

Nov. 18, 1941.

G. S. EVANS

2,263,169

INDIRECTLY HEATED CATHODE

Filed Oct. 12, 1940

Fig. 1.

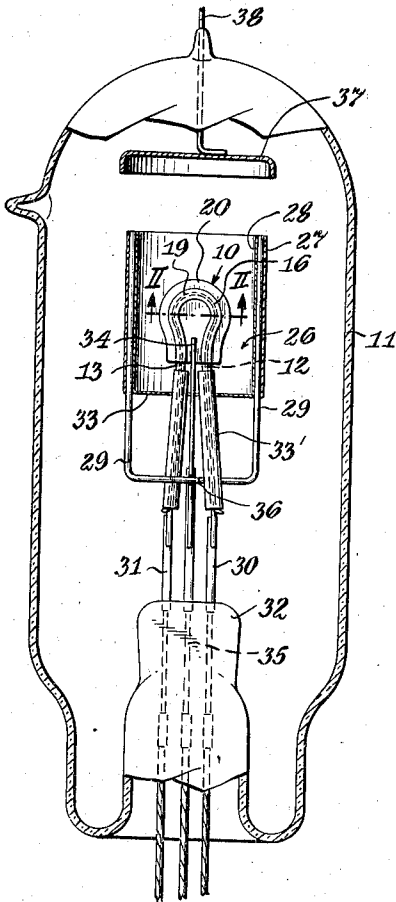


Fig. 2.

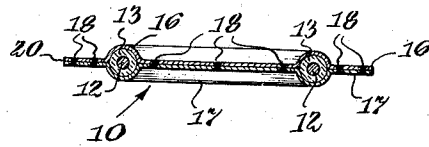


Fig. 3.

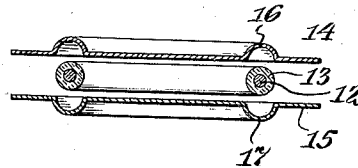


Fig. 4.

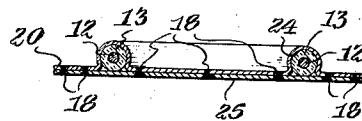


Fig. 5.

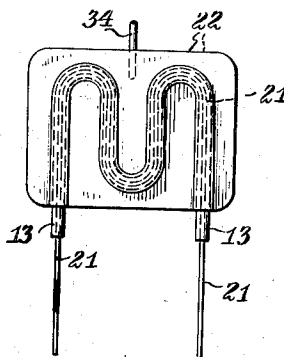


Fig. 6.

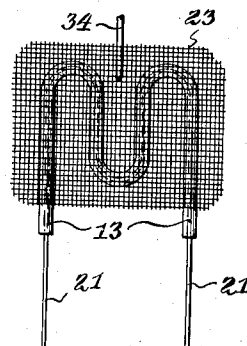


Fig. 7.

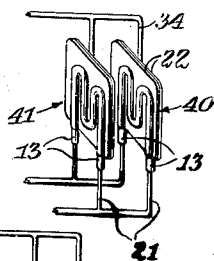
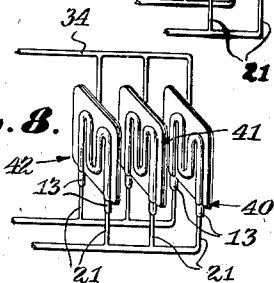


Fig. 8.



INVENTOR
G. S. EVANS
BY *J. M. Reubens*
ATTORNEY

UNITED STATES PATENT OFFICE

2,263,169

INDIRECTLY HEATED CATHODE

George S. Evans, East Orange, N. J., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

Application October 12, 1940, Serial No. 360,885

9 Claims. (Cl. 250—27.5)

My invention relates to discharge devices, and especially to the cathode arrangement therefor.

An object of the invention is to provide a relatively inexpensive indirectly heated cathode structure which heats quickly and uniformly and is adapted to quantity production.

Another object of the invention is to provide an indirectly heated cathode in which the design of the active cathode surface is not limited by the indirect heating means.

A still further object of the invention is to provide a unit cathode that can be assembled in any desired multiple.

Other objects and advantages of the invention will be apparent from the following description and drawing in which:

Fig. 1 is a view, mainly in cross section, of a discharge device incorporating my invention.

Fig. 2 is a view in lines II—II of Figure 1.

Fig. 3 is a cross-sectional view illustrating a step in the manufacture of Fig. 2.

Fig. 4 is a cross-sectional view through a modification of the cathode structure in Fig. 2.

Figs. 5 and 6 are front elevational views of still further modifications.

Figs. 7 and 8 are perspective views illustrating the adaptability of the invention for multiple installations.

As previously stated, the object of my invention is to provide a uniformly indirectly heated cathode structure and one which is inexpensive to make.

A preferred form of my indirectly heated cathode structure 10 is illustrated in Fig. 1 inside of the usual glass envelope 11.

In making this cathode structure, I take the heater wire 12, illustrated in Fig. 3, and cover it with insulation 13. I then take two thin blades or vanes 14 and 15, preferably of nickel, although other metals may be used, and indent curves 16 and 17 therein just large enough and of the proper shape to accommodate the insulation-covered wire 12 and 13.

These two plates are then clamped together about the insulated wire, as illustrated in Fig. 2, and the two plates spot welded or seam welded, as indicated at 18, into a unified plate 20, substantially plane except for the slight bulge caused by the insulated wire. The two plates and the heater wire therethrough may have any desired configuration. As illustrated in Fig. 1, the heater wire has a horseshoe shape 19, and the shape of the plate 20 is symmetrical therewith.

In Fig. 5, I have illustrated a substantially M-

shaped heater wire 21 enclosed by substantially rectangular plates 22. Preferably the corners are rounded. In place of the solid plates, a mesh wire 23 may be utilized, as illustrated in Fig. 6.

In place of having grooves in both plates, I may utilize grooves 24 in one plate to receive the insulation-covered wire 12 and 13, as illustrated in Fig. 4, and then spot or seam weld a flat plate 25 thereover. The surface of the plates or mesh may then be covered with well known electron-emitting material, such as barium, strontium and calcium oxide, or any combination of these oxides.

The cathode arrangement, as described, may be enclosed by a heat shield means 26, preferably formed of concentric cylinders such as 27 and 28, with standards 29 inserted between the shields for support. The inner heat shield may be closed by an integral or separate bottom plate 33.

The heater wire 12 is connected to two standards 30 and 31, passing through the press 32 of the tube. Insulation 33' may surround the heater wire where it passes through the bottom plate 33 closing off the lower end of the heat shield 26.

A cathode connection 34 is secured, as by welding, to the plate or mesh surface, and may be connected to either heater wire or have a separate connection 35 passing through the press of the tube. This cathode connection may also have the heat shield 26 connected thereto, as illustrated at 36, or the heat shield may be independently supported and connected by a separate conductor.

The anode 37 may have any desired form, such as the shallow cup-shaped form with an anode connection 38 extending through the bulb 11 at the upper portion, as illustrated in Figure 1. The envelope 11 may contain any suitable gas, such as argon, neon, or mercury vapor.

If double the cathode capacity is required, then two such cathodes 40 and 41 may be supported in parallel, as illustrated in Figure 7. If triple the capacity is required, then three such cathodes 40, 41 and 42, may be arranged in parallel, as illustrated in Figure 8. There is, accordingly, no necessity of redesigning another cathode for a larger capacity cathode in view of this multiple arrangement of my unit cathode structure.

The heaters of unit cathodes used in multiple arrangement may be connected either in parallel or series as desired.

Various means may be used for electrically insulating the heater. The electrical insulator which transmits heat however, may be a molded slit insulator having grooves therein for the heater wire, and in turn, fitting into the grooves

in the plate. The insulating coating may be any one of a number of suitable refractory insulating materials, such as aluminum oxide (Al_2O_3), applied by dipping or spraying. The heater may be wrapped in a sleeve or covering of a suitable metal, and after the cathode is assembled, the cathode is treated to convert the metal covering of the heater into an insulating compound. For instance, aluminum foil might be wrapped around a tungsten heater and after assembling in the plates the assembled cathode baked in super-heated steam to convert the aluminum into aluminum oxide. Similarly small magnesium wire, wrapped around the heater might be converted to magnesium oxide after the cathode is assembled. The insulation may be sprayed, painted or otherwise placed in the grooves of the plates and the bare or coated heater wire placed therein.

The heating wattage is distributed over the surface to be heated, giving uniform heating. The surfaces thus heated are in good heat conducting relationship with the heater, whereby the heating time is shortened. The heating time of a multiple arrangement, such as disclosed in Figures 7 and 8, is not increased over the single cathode installation, but is the same or may be shorter.

Because of the uniform, quick heating secured by use of this heating means, it is not necessary to resort to more complicated means such as folding the emitting surfaces symmetrically around a center heater to secure uniform quick heating. Thus the emitting surfaces are entirely open, and are wholly accessible for emission.

A cathode constructed in accordance with my invention having a nickel cathode surface of two square inches indirectly heated with 50 watts attained operating temperature in less than thirty seconds.

It is apparent that many modifications may be made in the particular type of heater and cathode surface form and arrangement, as well as in the installation thereof. Accordingly, I desire only such limitations to be imposed upon the invention as are necessitated by the spirit and scope of the following claims.

I claim:

1. A cathode comprising a vane, a continuous groove in said vane winding throughout the surface of the vane, insulation in said groove, a heater wire in said insulation and a second vane covering said groove and secured to said first vane.

2. A cathode comprising two vanes of the same shape secured together and having substantially flat portions except for a winding groove therein forming a continuous passage between and throughout the portions of said vanes, electrical insulation in said passage and a heater wire in said insulation.

3. A cathode structure comprising a plurality of units, each unit having two vanes secured together and having a winding passageway distributed uniformly throughout the joined faces of the two vanes, electrical insulation in the passageway and a heater wire inside said electrical insulation.

4. A cathode structure comprising a flat metallic plate, insulation on one of the flat surfaces of said plate, a heater wire inside said insulation and a second metallic member attached to the said flat surface of said plate, said second member having a groove therein fitting and covering said insulation and heater wire.

5. A cathode structure comprising a flat metallic plate, a coating of electron-emitting material on one surface of said plate, insulation on the other surface of said plate, a heater wire inside said insulation and a second metallic member attached to the other surface and having a groove therein fitting and covering the insulation and heater wire.

6. A cathode structure comprising a substantially plane metallic surface, a heater wire, insulation closely surrounding said heater wire, said wire and insulation distributed uniformly over said metallic surface and directly attached thereto.

7. A discharge device comprising an anode and a cathode, said cathode having a substantially plane electron-emitting surface exposed to said anode, and an insulated heater wire distributed uniformly over said surface and attached thereto.

8. A discharge device comprising an anode and a cathode structure, said cathode structure comprising a plurality of substantially plane electron-emitting surfaces exposed to said anode, and insulated heater wires distributed uniformly over said surfaces and attached thereto.

9. A discharge device comprising an anode and a cathode structure, said cathode structure comprising a plurality of substantially plane electron-emitting surfaces exposed to said anode, and insulated heater wires distributed uniformly over said surfaces and attached thereto, said heater wires being connected in parallel.

GEORGE S. EVANS.