in series with an incandescent lamp 2 so as to cause current flow in the lamp 2 from the time following triggering to the time at which the applied AC drops to zero (or nearly zero) during crossing. This bistable device 1 may be two silicon controlled rectifiers, or a bidirectional triode thyristor, commonly known as a triac. For the purpose of describing the theory of operation, the element 1 will be assumed to be an RCA triac, type 40431 or RCA 40432.

The operation of the triac 1 shown in FIG. 1 may be explained as follows. With no voltage applied, the impedance between main terminals (a) and (b) will be large. As the voltage between terminal (a) and (b) is increased, a point is reached, called the breakover voltage, at which the impedance between (a) and (b) drops to a low value. The triac 1 remains in this ON state until the current flow in line 7 drops below a value, called the holding current. The triac 1 then reverts to a high impedance OFF state. When a trigger current of either polarity is applied to the gate terminal (c), the breakover voltage is reduced. After the triac is triggered however, the current flow between main terminals (a) and (b) is independent of the gate signal at (c) and the triac remains in the ON state until the current in line 7 drops below the holding current.

The light output of an incandescent lamp depends upon the voltage applied. The effective voltage which appears across the lamp 2 will depend upon the time at which the triac 1 is triggered to the ON state during each half cycle of the A.C. input. If this trigger time occurs early in the cycle the maximum current (limited only by the lamp filament 6 and the ON impedance of the triac 1) will be proportional to the peak value of applied A.C. voltage. In the condition following initial turn on, the cold resistance of the tungsten filament 6 is much lower than its hot resistance, and the resultant peak current may be in excess of ten times the normal peak operating current for the lamp. Thus, if following initial turn on, the gating circuitry is such as to cause the triac to trigger prior to the time that the peak value of applied voltage occurs, both the lamp 2 and triac will be subjected to excessive stress. If however, the conduction angle is gradually increased following initial turn on, the temperature (and consequently the resistance) of the filament will increase so as to limit the current before the conduction angle reaches 90°.

While the concept of initially limiting current to allow for warmup is not new, most of the prior art schemes utilize a thermistor in series with the lamp, and

hence there is always some dissipation and loss. In the present invention, this function is accomplished in an auxiliary circuit which is extremely efficient. In addition, the present invention provides numerous collateral advantages not possible with a simple variable resistance in series with the load.

The elements required to effect gradual turn-on comprise a temperature sensitive resistance R_8 , and a resistive heating element R_9 , which function together with capacitors C_{11} and C_{12} and resistor R_{13} to provide a small conduction angle at the time S_1 is closed followed by a progressive increase in conduction angle. Typically, R_{13} would be in the neighborhood of 15 K, C_{11} and C_{12} would be 0.1 μ f, and R_8 would be a negative temperature coefficient thermistor having a resistance of approx. 150 K at 25°C. R_9 is preferably a piece of carbon (having a resistance of approx. 10 K) which is encapsulated with T_8 and T_{16} (whose function is discussed below) to provide close thermal conduction; the entire package (indicated by the dotted line 15) preferably having a thermal time constant less than 6 seconds.

When the switch S_1 is initially closed the resistance of T_8 (and T_{16}) are both large so that triac 1 will be off. Since the resistance of filament 6 is many times smaller than the resistance of R_9 , the voltage across R_9 will be nearly equal to the applied input voltage, and will generate approx. 1 watt of heat. The heat generated by R_9 raises the temperature of T_8 and T_{16} causing their resistance to decrease. The capacitor C_{12} is charged through T_8 and R_{13} , the voltage waveform across C_{12} being shifted by approximately 90° with respect to the applied AC. When the resistance of R_9 reaches the point where the voltage across C_{12} is sufficient to cause breakover, the triac will fire. The capacitor C_{12} then discharges through the triac during the remaining portion of the half cycle. C_{11} functions to maintain a charge on C_{12} to prevent the triac from firing earlier during the next half cycle in order to avoid excessive current while the filament 6 is still cold. The resultant intensity profile following turn on is indicated by numeral 19 in FIG. 2.

After switch S_1 has been closed, the light intensity progressively increases until a steady state condition is reached. This point is the maximum intensity indicated by the numeral 20 in FIG. 2. Almost all of applied voltage will appear across lamp 2 so that there is very little heat generated by R_9 . R_9 should thus be chosen to generate sufficient heat to maintain the resistance of T_8 such that the lamp 2 will, at steady state, produce its rated output under the lowest ambient temperature conditions likely to be encountered. This of course, will depend upon the thermal characteristics of 15.

Another important aspect of the invention is its characteristics following turn off. This is accomplished by thermistor T_{16} , which is encapsulated in the same package as resistor R_9 and thermistor T_8 . This thermistor should have a nominal resistance of approx. 300–400 K at room temperature. Following turn on its resistance will decrease to a value which will continue to cause conduction of triac 1 after switch S_1 is opened. This resistance, however, should not be so low as to cause the intensity of lamp 2 to remain unchanged when S_1 is opened — but should, rather, cause an abrupt decrease to a lower level (so as to indicate to the operator that the switch has actually performed) followed by a gradual diminution as indicated by the curve 21 shown in

FIG. 2. The rate at which the light intensity decreases will again depend upon the thermal time constant of 15 and the surrounding environment.

Another aspect of the invention lies in the very small amount of additional circuitry which is required to effect continuous dimming. While the actual circuitry for accomplishing this function is well known, its use with the progressive intensity circuitry results in highly complementary combination. In FIG. 1, the block 24 represents the additional elements required for continuous dimming. These usually comprise a resistor-potentiometer combination. When it is desired to operate the unit as a dimmer, it is only necessary to switch S_2 from contact 27 to contact 28, and manually adjust some variable element which is included within the block 24 to achieve the desired light intensity. The triac is then totally under the control of element 24, irrespective of the thermal condition of 15.

In the embodiment shown in FIG. 1, it is desirable to use a switch such as S_2 to separate the progressive intensity switch mode from the continuous dimming mode because of the dependence of temperature upon the effective voltage between (a) and (b). In other embodiments to be described below, the progressive intensity mode and the continuous dimming mode operate in conjunction to provide results not obtainable from either circuit alone.

FIG. 3 shows a system for operating the lamp 2 from two different locations. This arrangement is particularly useful when the circuitry for the progressive switch and continuous dimmer are mounted in a household wall switch, herein designated as the main station 23, and it is desirable to be able to control the light from station 23 at one end of a room or station 22 at the other end of the room. The lamp 2 may be located at a distance which is remote from both 22 and 23. Except for substitution of switches S_3 for S_1 , and S_4 for S_2 , the circuitry in the main station 23 is the same as that shown in FIG. 1. The system operates as follows: If the switches S_3 - S_6 are initially in the position shown, the lamp 2 will be off. If the operator is at station 22, switching S_6 so as to contact terminal 51 causes the lamp 2 to turn on to the level of intensity determined by network 24. If, instead, switch S_6 is on terminal 50 and the operator switches S_5 to 52, the lamp 2 will turn on progressively as a consequence of network 15. If S_5 is switched to 53 and S_6 is switched to 51, the lamp 2 will revert to the control of network 24. Finally, the operator can turn off the lamp by switching S_6 to 50 and S_5 to 53. The operator is thus able to switch to a pre-established light intensity or effect progressive on-off from a remote location. The same thing can be accomplished at the main station 23 via S_3 and the double pole-double throw switch S_4 . At this station the operator can also adjust the intensity since he will have access to the control 24.

FIG. 4 shows a three-way circuit for operating an alternative embodiment utilizing the self-heating effect of the thermistors. When either S_{73} or S_{74} is changed to bring the switches to the state shown, thermistors 60 and 61 will be heated as a consequence of the applied AC causing the resistance of both thermistors to decrease. As the resistance decreases, the conduction angle of triac 1 increases, causing an increase in the intensity of lamp 2. As the effective voltage drop across lamp 2 increases, the effective voltage available to heat thermistors 60 and 61 decreases until an equilibrium

thermal condition is achieved. The values of the thermistors and resistors 62, 63 and 64 should be chosen such that this equilibrium condition will occur at or near the rated intensity of lamp 2 when the circuit is operating at the lowest ambient temperature likely to be encountered. Typical values would be as follows:

Thermistor 60	100K at 25°C
Thermistor 61	300K at 25°C
Resistor 63	70K
Resistor 62	10K
Potentiometer 64	40K

The maximum intensity of lamp 2, as well as its rate of intensity variation will depend upon these values. Changing the setting of potentiometer 64 will function therefore, not only to dim the lamp, but in addition, will allow the user to vary the length of time which is required to reach the maximum intensity or extinction. The lamp may be switched to the off condition at the main station 58 by switching S_{73} to terminal 40, or at the remote station 71 by switching S_{74} to 46. In either case the lamp will show an abrupt decrease in intensity from its preestablished level as determined by the setting of potentiometer 64 followed by a progressive decrease in brightness until final extinguishment. This turn-off characteristic results from the fact that the value of resistor 63 is greater than the hot resistance of thermistor 60, causing an initial drop in intensity (which is desirable as previously explained) upon switching S_{74} or S_{73} followed by a progressive decrease as thermistor 61 cools because of the increased voltage drop across resistor 63. As the value of thermistor 61 increases, more of the current will flow through the bottom leg 59 of potentiometer 64, causing the thermistor 61 to cool even further. It is this change in the current division between leg 59 and thermistor 61 which allows the thermistor 61 to cool to the point where the total impedance in the gating circuit of the triac is such as to effect total turn-off of lamp 2 subsequent to the time at which the mechanical contacts (S_{73} or S_{74}) were opened.

The circuit in FIG. 4 has several advantages over the system shown in FIG. 1. There is no requirement that the thermistors be externally heated. Thermal design is virtually eliminated by the use of "off the shelf" bead thermistors such as the Gulton 51 CA and 53 CA types which have thermal time constants of approx. 2 seconds. Moreover, the incorporation of the progressive modes with the dimming mode allows for a gradual rise and fall to and from pre-established intensities determined by the setting of potentiometer 64. In addition, the circuit includes a network comprised of diodes 65 and 66 which function together with capacitors 67 and 68 to provide a clamp which protects triac 1 against high voltage spikes which are likely to occur if the circuit is operated with an inductive load. There is generally no need for a choke (such as 69 shown in FIG. 1) to limit maximum current when the circuit is switched "Full On" by S_2 because in FIG. 4, the power is always applied gradually to the load, the load (lamp 2) being necessary in order to heat the thermistors. The arrangement shown in FIG. 4 also simplifies the problem of remote operation. When remote operation is not required, lines 43 and 44 as well as S_{74} may be eliminated and the point 41 may be directly connected to terminal 42. In some cases it will be desirable to substitute a fixed resistance for thermistor 60, particularly where a

more rapid turn on is desirable. In such a case, thermistor 61 functions to provide both gradual turn on and gradual turn off.

FIG. 5 shows a circuit which combines aspects of the circuits shown in FIGS. 1 and 4. In FIG. 5, the thermistors 78 and 82 are self heated, whereas bimetal switch 77 is heated by coil 76. When switch S_{201} is off (as shown) the circuit operates under the control of S_{200} causing the lamp 2 to gradually turn-on when 202 makes contact, and gradually decrease in brightness when switched to 203. The thermal time constant of the heater 76 and bimetal switch 77, together with enclosure 75 is assumed to be larger than the time constant of thermistors 78 and 82. As a practical matter, the contacts 77 should close approximately 10 seconds after S_{200} is switched to contact terminal 202 and open approximately 10 seconds after S_{200} is switched to contact 203. When the switch S_{200} is in contact with 203, the circuit may be operated as a dimmer by closing S_{201} . Potentiometer 81 can then be adjusted to produce the desired light intensity.

While the circuit shown in FIG. 5 requires additional elements, it does provide a completely open circuit after the contacts 77 have opened. In some cases it may be desirable to combine the progressive mode with the dimming mode as is done in FIG. 4, while at the same time include a provision for a delayed contact opening as per the circuit of FIG. 5. It may also be desirable to chose a resistor-thermistor combination (resistors 79, 80 and thermistors 78 and 82) such that the lamp 2 will immediately light upon closure of S_{200} (to terminal 202) and then progressively increase in brightness. These and other variations produced by a combination of what is taught in FIGS. 1, 4 and 5 will be within the skill of those having ordinary skill in the design of electronic circuitry.

FIGS. 6 and 7 illustrate an application of the teachings of the invention to a system employing a wall switch control 180 and "plug-in unit" 85 which houses the functional elements required to dim lamp 86. An important advantage of this arrangement lies in the fact that, upon unplugging unit 85 from the standard outlet on wall 84, any other device (such as a vacuum cleaner, etc.) may be "plugged-in" to directly pick up the AC power on lines 281 and 283. In other words, the female receptacle of the wall outlet functions in the conventional manner, and not under the control of switch 182 or potentiometer 181. When the switch 182 in wall control 180 contacts terminal 83 lamp 86 will gradually increase in brightness to a level determined by the setting of potentiometer 181. When switch 182 is changed to contact terminal 84, the lamp 86 will decrease in brightness at a rate primarily determined by the resistance 93. The elements 93, 92, 94, 90, 91, 89, 87 and 88 function identically to the corresponding elements 79, 80, 82, C_{11} , R_{13} , C_{12} , 1 and 83 shown in FIG. 5; although for optimum characteristics, the values are not necessarily the same. It is contemplated that the physical appearance of the wall unit 180 would be similar to that shown in FIG. 9a (described below), but recessed so that its front surface is nearly flush with the wall 184.

Referring now to FIGS. 8-10, a preferred embodiment of the invention for use in conjunction with pre-existing electrical wiring, comprises a control unit 193 which can be connected in series with the line cord of any incandescent lamp (such as table lamp 190) as shown in FIG. 9b. The connection to the line cord is

made on the underside of control unit 193 by first cutting either line 195 or 194 and stripping back the insulation. The stripped ends of the wire (in this case wire 194) can then be attached to screw terminals 111 and 112 in the same manner as is commonly used to replace an electrical plug on an appliance. FIG. 8, shows the lamp 190 and control unit 193 resting in close proximity on table 198.

FIG. 9a shows what is considered to be a preferred embodiment of the mechanical structure of control unit 193. Push button 197 is a mechanical latching switch which closes switch 113 when depressed once, and opens switch 113 upon being depressed a second time. Thumb wheel 196 operates potentiometer 106 and switch 108 which are interconnected as indicated by 107. The switch 108 will be "open" only when the wheel 196 is positioned such that potentiometer 106 is at maximum resistance.

In operation, the circuit shown in FIG. 10 is similar to the circuits previously described. Elements 102, 103, 105, 104, 116, 109, 101 and 115 function in a similar manner to the elements 82, C_{11} , R_{13} , C_{12} , 1, 183, 78 and 80 respectively. Resistors 99 and 114 provide a junction 303 for connection of a miniature neon 100. The function of this device 100 is two-fold. When the bulb 110 is off (switches 113 and 108 open) the voltage between terminals 11 and 112 will be almost equal the applied line voltage. The values of resistors 99 and 114 are chosen so as to provide a sufficient voltage to ionize neon 100, and at the same time limit its current to value which is commensurate with that of a conventional neon nightlight. It is contemplated that the cover of control unit 193 will be made of a lucent plastic material, so that the unit 193 will be illuminated in the dark (when the bulb 110 in lamp 190 is off). An alternative arrangement is to use a clear plastic button 197 and position the neon 100 behind it. In either case, the neon 100 will estinguish when light 110 begins to turn on (as a consequence of the voltage drop between 111 and 112). The second function of neon 100 is to provide a voltage clamp at point 303. This improves the reliability of the gradual turn-off mode by eliminating the effect of the feedback (after neon 100 ionizes), which results from the increasing voltage across the terminals 111 and 112. The neon 100 can also be incorporated in the circuits shown in FIGS. 4, 5 and 7 to effect the same results.

FIG. 11 shows an alternative embodiment of the system which could be used with pre-existing wiring. In this arrangement, the control unit 192 has essentially the same appearance as control unit 193, but it contains only the elements 113, 108, and 106 which are operated by 197 and 196 respectively. The remainder of circuitry is contained in unit 191 which plugs into the wall outlet. It is contemplated that the unit 192 would be attached to the wall using two sided masking tape or the equivalent.

The basic concepts of the invention are not limited to the particular circuits shown. In many cases it will be advantages to modify the various combinations to achieve cost savings. For example, in the circuits shown in FIGS. 4, 5 and 10, the thermistors 60, 78 and 101 could be replaced by an appropriately chosen resistor without producing a material degradation in turn on characteristics. Nor are the applications of the invention limited to those shown. Thus, although preferred embodiments have been shown and described, it will be

understood that numerous changes, modifications, and substitutions may be made without departing from the spirit of the invention.

I claim:

1. An apparatus for operating an electric light comprising:

a bistable device having at least one gate terminal and a pair of main terminals connected in series with the electric light and a source of alternating current power;

means operatively connected to said source of AC power and said gate terminal for generating an electrical signal so as to cause the impedance between the main terminals of said bistable device to change from a high non-conducting state to a low conducting state during a portion of the alternating current cycle;

a switch having an ON position and an OFF position; automatic means for producing a progressive increase in the phase time of each succeeding AC cycle at which the bistable device changes from a high impedance non-conducting state to a low impedance conducting state, following a change to the ON state of said switch, said automatic phase increase means comprising:

a network including a capacitor and a temperature sensitive resistive element;

means for heating said temperature sensitive resistive element when the state of said switch is changed so as to cause said element to alter its resistance, and wherein said temperature sensitive resistive element and said means for heating said temperature sensitive resistive element comprises a self-heated thermistor; and further including:

automatic means for producing a progressive decrease in the phase time of each succeeding cycle at which the bistable device changes from a high impedance non-conducting state to a low impedance conducting state following a change in the state of said switch to the OFF state.

2. The apparatus recited in claim 1 wherein said means for producing a progressive phase decrease comprises:

a network including a capacitor and a temperature sensitive resistive element;

means for heating said temperature sensitive resistive element during the time that said switch is in the ON state;

means for decreasing the heat supplied by said heating means when said switch is changed to the OFF state.

3. An apparatus for operating an electric light comprising:

a bistable device having at least one gate terminal and a pair of main terminals connected in series with the electric light and a source of alternating current power;

means operatively connected to said source of AC power and said gate terminal for generating an electrical signal so as to cause the impedance between the main terminals of said bistable device to change from a high non-conducting state to a low conducting state during a portion of the alternating current cycle;

a switch having an ON position and an OFF position; automatic means for producing a progressive decrease in the phase time of each succeeding AC

cycle at which the bistable device changes from a high impedance nonconductive state to a low impedance conducting state following a change to the OFF state of said switch, said automatic phase decreasing means comprising:

a network including a capacitor and a temperature sensitive resistive element;

means for heating said temperature sensitive resistive element during the time that said switch is in the ON state;

means for decreasing the heat supplied by said heating means when said switch is changed to said OFF state.

4. The apparatus recited in claim 3 wherein said temperature sensitive resistive element and said means for heating said temperature sensitive resistive element comprise a self-heated thermistor.

5. The apparatus recited in claim 4 including:

automatic means for producing a progressive increase in the phase time of each succeeding AC cycle at which the bistable device changes from a high impedance non-conducting state to a low impedance conducting state following a change to the ON state of said switch.

6. The apparatus recited in claim 5 including means for manually adjusting the steady state conduction angle of said bistable device.

7. An apparatus for operating a household incandescent light comprising:

a variable impedance device having at least one control terminal and a pair of main terminals;

means for connecting said main terminals in series with an electric light; and means for connecting a source of alternating current power to the series circuit comprised of said variable impedance device and light and;

a manually operable switch having at least one ON position and one OFF position;

means for supplying a control voltage to said control terminal so as to vary the impedance between the main terminals of said variable impedance device, said means including:

a control network operatively connected to said switch and said control terminal, said network comprising at least one temperature sensitive resistive element whereby the impedance between the main terminals of said variable impedance device will be dependent upon the state of said switch and the temperature of at least one temperature sensitive resistive element included in said network;

means for causing a temperature change of a control network temperature sensitive resistive element following a change in the state of said switch so as to produce a continuous variation in light intensity for an observable period;

and further including a manually adjustable impedance means operably connected to said control terminal of said variable impedance element for adjusting the steady state intensity of the light.

8. The apparatus recited in claim 7 wherein said means for causing a temperature change of a control network temperature sensitive resistive element comprises:

a self heated thermistor and;

means for connecting said thermistor to said switch and said control network so as to cause said thermistor to change its resistance when said switch is

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changed to an ON position so as to produce a gradual increase in light intensity.

9. The apparatus recited in claim 7 wherein said means for causing a temperature change of a control network temperature sensitive resistive element comprises:

- a self heated thermistor and;
- means for connecting said thermistor to a source of power, said switch, and said control terminal so as to cause said thermistor to change its resistance when said switch is changed to the OFF position so as to produce a gradual decrease in light intensity.

10. An apparatus for operating an incandescent lamp comprising:

- a variable impedance device having at least one control terminal and first and second main terminals;
- means for connecting the 1st main terminal of said variable impedance device to one side of a household AC main's supply;
- means for connecting the second main terminal of

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said variable impedance device to one terminal of an incandescent lamp which has the opposite terminal connected to the other side of the AC main's supply;

- a 1st switch having at least two positions;
- a network operatively connected to said control terminal and said 1st switch, said network including means for applying a signal to said control terminal to vary the impedance of said variable impedance device so as to produce a continuous decrease in the light intensity of said lamp for a period of at least two seconds following a change in the state of said switch to one position.

11. The apparatus recited in claim 10 including a second switch having at least two positions, said second switch to be located at a position which is remote from said 1st switch and including:

- means for interconnecting said first and second switches to operate the lamp from either switch.

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