Feb. 9, 1937. J. R. WILSON 2,069,867

ELECTRON EMITTER

Filed Dec. 29, 1934

FIG. 1

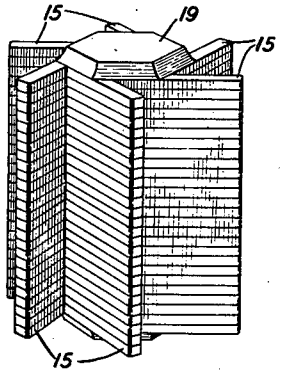


FIG. 2

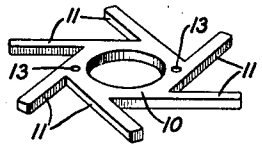


FIG. 3

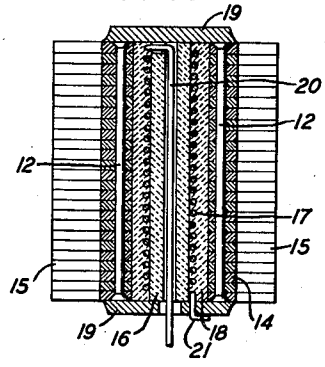


FIG. 4

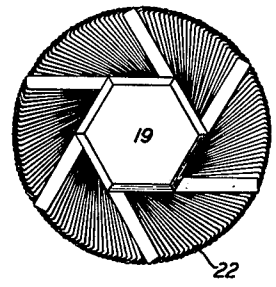


FIG. 5

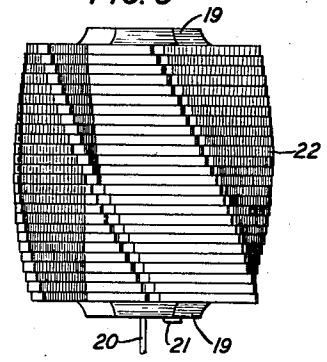


FIG. 6

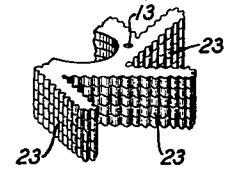
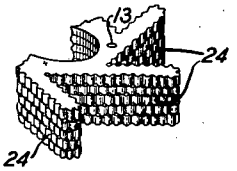


FIG. 7



INVENTOR
J. R. WILSON

BY

Walter C. Kiesel

ATTORNEY

Patented Feb. 9, 1937 2,069,867

UNITED STATES PATENT OFFICE

2,069,867

ELECTRON EMITTER

James R. Wilson, Mountain Lakes, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 29, 1934, Serial No. 759,695

10 Claims. (Cl. 250—27.5)

This invention relates to electron emitters and more particularly to large surface heater type equipotential cathodes for electric discharge devices.

One object of this invention is to obtain a high and efficient transfer of heat between the heater element and the thermionic material in heater type cathodes.

Another object of this invention is to assure good adhesion of a thermionic material to the carrier therefor in electron emitters.

Further objects of this invention are to expedite the fabrication and to reduce the cost of thermionic cathodes.

A cathode illustrative of this invention may be of the general form disclosed and claimed in the copending application of Vivian L. Holdaway, Serial No. 759,686, filed December 29, 1934, and comprises metallic laminae each including a central apertured portion and a plurality of arms extending therefrom. The central portions form a cylindrical surface in which the heater element may be enclosed and the arms form a plurality of vanes or fins which may be coated with a thermionic material, such, for example, as alkaline earth metal oxides.

The laminae may be assembled with the edges thereof coincident or the edges on the arms of adjacent laminae may be angularly displaced so that the arms form twisted or skewed fins or vanes. Furthermore, the laminae may be provided with edge indentations or projections so that the vanes or fins have rough or pitted surfaces and good adherence of the thermionic material thereto is obtained.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a perspective view of a heater type cathode constructed in accordance with this invention;

Fig. 2 is a detail view of one of the laminations of which the cathode shown in Fig. 1 is composed;

Fig. 3 is an elevational view in cross-section of the cathode shown in Fig. 1;

Figs. 4 and 5 are top and elevational views respectively of a heater type cathode illustrative of another embodiment of this invention; and

Figs. 6 and 7 are fragmentary views of modifications of the embodiment of the invention shown in Fig. 1.

Referring now to the drawing, a cathode constructed in accordance with this invention comprises a pile-up of laminae of a material having good heat conducting properties. For example, the laminae may be of nickel and formed by stamping or punching. Each lamination, as shown in Fig. 2, may comprise an apertured central portion 10 and a plurality of arms 11 extending from the central portion. Preferably the arms 11 are disposed at equal angles to radii of the central portion and may be arranged substantially tangentially to the central portion.

The several laminae may be secured together by a plurality of pins or stakes 12, extending through apertures 13 in the laminae, as shown in Fig. 3, to form a metallic member having a central portion 14 and a plurality of vanes or fins 15 extending from the central portion. Alternatively, the laminae may be secured together by a metallic eyelet extending through the central aperture in the central portion 10 and spun over against the end laminae. In this case, the central aperture preferably is elliptical and the eyelet of corresponding form to prevent displacement of the laminae relative to one another. The fins or vanes 15 may be coated with a thermionic material, such for example as alkaline earth metal oxides.

Disposed within the central portion 14 is a heater element which may comprise a tubular core 16 of insulating material, a helical filament 17 encompassing the core, and a coating 18 of insulating material covering the filament. The heater element may be held in position by metallic end plates 19 suitably secured, as by welding, to the end laminae. One end 20 of the heater filament may extend through the tubular core 16 to a suitable leading-in conductor, not shown, and the other end 21 of the filament may be secured to the lower end plate 19 which may be electrically associated with another leading-in conductor, not shown.

This construction insures a low impedance to heat flow from the heater filament to the edges of the vanes and hence to the thermionic material. Each lamination acts independently, from the standpoint of heat flow, so that all of the thermionic material is heated substantially uniformly and a substantially uniform emission from all portions of the vanes or fins is obtained. Furthermore, the several laminae provide discontinuities in the surfaces of the vanes so that a thermionic material will adhere readily to these surfaces. Inasmuch as the laminae may be stamped from sheet stock, cathodes in accordance with this invention may be fabricated expeditiously and with a relatively small cost.

The several laminae need not be arranged with their peripheries coincident as shown in Fig. 1,

but may be angularly displaced, as shown in Figs. 4 and 5 to form oblique, twisted or skewed vanes generally designated as **22**. As is apparent from Figs. 4 and 5, as a result of the angular displacement of the laminae, the surfaces of the vanes or fins **22** are discontinuous and irregular so that good adherence of a thermionic material to the vanes or fins is assured.

In modified embodiments of this invention illustrated in Figs. 6 and 7, the laminae may be formed with irregular edges or peripheries thereby producing indentations and projections in the longitudinal surfaces of the vanes or fins, further assuring good adhesion of a thermionic material to the vanes or fins. As shown in Fig. 6, the peripheries of the several laminae may be substantially coincident so that the surfaces **23** of the fins or vanes are in effect longitudinally corrugated.

As shown in Fig. 7, the edges on adjacent laminae may be misaligned so that the surfaces **24** of the vanes are rough or in effect pitted.

The cathodes shown and described may be utilized in a wide variety of devices. However, they are particularly suitable for use in electric discharge devices such as disclosed in the copending application of Vivian L. Holdaway noted hereinbefore, wherein a high electron current is desirable.

Although specific embodiments of the invention have been shown and described, it will be understood, of course, that modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electron emitter comprising laminae each including an apertured central portion and a plurality of arms extending from said central portion, means securing said laminae together to form a cylindrical surface composed of the central portions of said laminae and vanes composed of the arms of said laminae, and a heater element within said surface.

2. An electron emitter comprising laminae each including a plurality of arms, and means securing said laminae together with corresponding arms thereof in contact and in angularly displaced relation, whereby corresponding arms of said laminae form twisted vanes.

3. An electron emitter comprising laminae each including a central portion and a plurality of arms extending from said central portion at like angles to radii thereof, said laminae being secured together with the arms of each lamination in contact with and angularly displaced from the corresponding arms of the adjacent lamination.

4. An electron emitter comprising a central apertured portion and a plurality of skewed vanes extending from said central portion and substantially tangent thereto, a heater element within said central portion, and a thermionic material on said vanes, said central portion and said vanes being composed of laminae.

5. An electron emitter comprising a central portion and a plurality of angularly displaced vanes extending from and longitudinally of said central portion, said vanes being oblique to the longitudinal axis of said central portion.

6. An electron emitter comprising a central portion and a plurality of vanes extending from and longitudinally of said central portion, said vanes being disposed at like angles to radii of said central portion and oblique to the longitudinal axis of said central portion.

7. An electron emitter comprising a central apertured portion, a plurality of vanes extending from said central portion and substantially tangent thereto, a heater element within said central portion, and a thermionic material on said vanes, said vanes being oblique to the longitudinal axis of said central portion.

8. An electron emitter comprising laminae each including a plurality of arms having irregular peripheries, means securing said laminae together with corresponding arms on adjacent laminae in contact and forming vanes, and a coating of thermionic material on said peripheries.

9. An electron emitter comprising laminae each including a plurality of arms having irregular peripheries, means securing said laminae together with corresponding arms on adjacent laminae in contact and forming vanes, the peripheries of corresponding vanes on said laminae being coincident, and a coating of a thermionic material on said peripheries.

10. An electron emitter comprising laminae including arms having irregular peripheries, means securing said laminae together with corresponding arms of said laminae forming vanes, the peripheries of adjacent laminae being misaligned, and a coating of thermionic material on said peripheries.

JAMES R. WILSON.