Feb. 18, 1964 G. B. SAVIERS 3,121,817

ELECTRIC LIGHTING UNIT

Filed July 14, 1960

FIG. 1.

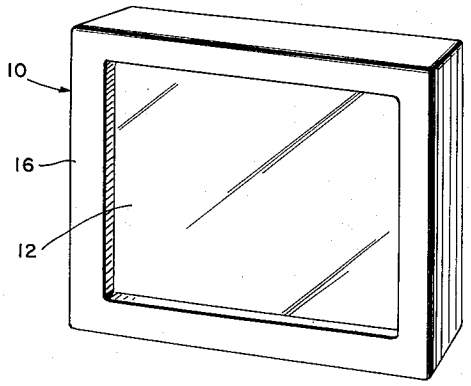


FIG. 2.

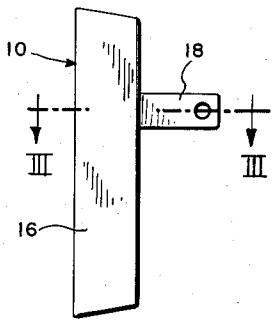


FIG. 3.

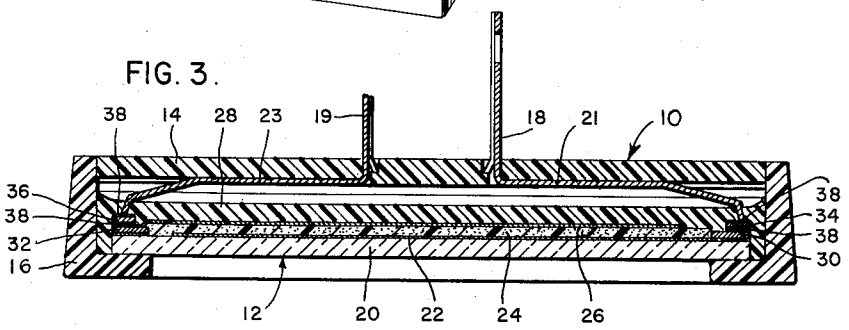


FIG. 4.

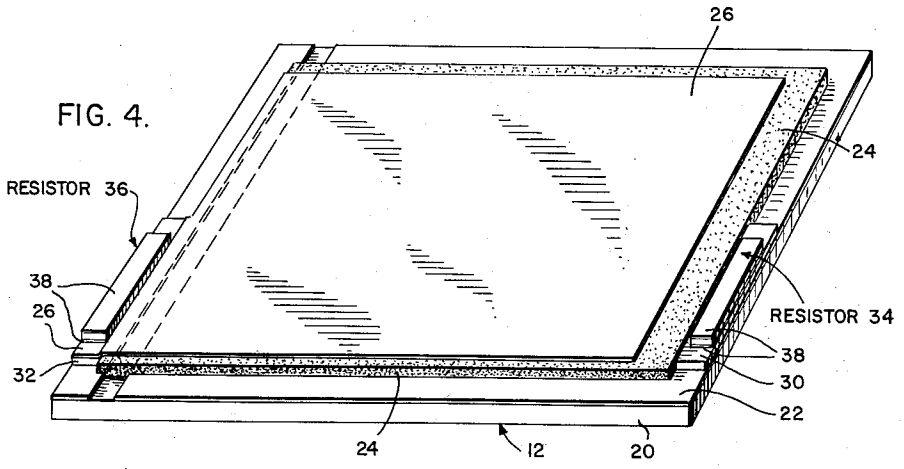
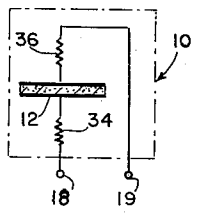


FIG. 6.



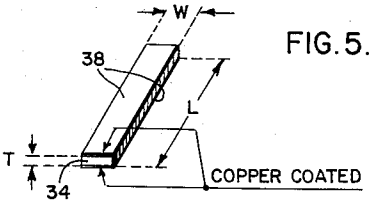


FIG. 5.

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3,121,817

ELECTRIC LIGHTING UNIT

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6 Claims. (Cl. 313—108)

This invention relates to electric lighting apparatus and, more particularly, to a combined electrical connection and arc suppressing means that is especially adapted for use in lighting units which employ an electroluminescent lamp as the light source.

The use of a limiting resistor instead of a separate fuse to protect an electrical device from arcing under temporary voltage and current overloads is well known. Such protection is especially important in lighting units employing electroluminescent devices insofar as destructive arcs and puncturing of the relatively thin electroluminescent phosphor-dielectric layer can occur if the applied voltage exceeds the breakdown voltage of the layer. It has accordingly been found necessary to employ a current and voltage limiting resistor in series with most electroluminescent devices, particularly those which are intended to be operated directly from a convenience outlet, such as the electroluminescent safety or night lights presently being marketed.

Heretofore such limiting resistor were either inserted into the external energizing circuit or included as an integral part of the lamp, as shown in U.S. Patent Nos. 2,765,419 to S. Roberts and 2,891,169 to F. H. Nicoll. When it was made part of the lamp the resistor element was disposed in overlying relationship with the electroluminescent phosphor layer. This type construction is also shown in U.S. Patent No. 2,880,346 to F. H. Nicoll et al., together with another variant wherein the resistive material is admixed with the electroluminescent phosphor and constitutes part of the phosphor layer itself.

While the aforesaid prior art structures afforded the desired overload protection, they either required that the supply circuit be modified or that the resistive material be incorporated into the device as an integral part of the lamp structure itself—both of which are impractical from a cost and manufacturing standpoint. In addition, admixing the resistive material with the phosphor or placing it in a separate layer over the phosphor layer inherently caused some light to be absorbed resulting in a decrease in the light output of the lamp.

With the foregoing in mind it is the general object of this invention to provide a combined electrical connection and arc suppressing means that is especially adapted for use with devices, such as electroluminescent lighting devices, that are susceptible to destructive arcing under transient overload conditions.

Another and more specific object is the provision of arc suppressing means for an electroluminescent lighting unit which can be very conveniently and inexpensively incorporated therein during the normal sequence of assembly operations and which will not reduce the light output of the electroluminescent lamp component.

The aforesaid objects, and others which will become apparent as the description proceeds, are achieved by clamping a flat composite type resistor of predetermined thickness and resistivity between one of the electroluminescent lamp contacts and a contactor member that constitutes part of the lighting unit and which normally presses against the aforesaid contact and effects a pressure connection therewith. The resistor thus constitutes an integral part of the electrical connection between the lamp and contactor components and thus limits the current that can flow through such connection and the electroluminescent lamp in addition to increasing the breakdown voltage of the lamp.

The present invention is particularly adapted for use in electroluminescent lighting units wherein the electrical connection between the lamp and contactor components is effected by means of pressure alone. A lighting unit having this type of electrical connection is disclosed and claimed in copending application Serial No. 824,249, of W. J. Knochel et al., filed July 1, 1959, now Patent No. 3,056,897, issued October 2, 1962, assigned to the assignee of the present invention. In the aforesaid copending application the lamp is mounted in a frame and the contactor members are maintained in pressure engagement with the lamp contacts by means of a panel that is snap-fitted into the back of the frame or by means of a filling of cured thermosetting plastic that covers the back of the lamp. An improved lighting unit of this type is disclosed and claimed in copending application Serial No. 825,961, of W. J. Knochel et al., filed July 9, 1959, Patent No. 3,056,898, issued October 2, 1962, and assigned to the present assignee, wherein both the aforesaid panel and layer of plastic are employed. In this design the inner ends of the contactor members are embedded in the plastic layer and are thus permanently locked thereby in pressure engagement with the lamp contacts.

The further modification of such electroluminescent lighting units to include the combination electrical connection and arc suppressing means in accordance with the present invention accordingly constitutes an improvement over the structures disclosed and claimed in the aforementioned copending applications.

A better understanding of the invention will be obtained by referring to the accompanying drawing wherein:

FIG. 1 is a perspective view of a plug-in electroluminescent lighting unit which incorporates the present invention;

FIG. 2 is a side elevational view of the lighting unit shown in FIG. 1;

FIG. 3 is an enlarged sectional view along the line III—III of FIG. 2, in the direction of the arrows;

FIG. 4 is an enlarged pictorial view of the electroluminescent lamp component of the lighting unit shown in the preceding figures, with the resistor elements disposed in overlying relationship with the lamp contacts in accordance with the present invention;

FIG. 5 is a pictorial view of one of the resistor elements shown in FIG. 4; and

FIG. 6 is a schematic representation of the internal circuit of the lighting unit in accordance with this invention.

With specific reference to the drawing, in FIGS. 1 to 3 there is shown a lighting unit 10 comprising an electroluminescent lamp 12 that is mounted in an enclosure such as a frame 16 of plastic or the like. As shown more particularly in FIGS. 2 and 3, a pair of prongs 18 and 19 project from the back of the lighting unit to provide plug-in type terminals. The aforesaid prongs constitute the outer ends of generally L-shaped resilient contactor members 21 and 23 (FIG. 3) which are rigidly anchored to and project through a back panel 14 secured to the back of the frame 16. The inner ends of the contactor members are compressed against the back of the lamp by the panel. Electrical connection between the lamp and contactor members is accordingly effected by pressure alone. A layer of cured plastic 28 (FIG. 3) such as epoxy or the like is desirably cast over the back of the lamp 12 and around its edges thereby permanently sealing said lamp within the frame and preventing the ingress of moisture. The inner ends of the resilient contactor members 21 and 23 are embedded in and pierce the aforesaid layer of plastic and are permanently locked

in pressure engagement with preselected portions of the back of the lamp.

As shown in FIGS. 3 and 4, the electroluminescent lamp 12 is of the glass-plastic type wherein a glass base plate 20 is coated with a light-transmitting electrode 22, such as tin oxide or the like, which is followed by an electroluminescent phosphor-dielectric layer 24 and then by a second electrode 26 of vaporized aluminum or the like in accordance with standard lamp making practice. A pair of generally rectangular bus-bars or contacts 30 and 32 are provided along the opposite side edges of the back of the lamp 12 by applying a strip of silver paint or the like. The contact 30 is connected to the light-transmitting electrode 22 whereas the contact 32 connects with the metallic electrode 26 through an overlapping extension thereof, as shown. The exposed surface of the contact 32 accordingly comprises the overlying part of the metallic electrode 26 and both contacts are substantially flat. A more detailed description of the construction of the lighting unit 10 and the manner in which it is assembled is given in the previously referred to copending application Serial No. 825,961 of W. J. Knochel et al.

In accordance with the present invention, the desired arc suppressing means is very conveniently incorporated as an integral part of the lighting unit 10 by placing flat composite type resistors 34 and 36 in overlying relationship with the lamp contacts 30 and 32, respectively, prior to the insertion of the lamp 12 into the frame 16. The resultant lamp and resistor assembly is shown in FIG. 4. A coating of silver paint or the like is desirably applied to the lamp contacts before the resistors are placed thereon in order to hold the latter in their assembled position while the lamp 12 is being inserted into the frame 16 and the back panel 14 is being fastened in place.

As shown in FIG. 3, in the completed lighting unit 10 the resistors 34 and 36 are securely clamped flatwise between the compressed inner ends of the resilient contactor members 21 and 23 and the lamp contacts 30 and 32, respectively. Thus, the aforesaid resistors are securely held in positive electrical engagement with the contactor members and lamp contacts solely by means of the clamping force exerted by the latter. In addition to completing and forming a part of the electrical connection between the lamp 12 and plug-in terminals 18 and 19, the resistors 34 and 36 limit the current which can pass through such connection and, of course, the lamp.

As shown in FIG. 5, each of the resistors 34 and 36 is rectangular in shape and of predetermined length L, width W and uniform thickness T. They are of the composite type and comprise pressed bars of a suitable semiconductive material, such as silicon carbide or the like, or a mixture of such materials that is admixed with a suitable binder to form a hardenable compound. More specifically, the resistors are so dimensioned and fabricated that they are of substantially uniform resistance throughout and constitute a predetermined series impedance when interposed flatwise between the contactor members and lamp contacts as above described. The flat surfaces of the resistors are coated with a suitable highly conductive material 38 such as copper (as shown in FIGS. 3 to 5) so that the entire volume of the resistor is included in the circuit even though the ends of the contactor members 21 and 23 are much smaller in area than the area of the flat surface of the resistors which they engage. Thus, the impedance placed into the circuit is equal to the total impedance of the resistors even though only a small fraction of the latter are actually engaged by the ends of the contactor members. Since the lamp contacts 30 and 32 are substantially flat and greater in area than the flat surfaces of the resistors, as shown in FIGS. 3 and 4, they obviously connect with the entire surface of the resistors which they engage.

As a specific example of the size and magnitude of the resistors 34 and 36, it has been found that approximately 36,000 to 60,000 ohms are required to provide the desired overload protection in the case of the 120 volt 0.0003 ampere electroluminescent safety light 10 here shown. The lamp contacts 30 and 32 in the particular case here shown are approximately ⅛" by ¾". The necessary impedance was obtained by using two composite resistors approximately ⅝" long, ⅛" wide and 0.035" thick which had a resistance of approximately 18,000 to 30,000 ohms each and a coating of copper on their flat surfaces. By providing such resistors in the aforesaid electroluminescent light unit it was found that arcing under transient high voltage conditions was prevented and that the breakdown voltage of the lamp 16 was increased by approximately 80 to 100 volts compared to similar lighting units without resistors.

As shown in FIG. 6, the resistors 34 and 36 are in series circuit between each of the plug-in terminals 18 and 19 and the electrodes with which they connect.

While two resistors have been shown in series with each of the lamp contacts it will be obvious that a single series resistor of approximately equal value can also be employed.

It will be apparent from the foregoing that the objects of the invention have been achieved insofar as the desired arc suppressing means has been provided which means not only constitutes an integral part of the electrical connections of the lighting unit but can be very easily and inexpensively incorporated therein during the regular sequence of assembly operations.

While a preferred embodiment has been illustrated and described in detail, it will be understood that various modifications in the configuration and organization of parts may be made without departing from the scope of the invention.

I claim:

1. In combination with an electric lighting unit of the type wherein a planar light source is held in an enclosure by retaining means secured to said enclosure, and wherein said light source is susceptible to damage from arcing and carries contacts disposed to effect pressure engagement with resilient contactor members held by said retaining means; means for inhibiting and minimizing arcing within said light source under overload conditions comprising a composite type resistor clamped between the end of one of said contactor members and the respective contact of said light source, said resistor having an electrically conductive coating on each of its engaged surfaces and being of such dimensions that it constitutes a predetermined impedance in series with said light source.

2. The combination as set forth in claim 1 wherein, said resistor is of flat rectangular configuration, the said light source contact in engagement with said resistor is substantially flat and larger in area than the flat surface of said resistor which it engages, the end of said contactor member is smaller in area than the flat surface of said resistor which it engages, and said resistor is clamped flatwise between said contact and the end of said contactor member.

3. The combination as set forth in claim 1 wherein, said light source comprises an electroluminescent device, said contact is substantially flat and larger than said resistor and is located at the back of said electroluminescent device, and said retaining means comprises a back panel that compressively locks said contactor member against said contact and resistor.

4. The combination as set forth in claim 1 wherein said light source contact, said resistor and the end of said contactor member are embedded in and locked in pressured engagement with each other by a body of cured plastic that covers a portion of said light source.

5. In a lighting unit comprising an electroluminescent device that is mounted in a frame and locked therein by retaining means secured to said frame, the combination of a generally flat contact on the back of said electroluminescent device, a generally flat resistor of

semiconductive material overlying said contact, a resilient contactor member compressed by said retaining means against said resistor and locking the latter in positive electrical engagement with said contact, and a layer of cured plastic on the back of said electroluminescent device overlying said contact and resistor and the portion of said contactor member in pressurized engagement therewith, the engaged sides of said resistor being coated with electrically conductive material whereby the entire volume and impedance of said resistor is included in the device circuit.

6. In a lighting unit comprising an electroluminescent device that is mounted in a frame and locked therein by retaining means secured to said frame, the combination of a plurality of generally flat contacts on the back of said electroluminescent device, a corresponding number of generally flat resistors of semiconductive material arranged in overlying and paired relationship with said contacts, a corresponding number of resilient contactor members compressed by said retaining means against preselected and different ones of said resistors

and locking said resistors in positive electrical engagement with the respective contacts, and a layer of cured plastic on the back of said electroluminescent device overlying said contacts and resistors and the portions of said contactor members in pressurized engagement therewith, the engaged sides of said resistors being coated with electrically conductive material whereby the entire volume and impedance of each of said resistors is included in the device circuit.

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