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METHOD FOR CLEANING ELECTRODES

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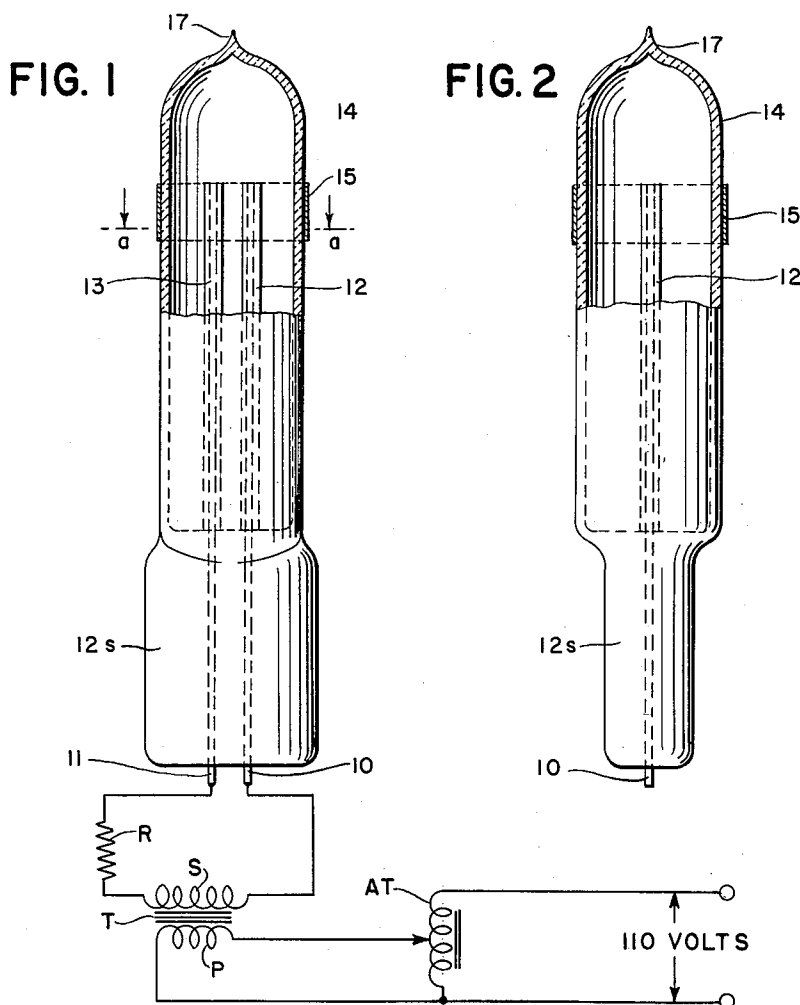
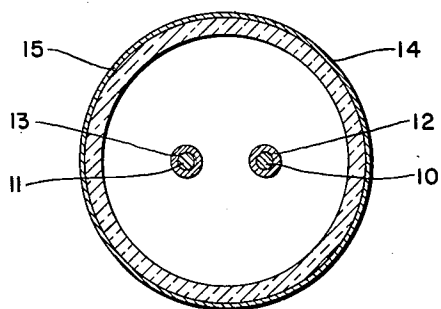


FIG. 3

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METHOD FOR CLEANING ELECTRODES

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4 Claims. (Cl. 316—26)

This invention relates to electron tubes and more particularly to a novel means and method for removing the impurities from the electrodes of tubes.

In gaseous discharge tubes impurities are usually present in the metallic electrode structure used. These impurities may shorten the useful operable life of the tubes. Also, the presence of impurities causes tubes to have a relatively high internal resistance and requires a relatively high R. F. voltage to effect a firing of the tubes or a deionization of the gaseous atmosphere within the tubes.

Accordingly, it is an object of the present invention to provide a novel means and method for eliminating the impurities present in the electrode structure of a tube.

Another object is to utilize heating and cooling means for eliminating impurities present in the metallic electrode structure of a tube.

A further object is to provide a novel method of removing the impurities from the electrodes of a gaseous discharge tube which method includes vaporizing a portion of the metallic electrode structure including the impurities and depositing the same upon the envelope of the tube, subsequently vaporizing the electrode metal deposited upon the envelope and redepositing it upon the same electrodes of the tube.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is an elevation view of a gaseous discharge tube showing means for heating the electrodes,

Fig. 2 is an elevation view of the tube shown in Fig. 1 wherein the tube has been rotated 90° about its longitudinal axis, and

Fig. 3 is a cross-sectional view along line *a—*a** of Fig. 1.

The novel method of the invention will be explained by way of example with specific reference to its use in connection with a gaseous discharge diode. In such a tube impurities in the electrode structure are especially objectionable in that they cause short tube life because of the influence of the impurities upon the ionization and deionization of the gaseous atmosphere within the tube.

Briefly, in the practice of the invention the electrode supports of a tube may be of any suitable type or form such as a wire type nickel alloy. A thin-walled aluminum sleeve is placed over each of these electrode supports. These sleeves serve as the normal operable electrodes of the tube and the usual impurities must be removed from them in order to realize optimum tube operation. Among these impurities, for example, is magnesium, aluminum oxide, occluded gases and dirt. These impurities along with aluminum from the surface of the sleeves are vaporized and partly deposited upon the relatively cool envelope of the tube. The aluminum on the envelope is then vaporized and deposited upon the electrodes. As a result, the surface of the electrodes is substantially free of any

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impurities which adversely affect the operation of the tube.

Referring more particularly to the drawings, the electrode supports 10 and 11 are supported by a standard press seal 12s. The aluminum sleeves 12 and 13 are placed over the electrode supports 10 and 11, respectively. These sleeves are contained within the glass envelope 14 which is filled with any suitable gaseous atmosphere. A conductive band 15 is placed around the envelope 14 as shown. If it is desired to ionize and deionize the tube in response to a change of R. F. voltage, such is accomplished by applying that voltage to the band 15. This band may be of any suitable type and does not constitute part of this invention. For example, a band may be formed from painting the envelope with conductive silver paint to form an annular ring therearound approximately .002 inch in thickness.

The actual spacing and size of the electrode supports is not critical in the performance of the invention. It is merely required that these supports be more heat resistant than the aluminum sleeves 12 and 13 placed thereover. As an example the electrode supports may be .020 inch in diameter and spaced .025 inch apart. The outer diameter of the aluminum sleeve may be .030 inch and the inner diameter of any appropriate size to be received by the electrode supports. The outside diameter of the glass envelope may be approximately 8 millimeters and of standard wall thickness.

The winding of an auto transformer AT is connected to the terminals of a 110 volt A. C. supply and its output is connected to the primary winding *p* of a transformer T having one end of its secondary winding *s* connected to electrode support 10. The other end of the winding *s* is connected through a current limiting resistor R to the electrode support 11. These circuit connections to the electrode supports 10 and 11 are provided to apply a suitable voltage, determined by the positioning of the variable contact of the auto transformer AT, to the aluminum sleeves 12 and 13 as required for carrying out the invention. The impurities are removed from the electrodes after they are placed in the envelope and before the envelope is sealed or the tip-off 17 is formed.

First, the envelope is evacuated and is heated by means of an oven or torch to a temperature below that which will effect a softening of the glass, that is, below approximately 300° C. This heat effects a cleaning of the glass and liberates occluded gases from the glass. The gases thus liberated are then pumped out of or evacuated from the envelope.

After evacuation of the liberated gases is effected the pump or evacuating means is rendered ineffective and neon is admitted into the envelope until a pressure of 10 to 15 millimeters of Hg is obtained. The transformer T and the auto transformer AT are now utilized to apply 200 to 250 volts A. C. across the electrode supports 10 and 11 to effect an ionization of the neon between the sleeves 12 and 13. If this voltage is applied for approximately two minutes the aluminum sleeves become very hot and the glass envelope is at a lower temperature. At this time the temperature of the electrodes and the envelope are substantially stable and each approach a state of thermal equilibrium. The voltage applied to the electrode supports is now increased to approximately 300 volts. This causes impurities present in the aluminum sleeves 12 and 13 and a portion of the aluminum of the sleeves to be vaporized and deposited upon the surface of the relatively cool glass envelope. This vaporizing is indicated by a purple glow discharge between the aluminum sleeves and is terminated by manipulation of the arm of transformer AT when a substantially solid sheet of aluminum appears on the walls of the envelope.

The above described heating and vaporizing may also

be accomplished by any gradual heating of the aluminum sleeves which causes the vaporization to take place.

The envelope is again evacuated. The neon previously placed in the tube and the occluded gases liberated by the vaporization are removed.

Evacuation of the envelope is continued. The glass envelope of the tube is again baked or heated. This causes most of the aluminum present on the envelope to be vaporized and to return to the relatively cool aluminum sleeves 12 and 13. Most of the impurities remain on the glass.

Evacuation is continued until the desired vacuum is attained and then it is stopped. The desired gas is admitted, for example, 2 millimeters of argon, then 30 millimeters of neon. The tube is then tipped off or closed. An A. C. voltage is again applied to the electrode supports 10 and 11 to effect ionization of the gas all along the aluminum sleeves 12 and 13 to thereby effect an aging or preoperational conditioning of the tube in a usual manner.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In the manufacture of a gaseous discharge tube having at least two metallic electrodes to be enclosed in an outer envelope the process of eliminating impurities from the electrodes including the following steps; evacuating said envelope while heating said envelope to a temperature less than the melting point thereof to thereby effect a cleaning thereof and liberation of occluded gases therefrom; injecting neon into said tube until a predetermined pressure is realized; applying an alternating current voltage of between 200 and 250 volts across said electrodes to ionize said neon until the temperature of said electrodes and said envelope approach a state of substantial thermal equilibrium; increasing the voltage across said electrodes to approximately 300 volts to vaporize metallic particles and impurities from said electrodes until a substantially opaque metallic sheet is deposited upon said envelope; evacuating said envelope to remove said neon and occluded gases therefrom and heating said envelope to evaporate metallic particles therefrom and deposit them upon the surface of said electrodes thereby providing a substantially pure metallic surface upon the electrodes.

2. The process set forth in claim 1 wherein said elec-

trodes include aluminum sleeves supported upon electrode supports made of a nickel alloy and said envelope is made of glass.

3. In the manufacture of a gaseous discharge tube having at least two aluminum electrodes to be enclosed in an outer glass envelope the process of eliminating impurities from the electrodes which includes the following steps; evacuating said envelope while heating said envelope to a temperature less than the melting point thereof to thereby effect a cleaning thereof and liberation of occluded gases therefrom; injecting neon into said envelope until a predetermined pressure is realized; applying A. C. voltage of between 200 and 250 volts across said electrodes to ionize said neon until the temperature of said electrodes and said envelope approach a state of thermal equilibrium; applying heat to said electrodes to vaporize aluminum particles and impurities from said electrodes until a substantially opaque aluminum sheet is deposited upon said envelope; evacuating said envelope to remove said neon and occluded gases therefrom and heating said envelope to evaporate aluminum particles therefrom and deposit them upon the surface of said electrodes thereby providing a substantially pure metallic surface upon the electrodes.

4. In the manufacture of a gaseous discharge tube having at least two metal electrodes to be enclosed in an outer glass envelope the process of eliminating impurities from the electrodes which includes the following steps: evacuating said envelope while heating said envelope to a temperature less than the melting point thereof to thereby effect a cleaning thereof and liberation of occluded gases therefrom; injecting an inert gas into said envelope until a predetermined pressure is realized; applying an alternating current voltage of between 200 and 250 volts across said electrodes to ionize said inert gas until the temperature of said electrodes and said envelope approach a state of thermal equilibrium; applying heat to said electrodes to vaporize metal particles and impurities from said electrodes until a substantially opaque metal sheet is deposited upon said envelope; evacuating said envelope to remove said inert gas and occluded gases therefrom and heating said envelope to evaporate metal particles therefrom and deposit them upon the surface of said electrodes thereby providing a substantially pure metallic surface upon the electrodes.

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