

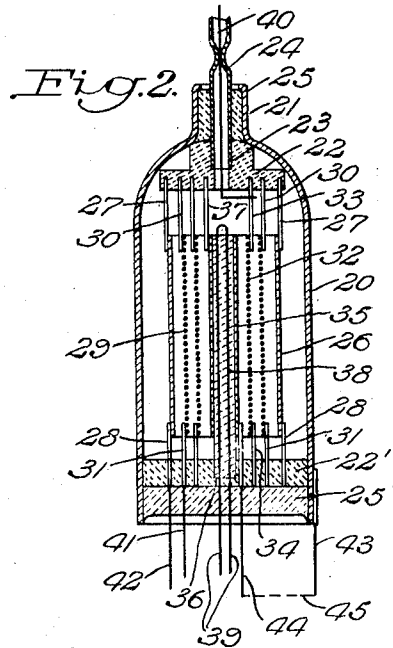
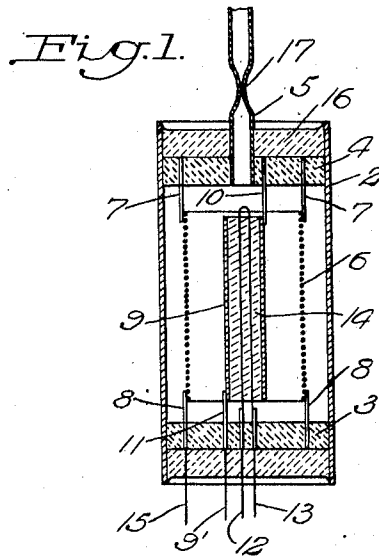
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THERMIONIC TUBE

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THERMIONIC TUBE

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This invention relates to thermionic tubes such as those commonly used in radio communication circuits, sound and signal amplifying circuits and the like, and to a method for making the same, and constitutes an improvement on the invention disclosed in my prior U. S. Patent No. 1,615,023, dated January 18, 1927.

Heretofore it has been proposed to construct thermionic tubes with a metal envelope in place of the usual glass envelope, the metal envelope constituting one of the electrodes of the tube. The commercial development of such tubes, however, has been limited to the so-called "power tubes" for two reasons. The first is that methods of manufacture as heretofore commercially developed are relatively expensive and consequently such devices have only been made in cases where the glass envelope could not be practically used. The second reason is that in power tubes the exposed metal envelope can be water-cooled from the outside, thus enabling the tube to handle a very large current output.

In my prior patent above referred to I have disclosed a form of vessel and method of making the same particularly adapted to the radio tube industry for the manufacture of tubes having a metal envelope and having porcelain or other earthen or ceramic material joined thereto and through which a seal for the metal envelope is effected.

The present invention adapts the disclosure of my said prior patent to the manufacture of metal tubes which can be economically produced on a commercial scale and constructed in various sizes. It thus enables the glass envelope to be omitted from small tubes, such as those used in radio receiving circuits, and because of the elimination of the glass envelope, it cheapens the cost of manufacture. Also because of the fact that the tube need not be provided with a glass envelope, the tubes can be made very small and occupy considerably less space than is required at the present time.

The invention may be readily understood by reference to the accompanying drawing in which

Figure 1 represents a longitudinal section through one form of tube made in accordance with my invention; and

Figure 2 is a similar view of a different form of tube.

Referring first to the tube construction shown in Figure 1, the tube comprises a metal shell 2, which may be conveniently formed of circular tubing. Inserted into the lower open end of the tube is a molded disc 3 of insulating material,

and an insulating material of a highly refractory nature is preferably employed. For example, the disc 3 may be formed of bonded magnesium oxide. At the opposite end of the metal shell is a somewhat similar insulating disc 4, also preferably made of magnesium oxide. This disc is provided with an opening into which a glass tube 5 is fitted. The discs 3 and 4 carry the supporting posts on which the electrodes within the tube are supported. For example, I have shown the tube as having a grid 6 supported by posts 7 in the disc 4 and posts 8 in the disc 3. There is also supported within the tube a cathode 9 of the indirectly heated type, this cathode being supported by posts 10 and 11. Passing through the lower disc 3 are lead wires 12 and 13 for supplying current to the cathode heater 14, the cathode heater being supported inside the cathode 9. The lead wire 9' may attach to the cathode supporting post 11 and a lead wire 15 may attach to one of the grid supporting posts 8.

It will be noted that the insulating refractory discs 3 and 4 are preferably set slightly in from the ends of the cylinder, leaving a space which is filled with an insulating fusible composition, preferably of a ceramic nature, but which has a melting point above the temperature to which the tube is subjected in the heating which accompanies the sealing off of the tube, but at a temperature much lower than the melting point of the refractory discs 3 and 4. This ceramic sealing material is designated 16. It is fused into place, so that it adheres to the metal shell 2 and to the ceramic discs 4 and to the various wires 12, 13, 14, 15, etc., coming through the base of the tube and to the glass tubulation 5. Its melting point is preferably lower than the melting point of the glass tubulation 5. In the finished tube the glass tubulation 5 is sealed off as indicated at 17, but preferably quite close to the end of the tube.

In the manufacture of the tube the electrodes comprising the cathode and its heater and the grid are welded to their respective supporting posts in accordance with the usual practice, and as will be readily understood by those skilled in the art, after which the posts are inserted in preformed holes in the discs 3 and 4. For convenience of assembly the holes preferably go all the way through the discs 3 and 4 and are of such diameter that the posts have a fairly tight fit therein. The assembly is then inserted in the tube 2, and the low temperature fusing material 16 is filled in. This material is then heated to its fusing point, or if preferred, it may be poured

into place in a fused condition. The material employed may be similar to glazes commonly used in the ceramic industry, or to earthen enamels, or may be in the nature of a boro-silicate composition. Various compounds suitable for the purpose are well-known in the ceramic art and form no part of the present invention per se.

When this fused mass 16 sets it is firmly bonded to the various elements with which it contacts and forms an air-tight seal at each end of the tube. The tube can then be attached to an exhausting pump through the tube 5 and degasified in accordance with the usual procedure. The procedure of degasifying usually includes the heating of the electrodes to a very high temperature to drive out occluded gases. The fusible material 16 has a melting point high enough to resist fusion, and because of the insulation afforded by the supporting discs 3 and 4 and the fact that it is adjacent the ends of the tube, it is not likely to soften, at least to an extent which is detrimental to the sealing of the tube. When the pumping of the tube has been effected, the sealing off can be accomplished in the usual manner by softening the walls of the glass tube 5 at 17 to cause the walls to collapse and close the tube.

The completed structure thus formed can be mounted on any standard or special base in accordance with the usual practice, and I have not shown any such base, as these are well-known to the art, as is also the manner of mounting. In the drawing I have shown for the purpose of clarification the parts, or some of them, much larger and more widely separated than would be required in a receiving tube such as is used in radio receiving circuits.

It will be seen, therefore, that the overall dimensions of the tube may be very small as compared with the overall dimensions of the present glass tubes. The manufacture is more simple than the manufacture of the present type of glass enveloped tubes.

The tubes can therefore be manufactured commercially on an economic basis.

The glass tube 5, when sealed off, provides a window for the otherwise completely opaque structure by means of which one inspecting the tube or using it can readily determine whether the cathode is heated properly or not. When the cathode is of the proper operating temperature it is usually red hot and the sealed off glass tubulation will permit the light thus emitted to be detected. This is of particular advantage to the user of the tube who may not be equipped with testing devices to determine in other ways whether a tube is defective or not.

In the arrangement shown in Figure 2 the construction is generally similar to that described, but the envelope of the tube, instead of constituting the anode for the tube, preferably comprises a shield. In this modification the metal shell, designated 20, is drawn with a restricted neck portion 21, the lower end of the shell being of full diameter. Inside the upper end of the tube and setting against the shoulder formed where the neck begins to flare out, so as to substantially close the neck, is a ceramic supporting disc 22 having a central opening 23 to receive a glass tube 24. Filling the neck of the tube around the glass tubulation and above the top of the disc 22 is the fusible ceramic material 25 for sealing the upper end of the tube. Adjacent the opposite end of the tube is a ceramic

supporting disc 22', and 25' designates a layer of fusible material for sealing the lower end of the tube. The plates 22 and 22' are of a material similar to the discs 3 and 4 and they are provided for the purpose of accommodating the supports for the various electrodes within the vessel or shell 20. These electrodes comprise a cylindrical plate or anode 26 supported on post 27 at its upper end and 28 at its lower end, a screening grid 29 supported on its upper end by posts 30 and at its lower end by posts 31, a control grid 32 supported on posts 33 and 34, and the cathode 35 which may be positioned in a recess at 36 in the lower disc 23 and centered by a supporting post 37 at its upper end. I have indicated the cathode as being of the indirectly heated type, the heater being designated 38. The lead wire is designated 39. The lead wire to the control grid is designated 40, and it passes out the tubulation 24 at the top of the tube so that in the completed tube it may be attached to the metal which sets on the neck 21 and which is not shown, but which is commonly provided in screen grid tubes. The numeral 41 designates the wire leading to the screen grid, and 42 is the anode lead wire.

A lead wire 43 may be connected onto the metal envelope 20 by means of which the envelope 20 can be included in a circuit according to any desired manner. Generally, this field would be connected to the cathode lead wire 44, as indicated by the dotted line 45, thus eliminating the necessity for a separate metal shield around the tube.

In assembling the tube the procedure is similar to the procedure heretofore described. The various elements are assembled on the supporting discs 22 and 22' and slipped through the wide end thereof, the sealing material at 25 and 25' is applied to the ends and fused to seal the tube, after which the tube is degasified and sealed off.

The tube as described forms a very compact shielded screen grid tube in which the envelope of the tube constitutes a metal shield.

The tubes as thus constructed can be cheaply assembled. A fusible material which adheres to both the metal and the porcelain and which is in the nature of a low temperature glaze adheres to the metal and is not affected by the expansion and contraction thereof while the electrodes are carried on the stronger and more heat-resistant refractory discs or plates, which plates keep the low fusing sealing material from flowing down into the tube.

While I have described certain specific embodiments of my invention, it will be appreciated that this is merely by way of illustration and that various changes and modifications may be made in the details of construction and the details of manipulation without departing from the spirit of my invention and the scope of the following claims. It will be further understood that the electrodes have been more or less conventionally illustrated as any accepted form, construction and spacing may be utilized.

I claim:

1. A thermionic tube comprising a metal shell, a refractory supporting member adjacent opposite ends of the shell, a ceramic sealing material fused to the supporting members and to the shell for forming an air-tight seal, an anode within the shell carried on the supporting members, and a cathode within the shell carried on one of said supporting members, said metal shell

constituting a shielding electrode around the anode and cathode.

5 2. A thermionic tube comprising a metal shell, a refractory supporting member adjacent opposite ends of the shell, a ceramic sealing material fused to the supporting members and to the shell for forming an air-tight seal, an anode within the shell carried on the supporting members, and
10 supporting members, said metal shell constituting a shielding electrode around the anode and cathode, said tube being provided with a grid between the cathode and the anode and also being provided with a second grid between the
15 anode and the cathode.

3. A thermionic tube comprising a metal ex-

ternal envelope, a ceramic supporting body at each end of the envelope, a fused ceramic sealing material forming a seal between said metal body and said supporting members at each end of the tube, anode, cathode and grid electrodes within the shell carried by the ceramic supporting members, said metal envelope constituting an electrode other than an anode.

4. An electron tube comprising a metal shell having an insulating disc sealed into one end
10 thereof and having supports thereon for electrodes, electrodes within the shell on said supports, a sealing disc at the other end of the shell having an exhaust passage therein, and means sealing the exhaust passage.
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