April 17, 1934. L. J. DAVIES 1,955,537

ELECTRON EMITTING CATHODE

Filed Feb. 7, 1931

Fig. 1.

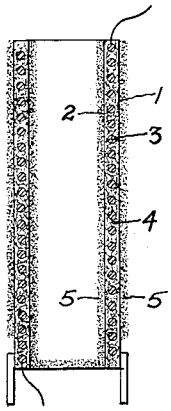


Fig. 2.

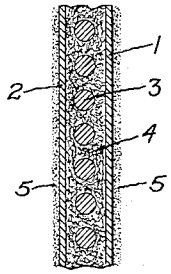
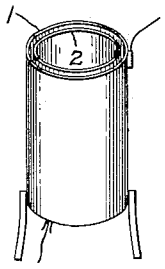


Fig. 3.



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ELECTRON EMITTING CATHODE

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In Great Britain February 11, 1930

1 Claim. (Cl. 250—27.5)

This invention relates to electron emitting cathodes for electric discharge devices, of the type usually referred to as equipotential or indirectly heated, and in particular, though not exclusively, to such cathodes used in devices in which electron space charge is absent by reason of gaseous ionization, such as, for example, hot cathode mercury vapor rectifiers of the electrostatically controlled and uncontrolled type.

Indirectly heated cathodes are frequently constructed by coating a refractory wire, such as tungsten, molybdenum, or nichrome, with an insulating medium such as kaolin, quartz, or the like, to form the heater core of the cathode. In another method, the heater core is made by winding the heater wire on a rod or tube of refractory insulating material. In whatever manner the heater core is made, it is usual to surround the core with a sheath or cylinder of metal, such, for example, as platinum or nickel, and to coat this with materials of high electron emitting efficiency, such as, for example, the oxides of barium, strontium, or cæsium. In the usual applications of such cathodes, which in vacuum devices are working with substantially pure electronic discharges, it is inadvisable to have any portions of the emitting surface of the cathode reentrant or in any way shielded by other emitting portions, for the reason that space charge will prevent the escape of electrons from such portions and, therefore, these areas will serve no useful purpose. This is not the case, however, when such cathodes are used in electronic devices in which gas is allowed to be present at sufficient pressure that there is no appreciable space charge of electrons.

The invention consists in constructing a thermionic equipotential cathode as a thin-walled hollow open ended box of conducting material in the walls of which, and suitably insulated therefrom, the heating element is located.

In the drawing which shows a preferred embodiment of the invention, Fig. 1 is a longitudinal cross section of the improved cathode; Fig. 2 is an enlarged section of the cathode wall, and Fig. 3 depicts in perspective, the completed cathode.

The improved cathode, as shown, is preferably constructed as a hollow box-like member which may be of metal and having two open ended cylinders 1, 2 of somewhat different diameter with the heating element 3 located in the annular space formed between them when assembled concentrically. The heating element may be formed as a helically wound strip or wire of a refractory metal, such as tungsten or molybdenum, coated with kaolin or other refractory insulating material. The space between the cylinders may be entirely filled with the heating element and with the surrounding insulating material 4. The cylinders may be coated on their outer surfaces with highly emissive material, as indicated by reference character 5.

In accordance with a preferred method of construction, a helix of tungsten or suitable wire is wound so that adjacent turns are separated by a small gap only. This helix will be sufficiently self-supporting to enable it to be put through the following treatment. The helix is dipped, sprayed, or in any way coated with sufficient kaolin or other similar material, then baked and formed into a rigid insulated member of small wall thickness that can be mounted in the space between the two thin walled concentric cylinders. If desired, the metal cylinders may be positioned within the envelope as two separate cylinders, each one being eventually attached by a welded wire or other suitable means, to leading-in conductors sealed into the stem of the tube.

Although in the preliminary stages of its manufacture, the heater elements are, owing to the small amount of insulation material used, necessarily fragile, they are, when completely assembled within the metallic sheaths, robust, yet light, and even when of comparatively large diameter, can be satisfactorily supported by rigid wires sealed into a glass stem in any of the known ways.

Although the cathodes described herein are formed in such a way that the helix of the heater wire is not wound on the refractory insulating tube, but rather has the insulating material moulded round the heater wire after it has been formed, this is only one method of preparation. The invention includes the possibility of winding the heater wire first on a thin walled tube of porcelain or quartz and then holding it in position by an additional coating of semi-liquid insulating material which by suitable firing is rendered hard, thus serving to fix and protect the heater wire.

Instead of using metal cylinders to cover the heating element, metal may be sprayed onto the latter when it has been formed as above described, by Schoop process or a coating of metal may be produced by other well-known means.

The advantages of such a cathode are twofold. In the first place, the electron emitting surfaces is approximately doubled without materially increasing the radiating or evaporative sur-

face. This means that the cathode is economical and has a favorable life. In the second place, the thermal capacity, by reason of the absence of any large mass of material in the volume of cathode, is low, and therefore the cathode quickly attains its operating temperature.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

A cathode for an electric discharge device comprising a pair of metal cylinders of different diameters and concentrically arranged, a heater coated with insulating material and contained between said cylinders, the outer surface of the larger cylinder and the inner surface of the smaller cylinder being coated with electronically active material.

LEONARD J. DAVIES.