June 3, 1941. A. KRATKY 2,243,849

ELECTRIC LAMP FILAMENT

Filed Feb. 28, 1940

Fig. 1.

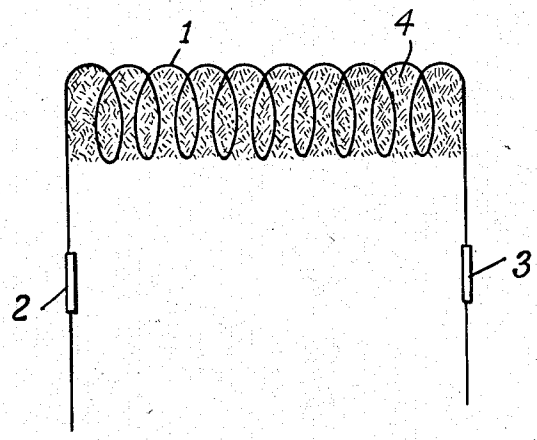
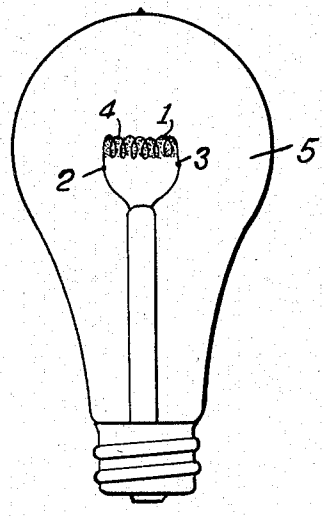


Fig. 2.



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Patented June 3, 1941 2,243,849

UNITED STATES PATENT OFFICE

2,243,849

ELECTRIC LAMP FILAMENT

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Application February 28, 1940, Serial No. 321,171

10 Claims. (Cl. 176—40)

My invention relates to incandescent metallic filament electric lamps for lighting purposes and to methods for their manufacture. It has particular reference to such lamps in which the metallic filament to be brought to incandescence is of tungsten, tantalum, osmium or similar metal.

In early electric lamps of this type, the filament was usually disposed in substantially straight lines between supports. This filament arrangement was unsatisfactory in that a large amount of the heat developed by its electrical resistance was ineffective because of heat radiation from the filament within the lamp receptacle, whereby the amount of current required to bring the filament to incandescence was increased.

To overcome this disadvantage, it was proposed to construct the filament of spirally wound wire. The spirals were at first single, that is, a single straight wire twisted into spirals or helices, and later were also double, that is, a spirally wound wire forming a helix which is in turn wound upon itself to form another helix. Lamps so constructed were much more efficient than those made with the single, straight filament. However, neither construction has proven fully effective in eliminating the undesirable heat radiations which so reduce the efficiency of the straight filament lamp. Moreover, both types of spirally wound filaments have the additional disadvantage that, at the temperature necessary to produce incandescence, the filaments tend to soften, and the individual windings to change position until they contact with each other. Under such conditions a short circuit between adjacent turns of the spiral may take place and eventually destroy the lamp.

It is an object of the present invention to construct a lamp of the character described, which can be operated with a minimum of electric current and a maximum of efficiency, and which will not have the disadvantages just mentioned.

An illustrative embodiment of my invention is shown in the accompanying drawing in which

Fig. 1 is a diagrammatic representation upon a greatly enlarged scale of a metallic lamp filament constructed according to my invention.

Fig. 2 shows such a filament inserted in a conventional lamp body.

The numeral 1 represents a spirally wound metallic incandescent lamp filament having the terminal portions 2 and 3 adapted for mounting in the usual manner within a lamp body 5. Surrounding and interwoven around and between the individual windings of the filament is an elastic, fibrous, cohesive, skeleton-like frame structure 4 adapted to support the spiral in normal position when the lamp is in use.

I have discovered that if the frame structure 4 be made of a refractory material of higher softening point than that of the filament the disadvantages just described can in large measure be avoided. The refractory material supports the wires in their normal position and prevents them from becoming disturbed or displaced when the filament is heated to say about its softening point, and insulates the individual bare windings against loss of heat by radiation and also from direct contact with each other with consequent short circuiting, should some slight distortion of the wires occur at the operating temperature.

I have found that oxides of thorium, zirconium or magnesium, used alone or mixed with the oxides of cerium, lanthanum, or praseodymium are most effective for my purpose, and of these, thorium oxide is the most satisfactory.

Thorium oxide has a melting point of about 3000° C. and a softening point of about 2700° to 2800° C. at atmospheric pressure, as against a softening point for the tungsten wires of about 2500° C. Thus, even though the filament be heated to 2500° C. or slightly higher, the thorium compound remains stable and will hold the tungsten wires effectively against distortion and displacements.

A lamp according to my invention may conveniently be constructed by immersing the spirally wound metallic filament 1, whether single or double spiral, before it is mounted in the lamp receptacle, into a solution of a nitrate or acetate of thorium, zirconium or magnesium. To this solution nitrates or acetates of cerium, lanthanum or praseodymium or similar rare earth metals may be added to the extent of about 0.5% to 10%. There may also be added to this solution, with advantageous results, threads of organic fibers such as wool, artificial silk, ramie fiber and the like. Thus there is imparted to the filament a coating of the solution around and between the individual filament windings. The metal filament is now removed from the solution and mounted in the lamp receptacle by connecting the binding terminals 2 and 3 in the usual manner, and the current is turned on, preferably while the receptacle is being evacuated. This results in the burning away of the organic fibers and the conversion of the metallic nitrates or acetates to metallic oxides.

There may also be added to the nitrate or acetate solution fibers or threads of inorganic material such as thorium oxide, zirconium oxide or magnesium oxide. These threads may be produced according to known processes such as the extruding of colloidal solutions in the manner employed in the manufacture of artificial silk, or according to known processes of manufacturing glass wool or quartz glass wool.

The combined fibrous material and metallic oxide particles will be found to have arranged themselves into a lattice-like skeleton around and between the individual windings of the filament, as shown, for example, at 4 in the drawing and in some instances within the cylindrical space enclosed by the spiral. It may sometimes be advantageous to form a loose bundle or assembly of the threads of inorganic material hereinabove mentioned and to insert these threads in the cylindrical space defined by the turns of the spiral prior to the immersion of the spiral in the acetate or nitrate solution above mentioned. This fibrous, cohesive, elastic structure will serve as a support for the individual windings so that each will retain substantially its normal position even when the filament is heated above the point at which the metal begins to soften. Should some slight displacement of one or more of the individual windings nevertheless occur, the particles of metallic oxide intertwined between the windings will insulate them against contact with each other, thus preventing undesirable short circuiting.

The thickness of this elastic, cohesive skeleton frame will be materially increased if prior to this immersion in the metal nitrate or acetate solution, the spiral is immersed in an acetate or like solution which contains no thorium or like metallic compounds and thereafter is immersed in the metallic solution.

A lamp thus constructed not only has the advantages over former known lamps that heat radiations and short circuiting with consequent premature destruction of the lamp, as above described, are avoided, but in addition, the lamp filament may be heated to a higher temperature than formerly, with consequent increase of light yield from the incandescent filament; and this yield is increased still further because at that temperature the skeleton itself also becomes incandescent.

Practically all of the visible rays of the spectrum will pass through this skeleton so that my lamp will burn with a clear, white light.

I claim as my invention:

1. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous expansible and contractible supporting structure containing a refractory material having a softening point higher than the softening point of the filament.

2. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous lattice-like supporting structure containing fiber ash and a refractory material having a softening point higher than the softening point of the filament.

3. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous expansible and contractible supporting structure containing an oxide of a metal selected from the group consisting of thorium, zirconium and magnesium.

4. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous lattice-like supporting structure containing fiber ash and a plurality of oxides of metals selected from the group consisting of thorium, zirconium and magnesium.

5. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous expansible and contractible supporting structure containing a plurality of oxides of one or more metals from the group consisting of thorium, zirconium and magnesium, and oxides of metals selected from the group consisting of cerium, lanthanum and praseodymium.

6. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous lattice-like structure containing fiber ash, an oxide of a metal selected from the group consisting of thorium, zirconium and magnesium, and an oxide of a metal selected from the group consisting of cerium, lanthanum and praseodymium.

7. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous expansible and contractible supporting structure containing thorium oxide.

8. An electric lamp comprising, in combination, a lamp body, a spirally wound metallic filament mounted within said lamp body, and means to retain the spiral turns of the filament in proper relative position comprising a porous lattice-like supporting structure containing fiber ash and thorium oxide.

9. In an electric incandescent lamp, a filamentary element capable of being rendered incandescent comprising, a spirally wound refractory metallic filament, the individual convolutions of which are held in proper relative position by the threads of a porous, cohesive, expansible and contractible supporting structure of refractory material of higher softening point than that of the filament, intertwined around, between, and within the space enclosed by, said convolutions, and having interwoven therethrough as an integral part thereof, threads of fibrous material.

10. In an electric incandescent lamp, a filamentary element capable of being rendered incandescent, comprising, a spirally wound refractory metallic filament, the individual convolutions of which are held in proper relative position by the threads of a porous, cohesive, expansible and contractible supporting body of refractory material of higher softening point than that of the filament, intertwined around, between, and within the space enclosed by, said convolutions, and having interwoven therethrough as an integral part thereof, threads of fibrous material from which all combustible matter has been burned away.

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