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D. J. DELANEY

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HEATER TYPE VACUUM TUBE

Filed March 7, 1928

Fig. 1.

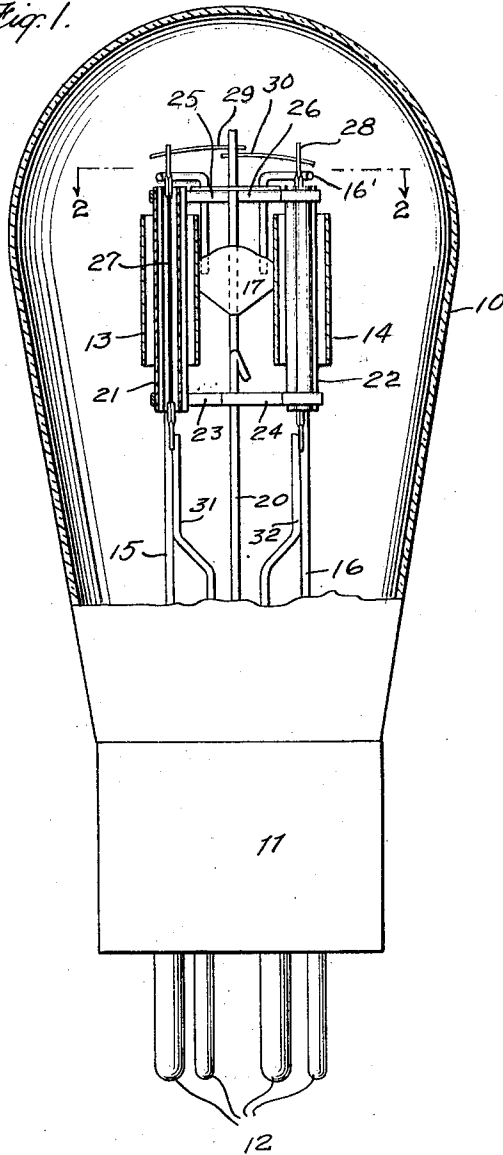


Fig. 2.

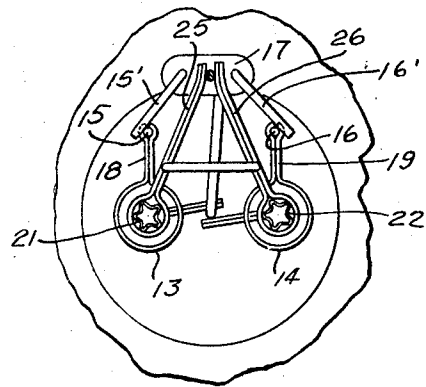
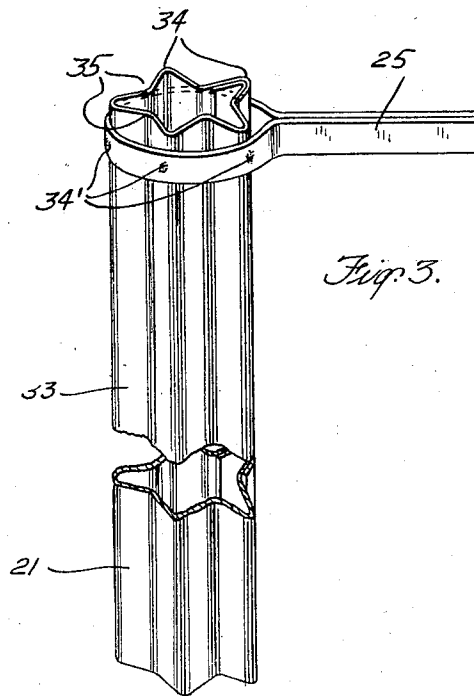


Fig. 3.

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HEATER TYPE VACUUM TUBE

Application filed March 7, 1928. Serial No. 259,647.

This invention relates to a vacuum tube of the heater type and particularly to a cathode construction for such a tube.

In the co-pending application of Clarence A. Horn, Serial No. 249,256 entitled "Multiple filament rectifier" filed January 25, 1928, there is shown a full wave rectifying tube of the heater type in which two filaments are connected in parallel and are surrounded by cylindrical cathodes which are coated with electron-emitting oxides and in turn are surrounded by two cylindrical plates or anodes. In this type of vacuum tube the cathode is heated from a filament of carbon or other material adapted to be raised to incandescence by the current flowing therethrough, and inasmuch as the heat radiated by the filament varies as the square of the distance, the cathodes should be placed as close as possible to the heater in order to utilize a maximum of the heat energy produced therein. The electron emission from the outer surface of the cathode depends not only on the material comprising the surface and the temperature to which it is raised, but also on the amount of surface which is energized. To increase the surface will increase the electron emission, but where a cylindrical cathode is used such increase of surface must necessarily increase the diameter of the cathode and therefore space the walls thereof farther from the heating filament with the result that the heat energy intercepted by the cathode is materially reduced.

It is one of the objects, therefore, of the present invention to provide a cathode in which the electron-emitting surface is considerably increased while at the same time the effective distance of the walls of the cathode from the heater are such that the maximum possible heat energy therefrom is utilized.

Another object of the invention is to provide a cathode for a heater type vacuum tube in which the electron-emitting surface is large enough so that a relatively high temperature for efficient operation of the tube need not be maintained.

Another object of the invention is to provide a cathode having great rigidity so that it

will resist torsional strains set up therein due to heating of the cathode.

Other objects of the invention and objects especially relating to construction and design thereof will be apparent as the description proceeds.

One embodiment of the invention has been illustrated in the accompanying drawings, in which

Fig. 1 is a sectional side elevation of a vacuum tube embodying the invention;

Fig. 2 is a sectional plan view taken on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged perspective view of the cathode.

Referring more specifically to the drawings, the invention is shown in connection with a full wave rectifier tube such as is illustrated and described in the co-pending application above referred to and which comprises an envelope 10 mounted on the usual base 11 which carries the pins 12 adapted for making the connections to the socket terminals when the tube is inserted in the socket. A pair of plates 13 and 14 are mounted upon uprights 15 and 16, respectively, which are sealed into the usual press (not shown), the upper ends thereof being supported by means of auxiliary posts 15' and 16' which are sealed in the glass bead 17 so as to insulatingly space the upper ends of the plates. The plates 13 and 14 may be formed of sheets of metal bent in cylindrical form and provided with flanges 18 and 19 by which they may be attached to the supports 15 and 16. A central conductor 20 is mounted in the center of the tube and forms the support for the cathodes 21 and 22 which are mounted inside of the plates 13 and 14. To this end a strip 23 is welded around the lower end of the cathode 21 and a strip 24 is welded around the lower end of the cathode 22, both said strips 23 and 24 being welded to the support 20. The support 20 is bent outwardly at a point slightly above its juncture with the strips 23 and 24 and then upwardly to a point near the top of the tube and strips 25 and 26 which are welded to the upper end of the support 20 are secured to the upper ends of the cathodes 21 and 22 in a similar manner as the strips 23 and 24 and rigidly support

the tops thereof. Filaments 27 and 28 are positioned inside of the cathodes 21 and 22 and are supported at their upper ends by springs 29 and 30 which are attached to the upper ends of the filaments and welded to the upper end of the central supporting post 20. The lower ends of the filaments 27 and 28 are attached to supporting rods 31 and 32 which are connected to one of the filament terminals of the tube, the central post 20 being connected to the other filament terminal and forming the conductor for the other ends of the filaments and for the cathodes. The glass bead 17 may be sealed around and supported by the upper end of the post 20.

As outlined above, the construction of the full wave rectifier tube is similar to that described and shown in the above entitled co-pending application. The cathode forming the subject matter of the present invention comprises a tubular shell 33 having corrugated walls, which, as illustrated in Fig. 3 in the embodiment shown, has five outwardly extending ridges 34 and five indentations 35 running the full length of the cathode. The strip of supporting material 25 may be circularly bent around the cathode and welded to the upper ends of the ridges 34 at the points of contact as shown at 34; two or three such welds being sufficient in most cases. The cathode, of course, is properly coated with electron emitting oxides as is well known in the art.

With this construction it will be evident that the external surface or electron-emitting surface of the cathode is greatly increased, such increase being in one instance, using a similar cathode, about 75 per cent. The filament may be spaced approximately the same distance from the indentations 35 as a cathode having a cylindrical form, or such indentations may come somewhat nearer the filament if desired, whereupon the ridges 34 are heated by radiation from the filament and also by conduction from the nearer inner portions 35. Such a construction provides a uniform heating effect as though a heater were used having a diameter such that the cylinder walls would come somewhere between the ridges 34 and the indentations 35, this imaginary heater being the mean depth of the corrugations and the electron-emitting quality of the cathode may be greatly increased without the necessity of increasing the current flowing through the heater.

It has been found that with the use of a cylindrical cathode certain torsional strains are set up when the cathode is raised to a high temperature during the process of exhaustion. These torsional strains may distort the cathode slightly so that one end, generally the upper, is caused to move slightly out of alignment with the result that it touches the filament, which completely

destroys the usefulness of the tube, and necessitates scrapping the same. In the present invention the corrugated cathode provides great strength in the cathode walls which absolutely resist any tendency toward distortion when heated and, therefore, the danger of a failure of the tube due to movement of the cathode against the filament or grid is eliminated.

While I have shown and described a corrugated cathode having longitudinal ridges and indentations, it is to be understood that any cross section or formation of the walls which will increase the surface of the cathode and at the same time permit the average mass to be relatively close to the heater is within the spirit of the invention and it is my intention that the word "corrugated" as used throughout the specification and claims, shall cover any such construction.

I have also shown and described the invention as adapted to be used with a rectifying tube but it is obvious that such a cathode may be used in any radio vacuum tube such as a detector or amplifier and therefore, I do not desire to limit myself to the specific construction shown and described, but to interpret the invention broadly, within the scope of the appended claims.

What I claim is:

1. In a thermionic tube, a heating filament, a corrugated cathode adjacent said filament, the corrugations on said cathode extending longitudinally thereof, and a strip of metal around each end of said cathode engaging only the peaks of the corrugations, said strip being welded to a plurality of said corrugations.
2. A cathode for thermionic tubes comprising an elongated shell having longitudinal corrugations around the entire surface thereof providing alternate depressions and ridges thereby both materially increasing the surface area and rigidity of said shell throughout its circumference.
3. A cathode for thermionic tubes comprising an elongated shell having a central axis and having longitudinal corrugations, the mean depth whereof by which the heating effect is rated, centers on said axis, and the electron emissive surface is increased materially.
4. A cathode for thermionic tubes comprising an elongated shell having alternate longitudinal depressions and ridges of substantial depth and height respectively as compared to the distance between the peaks of successive ridges, whereby the rigidity and surface area of the shell are materially increased.
5. A cathode for thermionic tubes comprising an elongated shell having corrugations providing alternate longitudinal depressions and ridges of substantial depth and height

respectively as compared to the distance between the peaks of successive ridges, the several peaks and ridges being inversely shaped to each other for obtaining a mean depth of corrugations substantially equi-distant from
5 a central axis.

In testimony whereof I affix my signature.
DANIEL J. DELANEY.

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