July 11, 1961 P. OKSTEIN 2,992,348

ELECTRON TUBE MOUNT

Filed Feb. 29, 1960

Fig. 1.

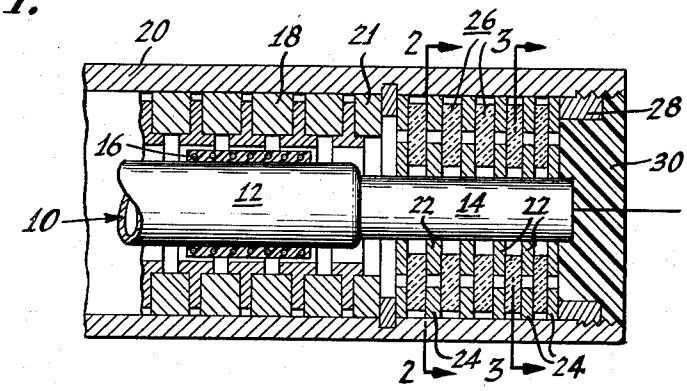


Fig. 2.

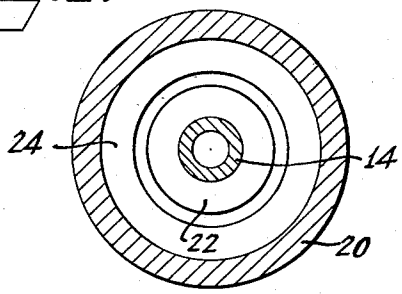


Fig. 3.

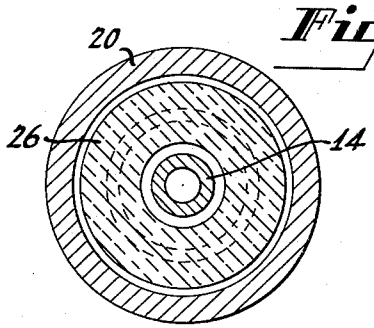
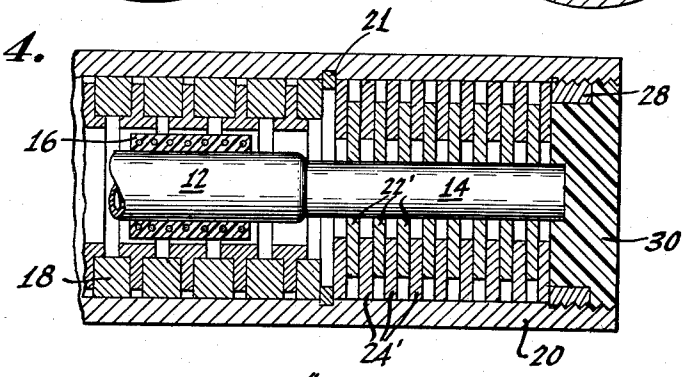


Fig. 4.



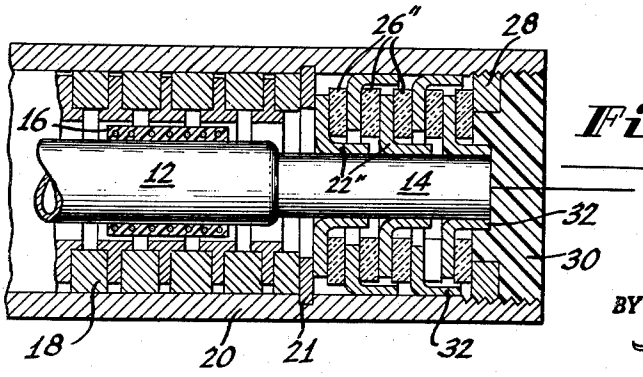


Fig. 5.

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ELECTRON TUBE MOUNT

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The present invention relates to a mount structure for use in an electron tube, and particularly to an adjustable, heat-conducting, electron collector mount in a traveling wave tube.

In a conventional traveling wave tube, an electron beam is projected axially through an elongated helix, or other slow wave structure, for interaction with waves propagated along the helix at substantially the same velocity. In one form of tube, the helix is coaxially mounted within an elongated cylindrical envelope of non-magnetic material, and a tubular magnetic focusing structure coaxially surrounding the tube provides an axial magnetic focusing field along the beam path for confining the electron beam. Usually, the magnetic focusing structure is fixed within a tubular metal support which serves as a package or "capsule" for the tube and focusing structure. In high power tubes, the collector mount must be designed to dissipate considerable heat generated therein by electron bombardment by the beam.

An object of the present invention is to provide a new and improved collector mount.

Another object of the invention is to provide a collector mount which provides mechanical support, heat dissipating means, and electrical insulation, for the collector.

A further object is to provide a mount for an electron tube which includes novel means for adjustably positioning the tube within its support or capsule.

A more specific object is to provide a collector mount for a magnetically-focused electron beam tube which includes not only means for supporting, dissipating heat and electrically insulating the collector from its support, but also means for adjustably centering the collector end of the tube within its magnetic focusing structure.

The above objects are accomplished, in accordance with the invention, by use of a mount structure comprising at least two sets of axially-spaced washers, with the washers of the first set surrounding and fixed to the collector, or other exposed portion of the tube, and the washers of the second set located within and fixed to a tubular support, and means clamping the washers in a rigid assembly. The washers of the two sets may be radially-overlapping and in contact with each other, or they may be separated by the washers of a third set which may be of good heat conducting, electrical insulating material, such as beryllium oxide, to provide electrical insulation as well as heat transfer and support for the collector. Where electrical insulation is not required, the third set of washers may be of metal.

In the accompanying drawing:

FIG. 1 is an axial sectional view of a traveling wave tube collector mount incorporating the present invention;

FIGS. 2 and 3 are transverse sectional views taken on lines 2—2 and 3—3, respectively, of FIG. 1;

FIG. 4 is an axial sectional view of another embodiment of the invention; and

FIG. 5 is an axial sectional view of a third embodiment of the invention.

In the embodiment of the invention shown in FIGS. 1–3, the numeral **10** designates an electron beam tube, such as a traveling wave tube, comprising a non-magnetic envelope **12** containing a helix or other slow wave structure (not shown), and a cup-shaped external collector **14** sealed to the end of the envelope. For amplifier operation, the tube may be provided with suitable output coupling means **16** around the envelope and helix near the collector.

The tube **10** is positioned within a conventional axial magnetic focusing structure, which may be a periodic permanent magnet stack **18**, as shown, or a magnetic field coil or solenoid. The magnet stack **18** is fixed within a close-fitting tubular metal support or capsule **20** by two split retaining rings **21**, one of which is shown in the drawing. A small clearance is provided between the inner surfaces of the stack **18** and the tube **10**, including the coupling means **16**, if provided, in order to permit relative radial adjustment of the tube in the focusing magnetic field.

In accordance with the invention, the collector **14** is adjustably supported within an end portion of the tubular capsule **20** by means of an assembly of apertured discs or washers stacked together in a manner permitting relative radial movement thereof. The washer assembly comprises a first set of axially-spaced metal washers **22** each surrounding and fixed to the collector **14**, as by frictional engagement therewith, and a second set of similar washers **24** similarly fixed to the inner wall of the tubular capsule **20**, with each of the washers **24** spaced radially from one of the washers **22**, and in the same plane. The washer assembly also includes a third set of washers **26** each interposed between and radially overlapping two adjacent washers **22** and **24** of the first two sets, as shown in FIG. 1. The stacked washers **22**, **24**, and **26** are clamped together, against the retaining ring **21**, by means of a clamping ring or nut **28** threaded within the capsule **20** and engaging the outermost washer **24**.

The parts may be assembled in the following order. The magnetic focusing stack **18** is inserted within the capsule **20** and the retaining rings **21** installed. The tube **10** with its coupling means **16** and bare collector **14** is positioned within the capsule and magnetic stack in the position shown in FIG. 1. The washers **22**, **24**, and **26** are inserted between the collector and the capsule, either one at a time or in groups of three, and the nut **28** is inserted, but not tightened. The tube **10** is operated to the extent of projecting an electron beam through the helix in the focusing magnetic field, and the tube is adjusted radially within the capsule to a position of minimum collection of electrons by the helix. Then, the nut **28** is tightened to clamp the washers **22** and **24** between the washers **26** in a rigid assembly. The open end of the capsule **20** is filled with a plastic potting compound **30** to hold the nut **28** and the collector in final position and seal the opening against moisture and other contaminating materials.

The collector **14**, washers **22** and **24** and the capsule **20** are preferably made of good heat conducting metal, such as copper or aluminum, to provide a heat conducting path for dissipation of heat generated in the collector by electron bombardment. To provide electrical insulation of the collector from the capsule as well as heat transfer therebetween, the washers **26** are preferably made of an electrical insulating material having high heat conductivity, such as beryllium oxide. Thus, the stacked assembly of washers provides a satisfactory means for making radial adjustments, provides rapid heat dissipation from the collector and provides electrical insulation of the collector from the capsule.

FIG. 4 shows a modification of FIG. 1 which can be used in cases where the collector and capsule are operated at the same potential, and thus, no electrical insulation is necessary. In this embodiment, metal washers **22** and **24**, which are fixed to the collector **14** and capsule respectively, overlap each other radially, thus eliminating the necessity for the third set of washers of FIG. 1.

FIG. 5 shows an embodiment, combining some of the features of FIGS. 1 and 4, in which metal washers 22'' engaging the collector 14 are spaced and electrically insulated from overlapping metal washers 24'' engaging the capsule 20 by washers 26'' of an electrical insulating material having high heat conductivity, such as berryllium oxide. Some or all of the metal washers 22'' and 24'' may be formed with integral axial flanges 32, as shown, to increase the area of contact between the washers and the engaged surface for greater heat conduction. It will be understood that similar flanges may be provided in FIG. 1 and/or FIG. 4.

What is claimed is:

1. An electron collector mount comprising a hollow cylindrical support, a cylindrical collector, and means supporting said collector within said support; said supporting means comprising two sets of axially-spaced metal washers, the washers of one set surrounding and fixed to said collector and radially spaced from said support, the washers of the other set located within and fixed to said support and radially spaced from said collector, and means clamping said washers in a rigid heat conducting assembly.

2. A collector mount as in claim 1, wherein said clamping means includes a third set of axially-spaced washers each interposed between adjacent washers of said two sets.

3. A collector mount as in claim 2, wherein adjacent washers of said two sets are co-planar and radially spaced apart.

4. A collector mount as in claim 2, wherein the adjacent washers of said two sets are radially overlapping and separated by a washer of said third set.

5. A collector mount as in claim 2, wherein the washers of said two sets are of metal and the washers of said third set are of an electrical insulating material having high heat conductivity to provide electrical insulation and heat transfer between said collector and said support.

6. A collector mount as in claim 1, wherein the washers of each set radially overlap the washers of the other set.

7. A collector mount as in claim 6, wherein the washers of said two sets are clamped directly together.

8. A collector mount as in claim 1, wherein each of the washers of said one set has an integral axial flange in contact with said collector.

9. A collector mount as in claim 1, wherein each of the washers of said other set has an integral axial flange in contact with said support.

10. An electron tube mount comprising a hollow support, an electron tube, and means supporting a portion of said tube within said support; said supporting means

comprising two sets of metal washers, the washers of one set surrounding and fixed to said tube portion and spaced radially from said support, the washers of the other set located within and fixed to said support and spaced radially from said tube portion, and means clamping said washers in a rigid assembly.

11. An electron beam tube mount comprising a tubular support, a tubular magnetic focusing structure mounted within one portion of said support, an electron beam tube comprising a first portion located within said focusing structure and a second portion located within another portion of said support, and means supporting said second portion within said other portion; said means comprising two sets of axially-spaced washers, the washers of one set surrounding and fixed to said second portion and spaced from said other portion, the washers of the other set located within and fixed to said other portion and spaced from said second portion, and means clamping said washers in a rigid assembly.

12. An electron beam tube mount as in claim 11, wherein said second portion of said tube is a cylindrical external electron collector, and said washers are of good heat conducting material.

13. An electron beam tube mount comprising a tubular support, a tubular magnetic focusing structure mounted within one portion of said support, an electron beam tube comprising a first portion located within said focusing structure and a cylindrical external electron collector portion located within another portion of said support, and means supporting said collector portion within said other portion of said support; said means comprising two sets of axially-spaced washers of good heat conducting material, the washers of one set surrounding and fixed to said collector portion, the washers of the other set located within and fixed to said other portion, and means clamping said washers in a rigid assembly, said clamping means including a set of washers of an electrical insulating material having high heat conductivity each interposed between adjacent washers of said two sets, to provide electrical insulation and heat transfer between said collector portion and said support.

14. An electron tube mount as in claim 13, wherein said electron beam tube is a traveling wave tube and said first portion comprises an evacuated cylindrical nonmagnetic envelope with an elongated helix coaxially mounted therein.

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