Oct. 10, 1939. N. R. SMITH 2,175,708

CATHODE

Filed Dec. 24, 1937

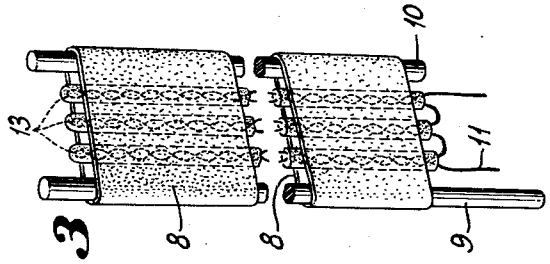


Fig. 3

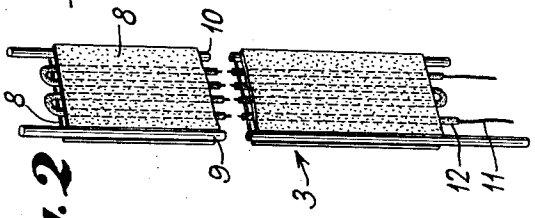


Fig. 2

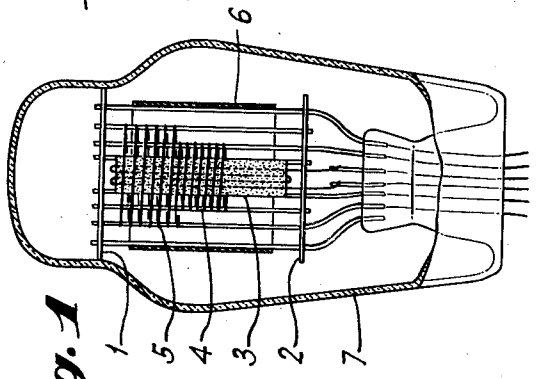


Fig. 1

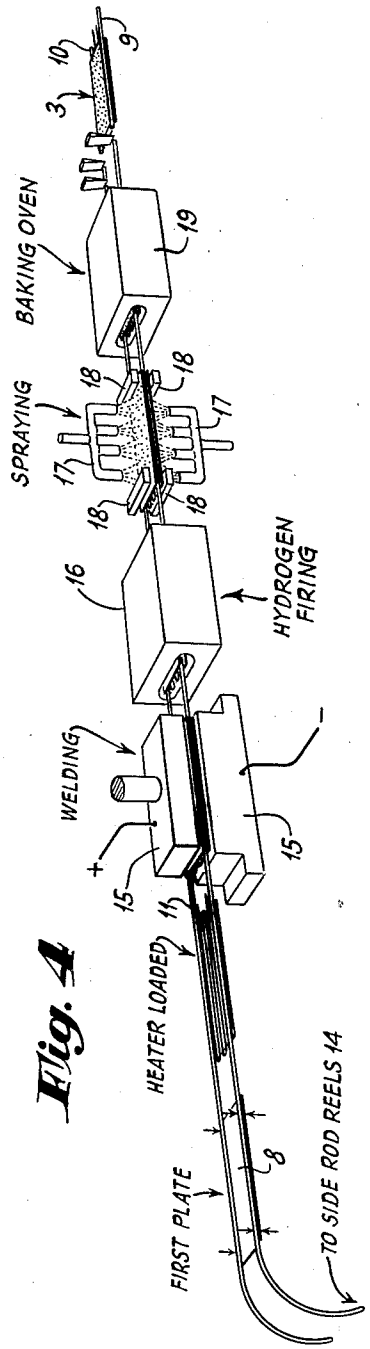


Fig. 4

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Patented Oct. 10, 1939

2,175,708

UNITED STATES PATENT OFFICE

2,175,708

CATHODE

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Application December 24, 1937, Serial No. 181,669

2 Claims. (Cl. 250—27.5)

My invention relates to thermionic cathodes, particularly indirectly heated cathodes for use in electron discharge devices.

The usual indirectly heated cathode comprises a metal tube or sleeve surrounding a heating element, activated with an electron emitting coating on its outer surface, and inserted at its ends into the insulating spacers of the electrode mount in the tube. The metals commercially suitable for carrying the electron emitting coating are not particularly strong at the operating temperature of the cathode and may suffer deformation caused by thermal and mechanical stresses in use. It is particularly difficult to accurately mount and maintain the conventional cathode in close spaced relation to other electrodes in the tube, especially when the cathode is long or when the metal is thin.

An object of my invention is to make an indirectly heated cathode that is strong at operating temperatures, and is easy and inexpensive to manufacture.

A further object of my invention is to make a cathode which is easy to position in the mount and which will remain a fixed and predetermined distance from adjacent electrodes.

Further objects will appear in the following specification of my invention, a more complete understanding of which may be obtained in the description of specific embodiments set forth in the specification and shown in the accompanying drawing in which Figure 1 is an electron discharge device with a cathode embodying my invention, Figures 2 and 3 are detailed views of indirectly heated cathodes constructed according to my invention, and Figure 4 is a schematic representation of means for continuously and automatically assembling my improved cathode.

The tube shown in Figure 1 comprises the conventional parallel insulating spacers 1 and 2 engaging in perforations the ends of tubular cathode 3 and side rods of conventional helically wound grids 4 and 5, and anode 6. The electrode assembly is supported upon the re-entrant stem of envelope 7.

In one embodiment of my improved cathode, shown in detail in Figure 2, a cathode sleeve rectangular in cross section is formed of two metal plates 8 with their edges attached to side rods 9 and 10. Side rods 9 and 10 may be tubular or solid and may be round, rectangular, or of any desired cross sectional shape and size to properly space the plates 8. Within the rectangular sleeve formed by the two plates 8 and the rods 9 and 10 is placed a heating wire 11 coated with insulating material 12. The heating element may be folded as shown with any desired number of convolutions, or may be spiraled and one, two or more of the spiraled heating coils placed side by side in the sleeve.

My improved cathode may conveniently be made by attaching, as by welding, one of the plates 8 along its edge to side rods 9 and 10, laying heating element 11 between the side rods, welding the second plate 8 in place, and then spraying the desired electron emissive material on the plate. One of the side rods may be cut longer than the other to provide a convenient tab for connection to the cathode lead-in conductor.

Plates 8 may be chosen of a material particularly adapted for carrying the oxides of the electron emissive material coated on the plates. Many refractory metals suitable as cathode core material for carrying barium-strontium oxides, for example, are expensive and cannot feasibly be drawn into self-sustaining sleeves for the cathodes. A cathode constructed according to my invention, however, may be made with plates 8 of such desirable material as nickel or tantalum drawn into thin sheets and welded or brazed to the relatively heavy and strong side rods which may be easily handled in manufacture, and because of the high hot strength maintains the cathode in fixed spaced relation with the other electrodes. The side rods extend beyond the ends of the tubular cathode and may be easily inserted in perforations in the insulating spacers, the perforations for receiving the cathode side rods being accurately punched in alignment with the side rod perforations for the other electrodes to fix the cathode in predetermined spaced relation to the other electrodes. The restricted flow of heat along the side rods materially reduces the temperature of ends of the side rods and prevents burning of the mica and loosening of the side rods. Tight fitting electrodes are necessary for low microphonic noise.

The plates 8 may, if desired, be combined in a unitary structure by flattening the sides of a cylinder and attaching the edges of the flattened cylinder to the side rods 9 and 10 as shown in Figure 3. The side rods are inserted in the flattened cylinder and attached to the walls of the cylinder near to or adjacent to the edges of the cylinder. A plurality of helically wound heating elements 13 coated with insulating material are shown placed side by side in the tubular cathode of Figure 3. Plates 8 between the side rods may be planar, or if more room is necessary

for the heating element, the plates may be curved outwardly betwen the junctions with the side rods.

In making an electrode assembly with a cathode constructed in accordance with my invention the insulating spacers 1 and 2 are perforated to receive the side rods of each of the electrodes including the side rods of my cathode, the large hole usually punched in the center of the spacers being omitted. In one tube made in accordance with my invention, each of the electrodes were accurately positioned by side rods in the perforations in the spacers and a spacing of .005 inch between the cathode 3 and grid 4 was easily obtained and this spacing was maintained during normal operation of the tube. The coated area of my improved cathode is removed from the spacers and because substantially all of the high temperature portion is coated, the efficiency of the cathode is high.

A complete cathode assembly containing an insulated heater within a tubular sleeve and exteriorly coated with electron emissive material may be automatically manufactured according to my invention. In Figure 4 the side rod material is reeled from two spools 14 over a welding electrode where one of the plates 8 is spot welded to the two wires. Upon this plate is deposited an insulated heating element 11 shown as a folded wire heater and then as the side rod material proceeds toward the right the second plate 8 is laid upon the side rods and welded in place by welding electrode 15. The cathode assemblies are then fired in hydrogen at 16 to deoxidize and clean the parts before they are sprayed by nozzles 17 with the electron emissive material such as barium-strontium carbonate. Preferably masks 18 are provided to localize the sprayed material on the outer faces of the two plates. After the spraying material has been baked at 19 the side rods are cut, and the cathode assemblies are ready for use.

Cathodes constructed according to my invention may be placed close to cooperating electrodes, will not deform or shift during use, are inexpensive to manufacture and easy to mount in electrode assemblies.

I claim:

1. An electron discharge device comprising an electrode assembly with two parallel spaced insulators, grid and anode electrodes coaxially held in spaced relation between said insulators, and a cathode inside and coaxial with said electrodes comprising two self-supporting spaced parallel side rods and two spaced parallel plates of thin sheet metal joined along their edges to said side rods, the ends of said side rods engaging perforations in each of said insulators, a heating element between said plates and an electron emissive coating on the outer surface of the plates.

2. In combination, a tubular cathode for an electron discharge device comprising two separate parallel spaced plates, two relatively heavy parallel spaced side rods longer than said plates, the edges of said plates being joined to said side rods intermediate the ends of the side rods, electron emissive material on the outer surfaces of said plates, and an insulated heating element between said plates, the plates being thin sheets of metal, particularly adapted for carrying and activating said electron emissive material.

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