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ELECTRODE SUPPORT ARRANGEMENT

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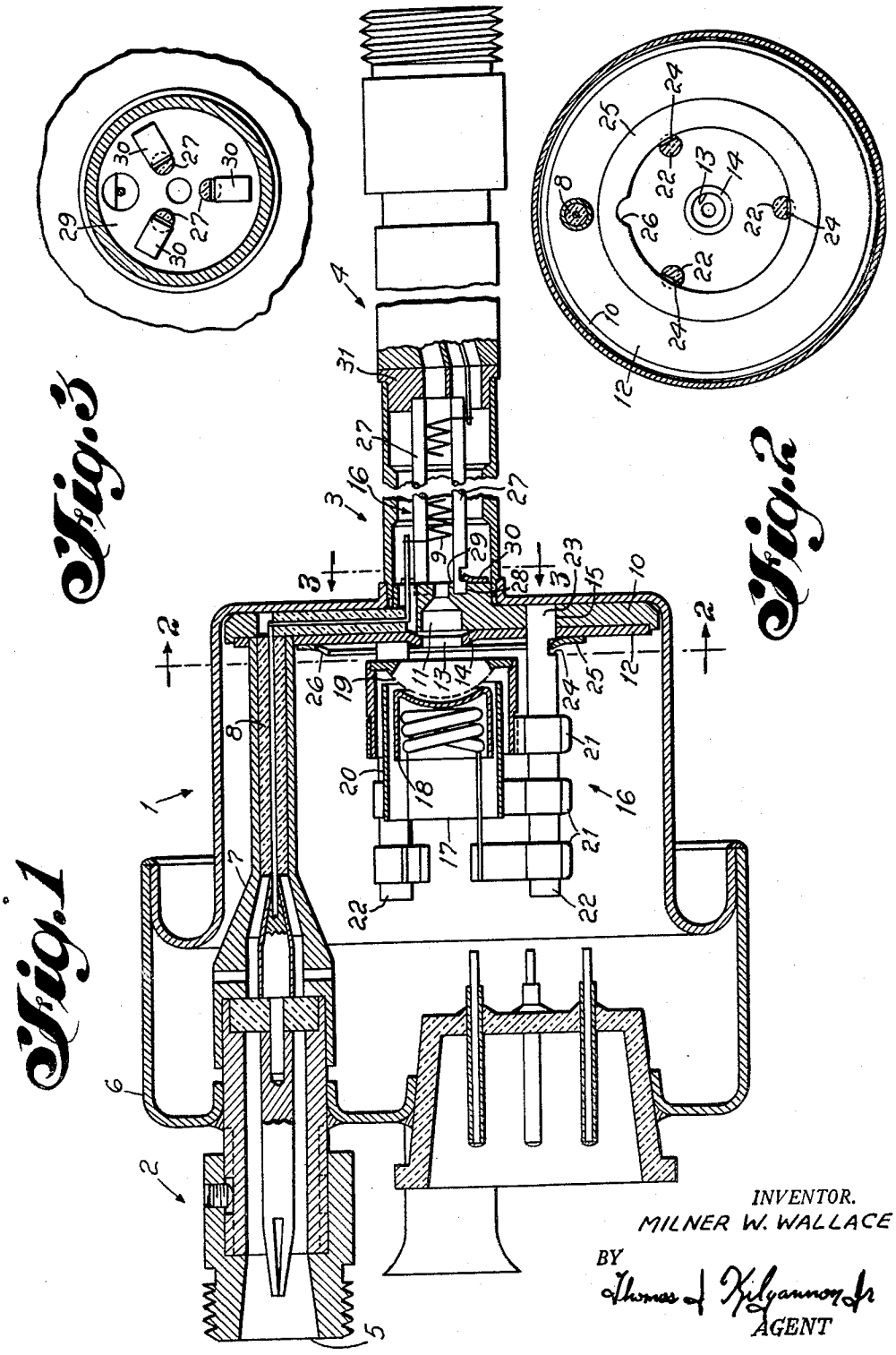

Fig. 1

Fig. 2

Fig. 3

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ELECTRODE SUPPORT ARRANGEMENT

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This invention relates to electron discharge devices and more particularly to electron support arrangements therefor.

The wide utilization of electron discharge devices such as klystrons and traveling wave tubes in present day radar and communications systems has made it imperative that mass-production techniques be utilized in their manufacture in order to make such devices economically feasible and to insure a reasonable output of good quality devices in a highly competitive market.

Mass-production techniques can be most effectively applied in connection with assembly steps for properly aligning and supporting various electron discharge device electrodes. Formerly, the assembly of electrode support structure and their subsequent mounting and alignment required the employment of highly skilled workers. This technique is no longer feasible in that it is both expensive and time consuming and is productive of only a small number of devices. A mass-production technique is, therefore, required which permits assembly of electron discharge devices by relatively unskilled labor and yet provides a tube which is rugged while possessing the accuracy and tolerances of more complicated prior art assembly techniques. Further, a technique is required which effectively minimizes the physical spacing of the elements of electrode support arrangements without increasing the danger from breakdown between these elements.

It is, therefore, an object of this invention to provide an electrode support arrangement which is an improvement on prior art arrangements.

It is a further object to provide an electrode support arrangement which is amenable to mass-production techniques.

A feature of this invention is the utilization of a reference member having an opening disposed therein and an electrode support unit having a portion which registers with the opening and which extends therein. The electrode support unit portion has a retainer engaging means disposed thereon adjacent the reference member, and a retaining member which engages the retainer engaging means and the surface of the reference member at a predetermined location.

A further feature is the utilization of an electrode support unit which has a number of rods designed to register with openings in a reference member. The rods have protuberances or indentations on a portion of their surface adjacent the reference member wihch are so designed that in cooperation with a retaining member the rods can be rigidly and accurately arranged with respect to the reference member.

A still further feature is the utilization of an annular ring which engages notches in the rods of the electrode support unit; the annular ring having an inner diameter smaller than the diameter of a circle which could be circumscribed about the rods of the electrode support unit.

The above mentioned and other objectors and features of this invention will become more apparent by reference

to the following description of the embodiments thereof taken in conjunction with the accompanying drawings in which:

Fig. 1 is a longitudinal partial cross-sectional view of a traveling wave tube utilizing electrode support arrangements in accordance with the teachings of this invention.

Fig. 2 is a cross-sectional view taken along lines 2—2 of Fig. 1.

Fig. 3 is an enlarged cross-sectional cut-away view taken along lines 3—3 of Fig. 1.

Referring to Fig. 1, there is shown therein a traveling wave tube **1** having an input section **2**, a radio frequency interaction portion **3** and an output section **4**. Input section **2** includes a coaxial connector **5** which pierces vacuum envelope **6** and is utilized to couple an input signal from a point externally of traveling wave tube **1** to coaxial line transition **7**. The input signal is then coupled to coaxial line portion **8** and from thence through two right angle bends to the helix **9** of radio frequency interaction portion **3**. Radio frequency interaction portion **3** and input section **2** are separated one from the other by a reference member **10** which is made of a magnetic material of high permeability such as Armco Iron and which functions as a gun barrier electrode to and in focusing an electron beam in its passage therethrough. The electron beam passes through reference member **10** by means of aperture **11** which is appropriately designed so that portions of a magnetic field supplied by a solenoid, not shown, emanate from portions of member **10** in a direction longitudinally of tube **1** in the direction in which an electron beam is projected. Reference member **10** includes an aperture disc **12** which is welded to reference member **10**. An aperture **13** in disc **12** is disposed in overlying relationship with aperture **11** of reference member **10** and has a conical portion **14** which, in cooperation with other focusing elements, provides the proper electrostatic entrance conditions for an electron beam which is to be projected through apertures **11**, **13**. Reference member **10** need not be made of two portions as described hereinabove, but may be made of a single section of high permeability magnetic material. Member **10** has been designed to include disc **12** in the device of Fig. 1 solely for purposes of ease of fabrication.

Referring now to Figs. 1 and 2, it may be seen that aperture disc **12** contains three holes **15**, spaced 120° apart and spaced an equal radial distance from the center line of aperture disc **12**. In Fig. 1, it may be seen that holes **15** in aperture disc **12** extend through aperture disc **12** and through reference member **10**. Holes or openings **15** in their predetermined location, are adapted to receive an electrode support unit **16**. Electrode support unit **16** includes a plurality of dielectric rods spaced 120° apart which can be utilized to support either the electrodes of an electron gun **17** or an electrode such as helix **9** of radio frequency interaction portion **3**.

In connection with the mounting of an electrode support unit **16**, such as an electron gun **17**, it may be seen from a consideration of Fig. 1 that the various electrodes such as cathode **18**, grid **19** and focus cylinder **20** are held in fixed spaced relationship by means of tabs **21** which are fixedly attached to dielectric rods **22**. Dielectric rods **22**, as can be seen in Fig. 2 are spaced 120° apart and their radial distance from a centerline is such that the rods **22** register with openings **15** and have portions **23** which extend into openings **15** and butt up against a portion of vacuum envelope **6**. Alternatively, the openings **15** may be drilled to a given depth and need not extend all the way through reference member **10**.

Dielectric rods **22** as shown in Figs. 1 and 2 have a retainer engaging portion **24** disposed adjacent reference member **10** such that the retainer engaging means is

raised slightly above the surface of aperture disc **12**. Retainer engaging means **24** is shown in Figs. 1 and 2 as a notch cut in dielectric rods **22**, but a raised portion or protuberance could be utilized equally well in accordance with the teaching of this invention. The retainer engaging means in the form of a protuberance or notch **24** could extend circumferentially around rod **22**, but clearly it is only necessary that a retainer engaging means be disposed on a portion of the rod which will be engaged by a retainer member **25**. Notches **24** then, are designed to be engaged by a retaining member **25** which in Fig. 2 is shown as an annular ring. Retaining member **25** may be made of Monel, for instance, and should be sufficiently flexible to permit the portion near the inner circumference thereof to engage the notches and yet permit retainer **25** to be adjusted such that the portion near the outer circumference can be held against the surface of aperture disc **12** for effective welding thereto. In this manner, therefore, electron gun **17** is accurately positioned and radial motion is prevented by the registration of dielectric rods **22** with holes **15** and the action of notches **24** in cooperation with retaining member **25** prevents any motion of electron gun **17** in a longitudinal direction. Thus, all the elements involved in accurately positioning electron gun **17** may be preassembled and the only step required to provide an electron gun which is accurately aligned with a reference member **10** is to insert the dielectric rods **22** of electrode support unit **16** into holes **15** engage retaining member **25** in notches **24** and weld retaining member **25** to the surface of aperture disc **12**.

In connection with retaining member **25**, it has been noted that the annular ring has an inner diameter less than the diameter of a circle which could be circumscribed about rods **22**. Because of this, a cut out portion **26** has been provided to permit retaining member **25** to be slipped over rods **22**. When it is desired to place retaining member **25** in the notches, retaining member **25** is rotated such that portions of the inner circumference of retaining member **25** engage notches **24**. If, however, a raised portion instead of a notch is utilized to be engaged by retaining member **25**, the inner diameter of retaining member **25** should be equal to the diameter of a circle which could be circumscribed about rods **22**.

Referring to Figs. 1 and 3 there is shown therein another embodiment which is utilized in accordance with the teachings of this invention. In Fig. 1, helix **9** and its associated helix support rods **27** form an electrode support unit **16**. The helix support rods **27** are disposed 120° apart and are spaced an equal radial distance from a centerline and are adapted to register with holes or openings **28** which have been drilled to a given depth adjacent aperture **11** and on surface **29** of reference member **10** opposite to that to which aperture disc **12** has been fixed. Helix support rods **27**, like dielectric rods **22**, contain notches adjacent surface **29** of reference member **10**, the walls of which are designed to engage a retaining member similar to retaining member **25**. In lieu of an annular ring type retaining member **25**, tabs **30** as shown in Fig. 3 may be utilized to engage the notches in the rods thereby effectively retaining the helix **9** and it's associated support rods in fixed relationship with surface **29** of reference member **10**.

Thus, Fig. 1 clearly shows a reference member **10** having electrode support units **16**, disposed on opposite surfaces thereof and perpendicular to said reference member **10** to permit an electron beam to be projected therethrough without interference.

The helix **9** and its support rods **27** may be fixed to the reference member **10** as described hereinabove, however, the same technique may be utilized at output section **4** and electrode support unit **16** may be fixed to the collector element **31**. Since it is not desirable to fix a helix at both extremities, it should be affixed only at one end and if affixed as described above, the gun barrier electrode is utilized as reference member **10** but if affixed at output section **4** a surface of the collector **31** may be used as a reference surface.

It should be noted that the combination of the coacting notches **24** and retaining member **25** provides an arrangement which occupies a minimum amount of space, particularly in a direction lengthwise of electron discharge device **1**. This factor is particularly important in view of the close proximity of retaining member **25** to elements of electron gun **17** which may have very high potentials applied thereto. Thus, by circumferentially engaging rods **22** with a retainer **25**, as described hereinabove, electrode support unit **16** can be effectively fixed and positioned and the danger from breakdown between tube elements is minimized.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. In an electron discharge device having an electron gun adapted to project a beam of electrons along a given path and a gun barrier member having an aperture through which said beam is adapted to pass; a combination therewith of a support structure for supporting said gun on said gun barrier member comprising a plurality of fixed dielectric rods, said gun barrier member having a corresponding plurality of openings spaced apart in a circle about said aperture to receive the ends of said rods for retention, an annular member having an inner surface, and means associated with said inner surface of said annular member to eccentrically locate said annular member in surrounding relationship with said rods, and means cooperating with said inner surface of said annular member to concentrically locate said annular member in surrounding relationship with said rods, said inner surface of said annular member cooperating with the surfaces of said rods to retain said rods in assembled relation with respect to said barrier member.

2. A structure according to claim 1 wherein said means to eccentrically locate said annular member includes a recess disposed on the inner surface of said annular member.

3. A structure according to claim 1 wherein said means to concentrically locate said annular member includes portions of reduced diameter in said rods adjacent the gun barrier element such that the annular member when shifted from its eccentric location to its concentric location circumscribes a circle about the reduced portions of said rods.

4. In an electron discharge device having an electron gun adapted to project a beam of electrons along a given path and a gun barrier member having an aperture through which said beam is adapted to pass; the combination therewith of a support structure for supporting said gun on said gun barrier member comprising a plurality of fixed dielectric rods, said gun barrier member having a corresponding plurality of openings spaced apart in a circle about said aperture to receive the ends of said rods for retention, said rods each having a portion of reduced diameter adjacent an end thereof, an annular element having an inner diameter less than the distance between the outer surfaces of said rods when assembled, said element having a recess on the inner edge thereof to receive one of said rods to allow sufficient spacing within said element to surround the assembled rods, means to mount said gun in assembled position on said rods to locate said gun in alignment with said aperture, and means securing said element to said gun barrier member after said rods are located in said openings and said annular element has been shifted to disengage said recess from said one rod and cause said element to engage each of the portions of said rods of reduced diameter.

5. In an electron discharge device having an electron gun adapted to project a beam of electrons along a given path and a gun barrier member having an aperture through which said beam is adapted to pass; the combination therewith of a support structure for supporting said gun on said gun barrier member comprising a plurality of fixed dielectric rods, said gun barrier member having a corresponding plurality of openings spaced apart in a circle about said aperture to receive the ends of said rods for retention, said rods each having a notch in a side surface thereof, an annular element having an inner diameter less than the distance between the outer surfaces of said rods when assembled, said element having a recess on the inner edge thereof to receive one of said rods to allow sufficient spacing within said element to surround the assembled rods, means to mount said gun

in assembled position on said rods to locate said gun in alignment with said aperture, and means securing said element to said gun barrier member after said rods are located in said openings and said annular element has been shifted to disengage said recess from said one rod and cause said element to engage each of the notches of said rods.

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