

May 8, 1951

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2,551,871

THERMIONIC CATHODE CONSTRUCTION

Filed Feb. 11, 1949

3 Sheets-Sheet 1

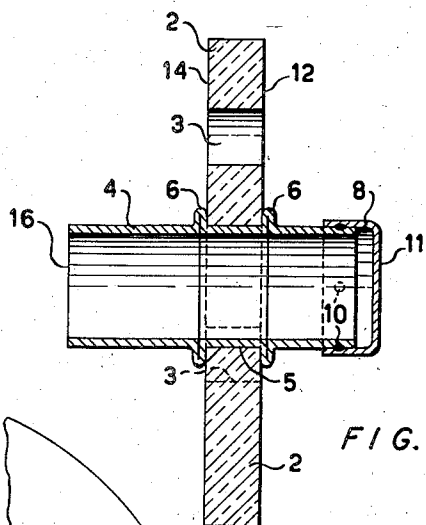


FIG. 1.

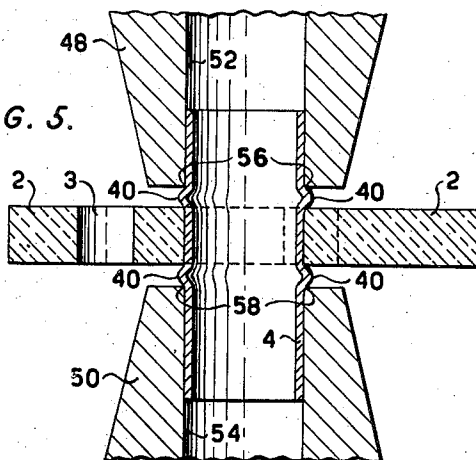


FIG. 5.

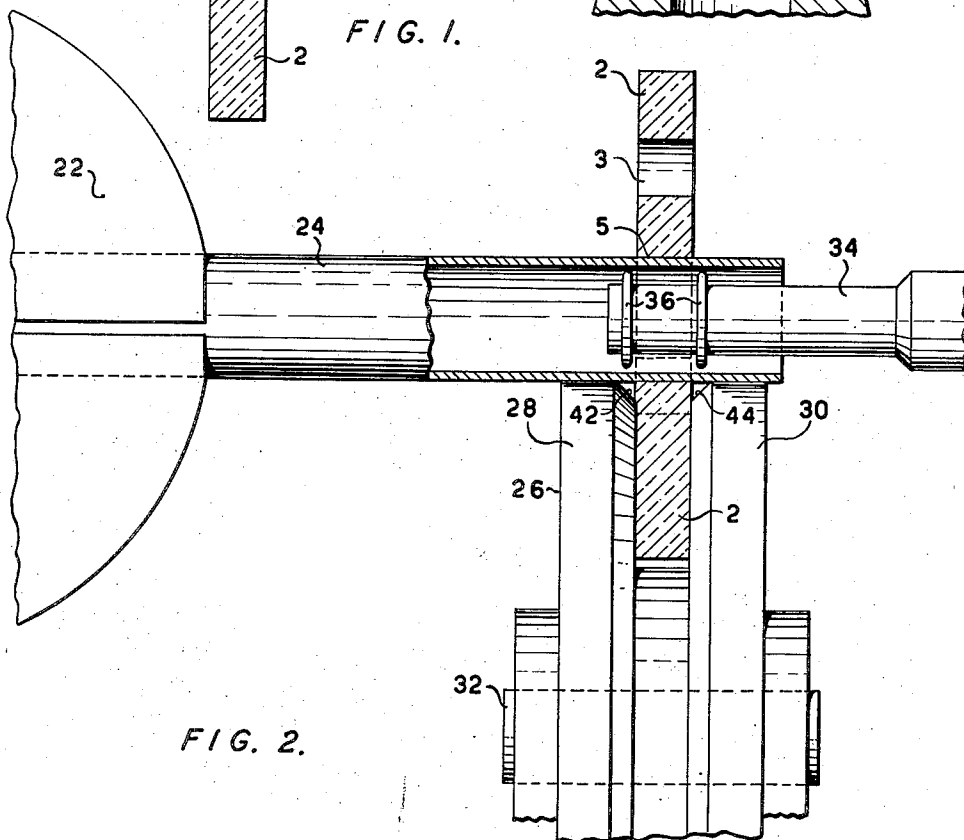


FIG. 2.

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3 Sheets-Sheet 2

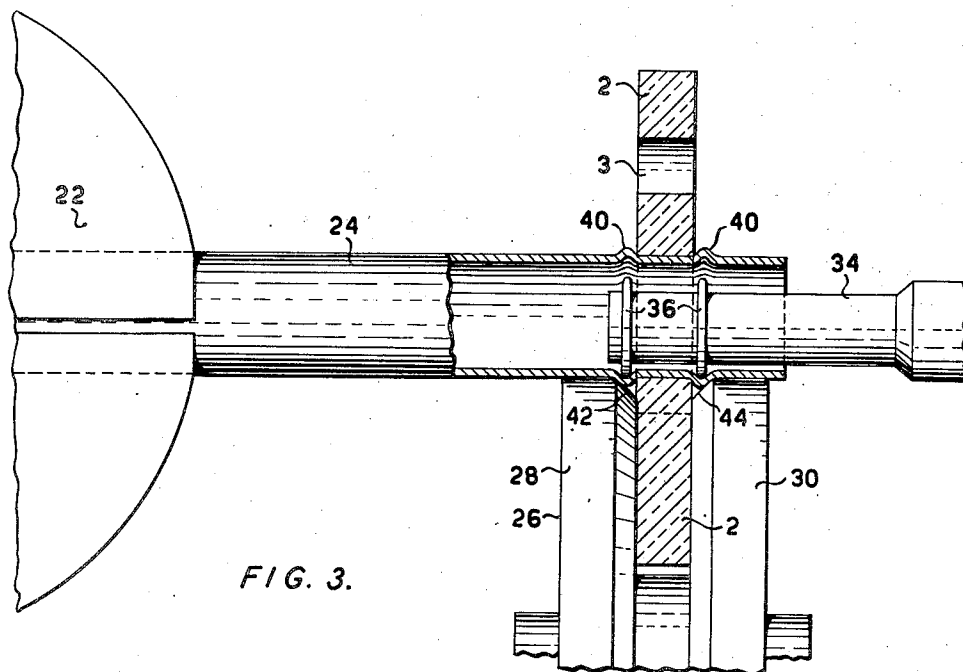


FIG. 3.

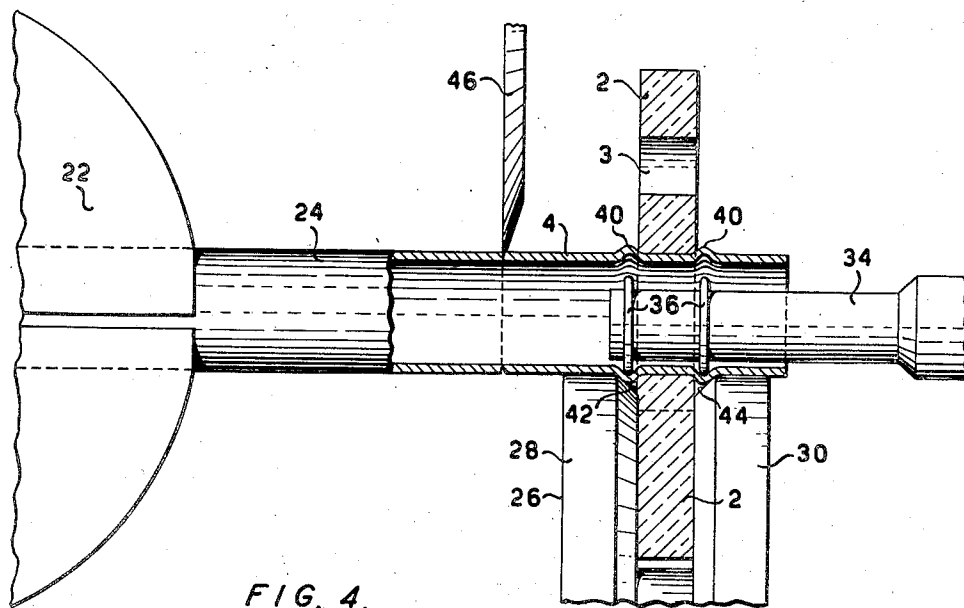


FIG. 4.

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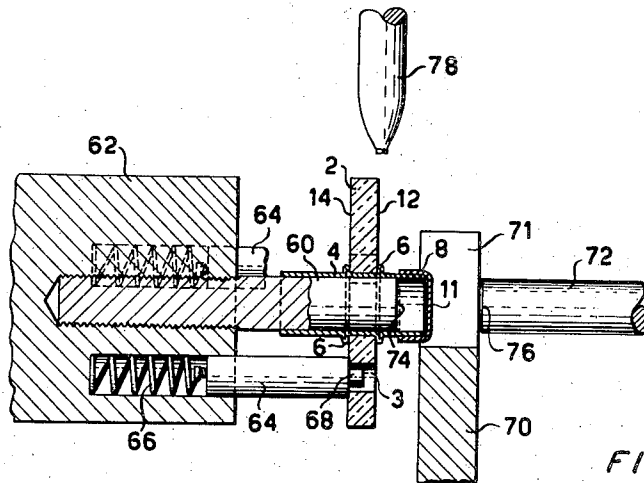


FIG. 7.

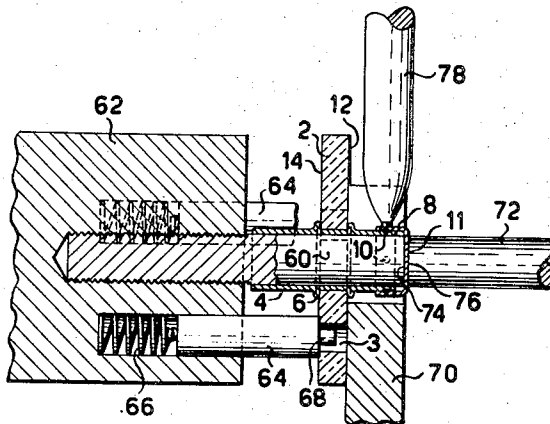


FIG. 8.

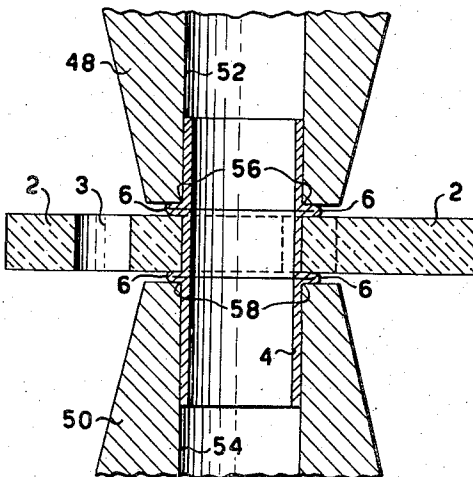


FIG. 6.

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2,551,871

THERMIONIC CATHODE CONSTRUCTION

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Application February 11, 1949, Serial No. 75,845

6 Claims. (Cl. 250-27.5)

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This invention relates to the construction of cathodes for thermionic tubes and has particular reference to the disc type of cathode which is used in various cathode ray tubes, television pick-up tubes and tubes of so-called lighthouse construction.

This application is in part a continuation of my application Serial Number 662,028, filed April 13, 1946, now Patent 2,067,967.

In tubes of the type just mentioned the thermionic emission is obtained from a relatively small flat disc coated with alkaline earth oxides. The disc must be rigidly and accurately mounted within the tube a few thousandths of an inch from a grid member and in extremely accurate parallel relationship thereto. The disc is supported by a metal tubular member which may be of any of the conventional forms, i. e., seamless, welded, and drawn, boxed or wrap around ribbon type. The disc, which may be in the form of a cup may be mounted over the end of the tube as a cap. The tube also serves as a means of conducting heat to the disc or cup carrying the oxides to heat it to electron-emitting temperature. An insulated tungsten, molybdenum or similar wire is usually placed inside the tube to provide sufficient heat by electrical resistance to make possible the attainment of the proper temperature.

In order to support the cathode assembly a ceramic or similar heat resistant insulator is employed. Heretofore the tubular member has been held in place in various fashions, for example, by the use of two collars carrying flanges, the collars being welded on the tube at each side of the insulator, by embossing the tube on one side of the insulator and providing a collar having a flange on the other side or by providing an embossing on the tube on one side of the insulator and providing on the other side a deep drawn cathode cap with a flange engaging the insulator. These constructions are expensive and require an undue amount of welding and, in the case of the use of a deep drawn cathode cap, there is a limitation due to the drawing on the metals which may be used.

It is the general object of the present invention to provide an improved simplified cathode construction and method of assembly capable of locating to a high degree of accuracy the emitting surface. This is particularly necessary in the case of television tubes of various types involving electron optics and in extreme frequency tubes such as lighthouse tubes in which the relative positioning of the tube elements is quite critical.

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More particularly it is an object of the invention to provide a cathode construction and a method of assembling the cathode providing an accurate longitudinal dimension and an accurate parallel plane alignment between the face of the insulating supporting disc and the face of the electron emitting cap.

These and other objects of the invention relating particularly to details of construction and the method of assembly will become apparent from the following description read in conjunction with the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view showing the improved cathode construction;

Figure 2 is a fragmentary sectional view showing a tubular member having been fed through the central bore of a ceramic disc, a guide roll locating the disc on the tubular member and bead forming means inserted in the end of the tubular member;

Figure 3 is a fragmentary sectional view of the apparatus shown in Figure 2 showing the bead forming means in the position assumed when the beads are formed in the tubular member;

Figure 4 is a fragmentary sectional view of the apparatus shown in Figure 3 with the addition of the cut-off means in the process of cutting the tube;

Figure 5 is a fragmentary longitudinal sectional view showing the tube mounted in die members of a press preparatory to flattening the beads against the disc;

Figure 6 is a fragmentary longitudinal sectional view of the apparatus shown in Figure 5 in the position assumed when the beads are flattened against the disc;

Figure 7 is a fragmentary longitudinal sectional view showing the tube and disc assembly with a cap in place and mounted in aligning and welding apparatus prior to the alignment and welding of the cap to the tube; and

Figure 8 is a fragmentary longitudinal sectional view of the parts and apparatus shown in Figure 7 in the position gauging the relation between the disc and the cap and with the welding electrode in position to weld the cap to the tube.

Referring to Figure 1 there is shown disc 2 of ceramic or similar heat resistant material containing three uniformly spaced bores 3 and a central bore 5. Mounted within the central bore 5 in the disc is the tubular member 4 composed of nickel, nickel alloy or similar material and being formed with beads 6 lying flat and bearing firmly against opposite faces of the disc 2

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thereby mounting the tube in the disc. The cap 8, composed of nickel, nickel alloy or similar material, is located over the end of the tube 4 and is held in position by welds 10. The cap 8 is located with extreme accuracy providing accurate parallel plane alignment and accurate longitudinal dimension between the face 11 of the cap 8 and the face 12 of the disc 2. The dimension between the face 14 of the ceramic disc and the end 16 of the tube 4 is held to reasonably accurate tolerances. It should be noted that the tube 4 and the cap 8 are of extremely thin wall construction and in the figures the wall thicknesses are exaggerated in the interest of clarity.

In connection with the following description relating to the details of the method employed in producing the improved cathode assembly it should be noted that the apparatus employed in forming the beads is described in detail in the copending application, Price Reed Case 1, Serial No. 75,577, filed February 10, 1949 and the apparatus employed in gauging and aligning the cap and welding the cap to the tube is disclosed in detail in the patent to Price Reed No. 2,476,454, dated July 19, 1949.

There is shown in Figure 2 a rotating chuck 22 through which has been fed a predetermined length of a tubular member 24 by means not shown. The tubular member having been fed through the chuck from left to right, as viewed in Figure 2, has passed through the central bore 5 in the ceramic disc 2, the ceramic disc having been positioned in proper alignment with the tubing by positioning means, now retracted and not shown. The disc 2 is free to rotate with the rotating tubular member 24. The guide roll 26, having peripheral surfaces 28 and 30 contacting the outer surface of the tubular member 24, is rotatably mounted on the shaft 32 and engages the disc 2 accurately locating the disc at a predetermined distance from the open end of tubular member 24, and on a plane perpendicular to the longitudinal axes of the tubular member. Inserted through the open end of tubular member 24 is spinning tool 34, which carries beads 36. The spacing of the beads 36 and the location of the tool 34 is such that the beads may be brought to bear on the inside of the tube adjacent to the opposite faces of the disc 2, as shown in Figure 3. The means actuating the spinning tool 34, guide roll 26, disc supporting means and tubular member feeding and rotating means are all disclosed in detail in the above mentioned application, Price Reed Case 1, Serial No. 75,577.

The spinning tool 34 is rotatably mounted in a mounting, not shown, thereby allowing the spinning tool to rotate when the beads 36 contact the inside wall of the rotating tubular member 24. The spinning tool 34 is brought to bear on the inside wall of the tubular member 24 with sufficient force to cause beads 40 to be formed in the wall of the tube. It will be noted that the peripheral surfaces of the guide roll are bevelled as shown at 42 and 44 providing space and limiting the height of the beads 40. It should also be noted that beads formed by a point contact on the wall of a rotating tube will lie on a plane perpendicular to the longitudinal axes of the rotating tube. Thus, these beads, which when formed bear against opposite faces of the disc 2, will hold the disc not only firmly but also accurately in perpendicular plane alignment with respect to the longitudinal axes of the tube.

At the completion of the bead forming operation a rotatably mounted cut-off disc 46, mount-

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ing not shown, is brought to bear against the wall of the tubular member 24, as shown in Figure 4, at a location accurately dimensioned longitudinally from the face of disc 2 thereby establishing an accurate length of the tube 4 extending from the face of the disc 2. Again it is obvious that the rotating tube, which is contacting the cut-off disc at essentially a point contact, will be cut on a plane which is exactly perpendicular to the longitudinal axes of the tube. While the cut is in progress the spinning tool 34 may be retracted from the tubular member; and, while it is desirable to allow the guide roll to bear against the tubular member until the cut is completed, thereby providing restraint against the force applied by the cut-off disc, if this force is small and the cut is accomplished at a moderate speed the guide roll may be retracted at any time during or prior to the cutting operation to allow the assembly comprising the disc 2 and the measured length of tube 4 to fall away from the tubular member 24. The cut-off disc actuating means and the means retracting the spinning tool and guide roll are also shown in detail in the above mentioned copending application, Price Reed Case 1, Serial No. 75,577.

Referring to Figure 5 there are shown die members 48 and 50 each having a central bore 52 and 54, respectively, of a diameter such as to provide a slidable fit over the tube 4. These die members may be mounted in a manually or machine operated press having an opening stroke sufficient to allow the insertion of the tube and disc assembly. When the dies are brought together the inner edges of the faces 56 and 58 of the die members bear against the beads 40. The closing stroke of the die members is limited to that stroke which will flatten the beads, closing the two sides of each of the beads against themselves, forming the flattened beads 6 as shown in Figure 6, and causing the beads to bear firmly against opposite faces of the ceramic disc. Further travel of the dies is limited by suitable stop means to prevent the crushing of the ceramic disc 2. The dies are then parted and the assembly having flattened beads is removed. The beads 6 thus flattened hold the tube in a permanent position in the ceramic disc and will not be affected by vibration or repeated heating and cooling of the members.

After the beads have been flattened the cap 8 is placed over one end of the tube 4 in preparation for the subsequent operation of aligning and welding the cap to the tube. This operation is carried out as indicated in Figures 7 and 8. The tube, disc and cap assembly are placed over solid rod 60 which is composed of an electrically conductive material serving as a welding electrode and is mounted in member 62. Member 62 is fixed with respect to all motion with the exception that it may be rotatable about its longitudinal axis as will be hereinafter described. Also mounted in member 62 are three uniformly spaced pins 64 which are backed by springs 66 and have ends 68 of reduced diameter. The operator in applying the tube, disc and cap assembly over the member 60 will rotate the disc until the end portion 68 of the pins 64 drop into the three bores 3 of disc 2.

The gauge plate 70, which is notched at 71 to allow clearance for the cap 8, is mounted in fixed relation to the gauge rod 72. The longitudinal dimension between the face plate 70 and the end 76 of the rod 72 is accurately established. The end 76 of the rod 72, the face of the gauge plate

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70 and the end 74 of the member 60 are all in parallel plane alignment.

After the tube, disc and cap have been positioned on the member 60, as described above, the gauge plate 70 and the gauge rod 72 are moved by yieldable means to the left from the position shown in Figure 7 to that shown in Figure 8. Thus, the gauge rod 72 will move to the left until, as shown in Figure 8, the cap 8 is firmly engaged between the end face 74 of the member 60 and the end face 76 of the member 72, at which time further motion is arrested. At the same time the gauge plate has caused the ceramic disc 2 to bear against pins 64 compressing the springs 66. Thus, by the action of the springs 66 the ceramic disc 2 is held firmly against the gauge plate 70. It will be evident that the preestablished accurate longitudinal dimensional relation existing between the end face 76 of the gauge rod 72 and the face of the plate 70 will establish a similarly accurate longitudinal dimensional relation between the cap member 8 and the ceramic disc 2. It will also be evident that an accurate parallel plane alignment will be established between the face 11 of the cap 8 and the face 12 of the ceramic disc 2 by virtue of the preestablished accurate parallel plane alignment existing between the end face 76 of the gauge rod 72, the end face 74 of the member 60 and the gauge plate 70. With the parts thus held in position the welding electrode 78 is brought to bear upon the flange of cap 8 and a timed welding current is passed from the electrode 78 through the cap 8 and the tube 4 to the member 60 forming the weld 10 between the cap 8 and tube 4. The means actuating the gauge rod 72, gauge plate 70 and the electrode 78, and the welding circuit involved are described in the above mentioned copending application, of Price Reed, now Patent No. 2,476,454.

It is desirable that a plurality of welds 10 be employed to join the cap 8 to the tube 4. There is described in the above mentioned Patent No. 2,476,454, a mechanism for rotating the member 62 to four successive positions and in each position forming a weld between the cap 8 and the tube 4 by the operation of the welding electrode 78 and the welding circuit.

After the cap 8 has been welded to the tube 4, the gauge rod 72, gauge plate 70 and the electrode 78 are retracted providing clearance permitting the operator to remove the completed disc, tube and cap assembly and to place an unwelded assembly into the apparatus, as hereinbefore described.

It will be evident that various modifications may be made in the construction of, and procedure for assembling, the improved cathode assembly, for example, the cap 8 could be inserted in and aligned and welded to the inside of the tube 4 just as readily as it could be placed on the outside as has been described, the various welds employed to affix the cap to the tube could be made by a plurality of electrodes thus eliminating the necessity for rotating the tube and cap assembly, or the proportionate size and shape of the beads formed in the tube could be varied from those herein disclosed. These and other modifications could be made without departing from the essential principles involved in the invention disclosed herein.

The following claims are limited to product claims. The method of producing the cathode disclosed and claimed herein is claimed in my divisional application, Serial No. 207,708, filed January 25, 1951.

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What I claim and desire to protect by Letters Patent is:

1. A cathode construction for a thermionic tube comprising a member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof engaging the surfaces of the insulating element adjacent to opposite ends of its opening.

2. A cathode construction for a thermionic tube comprising a metal cup shaped member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof engaging the surfaces of the insulating element adjacent to opposite ends of its opening.

3. A cathode construction for a thermionic tube comprising a member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube by welding, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof engaging the surfaces of the insulating element adjacent to opposite ends of its opening.

4. A cathode construction for a thermionic tube comprising a member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof pressed flatly against and engaging the surfaces of the insulating element adjacent to opposite ends of its opening.

5. A cathode construction for a thermionic tube comprising a member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof pressed flatly against and engaging the surfaces of the insulating element adjacent to opposite ends of its opening mounting the element in a plane at right angles to the longitudinal axes of the tube.

6. A cathode construction for a thermionic tube comprising a member providing a flat electron emitting surface, a metal supporting tube for said member, said member being joined to said tube, and an insulating element provided with an opening receiving said supporting tube, said supporting tube having a pair of embossed shoulders provided by the expansion of the metal thereof pressed flatly against and engaging the surfaces of the insulating element adjacent to opposite ends of its opening there being an accurate longitudinal dimensional relation and an accurate parallel plane alignment established between the emitting surface of the member and the insulating element.

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