106. COMPOSITIONS, COATING OR PLASTIC

84

Cross Reference

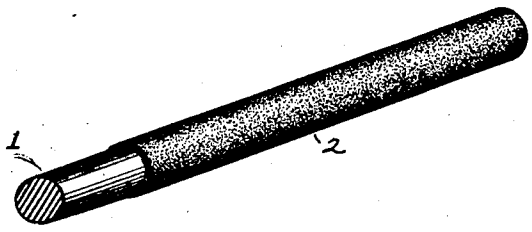
EXAMINER

Oct. 27, 1931. S. RUBEN 1,829,237

HEATER ELEMENT AND METHOD OF MAKING IT

Filed Oct. 11, 1928

117-61



Inventor
SAMUEL RUBEN

By his Attorney W. L. Clephane

Patented Oct. 27, 1931 1,829,237

UNITED STATES PATENT OFFICE

SAMUEL RUBEN, OF NEW YORK, N. Y., ASSIGNOR TO RUBEN TUBE COMPANY, A CORPORATION OF DELAWARE

HEATER ELEMENT AND METHOD OF MAKING IT

Application filed October 11, 1928. Serial No. 311,952.

This invention relates to heater elements and methods of making heater elements for indirectly heating cathodes in electron emission tubes. An object of this invention is the provision of a heater element that will afford long life and a high degree of thermal conduction and radiation to the cathode heater elements in electron emission tubes operating from an alternating current circuit.

The problem of suitable insulation for the member used for indirectly heating cathodes in electron emission tubes involves several important factors; they are, the vapor pressure of the coating, which should be a minimum, so as not to affect the pure electron discharge from the cathode surface; the thermal conductivity of the insulation, which should be as high as possible to maintain at a minimum the temperature gradient between the base heater surface and the exterior radiating or contacting surface; the thermal emissivity of the insulation which should be high in order to obtain maximum radiation; and the insulation resistance which should be as high as practicable, especially at the maximum operating temperatures. The insulation element should be of uniform thickness and should be closely and firmly adherent to the heater base.

Employed in the devices of the prior art to insulate the heater element from the cathode, an insulating tube or other rigid body is used, having spaces provided in it through which the heater wire is extended. In practice this has been usually in the form of a quartz or porcelain tube having bores of small cross section extending through it, for containing the heater wire of such refractory material as tungsten. The inherent drawback to this type of heater is that as the current is initially applied there is an excessive current flow, due to the contact of the heater wire with this relatively large mass of the insulating body; and as the wire contacts with the insulating member only in spots, those parts of the heater wire not so in contact are excessively heated, causing rapid deterioration.

By the terms of my invention a heater element, preferably flexible, with an electrical insulation of the desired properties is employed, by which the heat is uniformly distributed over its length to the cathode; this insures a long life for that member. The heater or resistance wire, such as tungsten, is coated with a layer of finely powdered aluminum oxide that has previously been calcined and mixed with a small percentage of sodium silicate. When this material is properly dried on the wire it is heated in a reducing atmosphere to about 1000° C., all of the undesirable binder material being then volatilized, and the aluminum oxide forming a crystalline layer of corundum. The resultant crystalline layer shows a high thermal conductivity and electrical insulation. A complete reaction between the sodium silicate and the aluminum oxide Al_2O_3 is of importance to obtain the proper crystalline form and surface adhesion. I have found that amorphous aluminum oxide or fused aluminum oxide, such as alundum, does not have the proper composition, and especially it does not adhere sufficiently to the base to withstand vibration or thermo-mechanical action.

The coating is preferably prepared by grinding the calcined aluminum oxide with a sodium silicate solution having a specific gravity of 1.05 until the proper fineness of material is obtained. The surface of the resistance wire base should be previously oxidized by heating for a short period in air, after which the oxide mixture is applied in three evenly distributed coatings, each being allowed to dry before the next is added. The completely coated wire is then slowly passed through a chamber maintained at 1000° C.. and then slowly cooled. The final coating is very tough and has a density of about double its initial density.

I have found that when this insulation is used in a high vacuum device there is a negligible evolution of gas or vapor from it; this permits the application of the heater to uses in which high voltages between the elements are employed.

In a preferred form of construction, the coated heater wire is suspended in and in close surface contact with a nickel cylinder

as the cathode, the exterior surface of which latter member is coated with an alkaline earth oxide for efficient thermo-electronic emission. So employed it has been found that the average insulation resistance between the cathode and the heater element is in the order of 3 megohms. This value varies with the extent and degree of pressure of contact and the size of the crystals of the coating.

Reference is made to the accompanying drawing representing a tungsten wire having an electrical insulation coating; a tungsten wire is represented at 1 and the coating of corundum is indicated at 2.

What I claim is:

1. A method of making a heater element for an electrical discharge device having an indirectly heated cathode element, which consists in coating a refractory metal body with a mixture of calcined aluminum oxide and sodium silicate and heating in a reducing atmosphere until the aluminum oxide crystallizes and forms corundum.

2. The method of insulating a heater element for an indirectly heated cathode of an electrical discharge device which comprises heating said element to form an oxide coating thereon, applying a thin coating of a mixture of powdered aluminum oxide and sodium silicate, allowing said mixture to dry, and heating said element in a reducing atmosphere to about 1000° C.

In testimony whereof SAMUEL RUBEN, has signed his name to this specification this 10th day of October, 1928.

SAMUEL RUBEN.