April 3, 1956 D. E. ELMENDORF ET AL 2,740,370

ELECTRICAL DEVICE WITH TEMPERATURE INDICATOR

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Fig. 1.

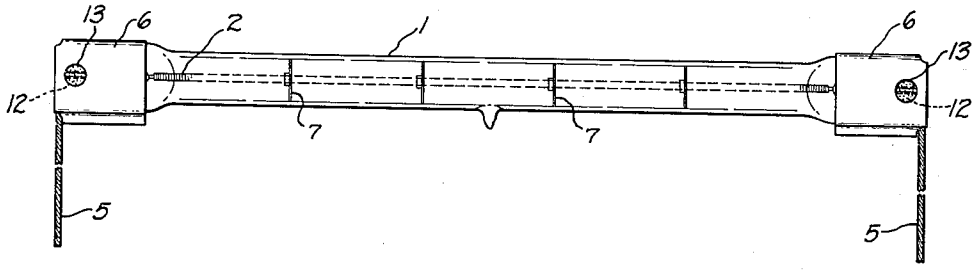
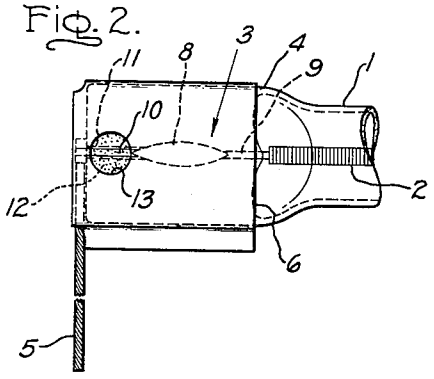


Fig. 2.



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ELECTRICAL DEVICE WITH TEMPERATURE INDICATOR

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3 Claims. (Cl. 116—114)

Our invention relates to electrical devices comprising a sealed envelope containing electric energy translation means, such as a filament or electrodes, and including a seal structure of vitreous material having a current lead-in conductor extending therethrough.

In the incorporation of such devices in certain installations, it sometimes happens that the seal structure is heated to such a high temperature that it fails due to cracking of the vitreous material with resultant leakage of air into the envelope and failure of the device. It has been determined that the failure is due to the fact that the seal has been overheated to a temperature sufficiently high to oxidize the metallic lead-in conductor which extends outwardly to the exterior of the seal. The oxidation progresses inwardly along the conductor and, because the resulting oxide has a greater volume than the original metal, a pressure is built up within the seal until the vitreous material finally cracks.

It is an object of this invention to avoid the above-mentioned difficulty by providing a simple and effective means for affording an indication of overheating of the seals in a proposed installation. While it is possible to employ means such as thermocouples, for the purpose here involved it is very difficult to correctly measure the temperatures in that manner.

In accordance with our invention, the problem is solved in a simple and efficacious manner by employing temperature-sensitive materials capable of changing their color at approximately the temperature at which the metallic conductor is subject to oxidation. A dye of that nature may be applied in any suitable manner to the seal portion of the device adjacent to the conductor. The user of the device, who may be designing equipment or experimenting with new uses of the devices, is thus informed, if his application of the device is such that the dye changes color, that the device will not operate satisfactorily and will fail prematurely.

Further features and advantages of our invention will appear from the following detailed description of a species thereof.

In the drawing,

Fig. 1 is an elevation of an infrared device or heat lamp embodying the invention, and

Fig. 2 is an elevation, on a larger scale, showing the seal structure at one end of the device.

The infrared device, or heat lamp, illustrated in the drawing may be of the type disclosed and claimed in application Serial No. 376,042, A. G. Foote et al., filed August 24, 1953, and assigned to the assignee of the present invention. The lamp comprises an elongated tubular envelope 1 of vitreous material, preferably fused silica or quartz. The envelope may be filled with a rare gas, such as argon, krypton or xenon, at a pressure in the neighborhood of one atmosphere. The envelope 1 contains electric energy translation means in the form of a coiled tungsten filament 2 extending longitudinally thereof and connected at its opposite ends to lead-in conductors 3 which are sealed through flattened press or seal portions 4 of the envelope 1. The lead-in conductors 3 extend to the exterior of the seal portion 4 where they are suitably connected, as by welding, to terminal conductors 5 for connection to a source of electrical energy. As herein illustrated, the seal portion 4 at each end of the envelope is enclosed by a flattened sheet metal sleeve base 6 which is clamped around the said seal portion. These bases may be of the type described and claimed in co-pending application Serial No. 424,418, W. F. Hodge, filed April 19, 1954, now Patent No. 2,705,310, and assigned to the assignee of the present invention. The filament 2 may be supported throughout its length by any suitable means such as discs 7.

As herein illustrated, the lead-in conductors 3 are formed of a refractory metal, preferably molybdenum. Each of the conductors 3 has a flattened or foliated intermediate portion 8 of a thickness of from .0005 to .0010 inch, and formed by a longitudinal rolling operation which produces a longitudinal crystal orientation as described and claimed in Patent No. 2,667,595, E. B. Noel et al., dated January 26, 1954, and assigned to the assignee of the present invention. The thin section 8 of the lead-in conductor is firmly "wetted" and bonded to the quartz in a hermetic seal. However, the inner end portion 9 and the outer end portion 10 of the conductor are not so bonded and there is a very small space, illustrated at 11 (though greatly exaggerated for purposes of illustration), between the wire and the quartz surrounding it.

In a specific embodiment, the lamp may be designed to operate at a power consumption of 1300 watts at 236 volts in an envelope having an inside diameter of about 7.75 mm. and a length of about 13½ inches between the seal or press portions 4. Normally, the lamp will operate for a long useful life. However, it has been shown that when operated in installations wherein the seal portions of such lamps are operated at too high a temperature, the quartz will crack, with resultant failure of the lamp. This is due to the fact that at some temperature in the neighborhood of 350° C. molybdenum in contact with air will oxidize. Because of the narrow space 11 around the outer end 10 of the lead-in conductor, this part of the lead is exposed to air and is therefore subject to oxidation. Because the volume of the molybdenum oxide is greater than that of the molybdenum, the oxidation causes an internal pressure to be built up within this small space with resultant cracking of the seal.

We have demonstrated that if the temperature is maintained at about 350° C. or lower by normal dissipation of the heat, the molybdenum will not oxidize and cracking of the seals will not occur. In accordance with the present invention we provide a means of indicating the occurrence of excessive temperatures by the use of a temperature-resistive material capable of changing its color. We have found that for the particular type of electrical device herein described, good results are obtained by employing an ammonium manganese phosphate which is sold under the name of Aurora Violet X2262 by the Imperial Paper and Color Corporation. Tests have indicated that the color of this dye will not fade or change at a temperature of 350° C. for several days, but that as 400° C. is approached the color fades out rather rapidly. The heat apparently releases the ammonia which causes the material to turn from a violet color to a solid white.

The dye may be painted directly on the flat quartz seal portion 4 near the critical area for temperature, that is, adjacent the outer end portion 10 of the conductor 3. The dye is illustrated by the dotted area indicated by the numeral 12. The base member 6, at each end of the lamp, may be provided with an aperture 13 through which the dye 12 may be viewed.

Instead of applying the dye 12 to each lamp in the process of manufacture thereof it may be omitted and applied

through the window or aperture 13 by the user of a particular lamp which it is desired to test in a proposed installation.

Although a preferred embodiment of our invention has been described in detail, it will be understood that the invention is not to be limited to the specific construction and arrangement of parts shown, or materials specified by way of example, but that they may be widely modified within the spirit and scope of our invention as defined by the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical device comprising a sealed envelope of vitreous material containing electric energy translation means and including a stem portion with a lead-in conductor extending therethrough and electrically connected to said energy translation means, said lead-in conductor comprising a seal portion firmly embedded in and hermetically sealed within the said stem portion of the envelope and an outer portion extending from the seal portion to the exterior of the stem, said outer portion of the lead-in conductor being composed of a metal which is oxidizable at an elevated temperature attainable by said outer portion of the conductor during operation of the device in a given environment and being embedded in said stem but not bonded thereto in a hermetic seal, and a temperature-responsive material capable of changing color at approximately the said elevated temperature and located on said stem adjacent to said outer portion of the lead-in conductor.

2. An electrical device comprising a sealed envelope of vitreous material containing electric energy translation means and including a stem portion with a lead-in conductor extending therethrough and electrically connected to said energy translation means, said lead-in conductor comprising a seal portion firmly embedded in and hermetically sealed within the said stem portion of the envelope and an outer portion extending from the seal portion to the exterior of the stem, said outer portion of the lead-in conductor being composed of a metal which is oxidizable at an elevated temperature attainable by said outer portion of the conductor during operation of the device in a given environment and being embedded in said stem but not bonded thereto in a hermetic seal, a base member enclosing said stem and having an aperture therein adjacent to said outer portion of the lead-in conductor, and a temperature-responsive material capable of changing color at approximately the said elevated temperature and located on said stem behind said aperture.

3. An electrical device comprising a sealed envelope of quartz containing electric energy translation means and including a stem portion with a lead-in conductor of molybdenum extending therethrough and electrically connected to said energy translation means, said lead-in conductor including a seal portion hermetically sealed in said stem portion of said envelope and further including an outer portion extending through said stem to the exterior of the envelope, said outer portion of the conductor being embedded in said stem but not bonded thereto in a hermetic seal and being subject to oxidation at an elevated temperature attainable thereby during operation of the device in a given environment, and temperature-indicating means comprising a quantity of ammonium manganese phosphate located on the wall of said stem portion of the envelope adjacent to the said lead-in conductor to afford an indication of overheating of said conductor to said elevated temperature by virtue of a change in color of said ammonium manganese phosphate at said elevated temperature.

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