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HEATER-CATHODE MOUNT

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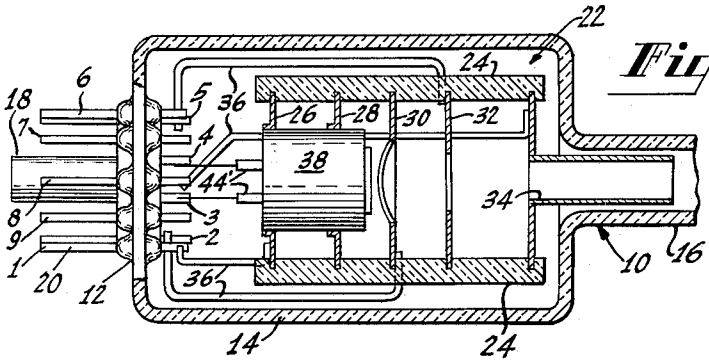

Fig. 1.

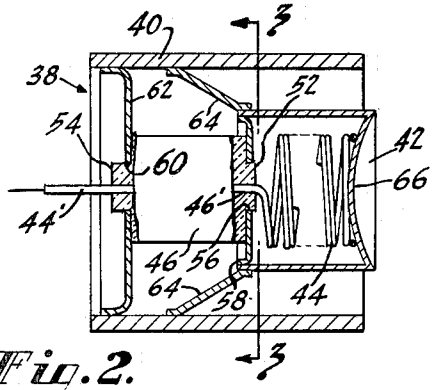

Fig. 2.

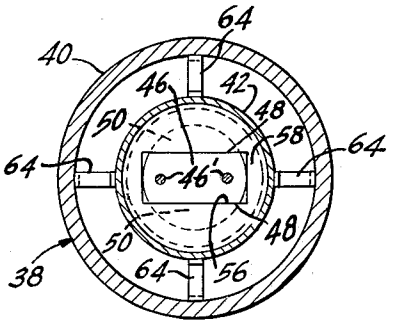

Fig. 3.

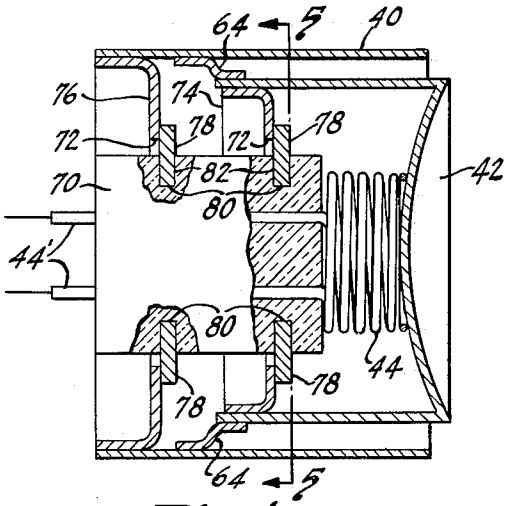

Fig. 4.

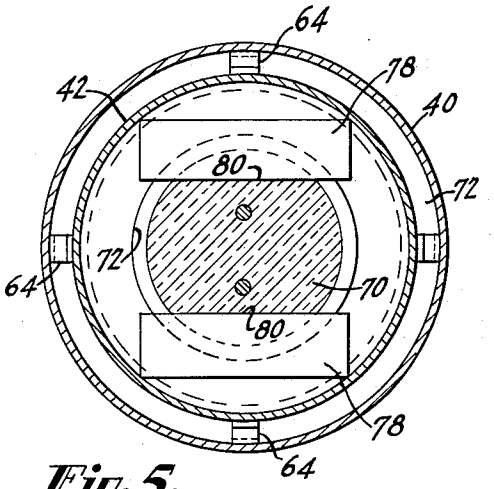

Fig. 5.

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HEATER-CATHODE MOUNT

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The present invention relates to an improvement in electron tubes, and particularly to a rugged heater-cathode mount.

In the case of indirectly-heated thermionic cathodes, a separate heater element is mounted adjacent to the cathode and in insulated relation therewith. Often the cathode and heater are independently mounted in a glass envelope by means of separate lead-in or terminal pins sealed through the envelope stem or base. Sometimes the cathode and heater are mounted on a common support with a heater insulator therebetween. However, in the mounts used heretofore the mechanical connection between the cathode, the heater and the heater insulator has not been sufficiently rigid to prevent damage to the insulator and/or undesirable electrical effects when the electron tube in which the mount is installed was subjected to vibration and shock during extreme environmental conditions of use. In one beam tube of the traveling wave type, for example, a cup-shaped cathode is mounted in a tubular support which is carried by stem leads; and the heater coil is loosely mounted within the cathode by two insulators which loosely extend through apertures in two transverse plates attached to the cathode and the tubular support, and by the heater legs which extend through the insulators and are attached to other stem leads. When subjected to vibration tests, the heater insulators vibrated both axially and transversely resulting in damage and sometimes complete failure thereof.

The object of the present invention is to provide an extremely rugged mount for a cathode, heater and heater insulator which will withstand vibration and shock encountered during extreme environmental conditions of use.

In accordance with the invention, a cathode, a heater and a single insulator are rigidly mounted relative to each other by two mounting members each axially engaging one end of the insulator, with the heater mounted on the insulator by legs extending therethrough and the cathode mounted on one of the mounting members, and means rigidly connecting the two mounting members. Preferably, the end of the heater firmly engages a base portion of the cathode to prevent movement of the heater therein. In a preferred embodiment, the insulator is cylindrical, with the end portions thereof flattened or cut away to provide opposed shoulders, and the mounting members are transverse plates or discs having apertured wall portions engaging the shoulders on the insulator to clamp the insulator firmly between the plates. The apertured plates are positioned within and welded to a tubular support member, which serves also as a heat shield for the cathode. The insulator mounting plates serve also as heat shields for the heater.

In the drawings:

FIG. 1 is an axial view, partly in section, of the electron gun portion of a beam tube incorporating the invention;

FIG. 2 is an enlarged axial section view of the cathode-heater mount of FIG. 1;

FIG. 3 is a transverse section view taken on line 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2 of a modification thereof; and

FIG. 5 is a transverse section view taken on line 5—5 of FIG. 4.

The beam tube shown in FIG. 1 comprises a glass envelope 10 including a stem or base 12, a gun portion 14 and an R.F. interaction portion 16. The stem 12 comprises a central exhaust tubulation 18 surrounded by a wall containing nine lead-in or terminal pins 20, numbered 1 through 9. The gun portion 14 contains an electron gun mount 22 supported by certain of the pins 20. The mount 22 comprises a plurality of parallel rods 24 of glass or ceramic to which are rigidly attached a pair of cathode support rings 26 and 28, a control grid electrode 30, an annular accelerating electrode 32 and a drift tube electrode 34. Ring 26 and electrodes 30, 32 and 34 are electrically and mechanically connected to terminal pins numbered 1, 2, 5 and 8, respectively, by rigid connecting wires 36. A cathode-heater mount 38 is rigidly mounted, as by welding, within the support rings 26 and 28.

The mount 38, which is shown in detail in FIGS. 2 and 3, comprises a hollow cylindrical or tubular metal support 40 in which a cup-shaped thermionic metal cathode 42, a cathode heater 44 and a cylindrical ceramic heater insulator 46 are rigidly mounted. The heater 44, which may be a coil of tungsten wire with an insulating coating of Alundum, is mounted on one end of the insulator 46 by legs 44′ extending through apertures 45′ in the insulator. Each end of the insulator 46 is formed on opposite sides with parallel flat surfaces 48 terminating in radial surfaces or shoulders 50. The flat surfaces 48 together with the arcuate connecting surfaces of the insulator 46 form cylindrical end portions 52 and 54 of reduced dimensions. The end portion 52 next to the heater 44 is snugly fitted within a rectangular aperture 56 in a small flanged metal support plate or disc 58. Similarly, the other end portion 54 is snugly fitted into a rectangular aperture 60 in a large flanged metal support plate or disc 62. Preferably, the radial clearance between the insulator end portions 52 and 54 and the apertures in the discs 58 and 62 is not more than about .002 inch. The outer edge or flange of the large disc 62 is rigidly attached to the tubular support 40. The flange of the small disc 58 is rigidly attached to the open end of the cup-shaped cathode 42, which in turn is rigidly connected to the tubular support 40 by a plurality (four, as shown) of rigid metal straps or struts 64.

The mount 38 may be assembled in the following manner. The coil heater 44 is dropped into the cathode with its hollow end fitting over and engaging a convex (inward) part 66 thereof, so that the convex part 66 extends into the heater 44 slightly. The small disc 58 is inserted within and welded to the cathode 42, and the struts 64 are welded to the cathode 42. The cathode and heater are inserted within the tubular support 40 and maintained coaxial therein by a jig while the struts are welded to the support 40. The insulator 46 is slipped over the heater legs 44′ and inserted within the aperture 56 of the disc 58 until the shoulders 50 engage the disc 58. Then, the large disc 62 is slipped over the end portion 54 of the insulator and is pushed into the tubular support 40 until the disc 62 engages the shoulders 50. The disc 62 is welded to the support 40 with the insulator 46 clamped tightly between the two discs 58 and 62. Preferably the disc 62 is relatively thin and resilient, in order to place the insulator 46 under compression and thus prevent movement thereof in the mount during vibration, shock and/or temperature change. The length of the heater 44 is such that when assembled as described the end opposite the insulator firmly engages the cathode base 66 and prevents relative movement thereof. As shown in FIG. 1, the heater legs 44′ are connected to two of the terminal pins, for electrical connection only.

The mount **38** is very rugged because the heater insulator is rigidly mounted at both ends and the heater coil is firmly supported within the cathode.

The embodiment shown in FIGS. 4 and 5 is very similar to that of FIGS. 2 and 3; the difference lying in the manner of attaching the insulator to the two support discs. The tubular support **40**, cathode **42**, heater **44** and struts **64** in FIGS. 4 and 5 are the same as in FIGS. 2 and 3. A cylindrical ceramic insulator **70** extends loosely through circular apertures **72** in two metal support discs **74** and **76**, and is rigidly mounted on the two discs by two pairs of metal strips or plates **78**. The plates **78** are inserted edgewise into straight grooves or channels **80** formed in opposite sides of the insulator **70**, and welded to the discs **74** and **76**. The parts are assembled as in FIGS. 2 and 3, except that two plates **78** are inserted into two insulator channels **80** and welded to the disc **74** before the disc **74** is inserted into and welded to the cathode **42**. Then the other two plates **78** are installed, and the disc **76** is welded to the plates **78** and the support **40** with the intermediate portion of the insulator **70** held under compression between the pairs of plates **78**. Each of the discs **74** and **76** and the two plates **78** welded thereto constitute a transverse support or mounting member rigidly attached to the tubular support and engaging one end of the insulator. The inner walls of the four channels **80** constitutes shoulders **82**, analogous to the shoulders **50** in FIGS. 2 and 3.

What is claimed is:

1. A rugged heater-cathode mount comprising:
(a) a heater insulator;
(b) two mounting members axially engaging opposite end positions of said insulator;
(c) a cathode heater mounted on one end of said insulator adjacent to one of said mounting members;
(d) a thermionic cathode rigidly mounted on said one mounting member; and
(e) means rigidly connecting said mounting members together, for preventing movement of said cathode and insulator in said mount.

2. A rugged heater-cathode mount comprising:
(a) a support;
(b) a heater insulator, having a pair of transverse shoulders near each end thereof, positioned in spaced relation to said support;
(c) a first transverse support member attached to said support and axially engaging one pair of said shoulders;
(d) a second transverse support member attached said support and axially engaging the other pair of said shoulders;
(e) a cathode heater mounted on said other end of said insulator; and
(f) a thermionic cathode rigidly mounted on said second support member.

3. A mount as in claim **2**, wherein each transverse support member comprises an apertured plate loosely surrounding said insulator and a pair of strips attached to said plate and engaging said shoulders.

4. A mount as in claim **2**, wherein at least one of said support members is resilient, and said insulator is resiliently clamped between said members.

5. A rugged heater-cathode mount comprising:
(a) a tubular support;
(b) a first transverse support member rigidly mounted within said tubular support;
(c) a heater insulator mounted within said tubular support with one end portion of said insulator axially engaging said first transverse member;
(d) a cathode heater mounted on the other end of said insulator;
(e) a second transverse support member axially engaging the other end portion of said insulator;
(f) a thermionic cathode rigidly mounted on said second transverse member; and

(g) rigid means extending between said cathode and said tubular support for preventing movement of said cathode and insulator relative to said tubular support.

6. A rugged heater-cathode mount comprising:
(a) a tubular support;
(b) a first transverse support member rigidly mounted within said tubular support;
(c) a heater insulator mounted within said tubular support with one end portion of said insulator axially engaging said first transverse member;
(d) a cathode heater mounted on the other end of said insulator;
(e) a second transverse support member axially engaging the other end portion of said insulator;
(f) a thermionic cathode rigidly mounted on said second transverse member; and
(g) rigid means including a plurality of struts rigidly attached to said cathode and said tubular support for preventing movement of said cathode and insulator relative to said tubular support.

7. A rugged heater-cathode mount comprising:
(a) a tubular support;
(b) a transverse support member rigidly mounted within said tubular support and having a central aperture;
(c) a cylindrical heater insulator coaxially mounted within said tubular support with a cylindrical end portion of said insulator of reduced transverse dimension fitted within said aperture;
(d) a cathode heater mounted on the other end of said insulator by legs extending through said insulator;
(e) a second transverse support member mounted on said other end of said insulator by means of a central aperture in said member in which a cylindrical end portion of said insulator of reduced transverse dimension is fitted;
(f) a thermionic cathode rigidly mounted on said second transverse member; and
(g) rigid means extending between said cathode and said tubular support for preventing movement of said cathode and insulator relative to said tubular support,
(h) said insulator providing transverse shoulders at said reduced portions which engage said transverse members and prevent axial movement of said insulator in said apertures.

8. A rugged heater-cathode mount comprising:
(a) a tubular support;
(b) a transverse support member rigidly mounted within said tubular support and having a central aperture;
(c) a cylindrical heater insulator coaxially mounted within said tubular support with a cylindrical end portion of said insulator of reduced transverse dimension fitted within said aperture;
(d) a cathode heater coil mounted on the other end of said insulator by legs extending through said insulator;
(e) a second transverse support member mounted on said other end of said insulator by means of a central aperture in said member in which a cylindrical end portion of said insulator of reduced transverse dimension is fitted;
(f) a cup-shaped thermionic cathode rigidly mounted on said second transverse member; and
(g) means, comprising a plurality of struts rigidly attached to said cathode and said tubular support, for preventing movement of said cathode and insulator relative to said tubular support;
(h) said heater coil being mounted within said cathode, with an end portion of said coil engaging a projecting portion of the base of said cup-shaped cathode to prevent movement of said heater coil in said cathode.

9. A rugged heater-cathode mount comprising:
(a) a tubular support;
(b) a resilient transverse metal support disc positioned within one end of said tubular support and welded thereto, said disc having a non-circular central aperture;
(c) a cylindrical heater insulator coaxially mounted within said tubular support with a non-circular cylindrical end portion of said insulator of reduced transverse dimension fitted within said aperture;
(d) a cathode heater coil mounted on the other end of said insulator by legs extending through said insulator;
(e) a second transverse support member mounted on said other end of said insulator by means of a non-circular central aperture in said member in which a non-circular cylindrical end portion of said insulator of reduced transverse dimension is fitted;

(f) a cup-shaped thermionic metal cathode surrounding said heater and welded to said second disc; and
(g) a plurality of metal struts extending between and welded to said cathode and said tubular support;
(h) said heater coil being mounted within said cathode, with an end portion engaging a projecting portion of the base of said cup-shaped cathode to prevent movement of said heater coil in said cathode.

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