April 5, 1932. H. W. PARKER 1,852,023

CATHODE FOR THERMIONIC TUBES

Filed July 25, 1930

Fig. 1 Fig. 2 Fig. 4 Fig. 5

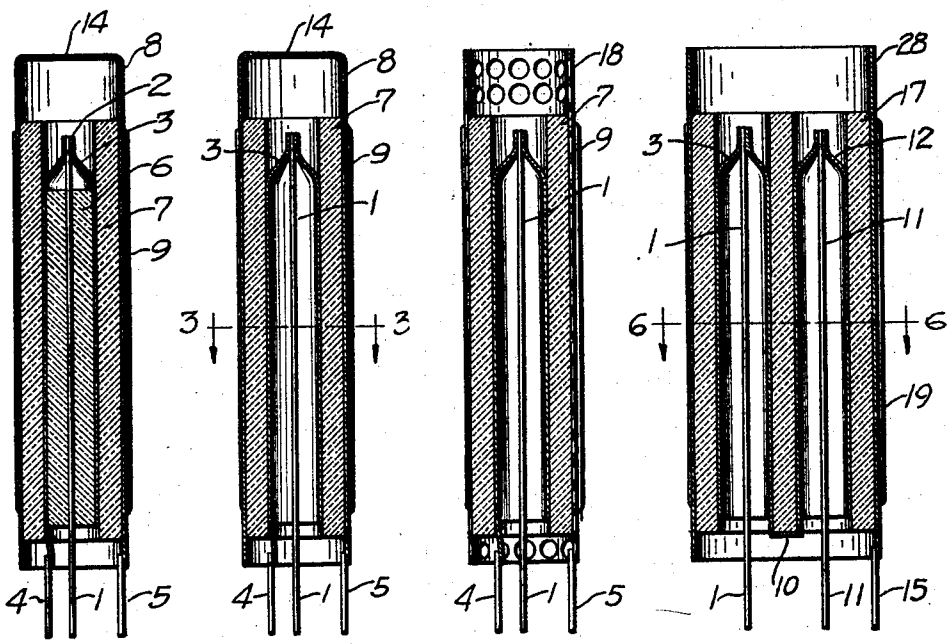
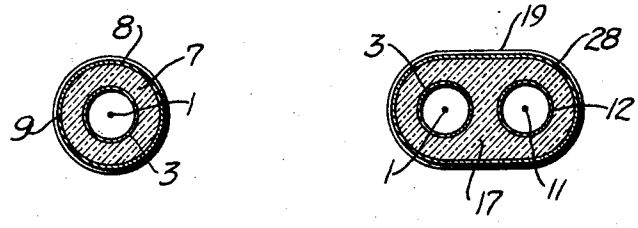


Fig. 3 Fig. 6



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CATHODE FOR THERMIONIC TUBES

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My invention relates to cathodes for electron discharge devices such as thermionic tubes and pertains more specifically to that type of cathode termed equi-potential and employing separate heating and emitting members.

An object of my invention consists in providing a cathode of the indirectly heated type in which the magnetic field in the proximity of the cathode produced by the alternating heating current is reduced to zero.

Another object contemplates providing a cathode through the use of which an alternating current heated thermionic tube may be constructed which exhibits no disturbing hum due to modulation of the space current of the tube by magnetic strays from the heating current.

A still further object consists in providing a cathode which will permit of the construction of thermionic tubes having a higher quality of output.

I accomplish all these and other desirable features which will be hereinafter pointed out and discussed by reducing the magnetic field in the proximity of the heating element to exactly zero by employing a heater in the form of a heating wire maintained co-axially within a conducting cylinder which likewise functions as a portion of the return circuit for the current traversing the heater wire.

Many attempts have hitherto been made to reduce the hum in thermionic tubes employing indirectly heated cathodes and up to the present time the most successful type of hum eliminating cathode utilizes a heater consisting of a wire shaped to form a loop. This so-called "hairpin" type of heater eliminates a certain portion of the stray magnetic field produced by the alternating heating current, but does not reduce such stray to zero.

With my improved form of cathode, I achieve complete and absolute elimination of magnetic strays from the alternating heating current and thus through the use of such cathode thermionic tubes exhibiting a hum-free output of higher quality may be constructed.

In the drawings accompanying and forming a part of this specification, in which like numerals designate corresponding parts throughout:

Fig. 1 is an enlarged sectional elevation of one embodiment of my improved cathode.

Fig. 2 is an enlarged sectional elevation of an alternative form of my cathode.

Fig. 3 is a cross-section taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional elevation of a further embodiment of my cathode.

Fig. 5 is an enlarged sectional elevation of an embodiment of my cathode applicable for use with standard thermionic tubes.

Fig. 6 is a cross-section taken on the line 6—6 of Fig. 5.

Referring now particularly to the figures which are shown with greatly exaggerated relative diameters in order to more clearly bring out the structural features of my invention:

Fig. 1 illustrates an embodiment of my idea in which the heater wire 1, composed of tungsten or other material which is rendered incandescent by the passage of electric current therethrough, is co-axially disposed within preferably a nickel cylinder or tube 3, the upper extremity of which is tapered to a point 2 as shown. The heater wire 1 is welded or otherwise conductively connected to the tapered point 2 and a terminal 4 is provided for the tube. The tube 3 functions as a portion of the return circuit for the heating current and as it completely encircles the heater wire 1, obviously there will exist outside of the tube no magnetic stray field resulting from the passage of the alternating heating current therethrough. A cylinder 6 of refractory material such as porcelain maintains the heater wire 1 in co-axial alignment with the tube 3. A metallic cylinder 8, provided preferably with a closed top 14, is co-axially maintained with respect to the heater wire 1 and tube 3 by means of the cylinder of the refractory material 7. Cylinder 8 is provided with a coating of electron emitting substance or substances such as strontium or barium oxide or a mixture thereof and constitutes the element from which electrons are emitted

through the agency of the heat developed by the incandescence of the heater wire 1.

In Figs. 2 and 3 I have shown another embodiment of my idea in which the refractory cylinder 6 is omitted and the heater wire is maintained in co-axial relationship with the return circuit tube 3 by tension or by the employment of a heater wire of proper dimensions to exhibit the necessary rigidity to accomplish the purpose. The cylinder 8 carries thereon electron emitting substances 9 and is separated from the tube 3 by the cylinder 7 of refractory material. A connection 5 to the cylinder 8 is provided for extension through the press of the thermionic tube that electrical connection may be made with the active portion of the cathode.

Referring to Fig. 4, I have illustrated a still further embodiment of my idea wherein the electron emitting substance or substances are carried by a perforated cylinder 18. The use of the perforated cylinder is not necessary but constitutes an embodiment whereby heat transfer from the heater wire 1 to the electron emitting substances 9 is facilitated.

The length of the present day heater is governed by the alternating current voltages used and the physical constants of the tungsten heater wire and it is not possible to use the standard heater wire length with my co-axial cylinder construction. In order to obtain the same length of heater wire as is now common in standard thermionic tubes, it is necessary in my construction to use two heaters connected in series as shown in Fig. 5. Heater wire 1 is connected to return co-axial cylinder 3, the lower extremity of which is connected through conductor 10 with the lower extremity of cylinder 12 to the top of which is attached heater wire 11. The twin heaters thus formed are surrounded by refractory material 17 which carries a metallic sleeve 28 bearing electron emitting substances 19 thereon and a connection wire 15 attached thereto.

With this type of construction, my improved cathode may be adapted to present day voltages in keeping with standard heater wire lengths. In other words, the embodiment of my invention just described may be utilized in standard thermionic tubes without requiring any change of voltage in the heater supply to permit the construction of a thermionc tube which may be used in standardized circuits and with standardized equipment.

It will be noted that my improved cathode reduces magnetic strays from the alternating heating current to zero as no magnetic stray can exist outside of the enclosing metallic tube 3 which functions as the return circuit for all of the heating current traversing the heating wire 1 and that thus I have produced a cathode by which thermionic tubes may be constructed which exhibit no hum due to magnetic strays from the heating current.

As noted hereinbefore, I have purposely exaggerated the diameters of the return tubes and the electron emissive cylinders in order that the construction of my cathode may be more clearly shown. Obviously, the diameters of the elements of my cathode must be so proportioned that the proper activation temperature may be obtained, but such requirement will be readily understood by anyone skilled in the art.

Having thus completely described my invention by the illustration and description of several embodiments thereof, what I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A cathode comprising, a pair of metallic cylinders conductively connected to each other, a heater wire co-axially disposed within each of said cylinders and conductively connected thereto and an electron emitting element disposed adjacent to said cylinders.

2. A cathode comprising, a plurality of cylindrical conductors conductively connected to each other at one of the extremities thereof, a heating element co-axially disposed within each of said conductors and conductively connected thereto and an electron emitting element enclosing said cylindrical conductors.

3. A cathode comprising, a pair of hollow cylindrical conductors one extremity of each of which is closed and the other extremities of which are conductively connected to each other, a heating element co-axially disposed within each of said conductors and conductively connected to the closed extremities thereof and an electron emitting element disposed adjacent to said cylindrical conductors.

4. A cathode comprising, a pair of hollow cylindrical conductors, one extremity of each of which is closed and the other extremities of which are conductively connected, a heating element of substantially the same length as said conductors co-axially disposed within each of said conductors and conductively connected respectively to the closed extremities thereof and an electron emitting element disposed adjacent to said conductors.

5. A cathode comprising, a pair of hollow cylindrical conductors closed at one extremity and conductively connected to each other at the other extremities thereof, a heating element co-axially disposed within each of said conductors and conductively connected respectively to the closed extremities thereof and a metallic member bearing electron emitting substances surrounding said cylindrical conductors.

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