April 13, 1954 K. D. McMAHAN 2,675,452

BALLAST DEVICE FOR INCANDESCENT LAMPS

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FIG. 1.

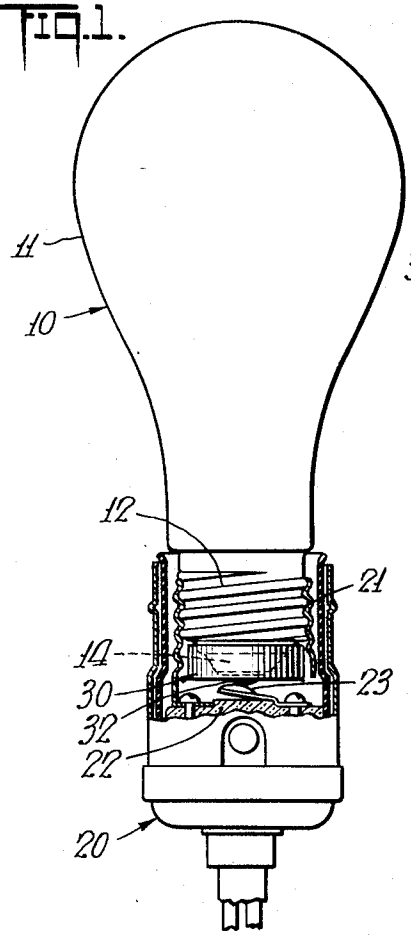


FIG. 3.

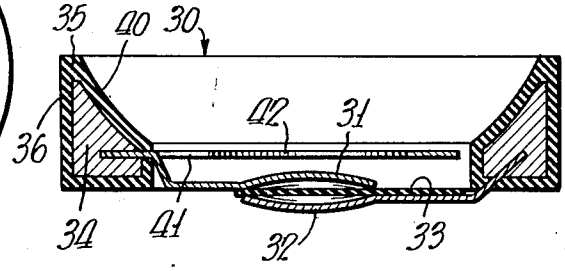


FIG. 4.

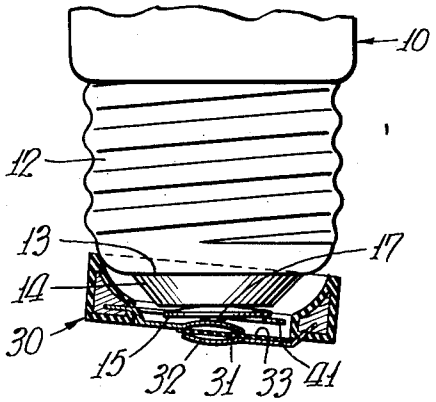


FIG. 2.

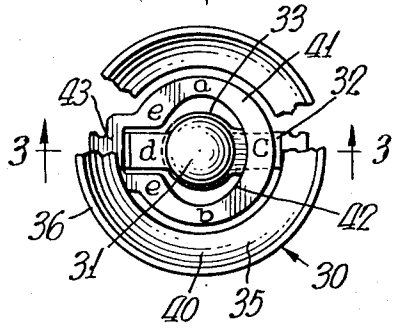
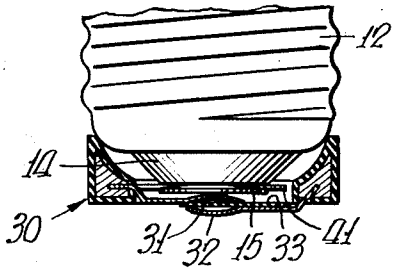


FIG. 5.



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BALLAST DEVICE FOR INCANDESCENT LAMPS

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Fig. 6.

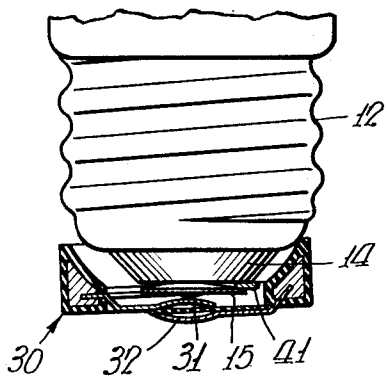


Fig. 7.

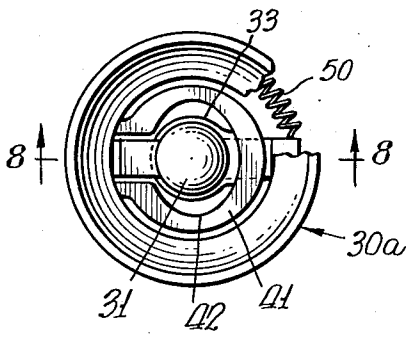


Fig. 8.

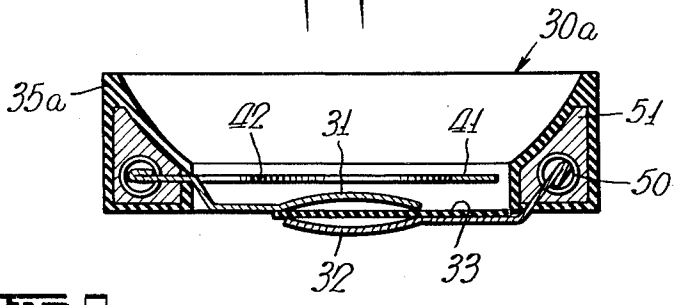


Fig. 9.

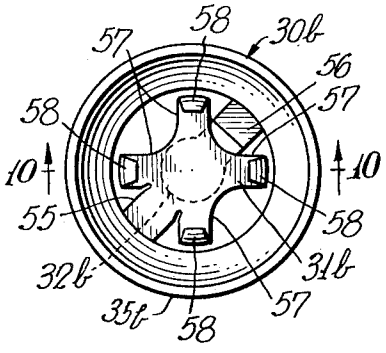
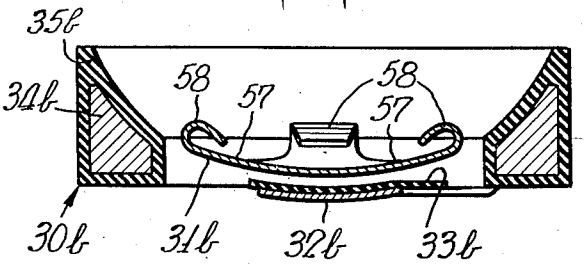


Fig. 10.



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FIG. 11.

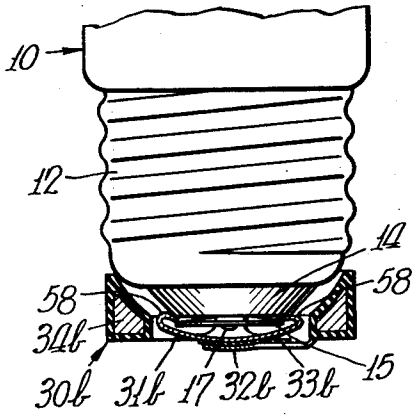


FIG. 12.

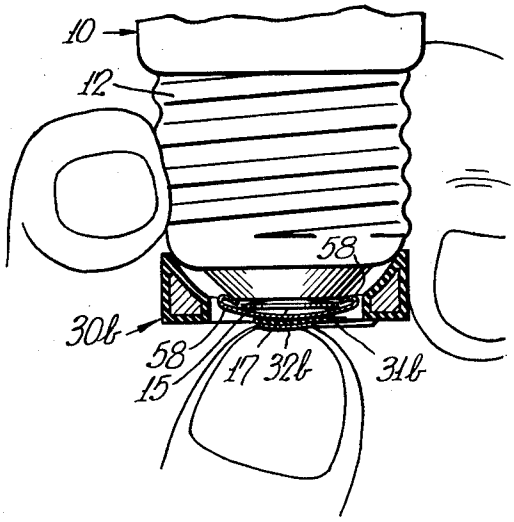


FIG. 13.

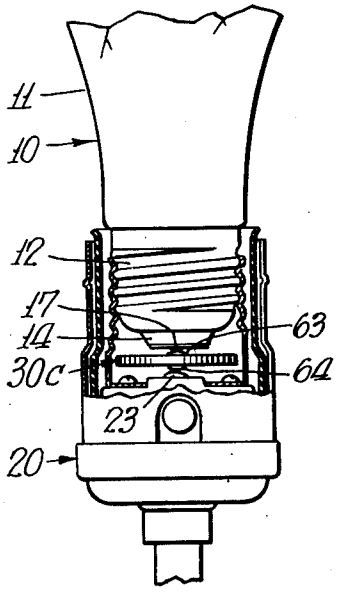


FIG. 14.

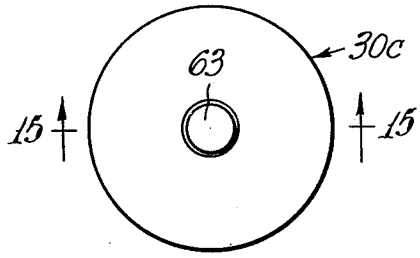
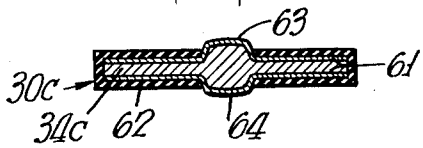


FIG. 15.



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BALLAST DEVICE FOR INCANDESCENT LAMPS

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FIG. 16.

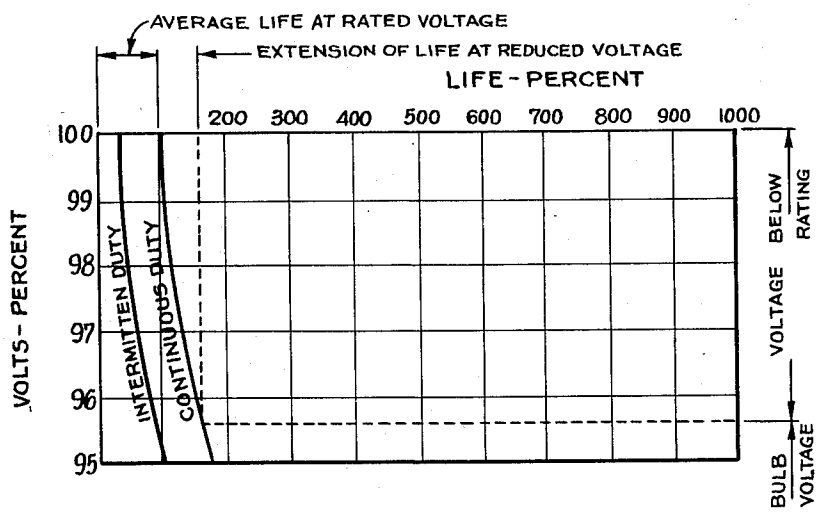
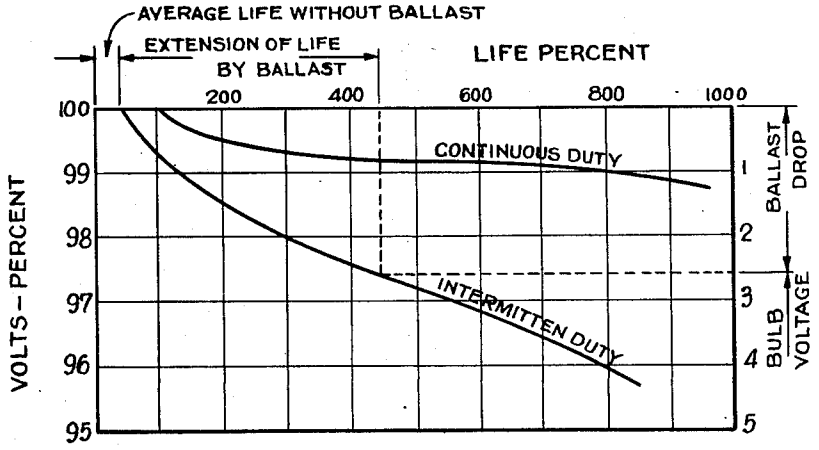


FIG. 17.



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UNITED STATES PATENT OFFICE

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BALLAST DEVICE FOR INCANDESCENT LAMPS

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Application December 20, 1951, Serial No. 262,540

13 Claims. (Cl. 201—49)

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The present invention relates to ballast devices for increasing the useful life of incandescent lamps and for increasing at the same time their light output efficiency (lumens per watt).

Some of the objects of the present invention are to provide an ohmic ballast device for an incandescent lamp, which can be conveniently placed in a conventional lamp socket between a conventional lamp base and the base finger contact in said socket, which is comparatively inexpensive to manufacture and easy to apply in operative position, which imparts to a conventional incandescent lamp to which it is applied increased useful life combined with increased light output efficiency when subjected to either intermittent or continuous duty and which has the darkening on the inside of its glass bulb due to vaporization of its filament delayed, thus improving its useful life cycle.

Another object of the present invention is to provide an ohmic ballast device which has the desirable characteristic described and which at the same time can be conveniently attached to the base of a conventional incandescent lamp to form a unit therewith adapted to be screwed as such into a conventional lamp socket or unscrewed therefrom, and which can be easily removed from the lamp base for reuse.

In accordance with the present invention, the ohmic ballast device is in the general form of a ring or in the form of a disc adapted to be located in use in a conventional lamp socket between the finger contact at the base thereof and the end contact of a conventional lamp screwed in said socket. The ballast device has an ohmic resistance which in use would be in series with the lamp filament and which would serve to reduce initial surges of current of destructive intensity through the filament when the lamp is first turned on. It has been found in accordance with the present invention that an ohmic resistance in series with the filament acts not only to prolong the lift of a bulb when subjected to frequent on and off cycles but also prolongs the life of a bulb when subjected to continuous duty. Therefore, the ohmic ballast device is designed to offer electrical resistance in series with the filament during the stage when the current is first turned on to serve as a ballast against high current surges at this stage and is also designed to offer resistance in series with the filament after the current has become stabilized during continuous duty.

Various other objects, features and advantages of the present invention are apparent from the following particular description and from an inspection of the following drawings, in which:

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Fig. 1 shows on an enlarged scale a conventional lamp screwed into a conventional lamp socket and shows an ohmic ballast device in the general form of an attachable ring in said socket constituting one embodiment of the present invention, the lamp being shown in side elevation, the lamp socket partly in side elevation and partly in vertical section and the ballast device in side elevation;

Fig. 2 shows the ohmic ballast device of Fig. 1 but on a larger scale, in top plan view with parts broken away;

Fig. 3 is a radial section of the ohmic ballast device taken on lines 3—3 of Fig. 2 but on a larger scale;

Figs. 4 and 5 illustrate on enlarged scale, successive steps in attaching the ohmic ballast device of Figs. 1–3 to the lamp base, the lamp base being shown in side elevation and the ballast device being shown in radial section;

Fig. 6 illustrates on enlarged scale a step in removing the ohmic ballast device of Figs. 1–3 from the lamp base, the lamp base being shown in side elevation and the ballast device being shown in radial section;

Fig. 7 shows on enlarged scale a top plan view with parts broken away of an ohmic ballast ring device constituting a second embodiment of the present invention;

Fig. 8 is a radial section of the ohmic ballast device taken on lines 8—8 of Fig. 7 but on a larger scale;

Fig. 9 shows on enlarged scale a top plan view of an ohmic ballast ring device constituting a third embodiment of the present invention;

Fig. 10 is a radial section of the ohmic ballast device taken on lines 10—10 of Fig. 9 but on a larger scale;

Fig. 11 illustrates on enlarged scale a step in attaching the ohmic ballast device of Figs. 9 and 10 to the lamp base, the lamp base being shown in side elevation and the ballast device being shown in radial section;

Fig. 12 illustrates on enlarged scale a step in removing the ohmic ballast device of Figs. 9 and 10 from the lamp base, the lamp base being shown in side elevation and the ballast device being shown in radial section;

Fig. 13 shows a conventional lamp base screwed into a conventional lamp socket and an ohmic ballast device in said socket in the form of a disc constituting the fourth embodiment of the invention, the lamp base and ballast disc being shown in side elevation and the lamp socket being shown partly in side elevation and partly in radial section;

Fig. 14 shows on an enlarged scale a top plan view of the ohmic ballast device of Fig. 13;

Fig. 15 is a radial section of the ohmic ballast device taken along lines 15—15 of Fig. 14;

Fig. 16 shows test curves of Life vs. Volts for conventional lamps without ohmic resistance ballast operating at reduced voltage under continuous and intermittent duty; and

Fig. 17 shows test curves of Life vs. Volts for conventional lamps but with ohmic resistance ballast operating under continuous and intermittent duty.

Referring to Figs. 1–6 of the drawings, the ohmic resistance ballast device of the present invention is shown applied to a standard incandescent lamp 10 comprising a glass envelope or bulb 11 containing therein a filament (not shown) and having a metal screw cap 12 serving as one terminal of the lamp. Projecting through an axial hole 13 of the screw cap 12 is an insulating generally frusto-conical base 14 carrying at its outer smaller end a round metal contact disc 15 held in position by a metal central rivet 17 having a contact head serving as the other terminal of the lamp. The lead-in base wires (not shown) of the lamp are connected to lead connections (not shown) respectively, which in turn are connected to the ends of the filament respectively. These lead-in wires are connected to the screw cap 12 and to the end contact 17 respectively of the lamp 10.

The lamp 10 is shown in Fig. 1 screwed into a conventional lamp socket 20 comprising a metal female screw 21 for receiving the lamp screw cap 12 and a base 22 carrying a finger contact 23 for engaging the end contact 17 of the lamp. The screw 21 and the base contact 23 serve as terminals for the lamp socket 20.

Disposed in the lamp socket 20 and located between the end contact 17 of the lamp 10 and the base contact 23 of said socket to form an electrical series connection therebetween is an ohmic ballast device 30 (Figs. 1–6) of the present invention. This ballast device 30 comprises two opposed contacts 31 and 32 adapted to make contact with the lamp contact 17 and the socket base contact 23 respectively and separated by an insulation strip 33. These ballast contacts 31 and 32 are connected together by a resistance 34 through finger extensions on said contacts, so that connection between the lamp contact 17 and the socket base contact 23 is effected through said resistance.

The ballast resistance 34 is in the form of a ring of uniform cross-section, the ballast contacts 31 and 32 having their finger extensions embedded at one end into said ring at diametrically opposite sides, resulting in two equal electric circuits connected in parallel around the ring. These contacts 31 and 32 lie in axial alignment with the lamp contact 17 and the socket contact 23 and are dished in opposite directions to present outwardly convex surfaces to said lamp contact and said socket contact respectively. The insulating strip 33 may be secured to one of the ballast contacts 31 and 32, as for example by adhesive as shown.

The ballast resistance ring 34 is made of a material having a negative resistivity coefficient, whereby its ohmic resistance decreases with increasing temperature. This resistance ring 30 is preferably of inexpensive molded construction such as is used for radio resistors and desirably consists of powdered carbon and an inert material such as talc with a synthetic resin binder, the proportions of these ingredients depending upon the desired resistance of the ring. A ring 34 of this composition has the desired negative resistivity coefficient.

The resistance ring 34 is protected by an outer insulating covering 35 molded of thermosetting plastic, as for example of Bakelite (phenol-formaldehyde resin). This insulating covering 35 has an outer cylindrical periphery 36 of a diameter to permit the ballast device to fit comfortably in a conventional lamp socket, and for that purpose a diameter slightly less than one inch ($\frac{31}{32}$'') is suitable. The insulation ring 35 is of such height as not to interfere with the screwing of the lamp 10 almost fully into the socket 20 and for that purpose, this height is no greater than the distance between the end of the lamp contact 17 and the end thread of the screw cap 12. A height of a little over one-quarter of an inch ($\frac{9}{32}$'') is suitable for the purpose.

The insulation ring 35 presents a concave inner periphery 40 of progressively decreasing diameter to conform substantially with the general frusto-conical contour of the base section of the lamp and to permit said lamp base section to nest into said ring in attached position of the ohmic ballast device 30.

For latching the ohmic ballast device 30 to the base end of the lamp 10, said device includes an attachment clip in the form of a ring 41 having a slot 42 therein to permit the lamp contact disc 15 to pass therethrough and to permit said attachment ring to be latched to said lamp base end between said disc and the insulating lamp base 14. This attachment ring 41 and the ballast contact 31 are desirably integral and made of a single sheet of thin spring material such as phosphor bronze (.976 Cu, .02 Sn, .002 P). This sheet of springy metal has a tail 43 embedded into or otherwise connected to the resistance ring 34 to establish electrical contact therewith and has its intermediate section stamped out from said sheet and offset from the plane of said sheet to form the ballast finger contact 31 and to define the slot 42 for the attachment ring 41.

The slot 42 in the attachment ring 41 is elongated in the direction transverse to the axis of the contact finger 31 extending along its length, and has the length of its major axis between the points *a* and *b* slightly greater than the diameter of the lamp contact disc 15 and has the length of its minor axis between the points *c* and *d* slightly less than the diameter of said lamp contact disc.

Before attaching the ohmic ballast device 30 to the lamp, the contact disc 15 of the lamp is separated around its peripheral edge from the insulating lamp base 14 by the thumb nail or by a thin knife blade. Then the ballast device 30 is slipped over the base end of the lamp and slightly tilted to slip the secured side of the attachment ring 41 in the region of its corners *e*, between the insulating lamp base 14 and the lamp contact disc 15, as shown in Fig. 4. The resiliency of the attachment ring 41 in the region of its corners *e* and the slight sidewise permissible play of the ballast device 30 on the base end of the lamp, facilitates this initial attaching operation. The ballast device 30 is then moved sideways edgewise of the attachment ring 41 to slide the secured side of said ring deeper into the recess between the insulating lamp base 14 and the lamp contact disc 15, until the opposite unsecured side of said ring in the region of its point *c* snaps over said contact disc, as shown in Fig. 5. The ballast

device 30 buttoned on to the lamp contact disc 15 as described, can then be centered on the lamp base end.

The concave surface 40 presented by the inner periphery of the ballast unit 30 serves to both center and align said unit with the insulating lamp base 14 and the lamp socket 20, so that all contacts are firmly pressed together. Moreover, the particular shape of the ballast unit 30 permits the resistance ring 34 and its insulation covering 35 to have a comparatively large cross-section without appreciably sacrificing the threaded depth of the lamp into a standard socket.

The ohmic ballast device 30 latched on to the lamp 10 as described, forms a unit therewith and these can be screwed as a unit into the lamp socket 20 in the usual way by merely turning the glass bulb of said lamp. The ballast device 30 during this operation may turn by friction with the lamp 10 in the lamp socket 20 or may be held against turning, but in either case, it will not interfere with the screwing of the lamp almost to the full extent into the socket.

When it is desired to remove the ohmic ballast device 30 from a burned out or spent lamp for reuse, the buttoning action described is reversed as shown in Fig. 6 by sliding the ballast device 30 sideways in one direction to cause the secured side of the attachment ring 41 is the region of its corners *e* to snap out of the recess between the insulating lamp base 14 and the lamp contact disc 15 and by subsequently moving the ballast device sideways in the opposite direction to complete the detachment of the ballast device from the lamp.

Fig. 16 shows the curves of Life vs. Volts in terms of percentage, derived from a number of conventional lamps tested at both rated and slightly reduced voltage on 60 cycle A. C. power without resistance ballast, under both continuous and intermittent duties and subjected to a small amount of vibration, such as would be experienced in many domestic and industrial applications. The lamps subjected to intermittent duty were continuously turned on and off every 12 seconds (4 seconds on, 8 seconds off). The average life of the lamp under continuous duty but under operating conditions at rated voltage has been indicated as 100% on the curve and the life of the lamp under intermittent duty at rated voltage is shown on this same scale to be only a fraction of 100%.

Fig. 17 shows the curves of Life vs. Volts in terms of percentage derived from a number of conventional lamps tested at rated voltage on 60 cycle A. C. power. These lamps were made by the same manufacturer and were tested under both continuous and intermittent duty under the identical conditions of the aforesaid tests on which the curves of Fig. 16 are based, except that these lamps were tested with varying amounts of ohmic resistance ballast in series with the lamp filaments.

A comparison of the corresponding curves of Figs. 16 and 17 show the very large extension of lamp life by using ohmic resistance ballast as against the slight extension of life by a corresponding reduction in operating filament voltage. Fig. 17 surprisingly shows that ohmic resistance ballast in an A. C. circuit prolongs the life of a lamp substantially, even when said lamp is subjected to continuous duty. The ballast necessary to extend the life of a bulb which is on continuously is less in ohmic resistance than that necessary to extend similarly the life of a bulb which is switched on and off at frequent intervals. It has been found in accordance with the present invention that for maximum lamp life and minimum power loss due to ballast, where the lamp is turned on and off occasionally and subjected to small amount of vibration, such as would be experienced in many domestic and individual applications, it is desirable to provide a ballast having approximately three times the resistance, when the lamp is turned off than when the lamp is operating continuously.

It has also been found in accordance with the present invention that a ballast device having an ohmic resistance 34 dissipating wattage equivalent to between six tenths of one and four percent of the wattage of the filament of the lamp under operating temperatures produces the desired results.

The darkening of the glass on the inside of the bulb due to the vaporization of the wolfram (tungsten) filament materially reduces the light output with age. There is therefore a limit to which the life of a lamp may be efficiently extended. Nevertheless, it has been observed in accordance with the present invention that a lamp using ohmic ballast darkens at a much reduced rate, so that even with its life increased many folds, the ultimate darkening at failure is no greater than that of a conventional lamp not having the extended life.

The exact theoretical explanation for the large extension of life and better performance of the improved lamp of the present invention using ohmic resistance ballast is not positively known. It is recognized that many complicated phenomena influence the structure and properties of materials at high temperatures. Due to some of these phenomena, the life of incandescent lamps vary widely between lamps of supposedly identical manufacture, and even more widely between lamps of different manufacture. It has been found that extremely small vibrations adversely affect average lamp life and widen the difference found among supposedly identical lamps. Observed test results in combination with known metallurgical theory lead one to believe that lamp filament failures are due to what is known metallurgically as "high temperature creep," the stresses being produced principally by thermal temperature gradients, often augmented by stresses due to mechanical vibration. It is believed that the ballast of the present invention materially reduces the magnitude of these thermal stresses for the following reasons:

1. The current surges at the instant the lamp is turned on are materially reduced resulting in lower thermal stresses at the junction of the filament and lead connections and along the filament due to rapid thermal expansion.

2. When operating on alternating current, the magnitude of the cyclic current peaks is reduced when the cooling of the filament between cycles is considered, resulting in reduced high frequency thermal stresses of comparatively low magnitude but of extreme importance because of the frequency.

3. Because of the reduced thermal stresses, the additional stress due to mechanical vibration or external means is not as severe.

The following handbook formula is based on operations under ideal conditions where the lamps are turned on only once and mounted on a vibrationless structure:

$$\frac{\text{life}}{\text{LIFE}}=\left(\frac{\text{VOLTS}}{\text{volts}}\right)^{13.1}=\left(\frac{\text{LUMENS/WATT}}{\text{lumens/watt}}\right)^{7.1}$$

It is evident from the foregoing formula for the operation of lamps that increased lamp efficiency expressed as lumens per watt can be obtained by increasing the filament voltage according to the formula indicated. Hence the improved lamp of the present invention may be operated at much higher voltage than that required to counteract the small resistance ballast drop and still maintain an expected life far greater than that of conventional lamps without the ohmic resistance ballast. For instance, a conventional lamp rated at 110 volts could be used with an external ballast on a 120 volt supply. For such an increased voltage and average usage, a resistance ballast having a voltage drop of about 1.5 per cent (Fig. 17) would be required to give for continuous duty an average life at rated voltage of 800 to 1200 per cent. At the increased voltage, the ballast drop would be 1.8 volts leaving a filament voltage of 118.2 as compared to a rated voltage of 110 for 100 per cent rated lumens per watt.

Using the formula,

$$\frac{800}{\text{LIFE}}=\left(\frac{118.2}{110}\right)^{13.1}=\left(\frac{\text{LUMENS/WATT}}{100}\right)^{7.1}$$

Then,

$$\text{LUMENS/WATT}=113.8\%$$

which when corrected for power loss in the ballast gives,

$$\text{LUMENS/WATT}=112\%$$

and

$$\text{LIFE}=317\%$$

The above formula for lamp life as a function of operating voltage does not truly represent the relationship for lamps with ohmic resistance under actual conditions, since under average actual conditions (lamp turned on occasionally and subjected to small amount of vibration), the actual life of conventional lamps is only a small fraction of their rated life. It has been found in accordance with the present invention that the operating conditions make little or no difference in the life of the lamps with ohmic resistance ballast and that the improved lamp under any condition is extended several fold in life.

Figs. 7 and 8 show a modified ballast ring device **30***a* having a coiled wire resistance element **50** in the form of a ring made of metal having high resistivity and embedded in a semi-conductor ring element **51** made of material having negative resistivity coefficient, so that the two elements are connected together in parallel. Materials having a resistivity at room temperature (20° C.) of above 10 microhms/cm.^{3} are considered for the purpose of the present invention to be classified as high resistivity materials, while those below this resistance value are classified as low resistant materials. To illustrate this classification, the resistivity of several metals and alloys is herein given:

Copper	1.7
Aluminum	2.53
Wolfram (tungsten)	5.50
Nickel	7.80
Iron	10.00
Platinum	10.00
Nichrome (.80 Ni, .20 Cr)	100.00
Radiohm (.785 Fe, .165 Cr, .05Al)	125.00

Therefore Nichrome or Radiohm can be effectively used for the coiled wire resistance element **50**.

The semi-conductor element **51** is made of a material which exhibits very high electrical resistivity at low temperatures and steeply negative resistivity coefficients with increased temperature. Suitable semi-conductors which have this property and which may be effectively used are designated "Varistors" and "Thermisters." Varistors consist essentially of silicon carbide sintered in vitreous ceramics. Thermisters which are preferred consist of a variety of metallic oxides, sulphides and mixtures of these materials to obtain different resistivity characteristics with temperatures. Some of the more common of these are nickel oxide NiO, iron oxide Fe_2O_3 and silver sulphide Ag_2S. For the semi-conductor element **51** of the present invention, a Thermister for example may be used made essentially of iron oxide Fe_2O_3.

The ballast device **30***a* of Figs. 7 and 8 comprises the opposed finger contacts **31** and **32** separated by the insulation strip **33** and connected to the resistance element **50** at diametrical opposite sides thereof as in the construction of Figs. 1–6 to form two electrical branches connected together in parallel, each of said branches consisting of one half of the element **50** and one half of the element **51** connected together in parallel. The ballast device **30***a* also has an insulating cover **35***a* and an attachment ring **41** as in said construction of Figs. 1–6.

The ballast element **50** has the necessary ohmic resistance to serve as a ballast against current surges when the current is turned on. At that instant, the ballast element **51** is inactive, because at room temperature, the resistance of the Thermister from which said element is made is extremely high, being of the order of 100,000 times greater than when hot. After the lamp has been operating for a few seconds and reaches operating equilibrium, the increase in temperature increases the resistance of the ballast element **50** but decreases the resistance of the ballast element **51** and causes thereby said ballast element **50** to be partially shorted automatically by said ballast element **51** to an extent sufficient to reduce materially the overall ohmic resistance of the composite ballast device **30***a* to the point required to extend the life of the lamp with efficiency during continuous duty.

The composite ballast device **30***a* described is ohmically designed to provide an automatically changeable ohmic resistance having approximately three times the resistance when the lamp is turned off than when it is operating continuously and to dissipate wattage of between six tenths of one and four percent of the wattage of the lamp filament under operating temperatures.

Figs. 9–12 show a modified ballast ring device **30***b* comprising two opposed contacts **31***b* and **32***b* of resilient metal adapted to make contact with the lamp contact and lamp socket base contact respectively and separated by an insulation strip **33***b*. These ballast contacts **31***b* and **32***b* are connected together by a resistance ring **34***b* through radial finger extensions **55** and **56** on said contacts **31***b* and **32***b* respectively embedded in or otherwise electrically connected to said resistance ring **34***b*. This resistance ring **34***b* is made of material having negative resistivity coefficient such as the ring **34** in the construction of Figs. 1–6, so that its resistance decreases with increase in temperature and is protected in an insulating cover **35***b* as in said construction. To permit easy attachment of the ballast device **30***b*

to the lamp base end, the contact 31b is dished with its concave surface facing axially outwardly and is formed with four quadrantly arranged radial spring arms 57 terminating in clip hooks 58 adapted to grab the lamp contact disc 15 as shown in Fig. 11. The contact 32b is similarly dished with its convex surface facing outwardly.

The lamp contact disc 15 may still have to be separated from the insulating lamp base 14 around its peripheral edges by the thumb nail or thin knife to prepare the lamp for attachment of the ballast device 30b thereto. Upon application of finger pressure axially to the ballast contact 32b, the ballast contact 31b is flexed, causing the hooks 58 to spread apart, so that they may be snapped by spring tension over the peripheral edge of the lamp contact disc 15 into latched engagement therewith, as shown in Fig. 11.

The ballast device 30b attached to the lamp as described will form a unit therewith, so that they can be inserted together into the lamp socket. The lamp can be screwed into the lamp socket to almost the full extent without interference from the ballast device 30b.

For removing the ballast device 30b from the lamp to permit reuse of said device, finger pressure is applied axially to the lower ballast contact 32b. This flexes the upper ballast contact 31b and expands the hooks 58 radially outwardly out of engagement with the lamp contact disc 15, as shown in Fig. 12, so that the ballast device 30b can be moved axially away from the lamp.

Figs. 1–12 show a type of ohmic ballast device in the form of a ring having clip means by which the device may be latched on to the lamp base. Figs. 13–15 show a modified ballast device 30c in the form of a disc comprising a resistance element 34c in the form of a wafer made of a material having negative resistivity coefficient, as for example of graphite, interposed between two metal contact discs 61 and covered by an outer insulation 62 of thermosetting material such as Bakelite. The graphite wafer 34c is axially enlarged to define two projecting metal covered contacts 63 and 64 adapted to engage the lamp end contact 17 and the socket contact 23 and has the electrical characteristics described in connection with the ballast devices of Figs. 1–12.

The ohmic ballast device 30c is of a diameter slightly smaller than the internal diameter of the lamp socket 20 to permit said ballast device to be dropped into said socket and has a small height to permit the lamp to be screwed almost to its full extent in said socket. Once this ballast device 30c has been dropped into the lamp socket 20, it can be retained therein without interfering with the screwing of the lamp into or unscrewing of the lamp from the lamp socket.

While the invention has been described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed is:

1. An ohmic ballast device separable from a conventional incandescent lamp and small enough to fit into a conventional lamp socket for said lamp, said ballast device being adapted to be disposed between the end contact of said lamp and the base contact of said lamp socket in series with the filament of said lamp, said ballast device having sufficient ohmic resistance to dissipate between six-tenths of one and four percent of the wattage of said filament at operating temperature and having negative resistivity properties affording about three times the ohmic resistance when the lamp is turned off than when it is at operating temperature.

2. An ohmic ballast device for an incandescent lamp small enough to fit into a conventional lamp socket and adapted to be disposed between the end contact of said lamp and the base contact of said lamp socket, said ballast device forming a self-contained unit insertable as such into operative position and removable as such from said position, and comprising a pair of contacts for engagement with said lamp contact and said socket contact respectively, and a pair of ohmic resistance elements in the form of rings encircling said contacts, said resistance elements being connected together in parallel between said pair of contacts and being electrically connected to said contacts, one of said elements being made of a material having high resistivity, the other element being made of a material having a negative resistivity coefficient.

3. An ohmic ballast device for an incandescent lamp small enough to fit into a conventional lamp socket and adapted to be disposed between the end contact of said lamp and the base contact of said lamp socket, said ballast device comprising an insulating ring adapted to encircle the base end of the lamp, a pair of contacts within the ambit of said ring for engagement with said lamp contact and said socket contact respectively, and an ohmic resistance element embedded in and covered by said ring and extending therealong, said resistance element being electrically connected to and located between said pair of contacts, said ring, said contacts and said resistance element being connected together into a self-contained unit, adapted to be inserted into operative position or removed from said position as a unit.

4. An ohmic ballast device for an incandescent lamp as defined in claim 3 comprising clip means for removably attaching the device to the base end of said lamp.

5. An ohmic ballast device for a conventional incandescent lamp having an insulating base with a disc contact secured thereto, said ballast device being small enough to fit into a conventional lamp socket and being adapted to be disposed between said lamp disc contact and the base contact of said lamp socket, said ballast device comprising a pair of contacts for engagement with said disc contact and said socket contact respectively, an ohmic resistance located between and electrically connected to said pair of contacts, and clip means adapted to removably latch on to the base end of said lamp between said disc contact and said insulating base, to attach thereby said device to said lamp, said contacts, said resistance and said clip means being connected together into a self-contained unit adapted to be inserted into operative position or removed therefrom as a unit.

6. An ohmic ballast device for an incandescent lamp having an insulating base with a disc contact secured thereto, said ballast device being small enough to fit into a conventional lamp socket and being adapted to be disposed between said lamp disc contact and the base contact of said lamp socket, said ballast device comprising an insulating ring adapted to encircle the base end of the lamp, a pair of contacts within the ambit of said ring for engagement with said lamp contact and said socket contact respectively, an ohmic resistance element enclosed in said ring

and extending therealong, said resistance element being electrically connected to and located between said pair of contacts, and clip means secured to said ring to removably latch the device on to the base end of said lamp between said disc contact and said insulating base and to attach thereby said device to said lamp.

7. An ohmic ballast device for an incandescent lamp small enough to fit into a conventional lamp socket and adapted to be disposed between the end contact of said lamp and the base contact of the lamp socket, said ballast device comprising an insulating ring adapted to encircle the base end of the lamp, a pair of axially opposed contacts within the ambit of said ring for engagement with said lamp contact and said socket contact respectively, and an ohmic resistance element in the form of a ring embedded in and covered by said ring and extending therealong, the contacts of said pair having finger extensions electrically connecting said pair of contacts to diametrically opposite sides respectively of said resistance element and being secured to said insulating ring, whereby said device forms a self-contained unit adapted to be handled as such in the operation of inserting said device into position and removing said device out of position.

8. An ohmic ballast device for a conventional incandescent lamp having a screw cap and an insulating substantially frusto-conical base projecting axially from said cap with the smaller end of said base at the end of said lamp, said ballast device comprising an insulating ring having a substantially cylindrical outer periphery and having an outside diameter not greater than the internal diameter of a conventional lamp socket and not greater than the outside diameter of said screw cap, and a height not greater than the axial distance between the end of said lamp and the first thread on said cap nearest said lamp end, said insulating ring defining an opening varying progressively in diameter to permit said insulating lamp base to nest therein, when said ballast device is applied in position on to the base end of said lamp, a pair of contacts within the ambit of said ring for engagement with a lamp contact and a lamp socket base contact respectively, and an ohmic resistance element embedded in and covered by said ring and extending therealong, said resistance element being electrically connected to and located between said pair of contacts, said ring, said contacts and said resistance element being secured together into a self-contained unit to permit said device to be handled as such, when inserted into operative position or removed therefrom.

9. An ohmic ballast device for a conventional incandescent lamp as described in claim 8, comprising a clip for attaching the device removably on to the base end of the lamp.

10. An ohmic ballast device for a conventional incandescent lamp having an insulating base with a disc contact secured thereto, said ballast device being small enough to fit into a conventional lamp socket and being adapted to be disposed between said lamp disc contact and the base contact of said lamp socket, said ballast device comprising a pair of contacts for engagement with said disc contact and said socket contact respectively, an ohmic resistance located between and electrically connected to said pair of contacts, and clip means adapted to removably latch on to the base end of said lamp between said disc contact and said insulating base, to attach thereby said device to said lamp, and comprising an attachment ring of thin sheet material having a latch slot to permit the disc contact of the lamp to pass therethrough and the edges of said slot to be slipped between said disc contact and said insulating base.

11. An ohmic ballast device for a conventional incandescent lamp having an insulating base with a disc contact secured thereto, said ballast device being small enough to fit into a conventional lamp socket and being adapted to be disposed between said lamp disc contact and the base contact of said lamp socket, said ballast device comprising a pair of contacts for engagement with said disc contact and said socket contact respectively, an ohmic resistance located between and electrically connected to said pair of contacts, and clip means adapted to removably latch on to the base end of said lamp between said disc contact and said insulating base, to attach thereby said device to said lamp, and comprising an attachment ring of thin resilient metal having an elongated slot, longer along its major axis than the diameter of said lamp disc contact and smaller along its minor axis than the diameter of said lamp disc contact, to permit the disc contact of the lamp to be slipped through said slot and to permit the edge of said slot to be retained between said disc contact and said insulating lamp base.

12. An ohmic ballast device for a conventional incandescent lamp having an insulating base with a disc contact secured thereto, said ballast device being small enough to fit into a conventional lamp socket and being adapted to be disposed between said lamp disc contact and the base contact of said lamp socket, said ballast device comprising a pair of contacts for engagement with said disc contact and said socket contact respectively, an ohmic resistance located between and electrically connected to said pair of contacts, and clip means adapted to removably latch on to the base end of said lamp between said disc contact and said insulating base, to attach thereby said device to said lamp, and comprising spring arms projecting radially from one of said pair of contacts and terminating in hooks adapted to be latched on to the edge of said disc contact between said disc contact and said insulating lamp base.

13. An ohmic ballast device for an incandescent lamp comprising an ohmic resistance element in the form of a wafer of a material having negative resistivity coefficient, a pair of metal conducting plates on opposite faces of said resistance element, and an insulating cover over said plates and said resistance element having a diameter smaller than the internal diameter of a conventional lamp socket, said resistance element being axially enlarged beyond said insulating cover to define two projecting metal covered contacts for said resistance elements.

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