

July 1, 1941.

B. W. KINYON

2,247,688

METHOD OF MAKING ELECTRON DISCHARGE DEVICES

Filed Sept. 19, 1940

Fig. 1

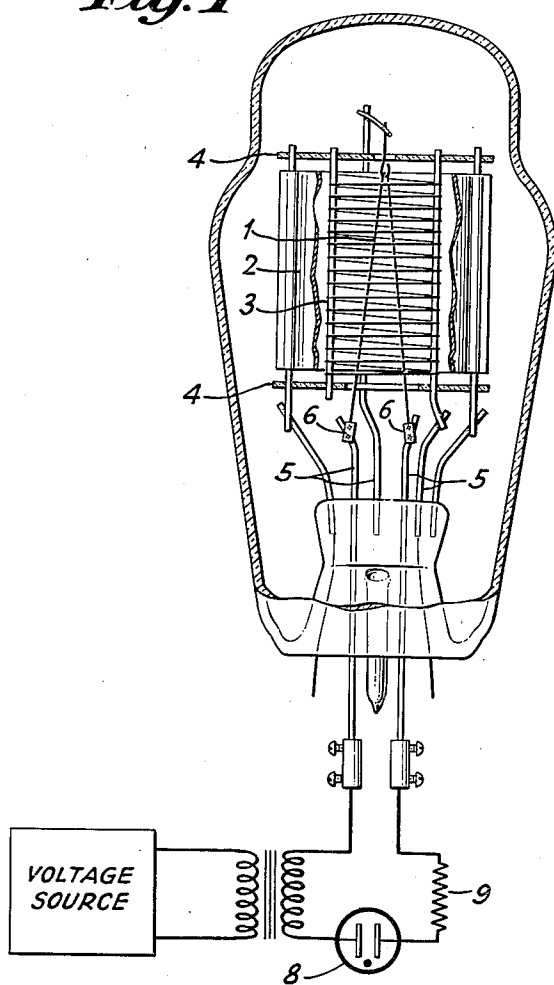


Fig. 2

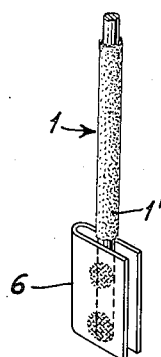
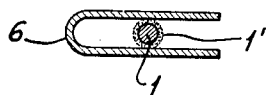


Fig. 3



INVENTOR
BRICE W. KINYON
BY *Charles McClair*
ATTORNEY

UNITED STATES PATENT OFFICE

2,247,688

METHOD OF MAKING ELECTRON
DISCHARGE DEVICESBrice W. Kinyon, Bloomfield, N. J., assignor to
Radio Corporation of America, a corporation of
Delaware

Application September 19, 1940, Serial No. 357,349

3 Claims. (Cl. 250-27.5)

My invention relates to the manufacture of electron discharge devices, particularly to methods of preventing open circuited lead-in conductors.

In the manufacture of radio tubes it is sometimes found that after the tube is sealed the lead-in conductors to some of the electrodes are open circuited. These open circuits usually occur after the envelope is sealed and during heating on exhaust, although tests before sealing may reveal no discontinuity in the circuits of the tube. It is observed these open circuits most often appear in the heating circuit of the cathode.

The object of my invention is an improved method of manufacturing electron discharge devices which will eliminate open circuited lead-in conductors in such devices.

The characteristic features of my invention are defined in the appended claims and one embodiment of the apparatus for carrying out my invention is described in the following specification and shown in the accompanying drawing in which Figure 1 is a sectional view of one conventional electron discharge device treated according to my invention, Figure 2 is a detailed perspective view of a connector for the end of a filament, and Figure 3 is a cross sectional view of a filament connector in which an open circuit exists between the filament and its connector.

The radio tube chosen for illustrating my invention comprises a filament 1, anode 2 and grid 3 assembled between insulating spacers 4 and attached to the inner ends of lead-in conductors 5 in the press of the envelope which is exhausted, by heating and pumping, and sealed off. To prevent burning or breakage of the small filament wire when attached to its lead-in conductors, a metal tab 6 is folded and clamped over each end of the wire and the tab then welded to the inner ends of the lead-in conductors.

The filament wire is usually coated with a layer of metal oxides and while the coating may be scraped from the ends of the filament and clamped in the tabs some of the coating material is frequently caught between the wire and the tab and effectively prevents good electrical contact between the filament and its tab. Often the open circuit does not appear in the heating circuit until after the tube has been sealed in and heat treated on exhaust.

Open circuited filaments are, according to my invention, eliminated by connecting a voltage, high compared to the operating voltage of the cathode, across the filament terminals and limiting the current flow to the current carrying ca-

5 capacity of the filament. A voltage of 60 volts has been found sufficient to force current, limited to 20 milliamperes, through a .001 inch nickel filament wire with a normal operating voltage of 1.4 volts, coated with barium strontium carbonate and clamped at its ends between nickel tabs. To prevent excess current in the filament after the current starts to flow, a current limiting device may be connected in series with filament circuit. Several types of voltage sources may be employed according to my invention, the preferred type being a conventional alternating current source 7 of commercial frequency coupled to the filament lead-in conductors through a gas glow tube 8 and a ballasting resistor 9. Alternatively, the high voltage current limited potential applied to the ends of the filament may be obtained from a charged condenser switched across the filament conductors, the condenser being chosen with a sufficiently high voltage to break down the insulation, and with the proper coulomb capacity to limit the current flow to the current carrying capacity of the filament. A third alternative may be a high voltage-high frequency spark coil or high voltage static machine connected across the filament for applying the necessary high voltage current limited energy to the filament lead-in connectors.

Good results have been obtained in eliminating open filament circuit of tubes commercially known as type 1A7-GT having filaments .0008 inch in diameter with a rated operating voltage of 1.4 volts, by connecting the filament conductors to 110 volts of commercial 60 cycle power through a conventional neon gas glow tube with a series nickel-chromium ballast resistor of 5,000 to 6,000 ohms. Many of the tubes having open circuited filaments thus treated were rendered operative for a long useful life. Though I am not certain, it is my belief that the high voltage applied across the filament terminals of the radio tube arcs through and mechanically breaks down insulating material between the filament wire and its connector tab. It may be that once the arc is established metal from either the filament core or the tab is carried across the gap and welds the filament and its connector together. The filament with the coating of insulating material may of course comprise the usual barium oxide coated wire of a filamentary cathode or the alumina coated heater wire of an indirectly heated cathode. My improved method of manufacturing electron discharge devices salvages such devices having open circuited lead-in conductors and is easy and inexpensive to practice.

I claim:

1. The method of making electron discharge devices with a filament connected at its ends to lead-in conductors and having an insulating film deposited in the junction between one lead-in conductor and one end of the filament comprising applying a voltage, high compared to the operating voltage of the filament, to the external ends of said conductors and limiting the flow of current to the current carrying capacity of said filament.

2. The method of making electron discharge devices with a filament attached at its ends to lead-in conductors, the resistance of the filament-to-conductor junctions of which is high, comprising exhausting and sealing the envelope of said device, applying a voltage across said conductors

sufficiently high to force current through said filament and for sufficient time to insure good electrical contact between the conductors and the filament.

3. The method of manufacturing electron discharge devices with oxide coated filament and lead-in conductors connected to said cathodes comprising exhausting and sealing the envelope of said device, applying a voltage to the connecting junctions of said filament and lead-in conductors, said voltage being sufficiently high to force current through coating material in said junctions, whereby said material in said junction may be broken down, and limiting the current to the current carrying capacity of the filament.

BRICE W. KINYON.