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SEMI-INDIRECTLY HEATED ELECTRON TUBE CATHODE

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This invention is concerned with a semi-indirectly heated electron tube cathode, especially for high power transmitter tubes, wherein the emitting surface of the cathode is formed by a metal sheet cylinder which is heated by radiation.

The following requirements are posed in connection with high power transmitter tubes for very high frequencies: The emitting cathode surface should be as large as possible. There shall be a possibility to provide for a grid-cathode spacing as narrow as possible, so as to reduce timing losses. In addition, the aim is to provide for an electrical length of the cathode which is as short as possible.

Previously employed wire cathodes, made of tantalum, tungsten or thoriated tungsten wires, are provided in the form of helices, wire baskets or mesh structures. In the case of helical cathodes and wire basket cathodes, there are experienced difficulties resulting from great electrical length and from problems arising in connection with the control of the thermal expansion. While better results have been obtained in the case of ultra high frequency high power tubes employing mesh type cathodes, these cathodes can nevertheless be improved with a view of the above noted requirements.

Known directly heated metal sheet cathodes are normally uneconomical so far as the required heating effect is concerned and the very high heating current must be conducted over springs, for the equalization or compensation of the heat expansion of the cathode, whereby the electrical length is intolerably increased. Oxide cathodes suffer, in connection with the present requirements, the disadvantage of presenting difficulties in the control of the thermal grid emission and in producing in the case of very high frequencies, due to poor heat conductivity, a strong heating affected by the reversed cathode bombardment. Moreover, the oxide layer or coating is in the case of high power continuously operative generators strongly heated by the capacitive oscillation current.

The object of the invention is to provide a cathode which combines the advantages of the large surface area oxide cathode with those of the metal cathodes. It is for the realization of this object proposed to provide for electron tubes a semi-indirectly heated cathode, the emitting surface of such cathode being formed by a metal sheet cylinder which is heated by radiation, wherein the heater arranged interiorly of the metal sheet cylinder is, according to the invention, made of a cylindrical wire mesh formed of left and right turn spirals of heating wires which are mutually interconnected, especially by welding, at least at part of the crossing points, one end of the heater being connected with the adjacent end of the metal cylinder which also serves as a current supply lead and the other end thereof being connected with the other current supply lead. It is particularly advantageous to dimension the metal sheet cylinder so that it is so strongly heated by the current flowing therethrough that the heat thereof is transmitted to the outer surface of the metal sheet cylinder, which heating current requirements are thereby reduced and the heating voltage can be increased, as compared with a directly heated metal sheet cathode, resulting in relieving the load on the supply conductors. No particular measures are required for the compensation of the axial heat expansion, since the current is supplied over the mesh cathode which is disposed inside of the metallic sheet cylinder, such mesh cathode, owing to its structural features, acting in the manner of a spring.

The invention will now be described with reference to the accompanying drawing showing in schematic representation an example of an embodiment of a semi-indirectly heated cathode.

Referring now to the drawing, numeral 1 indicates a metal sheet cylinder forming the emitting cathode surface. Such cylinder may be provided with a coating of well emitting material, for example, barium oxide. Inside of this cylinder is coaxially arranged the heater 2 which is likewise of cylindrical configuration and made of a mesh structure. The heater comprises left and right turn spirals of heating wires which are at least at part of the crossing points interconnected, for example, by welding. The emitting metal sheet cylinder is held in place by the likewise cylindrically formed current supply means 3 which is fastened in a ceramic plate 4. The heater 2 is held in position in the ceramic plate by the current supply means 5 which is fastened to one end thereof, for example, by welding. The other end of the heater 2 is electrically conductively connected with the metal sheet cylinder 1, such connection being accomplished with the aid of a cross-sectionally U-shaped intermediate ring 6 which may be welded or soldered to the corresponding parts. A metallic radiation shield 7 is likewise connected by welding or soldering with the ring 6 and a similar shield 8 is by soldering or welding connected with the current supply lead 5 at the other end of the heater 2. These metallic radiation shields are operative for completely shielding the entire cathode space.

The shield members 7 and 8 are as noted disposed gas-tight, by welding or soldering, and the required carburation of the metal sheet cylinder 1, at the outside thereof, can therefore be effected in simplest manner in a hydrocarbon atmosphere while preventing ingress of the hydrocarbon gas into the interior space which can be readily evacuated through the cylindrical extension 9 after sealing such space at the extension 10, if the latter is provided. The advantage accruing from this feature would be lost by providing for completely indirect heating of the cathodes made according to the invention since a separation between the heater and the cathode would have to be provided in some manner. Moreover, the heating current flowing in reversed direction could not be utilized for the heating of the metal cylinder but would have to be drawn off over special third current lead-through means.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and have protected by Letters Patent.

We claim:
1. An electron tube cathode structure heated both directly and indirectly, comprising a hollow cylindrical sheet metal body having an outer emitting surface, a heater disposed within and surrounded by said body, said heater being constructed in the form of a cylindrical wire mesh consisting of right and left hand spirals of heating wire which are fixedly interconnected at least at some of the crossing points thereof, one end of said heater being operatively connected to the adjacent corresponding end of said body, means for operatively connecting the other end of said heater to a current supply terminal, and means for operatively connecting the other end of said body to another current supply terminal with said body and heater
being connected in series whereby they are both traversed by the heating current.

2. A cathode structure according to claim 1, wherein the sheet metal body is so dimensioned that it is by the heating current flowing therethrough jointly with the radiation heat delivered by the heater, heated to the required emission temperature.

3. A cathode structure according to claim 2, comprising means forming radiation shields at both ends of the heater.

4. A cathode structure according to claim 2, wherein the exterior surface of said sheet metal body is provided with a coating of a material such as barium oxide.