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INDIRECTLY HEATED CATHODE AND INSULATOR ASSEMBLY

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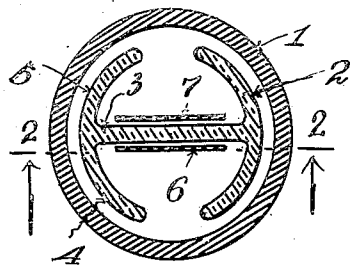

Fig. 1.

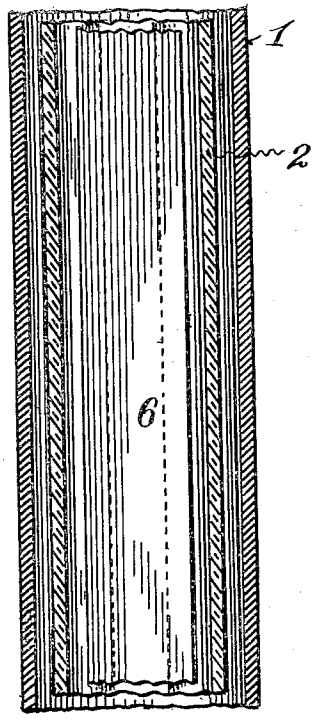

Fig. 2.

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INDIRECTLY HEATED CATHODE AND INSULATOR ASSEMBLY

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6 Claims. (Cl. 250—27.5)

This invention relates to a cathode assembly, especially as is employed in thermionic vacuum tubes, electron discharge devices, audions, etc.

The object of the invention is to provide a cathode structure and insulator assembly which is economical in manufacture and easy to assemble.

A further object of the invention is to provide an assembly of this nature which is highly efficient in operation.

A further object of the invention is to provide an assembly of this nature which is not only novel in itself, but utilizes novel structure of filaments and insulators.

Further objects of the invention will appear more fully hereinafter. The invention consists substantially in the construction, combination and relative arrangement of parts, all as will be more fully hereinafter set forth and finally pointed out in the appended claims.

Referring to the drawing:

Figure 1 is a top plan view in horizontal section of a cathode and insulator assembly;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 and looking in the direction of the arrows.

Similar reference characters refer to similar parts throughout the several views of the drawing.

In the art of thermionic vacuum tubes employed in electrical communications and allied arts, notably in radio sets, it is customary to use so-called indirectly heated cathodes, especially where alternating current from lighting mains are utilized for vitalizing the tubes in use. In essence, these structures comprise a resistor element adapted to be heated by a passage of current therethrough, which is usually in the form of a filament similar to a filament employed in an incandescent lamp or the filament employed in the standard audion constructions. The heat from the filament is utilized to render active an electron emissive element usually employed as a shield surrounding, or otherwise intimately associated with the filament, so that the heat from the filament may be most efficiently utilized. One great defect in the indirectly heated cathode tubes heretofore used has been well recognized to be the length of time consumed between the switching on of the current to the filament and the necessary electronic activity of the element heated thereby, in order to render the tube operative. So well recognized has been this disadvantage in indirectly heated tubes that intensive research has been conducted in the vacuum tube industry and concentrated effort been made to minimize the required time.

The problem has been difficult of solution due to a number of extraneous causes. In the first place, it has been necessary to employ carefully designed and produced insulators for the heating element. The constructions for elimination of microphonic noises due to relative thermal expansion between the filament and insulator, the cost of the insulator, the strength and rigidity thereof, have materially added to the difficulties of a practical solution of the problem of minimizing the length of time between the turning on of current to the vacuum tube and the time that it actually functions for its intended purpose. Different types of hairpin filament have been employed and are universally employed at the present time, and to prevent electric contact between one leg of the filament and the other leg thereof, as well as the necessity of avoiding short-circuiting, it has been necessary to completely insulate the respective legs of the filament from each other, as well as from the electronic emissive element.

Having in mind that the two important factors in minimizing the inactive period of the vacuum tube comprises the amount of heat available and the directness of radiation from the heat source to the element to be heated, I have created an assembly of novel construction in itself, as well as of the important parts thereof, which has solved the problem and enabled the provision of an indirectly heated cathode tube structure of maximum efficiency and minimum inactivity.

Referring to the drawing, where I have shown in exceedingly enlarged size the assembly and parts comprising my invention, reference character 1 designates what is usually known in the art as the shield and which contains, either as a constituent or as a surface layer, the electron emissive material. While I have shown the shield in the form of a cylinder, it is to be understood that I do not desire to be limited or restricted in this respect, as its particular shape or type forms no part of my invention. The insulator is illustrated at 2 and is in the form of what may be termed a "double anchor", viz., it has a central portion 3 at each end of which are provided arms 4 and 5 extending therefrom. This insulator may be formed of any suitable material commonly employed for such purpose and may be of any desired length, depending upon the dimensional requirements of the completed vacuum tube structure as dictated by the filament, power, size, etc. The insulator 2 is shaped so as to be positioned within the shield 1, and its position may be varied as conditions permit or may be desired. While I have shown the insulator as out of con-

tact with the shield 1, I do not desire to be limited in this respect as it may be positioned in contact with shield 1 or spaced therefrom evenly or unevenly, as desired.

Instead of employing the usual cylindrical filament, I employ a flat or ribbon type of filament, the two legs 6 and 7 of which are positioned on opposite sides of the central portion 3 of the insulator. While I do not desire to be limited to the employment of a ribbon type of filament, the advantages thereof will readily be apparent. In the first place, a large area of heating radiating surface is obtained. In the next place, greater strength, rigidity and life is secured and liability of breakage materially reduced. It will be understood, of course, in the form illustrated, that the filament is of the hairpin type, i. e., is formed of one piece, looped at the upper end.

The legs 6 and 7 projecting on opposite sides of the ends of the central portion 3 of the insulator 2 may be of any desired shape and may extend any desired distance. The important factor is that a substantial space is provided between adjacent ends of the respective legs so that the heat radiated from the legs 6 and 7 of the filament will directly impinge on the inner surface of the shield 1. Thus, direct heat radiation is secured from a heating surface extremely large as compared to the hairpin filament heretofore employed.

From the foregoing, it will be seen that both factors, viz., increased heat source and effective direct heating radiation, are present in the structure and assembly of my invention and inactivity, due to insufficient heating of the emissive element after supply of current is effected, is minimized.

Many modifications and changes in details and construction will readily occur to those skilled in the art without departing from the spirit and scope of my invention as defined in the claims, but having now set forth the nature of my invention and having shown and described a structure embodying the principles thereof, what I claim as new and useful and desire to secure by Letters Patent is:

1. The combination with an insulating member formed of one piece and open on opposite sides, a ribbon conductor for producing heat and provided with a leg extending longitudinally on each side of said insulator and opposite the said open sides, and an electron emitting member surrounding said conductor to be heated by direct heat radiation from said conductor through the open sides of said insulator.

2. A unitary insulator member shaped in cross section substantially like a double anchor with a central connecting portion and open sides on each side thereof, a flat ribbon shaped conductor with a leg positioned on each side of the central portion of said insulator and opposite the open sides thereof to permit unobstructed radiation of heat from said conductor therethrough, and an electron emitting member surrounding said insulator and adapted to be heated in part at least by direct radiation of heat from said conductor through the open sides of said insulator.

3. A cathode for electron discharge devices comprising a longitudinal rib of insulation, a pair of transverse ribs attached to the longitudinal edges of said rib, said transverse members being substantially cylindrical in shape and having their longitudinal edges spaced apart, a metallic sleeve embracing said curved transverse members, a coating of emissive material on the face of said sleeve, and means within said sleeve for heating the same.

4. The combination with an electrical conductor for creating heat having two substantially parallel ribbon legs, means for electrically insulating said legs from each other at adjacent sides throughout their length, and an electron emitting member surrounding said heating member and directly exposed thereto so as to be heated by direct radiation from said heating member.

5. An electron discharge device comprising an anode and a cathode, said cathode including an element having a surface adapted to emit electrons when heated, an insulator within said element having a plurality of relatively wide and shallow undercut slots on the sides of said insulator and a resistance element held in position in said undercut portions.

6. A cathode for electron discharge devices comprising a longitudinal rib of insulation, a pair of transverse ribs attached to the longitudinal edges of said rib, said transverse members being substantially cylindrical in shape and having their longitudinal edges spaced apart, a metallic sleeve embracing said curved transverse members, a coating of emissive material on the face of said sleeve, and means within said sleeve for heating the same, said heating means being in the form of a looped filament having portions extending longitudinally on opposite sides of said rib, and in registry with the spaced ends of said transverse members.

HENRY L. CROWLEY.