

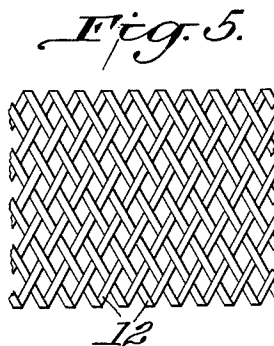
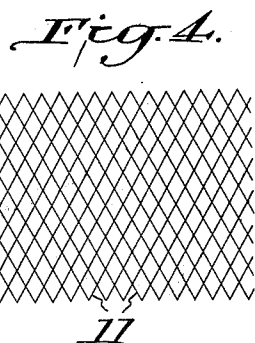
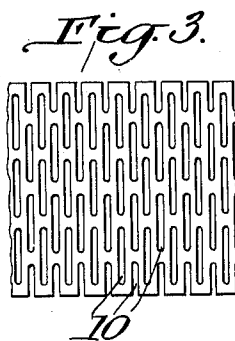
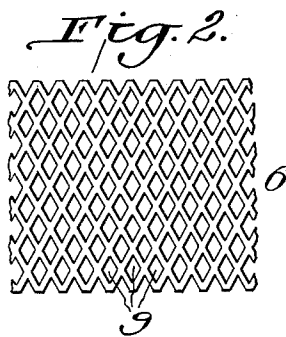
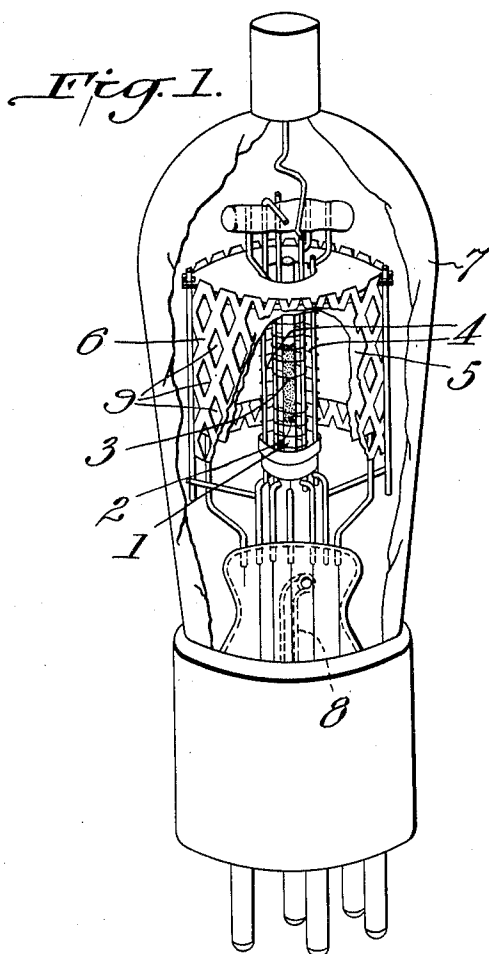
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VACUUM TUBE

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UNITED STATES PATENT OFFICE

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VACUUM TUBE

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4 Claims. (Cl. 250—27.5)

This invention relates to vacuum tubes and more particularly to the internal elements thereof.

The invention is of particular utility in the pre-treatment of vacuum tubes of the thermionic type containing several electrodes sealed in a glass envelope. These electrodes are operated in a high vacuum or in an atmosphere of a selected gas, and in either case it is necessary to preheat the electrodes during exhaustion of the envelope to remove occluded gases which otherwise would be driven off during the operation of the device and injuriously affect its operation.

Various schemes have been devised to heat these electrodes, one of them being to place the whole device in a magnetic field of sufficiently high frequency and intensity to heat these electrodes to the desired temperature. A heater of this type is known as the induction or high frequency furnace. However, the induction furnace, when used on a device having the usual electrodes, does not uniformly heat the electrodes. It is well known that, when heating vacuum tube electrodes by placing them in the same high frequency electromagnetic field, a large electrode is raised to a higher temperature than a small electrode, both electrodes being made of materials having about the same specific resistance. When the small electrode is placed within the large electrode, as is common practice in vacuum tube design, and the electrodes placed together in the magnetic field, the field in proximity to the small electrode is reduced in intensity by the shielding action of the large electrode, thus resulting in a further decrease in the heating of the smaller electrode.

An object of this invention is to provide a vacuum tube, the electrodes of which may be more uniformly heated by an induction furnace.

Another object is to provide a vacuum tube, the electrodes of which are of varying resistivity.

A further object is to provide a vacuum tube, the electrodes of which have a varying shielding effect upon adjacent electrodes.

These and further objects will be apparent from the following specification when taken with the accompanying drawing, in which,

Fig. 1 illustrates one form of thermionic vacuum tube embodying the present invention.

Fig. 2 is a section of the outer screen of Fig. 1, and

Figs. 3, 4 and 5 are sections of screens embodying different forms of the invention.

Referring to the drawing, Fig. 1 illustrates a conventional type of thermionic vacuum tube

having an internally heated cathode 1, preferably provided with an oxide coating 2, and cylindrical cold electrodes or elements constituting a control grid 3, screen grid 4, anode 5 and outer screen 6. These elements are metal cylinders mounted coaxial with the cathode 1, and are enclosed by an envelope 7. The envelope is exhausted to a low pressure by a suitable vacuum pump through the exhaust tube 8.

As commonly constructed, the outer screen 6 is formed of a woven wire fabric of low resistance to induced circulating currents and it is readily heated by the usual induction or high frequency furnace during the evacuation of the envelope. The low resistance of the outer screen 6, together with its physical arrangement about the other elements, shields the plate 5 and other interior elements from the action of the high frequency furnace to such an extent that it is difficult to raise these elements to a sufficiently high temperature to eliminate from them the occluded gases without endangering the outer screen 6 by overheating or melting.

In accordance with the present invention, the exterior element or elements of the tube are given such form or are constructed of such materials that the shielding effect on the interior elements is materially reduced, thus facilitating the heating of the interior elements.

As shown in Figs. 1 and 2, the outer screen 6 has the form of a plate with staggered diamond shaped openings 9, which may be produced by removing the material or by first cutting a metal strip and then elongating or "expanding" the same, i. e., by a process similar to that employed in the formation of the expanded metal lath used in building construction. As the induced current flows circumferentially of the outer screen 6, the openings 9 materially increase the length of the current path. A further increase in resistance to induced circulating currents may be secured by forming the outer screen 6 of a high resistance material, such as nichrome.

Where slotting of a tube element is undesirable, as may be the case with the anode 5, a plate or sheet of normally high resistance material may be employed. When the next inner element, such as the screen grid 4, is formed of the usual low resistance material, no difficulty is encountered in heating the elements uniformly when the anode 5 is an imperforate sheet of high resistance material and the outer screen 6 is given a high resistance to induced circulating currents either by openings, such as 9, which increase the length of the path of circulating currents, or by such

openings and the inherent resistance of a metal having a high specific resistance.

As shown in Fig. 3, the openings 10 which provide the elongated path may take the form of staggered slots of substantially rectangular outline.

Wire screen of the general type now employed for the outer screen may be used when so woven, as shown in Fig. 4, that the wires 11 extend diagonally of the band from which the screen is formed. Or a screen resembling that of Figs. 1 and 2 may be formed by weaving narrow metal ribbons 12 to form a band in which the ribbons are diagonally arranged, Fig. 5.

High resistance metals or alloys may, of course, be employed to effect a further increase in the circumferential resistance of these several types of outer elements.

From the description and illustrations given it will be evident to those skilled in the art that application of this invention is not limited to the devices shown but may be employed in connection with any process where it is desired to use an induction furnace to heat an element or elements which are located within or substantially enclosed by an outer element. Various changes and modifications are contemplated as being within the spirit of the invention and the scope of the following claims.

What I claim is:

1. An electrical discharge device comprising an envelope enclosing a cathode, an inner sheet metal cylinder coaxial with and surrounding said cathode, and an outer cylinder coaxial with and surrounding said inner cylinder and formed of perforated sheet metal having a greater electrical resistance than said inner cylinder to circulating

currents induced in said cylinders by a high frequency electro-magnetic field.

2. An electrical discharge device comprising an envelope enclosing a cathode, an inner sheet metal cylinder coaxial with and surrounding said cathode, and an outer cylinder coaxial with and surrounding said inner cylinder and formed of perforated sheet metal having its perforations staggered to provide tortuous conducting paths of a length greater than the circumference of said outer cylinder, said outer cylinder having the greater electrical resistance to circulating currents induced in said cylinders by a high frequency electro-magnetic field.

3. An electrical discharge device comprising a cathode, a circumferentially continuous control grid surrounding said cathode an anode of thin sheet nichrome surrounding said grid and having a higher resistance to induced circulating currents than said control grid, and a circumferentially continuous metal screen surrounding said anode and forming for circulating currents a closed circuit of higher resistance than said anode.

4. An electron discharge device comprising an electron emitting cathode, a control grid surrounding said cathode, an electrostatic screen surrounding said control grid, a cylindrical sheet metal anode surrounding screen and having a greater resistance to induced circulating currents than said screen and said control grid, and a metallic electrostatic shield surrounding said anode and forming a closed circuit for circulating currents and comprising a metal sheet having a multiplicity of openings positioned to cause said shield to have a greater electrical resistance than said anode.

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