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METHOD OF DEGASIFYING ELECTRON DISCHARGE TUBES

Filed Jan. 7, 1931

Fig. 1.

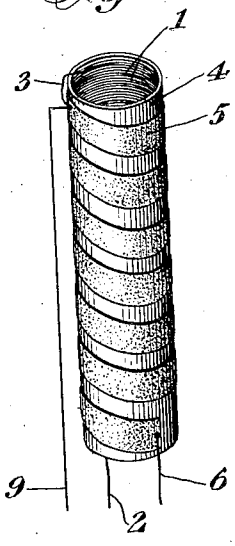
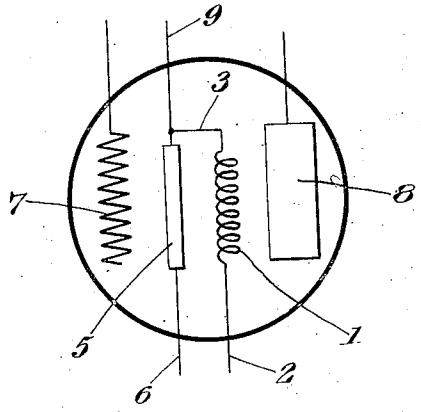


Fig. 2.



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METHOD OF DEGASIFYING ELECTRON DISCHARGE TUBES

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8 Claims. (Cl. 250—27.5)

This invention relates to a method of degasifying electron discharge tubes having a high resistance heater-cathode operating at high voltage such as the heater-cathode disclosed in the copending application of David A. Barnett, Serial No. 507,133, filed Jan. 7, 1931, entitled Electrode for electron-discharge devices.

An object of the invention is to provide a method whereby the electron emissive compound with which the cathode is coated may be thoroughly converted to the basic oxides and the gas eliminated without danger of flash-over of the current with resulting destruction of the heater coil during the conversion and degasifying.

Referring to the existing art upon which my invention is an improvement, the usual tubes, either of the filament cathode or the separately heated cathode type, have heating elements operative only with a current source of low voltage and, therefore, can be connected to a similar source of low voltage during the conversion of the emissive material and its degasification.

The emissive material most commonly used for coating the cathode consists principally of barium and strontium carbonates mixed with a suitable binder for spraying or painting on the cathode surface. Such carbonates are stable on exposure to ordinary atmospheric conditions while the basic oxides to which they are converted for best emission are deliquescent. The carbonates coated on the cathode mounted in the tube are subjected to temperatures of approximately 1200° C. when exhausting the tube to reduce them to the basic oxides.

In the coated filament type, the conversion of the emissive material and elimination of occluded and liberated gases are accomplished during the pumping process by high frequency bombardment and resultant inductive heating of the plate and grid elements at the same time that low voltage current for the conversion of the carbonates is applied directly to the coated filament.

In the separately heated cathode type of the existing art, degasifying the plate and grid is also accomplished by bombardment and some heat is also impressed inductively on the usual unipotential cathode, but this is chiefly procured by subjecting the heater for the cathode to low voltage current in conjunction with the bombardment.

These methods of the existing art are not applicable to the high voltage series heater-cathode type for the conversion of the emissive material and subsequent degasifying, since any high voltage current applied thereto to convert the carbonates while the tube is on the pumps would cause a flash-over of the current carried by the gas released from the carbonates, resulting in destroying one or more of the tube elements. This flash-over will take place at voltages even as low as 50 volts and, of course, the higher voltages of from 90 to 300 volts normal to the series heater-cathode element cannot be used.

My present invention obviates this by providing a modification of the tube consisting of an auxiliary lead-in wire connected to the junction between the cathode and the heating coil of the high voltage cathode heater element. Further, my invention provides a special method working in conjunction with said modification of the tube whereby the tube can be safely exhausted and freed from the released and occluded gases.

In the accompanying drawing serving to illustrate diagrammatically the modification of the tube, Fig. 1 illustrates one form of a high voltage heater-cathode element of the aforesaid Barnett type shown in enlarged perspective view and modified in accordance with the present invention; and Fig. 2 shows diagrammatically a three element electron discharge tube including a heater-cathode of the type shown in Fig. 1 modified in accordance therewith.

In the drawing, 1 is the high resistance heater coil whose total resistance preferably is such that at voltages as high as that of the usual house lighting service, the current consumption is of the order of a few milli-amperes. This high voltage coil has terminals 2 and 3, and the coil is externally coated by refractory insulating material forming a refractory insulating shell 4 which in turn is surrounded by a ribbon cathode 5 of comparatively large cross-section. This cathode coil 5 is coated with the emissive compound by spraying, painting, or other means. The terminal 3 of the heater coil is connected to one end of the ribbon cathode 5 and forms a union or junction between them. The other terminal of the cathode is designated 6. In other words, the heating coil and the ribbon cathode are connected in series with each other so that when mounted in the tube and energized with the high voltage current, the cathode coil carries not only the current of the heater coil 1 but in addition functions to carry the plate space current of the tube. Thus, the terminal 6 is both a heater coil and cathode terminal of the tube. For the purpose of carrying out the method of the present invention, an additional or auxiliary lead-in wire 9 is provided through the press of the tube connecting with the union or junction 3 between the heating

coil 1 and the cathode 5 so that a low voltage current can be applied to the cathode 5 to the exclusion of the heater coil by connecting said low voltage current to the terminals 9 and 6.

In carrying out the method while the tube is on the pump and has been exhausted to a relatively high degree of vacuum, it may be subjected in the usual manner to the action of a high frequency coil to heat by induction the plate and grid elements to a temperature sufficient to remove from them any occluded gases. Coincident with this heating, a source of low voltage current is connected to the terminal 6 and the auxiliary terminal 9 so that the cathode coil 5 is raised to a temperature sufficient to decompose the constituent carbonates or other emissive compounds with liberation of their gases which through continued pumping are eliminated.

After conversion of the carbonates has been accomplished and the gases have been substantially exhausted from the tube, a high voltage current comparable to or even somewhat greater than that intended for regular operation in radio reception, is or may be applied between the terminals 2 and 9 in conjunction with the continued low voltage current across terminals 6 and 9, or the low voltage current may be disconnected and the high voltage connected directly across terminals 2 and 6 so as to act simultaneously on both the heater coil and the cathode as in the normal operation of this type of tube. In this way, gases occluded in the heater coil are driven out and eliminated.

After the degasifying process, the function of the terminal 9 has been accomplished and this terminal may be cut off short on the outside of the stem of the tube.

The foregoing method has the particular advantage that it can be safely used without any danger of flash-over and destruction of the heating element and further assures thorough conversion of the emissive compound and degasifying.

What I claim is:

1. The method of treating a vacuum tube having a bi-part heater with one of the parts provided with an emissive coating, which includes the steps of first impressing a low voltage across the emissive part of the heater to reduce the emissive coating, and then impressing a high voltage across the non-emissive part of the heater.

2. Method of degasifying electron discharge tubes having a series high resistance heater-cathode, the cathode coated with emissive compound, said method comprising subjecting the elements in the tube to the action of a high frequency current; passing a low voltage current through the cathode part only of the series heater-cathode sufficient to reduce the emissive coating and to liberate gas therefrom without flashing-over; substantially exhausting the tube of said gas; and thereafter passing a high voltage current through the high resistance heater alone to remove occluded gas.

3. Method of degasifying electron discharge tubes having a series high resistance heater-cathode, the cathode coated with emissive compound, said method comprising subjecting the elements in the tube to the action of a high frequency field, passing a low voltage current through the cathode part only of the series heater-cathode sufficient to reduce the emissive coating and liberate gas therefrom without flashing-over; substantially exhausting the tube of said gas; and thereafter passing a high voltage current through the high resistance heater and the cathode to remove occluded gas.

4. Method of degasifying electron discharge tubes having a series high resistance heater-cathode, the cathode coated with emissive compound, which includes passing a low voltage current through the cathode part only of the series heater-cathode sufficient to reduce the emissive coating and to liberate gas therefrom without flashing-over; substantially exhausting the tube of said gas; and thereafter passing a high voltage current through the heater alone to remove occluded gas.

5. Method of degasifying electron discharge tubes having a series high resistance heater-cathode, the cathode coated with emissive compound, which includes passing a low voltage current through the cathode part only of the series heater-cathode sufficient to convert the emissive compound and to liberate gas therefrom without flashing-over; substantially exhausting the tube of said gas; and thereafter passing a high voltage current through the heater and the cathode to remove occluded gas.

6. The method of treating a vacuum tube having a bi-part heater with one of the parts provided with an emissive coating, which includes the steps of first impressing a low voltage across the emissive part only of the heater to reduce the emissive coating, and then impressing a high voltage across both parts of the heater in series.

7. The method of treating a vacuum tube having a bi-part heater with one of the parts provided with an emissive coating, which includes the steps of first impressing a low voltage across the emissive part of the heater to reduce the emissive coating; then substantially exhausting the tube of gas, and thereafter impressing a high voltage across the non-emissive part of the heater.

8. The method of treating a vacuum tube having a bi-part heater with one of the parts provided with an emissive coating, which includes the steps of first impressing a low voltage across the emissive part only of the heater to reduce the emissive coating; substantially exhausting the tube of gas, and thereafter impressing a high voltage across both parts of the heater in series.

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