Oct. 22, 1935. S. RUBEN 2,018,470

INCANDESCENT LAMP, FILAMENT THEREFOR AND PROCESS AND APPARATUS FOR MAKING THE SAME

Filed Sept. 23, 1929

Fig. 1.

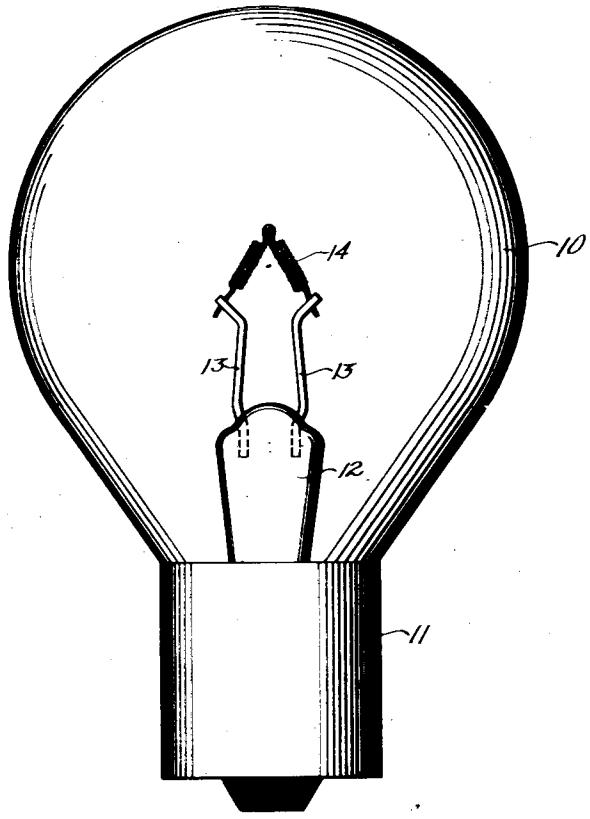
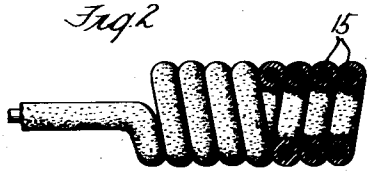


Fig. 2



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Patented Oct. 22, 1935 2,018,470

UNITED STATES PATENT OFFICE

2,018,470

INCANDESCENT LAMP, FILAMENT THEREFOR AND PROCESS AND APPARATUS FOR MAKING THE SAME

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Application September 23, 1929, Serial No. 394,649

2 Claims. (Cl. 176—131)

This invention relates to incandescent lamps, filaments therefor and process and apparatus for making the same. More specifically, the invention relates to a new type of electric lamp suitable for use in house lighting, automobile lighting, projector illumination and various other types of illuminating devices. The invention also pertains to a coated filament adapted to be heated by the passage of electricity therethrough which is an improvement over the ordinary simple form of tungsten filament.

Among the objects of the invention is the provision of a filament adapted for use in lamps and other means of light projection and illumination, having a core or base of refractory material such as tungsten on which is placed a coating having a material rich in light emitting characteristics, whereby a relatively high luminous efficiency is obtained.

Another object is to provide a filament in an electric lamp which consists of a core and a coating, the coating having bonding means to effectively unite the material of the coating to the core so that there is minimum loss of heat efficiency intermediate the core and the coating when the filament is utilized as an illuminant for electric lamps.

Still another object of the invention is to provide a bonding agent between a highly luminous coating and a refractory filamentary core which has high melting point characteristics similar to that of the material of the coating and core.

Another object involves the formation of an incandescent lamp of the gas-filled type, wherein pressure requisite to diminish the vaporization of the filamentary material is low relative to that of the ordinary gas-filled lamp.

Additional objects of the invention are the provision of a lamp which will operate with efficiency greater than that of the tungsten lamp and to provide a process and apparatus for manufacturing the improved filament and lamp.

Other objects will appear from the detailed description following, and from the drawing accompanying the description, in which

Fig. 1 is a view of an ordinary type of automobile lamp provided with a filament of the improved type herein set forth; and

Fig. 2 is an enlarged fragmentary view of a section of the lamp filament.

The use of tungsten and similar refractory filamentary substances as filaments for electric lamps is well known. Attempts to improve on tungsten for electric lamps have been made by many inventors, not only by substitution of the material but by the addition of other elements or compounds either as a part of the tungsten material or as a coating. The results of most of these investigations and researches, however, have been negative to the extent that the efficiency increases, if any, were too small to have practical value, especially as compared with the rigidity and refractory characteristics and high illuminating ability of tungsten.

Certain compounds have been known such as the material of the Welsbach burner and the Nernst glower which have a relatively high light radiation in the luminous range of temperatures, and efforts have been made to combine these and similar materials as a coating to a refractory core such as tungsten and molybdenum. None of these attempts, however, have achieved noteworthy success and my searches have indicated that the cause might be attributed to loss of heat energy between the coating and the core so that the effect of the coated filament was undesirable, the filament having a lesser efficiency than if tungsten alone were used.

I have succeeded in overcoming the difficulties above mentioned in the coated filament by utilizing a highly refractory material as a coating which does not have a tendency to become a good conductor when heated, and also by developing a bonding agent which secures a very intimate and permanent contact between the core and the coating, thus effectively diminishing the heat gradient between the coating and the core, and increasing the lamp efficiency.

As the core material, tungsten is preferably used, although molybdenum or other refractory metals or substances may be employed. This filamentary core is coated by a mixture of thorium oxide or thoria and cerium oxide or ceria, bound together into the core by means of boron oxide. The thoria-ceria mixture is made by heating a water solution of commercial thorium nitrate and cerium nitrate, the proportion being by weight 99% of thorium nitrate and 1% of cerium nitrate. This material is heated so as to be completely evaporated and then to the decomposition temperature, thus leaving a mixture of thoria and ceria, the proportion by weight being approximately 99% thoria and 1% ceria. To this mixture is added 25% by weight of crystallized commercial boric acid of various compositions (such for example, as $3H_2O$, B_2O_3 or H_3BO_3 or $B(OH)_3$ or $H_2B_4O_7$), and enough water to form a thin paste. The entire mixture is then ground in a ball mill of an ordinary type, preferably for a period of about twenty (20) hours, so as to give an intimate

and finely grained mixture, which is then in condition appropriate for coating on the filament.

As utilized for incandescent electric lamps, the coating mixture may now be applied directly to the formed filaments. Prior to the coating operation, however, the filaments should be thoroughly cleaned with a solution made of caustic soda and the coating may then be applied by appropriate means as a thin layer on the filament. The coating as applied has sufficient consistency so that it adheres to the filament until it is properly secured to its base in the lamp and then placed on the pump racks and subjected to exhaustion by vacuum pumps. When the proper degree of exhaustion has been obtained, the lamp filaments are slowly heated by electric current until the gas and vapor of the filament and base have been removed and the material of the filament coating sinters. After sintering, the lamps are available for illuminating purposes and the filament may be brought to an incandescent temperature; but in the form of lamp herein described, in order to prolong the life of the lamp by decreasing the vaporization rate of the filament, gas is introduced into the lamp bulb after the sintering operation at low pressures in a range not exceeding 75 millimeters, and preferably in the neighborhood of 25 millimeters. Argon gas is desirable for this purpose, although nitrogen is also available and may be used with good results. Other gases having a low heat conductivity and inert chemical characteristics may also be used.

Referring to the drawing, there is indicated in Fig. 1 an ordinary type of automobile lamp for headlamps having an envelope 10, base 11, stem 12, filament supports 13, and a coiled filament 14. In Fig. 2, the enlarged detail shows a wire core 15 of tungsten or similar material, on which is affixed the coating 16 consisting of a mixture of boron oxide, thoria and ceria.

Both thoria and ceria have high melting points and when combined as a mixture in the proportions stated, have high selective luminosity when heated to the luminous range of temperatures. When used alone, however, and with other types of binders, this mixture becomes a fairly good conductor at high temperatures, thus bringing about undesirable current and electrolytic effects. Boric acid used as a binder in the present invention is converted to boric oxide in the neighborhood of 1000° C. which also at that temperature is plastic and thoroughly binds the radiant layer to the tungsten base, giving an integral structure with a negligible temperature gradient between the base and radiator. Moreover, boric oxide is an excellent resistant material at high temperatures and, therefore, will not conduct any appreciable quantities of current so that the deficiencies above noted with reference to thoria and ceria alone are nullified by the intimate intermixture of the poorly conducting boric oxide.

By the process as herein above described, applicant has developed a filament which is highly refractory, which has a surfacing of selectively luminous radiating material and which material is intimately bound to the refractory base material so that heat losses between the surfacing or coating and the base are negligible. By this means, when employed in the bulb containing argon, for example, under low pressures, an electric lamp is provided which has an efficiency exceeding that of a lamp with a tungsten filament as measured in watts per candle power.

Various modifications may, of course, be made of the exact process and products described, and therefore the terms of the claims hereto appended are to be interpreted in their broadest sense.

Having thus described my invention, what I claim is:

1. A filament for an electric lamp comprising a refractory metal wire and a coating thereon formed of a mixture of approximately 99% of thorium oxide and 1% of cerium oxide through which boric acid is uniformly distributed to the extent of 25% of the thorium and cerium oxide mixture.

2. A filament for an electric lamp comprising a refractory metal wire and a coating thereon formed of a mixture of approximately 99% of thorium oxide and 1% of cerium oxide through which boron oxide is uniformly distributed to an extent less than 25% by weight of the mixture of thorium and cerium oxide.

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