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GETTER AND METHOD OF APPLYING THE SAME.

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This invention relates to electrical devices such as electron tubes and incandescent electric lamps, and has special reference to means for improving the quality thereof.

An object of this invention is the provision of a method of introducing desirable materials into electrical devices of the above character without the simultaneous introduction of substances deleterious to the same.

Another object of the present invention is the provision of simple and improved means for maintaining the candle power and increasing the efficiency of incandescent lamps.

Other objects of this invention will be apparent from a reading of the following specification.

While the present invention has many applications and is particularly useful in the manufacture of certain forms of electrical devices, it will hereinafter be set forth, for purposes of description, as directed to the manufacture of incandescent electric lamps of the vacuum type.

In the manufacture of incandescent electric lamps, there remains, after the evacuation of a bulb, a small amount of residual gas which it is not economical to withdraw. Further, after the completion of the manufacture of a lamp small amounts of gases or vapors are evolved from parts of the same when heated during operation. It is desirable to dispose of those vapors and gases in a manner which renders them harmless to the lamp.

Furthermore, on account of the high temperature at which the lamp is operated, portions of the filament vaporize and are condensed on the inner surface of the bulb, forming a dark colored deposit which decreases the amount of light emitted from the lamp. In order to maintain the candle power of the lamp it is highly desirable to nullify the effect of this obscuring deposit.

Various chemicals known as getters have been introduced into incandescent lamps for the purpose of eliminating deleterious gases and vapors and counteracting the obscuring effect of distilled filamentary material which condenses on the bulb of the lamp.

For obvious reasons these chemicals are introduced into the lamp in a comparatively fine state of sub-division, such as in granular form, and they are preferably disposed within the lamp in such a position that they may be activated by the normal operation of the same. In practice, these chemicals or getters are preferably placed on the filament or on the filament-supports of the lamp.

It is necessary to supply means for causing the granulated getter to adhere to the material to which it is applied, since the chemicals which have been found useful as getters are not of an adhesive nature. It has heretofore been the practice to mix the comminuted getter with an adhesive binding agent to cause the getter to adhere to the parts of the lamp to which it was applied. The use of a binding agent, however, has by so much, complicated the manufacture of incandescent electric lamps and introduced a material which was not in itself a getter and very frequently impaired the efficiency of lamps. Of the binding agents which have been used for these purposes, organic chemicals have been preferred as being less harmful to lamp parts than certain inorganic binders which have been proposed.

Nevertheless, many disadvantages and defects are inherent in organic binders. The objectionable properites of an organic binder manifest themselves when such binders are decomposed by the heat which is used to activate the getter material. The decomposition of the organic binder results in an evolution of electrically conducting gases which may cause the lamp to become short circuited between the leading-in wires, and further leaves a residual amount of carbon which combines with the filament, if of a metallic nature, to form carbides which greatly impair the strength of the filamentary material. To eliminate the considerable quantity of gases evolved in the decomposition of the organic binder, it has been the practice heretofore, to introduce into a lamp a material, such as phosphorus, which would react chemically with the evolved gases to form solid compounds of low vapor pressure. The introduction of a substance such as phosphorus for the purpose of removing harmful gases was not only a needless step, in view of the present invention, but by its presence, originated further difficulties; for instance, an excess of phosphorus beyond the amount required to combine with the evolved gases caused the lamp bulb to acquire an obscuring deposit which varied

from reddish brown to a yellow color, depending upon the amount of excess phosphorus. Furthermore, even in the presence of a substance such as phosphorus, the evolution of gas resulting from the decomposition of the organic binder necessitated the use of auxiliary apparatus to guard against arcs during the activation of the getter.

Aside from the deleterious effects of an organic binder, the method of thus affixing the getter within the lamp did not prove very satisfactory inasmuch as the getter was not capable of resisting even slight abrasions which normally occur during the process of manufacturing lamps.

It is known that finely divided material adsorbs a comparatively large quantity of gas if exposed to the same, and the amount adsorbed is proportional to the surface area. For this reason, the prior method of introducing getter into a lamp in pulverized form, although necessary, was the means for carrying into the lamp a quantity of undesirable gases adsorbed in the getter, which were liberated later when the getter was activated.

The present invention contemplates a method of firmly affixing a getter to one or more of the parts of a lamp without the use of a binding material. It also aims to provide a method of introducing a getter into a lamp in a manner to render the getter substantially free from adsorbed gases. By eliminating these factors which introduce extraneous gases into a lamp, the present invention thereby removes the necessity of providing a substance such as phosphorus to combine with such gases. It has been found that the small amount of residual gases remaining in a lamp after exhaustion may be efficiently disposed of by the same material which is introduced to offset the obscuring effect of volatilized filamentary material.

Many kinds of material may be used as a getter and various modes of accomplishing the desired results may be contrived, but the following description of a method of applying my invention will be given only as a preferred form.

The present invention contemplates the reduction of the surface area of the pulverized getter, whereby the adsorbed gas may be expelled from the same. This reduction of surface area leaves the getter in an optimum condition for minimum subsequent gaseous adsorption. As a method of expelling adsorbed gases the surface area is preferably reduced by fusing the getter. If the getter is fused to a lamp part means is thereby afforded for firmly affixing the getter to the lamp part.

The fusion of a getter into a mass of small surface contributes a further advantage when certain chemicals are used, in that such chemicals may be converted from a soluble to an insoluble state. This conversion may be stated as being a change from a hygroscopic to a non-hygroscopic condition. When it is noted that an exceedingly small amount of water vapor within an incandescent lamp can render the lamp useless within a very short period of time, it is apparent that a method for rendering a getter non-hygroscopic is very valuable in the art under consideration.

The getter is preferably disposed within the lamp in such position that it may be activated by heat developed by the incandescent filament thereof; such disposition may be on the lamp filament or on the supports thereof. The activation may consist in elevating the temperature of the getter to its reaction temperature, at which point it combines either chemically or physically with the residual gases, and thus renders them inactive. The activation may proceed to the point of vaporization of the getter to cause the same to act as an agent for nullifying the obscuring effect of volatilized filamentary material when the former is condensed on the inner side of the lamp bulb. The getter to be distilled on the lamp bulb is preferably colorless so as to form an invisible deposit. This deposit of distilled getter, according to a proposed theory, provides an indented surface of greater area than the smooth surface of a lamp, by which the obscuring effect of distilled filamentary material per unit area of bulb surface is diminished.

The method of distilling the getter is a means for combining with, or otherwise removing, the small amount of residual gas, since it is known that the distillation of a material in a vessel containing a small amount of gas adsorbs the gas while in the vaporized state and retains it when condensed; since the getter in the present instance is deposited on the comparatively cool surface of the lamp the adsorbed gas will not be re-evolved.

The getter material, according to the present invention, is preferably granulated and added to a liquid medium such as water, to form either a solution or a suspension, which is preferably applied to the filamentary material before the latter is mounted on the stem of the lamp. The getter preparation may be applied by passing a heated filamentary material, such as tungsten, through it. It is preferred to heat the wire while passing it through the getter preparation, as the heat serves to immediately dehydrate the preparation and to cause it to temporarily adhere to the filamentary material. The heating of the wire is continued after it has passed through the getter material, the temperature of the wire then being raised to

the fusion point of the getter. This process firmly affixes the getter to the filamentary material and at the same time expels the adsorbed gases and reduces the surface area so as to render it less adsorbent to gases.

The method of heating the wire by an electric current has been found to be very simple and efficient and is the preferred mode of heating. In applying the getter it is not necessary to perform the operation in an inert atmosphere although the filamentary material is raised to oxidation temperature, inasmuch as the wire is protected from the atmosphere by the coating of getter.

It has been found that the fused coating of getter strengthens a filamentary material, such as tungsten, so that the latter may be more readily handled without breaking. This additional strength is especially valuable in filament wire of very small diameter as such wire breaks very readily. Similarly, the fused coating further facilitates the manipulation of such filamentary material by lending to it qualities which prevent the wire from tangling and kinking.

The filamentary material with its fused coating of getter is mounted within the lamp in the usual manner, and after the evacuation and sealing of the envelope, the lamp is lighted at its designed potential, without the necessity of auxiliary apparatus to guard against short circuits therein, inasmuch as there is not present a sufficient quantity of gases to permit gaseous conduction at lamp voltages.

The incandescent filament serves to vaporize the getter, which, in the vapor state, combines with the small amount of residual gas either chemically or physically and, reaching the comparatively cool surface of the bulb, is condensed on the bulb as an invisible deposit and there serves its function of adsorbing the ordinarily obscuring deposit of filamentary material, according to the theory stated above.

The double fluoride of sodium and aluminum, known as cryolite, is an instance of a getter which has been applied in the manner described and which functions as stated in the foregoing exposition. This material in granular form may be suspended in water in any desired quantity, depending on the predetermined amount calculated as being necessary to maintain the candle power and increase the efficiency of an incandescent lamp.

Experience has shown that wire gettered according to the present invention resists the ordinary abrasion which may occur in manufacturing manipulations, and maintains itself on the wire to the full quantity as applied. This is a distinct advantage inasmuch as the amount of getter applied is a predetermined quantity calculated as being the optimum for making the most efficient lamp.

The present invention is also valuable in the manufacture of vacuum or gas filled tubes which employ an electron-emitting element. Such elements of electron tubes may consist of an electrode coated with materials, such as oxides, which function as the major electron-emitting element. It is necessary that the electron emission from such coated electrodes be constant in quantity, which requires that the coating be maintained on the electrode without loss therefrom. The method disclosed in the present invention of firmly affixing such a coating to an electrode will therefore be valuable in the manufacture of electron tubes.

It will be appreciated from the foregoing that the present invention accomplishes the objects of the invention and that it is a considerable advance over the prior art.

It is to be understood that in appreciating this invention the scope thereof is not to be limited to the specific illustrations cited herein but is confined only by the scope of the invention as set forth in the appended claims.

What is claimed is:

1. The step in the manufacture of a vacuum electric device employing a filament which consists in fusing onto the filament of such a device, prior to incorporation of the filament into the device, a uniformly distributed layer of a vaporizable material which is beneficial to the operation of the same.

2. The method of affixing a powdered getter material to a filament which consists in suspending the getter material in a liquid, passing the filament through the suspension in a heated condition and subsequently fusing the getter material onto the filament.

3. The method of uniting a getter substance in powder form to a filamentary substance which comprises heating one of said substances in contact with the other to a sufficient degree so as to fuse the getter substance to the filamentary substance and allowing the getter to solidify thereon.

4. The method of affixing a getter free from a binder to a filamentary material, which consists in coating the filamentary material with a getter and heating said getter to a temperature sufficient to fuse the same to the filamentary material and allowing the getter to solidify thereon.

5. The method of affixing a cryolite getter free from a binder to a filamentary material, which consists in coating the filamentary material with cryolite, heating said cryolite to a temperature sufficient to expel absorbed gases therefrom and to cause said cryolite to fuse and adhere to the filamentary material and allowing the getter to solidify thereon.

6. The method of affixing a getter free

from a binder to a filamentary material, which consists in applying a coating of cryolite to tungsten wire, heating said wire to a sufficiently high temperature to cause the cryolite to fuse and allowing the fused cryolite to solidify on the filamentary material.

7. The method of facilitating the manipulation of a filament of small diameter, which consists in fusing a coating of cryolite on the filament.

8. An electric device comprising an evacuated sealed envelope and a filament having a coating of cryolite fused and solidified thereon.

9. An incandescent electric lamp comprising an evacuated sealed envelope and a filament having thereon a fused and solidified coating of a getter substantially free from substances capable of evolving deleterious gases.

10. In an incandescent electric lamp, a getter in a fused and solidified condition substantially freed from substances capable of evolving deleterious gases, said getter being disposed so as to combine with free gases within the lamp and to form a non-obscuring deposit with the distilled portion of filamentary material in the envelope of said lamp.

In testimony whereof, I have hereunto subscribed my name this 17th day of May, 1921.

DUNCAN MacRAE.