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METHOD OF LAMP MANUFACTURE

No Drawing. Application filed November 27, 1929. Serial No. 410,259.

This invention relates to incandescent electric lamps and more particularly to incandescent electric lamps of the evacuated type and to the methods of manufacturing the same, and is an improvement in the process disclosed in my copending applications Serial No. 337,536 filed February 4, 1929 and Serial No. 399,877 filed October 15, 1929, which applications are assigned to the same assignee as the present invention.

It is one of the objects of this invention to provide an improved method of manufacturing incandescent electric lamps of the evacuated type.

It is another object of this invention to provide a suitable getter material for incandescent electric lamps of the evacuated type.

It is another object of this invention to provide a getter material, useful in the manufacture of incandescent electric lamps of the evacuated type, which will effect substantial clean up of residual amounts of the relatively inert gases, such as nitrogen, and which will also liberate within the device a proportion of readily vaporized highly reactive material for the effective clean up of gases that may be subsequently evolved within the device from the filament and the surface of the enclosing glass envelope during the operating life of the lamp.

Other objects and advantages will become apparent as the invention is more fully disclosed.

In copending application Serial No. 337,536 above identified, is disclosed the use of a low temperature reducing flush gas comprised substantially of an admixture of nitrogen, carbon monoxide and hydrogen known in the art as "water gas," in incandescent lamp and radio tube manufacture for the purpose of effecting the removal of surface metal oxides from the incorporated metal parts of the device.

The specific embodiment discloses the method I employ in the manufacture of incandescent lamps of the gas filled type. In such devices the residual amounts of the flush gas remaining is beneficial in that the small proportion of reducing flush gas present, and in particular carbon monoxide and hydrogen, is beneficial in some manner to the luminous efficiency of the device.

In employing this type of reducing flush gas in the manufacture of incandescent lamps and thermionic devices of the high vacuum type it is found that even under the most rigid manufacturing control the evacuation of the device by mechanical exhaust methods is incomplete and that residual amounts of the reducing flush gas remain within the device, and the usual type getter material heretofore employed does not substantially effect the removal thereof.

In copending application Serial No. 399,877 above identified, I have disclosed a method of manufacturing incandescent lamps and electron discharge devices of the high vacuo type employing the same type of reducing flush gas set forth in application Serial No. 337,536, wherein the residual gases remaining from the mechanical exhaust of the device are substantially removed by means of a "getter material" comprised at least in part of a rare refractory metal powder which is reactive with said gases. It is contemplated in this second copending application that the getter composition employed should be comprised at least in part of rare refractory metal powders and in particular, in part of zirconium metal powder.

I have found that such a type getter material is particularly effective in cleaning up residual gases in evacuated electric devices, such as thermionic devices, gas filled rectifiers, X-ray tubes and the like, wherein it is undesirable to employ the readily vaporizable highly reactive metals magnesium, aluminium, alkali, alkaline earth metals or misch metal getters which have heretofore been employed in the art.

In incandescent electric lamps of the evacuated type it appears highly essential and desirable that a proportion of getter material should be present within the device to react with deleterious impurities volatilized from the incandesced filament or the heat enclosing glass envelope during the operating life of the lamp. The use of the getter composition set forth in copending application Serial No. 399,877 above identified, effects initially

a substantial clean up of the residual gases of the evacuated envelope and produces a marked improvement in the life and maintenance of the lamp.

I have found, however, that it is inexpedient to incorporate the getter material within a getter helmet in a manner such as has heretofore been employed in thermionic devices, radio tubes and the like, which getter helmet is positioned with respect to the remaining parts of the lamp so that it is not substantially subjected to heat during the manufacturing process. The getter composition, therefore, is applied to the surface of the lamp filament in the customary manner heretofore employed with the usual type cryolite-phosphorus getter composition, as a result the getter material is subjected to the same deleterious heating as has been heretofore experienced, and the rare refractory metal component thereof is at least in part oxidized or rendered inert to serve most efficiently as a clean up agent when subsequently flashed from the filament.

In copending application Serial No. 410,257 filed November 27, 1929, by Ewald Dietz, entitled "Getter for incandescent electric lamps" is disclosed the use of a metal phosphide, specifically copper phosphide, in the place of the usual phosphorus in the getter composition heretofore applied to incandescent lamp filaments.

The advantage obtained through the use of the metal phosphide in place of phosphorus in a getter composition is primarily that the metal phosphide compound is substantially stable at the elevated temperatures, customarily employed in the baking out of the enclosing glass envelope of an incandescent lamp during the sealing in and exhaust operations of the manufacturing process, and that they may subsequently be thermally decomposed into their component elements, metal and phosphorus, by heating the phosphide to more elevated temperatures. In effect then, the phosphorus of the getter is fixed within the getter composition as an inert compound and subsequent to exhaust liberated within the device by the thermal decomposition of the inert phosphide compound.

In the manufacture of incandescent electric lamps of the evacuated type employing the reducing flush gas set forth in my copending application Serial No. 337,536, it is highly essential that not only should the residual flush gas be cleaned up, but that a proportion of a getter material should be evolved therein, which would be reactive with deleterious gases and vapors evolved from the filament during subsequent incandescence or liberated from the enclosing glass envelope during the operating life of the lamp.

It should be appreciated that under present day manufacturing conditions the filament of the lamp is not subjected to degasification prior to sealing off as is customarily done with the metal parts of evacuated devices of the electron emitting or thermionic type. Therefore, there is evolved from the lamp filament a certain gas content during the operating life of the same, which gases are particularly deleterious to the operating life and efficiency of the lamp.

In accordance with the objects of my invention, as above set forth, I have found that incandescent electric lamps of the evacuated type are substantially improved by subjecting the metal parts thereof to the surface cleansing action of the reducing flush gas in accordance with the invention set forth in copending application Serial No. 337,536 above identified.

I have also found that the inert residual gases of an evacuated device, which has been flushed by this reducing flush gas, may be substantially removed by incandescing therein a proportion of a rare refractory metal powder. I have also found that it is essential for high operating efficiency of the lamp to provide within the lamp a proportion of phosphorus for the absorption of gases evolved during the operating life of the lamp from the incandescent filament and the enclosing glass envelope. I have found that these three elements may be satisfactorily taken care of by employing a getter material comprised of the usual inert constituent cryolite, sodium ferric fluoride or sodium aluminium fluoride, in accordance with prior practice, to which has been added a proportion of a rare refractory metal phosphide compound, such as zirconium phosphide, thorium phosphide, titanium phosphide and the like.

The specific rare metal phosphide compound may be made in accordance with the process set forth in copending application Serial No. 410,245, filed November 27, 1929, by William C. Lilliendahl and Frank H. Driggs, which application is assigned to the same assignee as the present invention.

In accordance with the practice of the present invention an incandescent electric lamp of the evacuated type is subjected to the following manufacturing process.

The filament, either segmented or coil type, is coated in the customary manner with a getter composition comprised of cryolite containing a proportion of a rare refractory metal phosphide such as zirconium phosphide, titanium phosphide or thorium phosphide, in a sufficient proportion to give from .3% to 40% phosphorus, the specific proportion thereof depending upon the particular size and shape of the enclosing glass envelope of the lamp. Owing to the difficulty of maintaining "dip" or "spray" getter compositions free of moisture, organic suspension medium, such as amylacetate, alcohol, diethyl carbonate and the like solvents within which is dissolved a proportion of

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nitrocellulose binder, are unsatisfactory for general purpose use, as the moisture tends to react with the metal phosphide forming various undesirable decomposition products. I prefer, therefore, to use the dry getter method of gettering filaments such as is set forth and disclosed in copending application Serial No. 277,106, filed May 11, 1928 by D. S. Gustin, which application is assigned to the same assignee as the present invention. The gettered filament is then mounted in the usual manner and incorporated within an enclosing glass envelope by the customary sealing in operation.

The device is then exhausted by mechanical exhaust means and the enclosing glass envelope subjected during the exhaust operation to a baking temperature of from 375° to 600° C. depending upon the particular composition of the enclosing glass envelope. When a fair degree of vacuum has been obtained the device is then flushed with the low temperature reducing gas as set forth in my copending applications Serial No. 375,536 and No. 399,877 above identified, and the metal parts of the lamp cleansed of surface impurities. The reducing flush gas is then removed by the mechanical exhaust means and the evacuated device sealed off without permitting the cleansed metal parts to become exposed to deleterious atmospheric gaseous absorption.

After sealing off the lamp the filament is incandesced and the zirconium phosphide component of the getter, for example, is vaporized and thermally decomposed. The highly reactive zirconium metal component liberated thereby effectually cleans up the residual nitrogen, hydrogen and oxygen of the device and the liberated phosphorus component remains available within the envelope to clean up the oxygen or moisture evolved during the incandescing life of the device from the incandescent filament or from the enclosing walls of the glass envelope or produced therein by reason of certain cyclic reactions heretofore identified in the art.

As a result of the practice of the present invention a material increase in the life and maintenance of incandescent electric lamps is obtained, due it is believed to the eliminating, by use of the reducing flush gas, of surface metal oxide impurities which subsequently deleteriously effect the operating efficiency of the device by interaction with the liberated hydrogen of the incandescent filament.

It is also believed the material increase in life and maintenance is due in large part to the fact that the getter material upon decomposition is comprised in part of a component which is specifically reactive with the substantially inert residual gases of the evacuated device and in part of a vaporizable component which is highly reactive to residual gases which may be evolved subsequent to the initial clean up of the device during operation of the same. This combination of beneficial effects produces a uniformity in lamp quality not heretofore obtainable in lamp manufacture.

From the above description it is apparent that there may be many variations and departures from the specific embodiment herein disclosed without substantially departing from the nature of the present invention as set forth in the following claims:

What is claimed is:

1. The method of cleaning up residual gases in an incandescent electric lamp which comprises thermally decomposing a rare refractory metal phosphide.

2. The method of cleaning up residual gases in an incandescent electric lamp which comprises thermally decomposing zirconium phosphide.

3. The method of cleaning up residual gases in an incandescent electric lamp which comprises vaporizing therein a proportion of a rare refractory metal phosphide.

4. The method of cleaning up residual gases in an incandescent electric lamp which comprises vaporizing therein a proportion of zirconium phosphide.

5. In the manufacture of evacuated incandescent electric lamps, the steps of effecting substantial removal of residual gases which comprises thermally decomposing a proportion of a rare refractory metal phosphide compound.

6. In the manufacture of evacuated incandescent electric lamps, the step of effecting substantial removal of residual gases which comprises thermally decomposing a proportion of zirconium phosphide.

7. The method of manufacturing incandescent electric lamps of the evacuated type which comprises incorporating within the device a getter composition comprised at least in part of a proportion of a rare refractory metal phosphide compound, evacuating the device, flushing the evacuated device, evacuating the flush gas, sealing off the device, and then thermally decomposing the rare refractory metal phosphide component of the getter.

8. The method of manufacturing incandescent electric lamps of the evacuated type which comprises incorporating within the device a getter composition comprised at least in part of a proportion of a rare refractory metal phosphide compound, evacuating the device, baking the device, flushing the device during baking with a low temperature reducing flush gas, evacuating said flush gas, sealing off the device, and then thermally decomposing the rare refractory metal phosphide component of the getter.

9. The method of manufacturing incandescent electric lamps of the evacuated type

which comprises incorporating within the device a getter composition comprised at least in part of a proportion of a rare refractory metal phosphide compound, evacuating the device, flushing the device with "water gas" while maintaining the metal parts of the device at temperatures approximating 375° C. to 450° C. evacuating the flush gas, sealing off the device, and then effecting thermal decomposition of the rare refractory metal component of the getter composition.

10. The method of manufacturing incandescent electric lamps of the evacuated type which comprises incorporating within the device a getter composition comprised at least in part of zirconium phosphide, evacuating the device, flushing the device with a low temperature reducing flush gas comprised of nitrogen, carbon monoxide and a proportion of hydrogen, maintaining the metal parts of the device during the flushing operation at temperatures approximating 375° C. to 450° C. evacuating the flush gas, sealing off the device, and then effecting clean up of residual gases within the device by the thermal decomposition of the zirconium phosphide component of the getter.

11. The method of manufacturing incandescent electric lamps of the evacuated type which comprises applying to the filament prior to incorporation within the lamp a getter composition comprised at least in part of a rare refractory metal phosphide compound, incorporating the gettered filament into a lamp, evacuating the device, cleansing the metal parts with a "water gas" reducing flush gas, evacuating the flush gas, sealing off the device and then cleaning up the residual gases in the device by effecting a vaporization and decomposition of the rare refractory metal component of the getter composition.

12. The method of manufacturing incandescent electric lamps of the evacuated type which comprises applying to the filament prior to incorporation into the lamp a getter composition comprised at least in part of zirconium phosphide, incorporating the gettered filament into a lamp, evacuating the device, cleansing the metal parts with a "water gas" reducing flush gas, evacuating the flush gas, sealing off the device and then cleaning up the residual gases in the device by effecting a vaporization and decomposition of the rare refractory metal component of the getter composition.

13. An evacuated device containing a getter composition comprised at least in part of a rare refractory metal phosphide.

14. An evacuated device comprising a getter composition comprised at least in part of zirconium phosphide.

15. A getter composition for evacuated incandescent electric lamps comprised of an inert material vaporizable at a temperature above 600° C. and a proportion of rare refractory metal phosphide.

16. A getter composition for evacuated incandescent electric lamps comprised of an inert material vaporizable at a temperature above 600° C. and a proportion of zirconium phosphide.

17. A getter composition for evacuated incandescent electric lamps comprised of cryolite and a proportion of rare refractory metal phosphide.

18. A getter composition for evacuated incandescent electric lamps comprised of cryolite and a proportion of zirconium phosphide.

In testimony whereof, I have hereunto subscribed my name this 25th day of November, 1929.

LLOYD D. LOCKWOOD.

