Oct. 25, 1955 F. J. PILAS 2,721,374

MOUNTING JIG FOR ELECTRON TUBES AND METHOD OF ASSEMBLING TUBE MOUNTS

Filed March 11, 1950 2 Sheets-Sheet 1

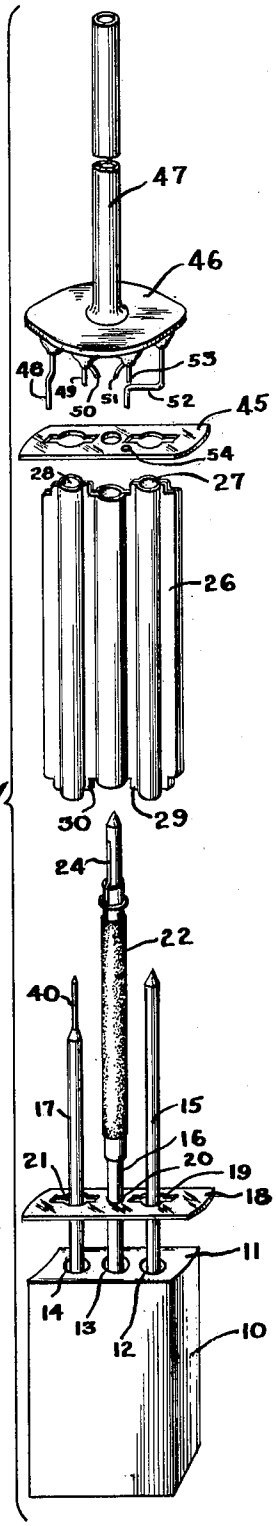


Fig. 1

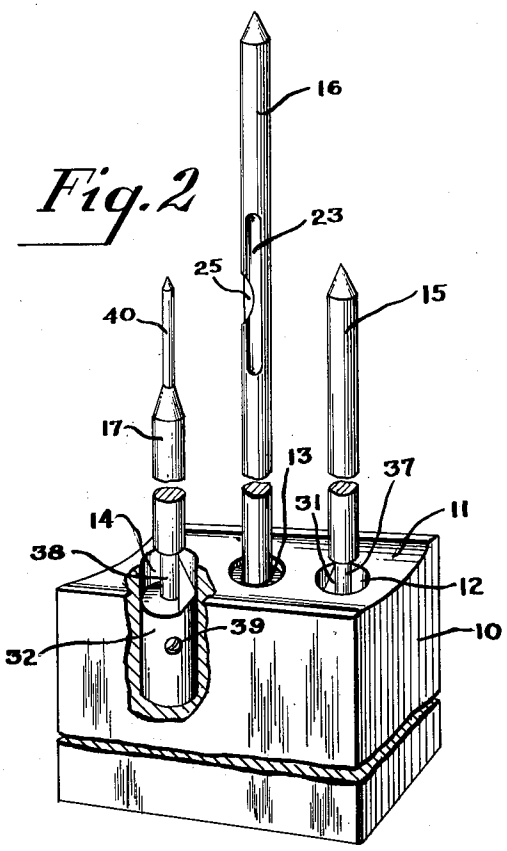


Fig. 2

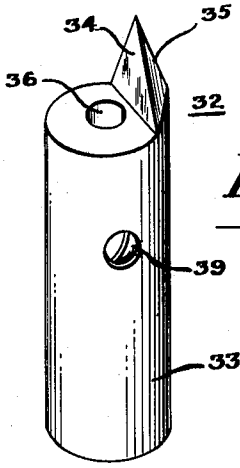


Fig. 3

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MOUNTING JIG FOR ELECTRON TUBES AND METHOD OF ASSEMBLING TUBE MOUNTS

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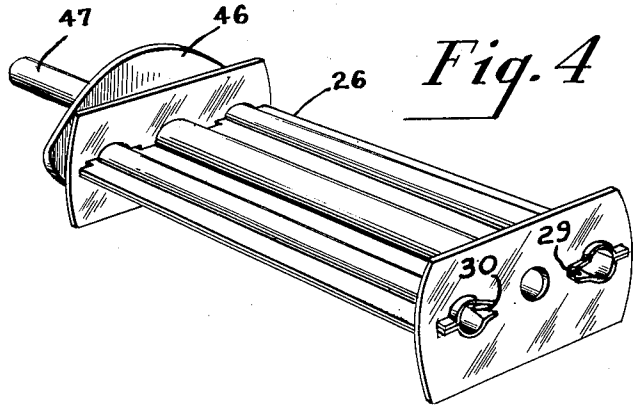
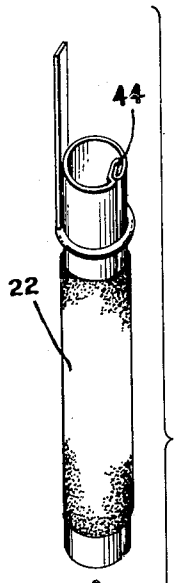


Fig. 4



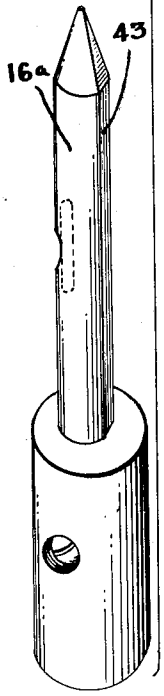
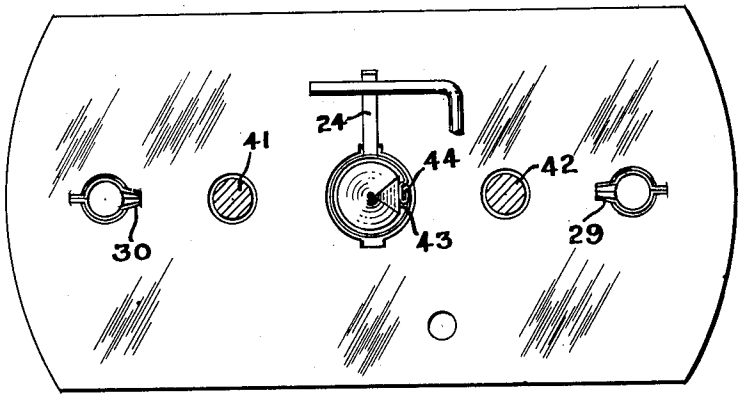


Fig. 5

Fig. 6



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MOUNTING JIG FOR ELECTRON TUBES AND METHOD OF ASSEMBLING TUBE MOUNTS

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13 Claims. (Cl. 29—25.19)

The present invention relates to a mounting jig for facilitating the assembly of an electron tube mount and to a method of mounting tube parts to form such mount. More particularly, it concerns a jig for mounting electrodes between two spaced insulating spacer plates and fixing the resultant assembly to a stem to provide a tube mount.

Electron tube mounts include an electrode assembly fixed to a tube stem. In some cases for good tube operation the electrodes in the assembly should be critically spaced. In addition after the electrodes are properly spaced they should be fixed against relative movement. Furthermore the electrode assembly should be aligned with respect to the axis of the stem. This results in proper orientation of the electrode assembly in an envelope subsequently sealed to the stem.

Additional factors are involved in a good mounting operation. For example, when the cathode sleeve includes a tab for connection to a lead-in it is necessary to take care that the tab is not bent or otherwise deformed as a consequence of the mounting operation. In addition the tab should be easily accessible for welding to a lead-in. Also, when affixing the assembled electrodes to lead-ins extending through the stem, as by welding, while held by the jig, precautions should be taken to avoid including a portion of the jig in the weld. A good mounting operation should also provide for ease in threading the terminal portions of electrode parts through apertures in the insulating spacer plates. In addition, it is sometimes desirable to orient a particular side of the cathode sleeve with respect to a predetermined side of the electrode assembly.

Accordingly, an object of the invention is to provide an improved mounting jig for mounting electron tube parts, and an advantageous method for accomplishing the mounting operation.

Another object is to provide an improved mounting jig and mounting method for automatically aligning an electrode assembly with a stem and critically spacing the electrodes with respect to each other.

A further object is to provide an improved jig for automatically fixing one of the electrodes to insulating spacer plates used in a tube mount.

Another object is to provide an improved mounting jig for shielding a tab on a cathode sleeve during the mounting operation and for providing ready access of the tab for a welding operation.

A further object is to provide a mounting jig for facilitating the entrance of tube parts into apertures in spacer plates.

Another object is to provide a jig for suitably orienting a cathode sleeve on its longitudinal axis with respect to other electrodes in an electrode assembly.

A further object is to provide an improved electron tube mount wherein an electrode is fixed to an insulating spacer plate by a tapered deformation of an end portion thereof.

Another object is to provide a tube mount wherein an electrode ear of two-ply material is fixed to a spacer

plate by separating a portion of the two-ply material to form a taper having an apex adjacent the spacer plate.

A further object is to fix an electrode having a tubular ear in a spacer plate by deforming said tubular ear.

The foregoing objects are realized by the novel mounting jig of the invention. Considering first structural aspects of the jig, it includes a base having an inwardly curved upper surface provided with a plurality of spaced recess disposed in a suitable array along the lower portion of the curved surface. From three of these recesses three elongated members or mandrels extend upwardly. The recesses at end portions of the array from which end mandrels extend, are provided with knife edged elements. One of the end mandrels is provided with an upper portion of smaller cross section than the lower portion thereof. Both of the end mandrels are of a length to extend through the two spaced insulating plates used in the mount. The middle mandrel is substantially longer than the end mandrels. Adjacent the upper end of the middle mandrel is a longitudinal groove. Merging with this groove but angularly displaced therefrom is a second groove. The middle mandrel may also be provided with a longitudinal reference surface for rotationally orienting one of the electrodes in a suitable manner.

The use of the jig of the invention in a mounting operation involves first threading a planar insulating spacer plate over the mandrels with the mandrels entering suitable apertures in the plate, until the plate rests on edge portions of the upper concave surface of the base. The cathode sleeve is next mounted on the middle mandrel, and if the cathode is of the lock seam type the seam is caused to engage the longitudinal reference surface referred to and the tab attached to the sleeve is extended into the first-named groove in the upper part of the mandrel. The mounting of the cathode sleeve is accompanied by a slight downward pressure thereon which causes the spacer plate resting on edges of the concave surface referred to to flex into engagement with the lower portion of the curved surface. This flexing action facilitates entrance of the sleeve into an aperture in the plate.

Thereafter an anode having tubular portions and two-ply ears is threaded over the end mandrels and readily enters apertures in the spacer plate due to a flexing of the plate previously described. As further force is applied to the anode urging it against the curved surface of the base of the jig it results in entrance of the two-ply ears of the anode into the recesses having the knife edged elements referred to. Engagement of the ears with the knife edged elements results in a spreading of the ears and a firm fixing thereof to the spacer plate. Thereafter, further electrodes such as grids having side rods may be mounted on the plate. Such further electrodes are suitably positioned by having their side rods engage predetermined apertures in the spacer plate. It is not necessary that additional recesses be provided in the base to accommodate the side rods referred to. The spacing between a central portion of the spacer plate and the upper surface of the base due to the curvature in said surface, may be sufficient to permit adequate extension of the side rods through the plate. The foregoing procedure results in engagement of adjacent ends of the electrodes with the spacer plate referred to. A second spacer plate may then be mounted on the opposite adjacent ends of the electrodes with portions of the electrodes and the mandrels extending through apertures in the plate.

After the electrodes and spacer plates are mounted on the jig in the manner described, a stem having an exhaust tubulation therein is positioned on the jig with the middle mandrel of the jig extending into the exhaust tubulation. This centers the stem with respect to the electrode assembly on the jig. The stem may be provided with spacing lugs for engaging the outer surface of the second plate,

to suitably space the stem longitudinally from the assembly. The stem may also have locating lugs for rotationally orienting the stem with respect to the electrode assembly.

When the stem is mounted as indicated, lead-ins extending therethrough are properly positioned to be adjacent appropriate electrodes. The cathode tab is then readily removed manually from its groove by means of the second groove referred to, and bent to contact the cathode lead and fixed thereto. The anode ear adjacent but spaced from the upper smaller cross sectioned portion of one of the end mandrels is then fixed to its lead-in as by welding without danger of also fixing the mandrel to the assembly. The side rods of the other electrodes are also fixed to their respective lead-ins. The finished mount may then be freely slid from the jig.

While the invention is pointed out particularly in the appended claims it may be best understood from the following detailed description thereof taken in connection with the accompanying drawing, in which:

Figure 1 shows an exploded view of an electron tube mount in relation to the mounting jig of the invention;

Figure 2 is a perspective view partly cut away and sectioned and depicts features of the mounting jig of the invention;

Figure 3 is a perspective view of a knife edged element forming part of the jig;

Figure 4 is a perspective view of a diode mount assembled with the aid of the mounting jig of the invention;

Figure 5 is an exploded view of a mandrel that may be used in the jig where the cathode is of the lock seam type; and

Figure 6 is an end view of a triode mount assembled according to the invention.

Referring to the drawing in more detail, there is shown in Figure 1 thereof by way of example a jig including a base 10 having an upper inwardly curved surface 11 and recesses 12, 13, 14, in said surface. From the recesses referred to extend three elongated members or mandrels 15, 16, 17. The recesses are slightly wider than the mandrels for a purpose to be described.

The jig is adapted to receive a planar insulating spacer plate 18 having apertures 19, 20, 21 for receiving the mandrels referred to. The apertures referred to are slightly larger than the width of the mandrels for providing a free space therebetween for receiving end portions of electrodes. This plate is intended to serve as the top plate of the finished mount. The middle mandrel 16 may be round and of a diameter for snugly receiving cathode sleeve 22. Alternatively it may be provided with a longitudinal reference surface the purpose of which will appear as the description continues. As more clearly shown in Figure 2, mandrel 16 is provided with a groove 23 adjacent its upper end for receiving tab 24 of the cathode. An additional groove 25 merging with groove 23 is also provided to facilitate manual removal of the tab from groove 23.

The end mandrels 15, 17 are adapted to receive an anode 26 by extending into tubular portions 27, 28 of the anode. The anode is provided with double ply ears 29, 30 which extend through plate 18 when the anode is mounted on the jig. In recesses 12, 14 are disposed knife edged elements 31, 32. As more clearly shown in Figure 3 these elements include a shank 33 dimensioned for a snug fit into recesses 12, 14. Affixed to or integral with shank 33 is a bevelled element 34 having a knife edge 35 extending upwardly from a side of the shank and angularly with respect thereto. The shank of each of the elements is provided with a longitudinal bore 36 for receiving the lower portions 37, 38 of mandrels 15, 17. A set screw 39 fixes these mandrels in their respective shanks. The knife edge 35 of the elements 31, 32 in the example described are disposed to engage the double ply material of ears 29, 30 to separate the plys thereof. The separation of the plys is accomplished on a portion of the ears extending from the side of the spacer plate remote from the anode proper, and results in a configuration of the ears shown in Figure 4. It will be noted that the plys of ears 29, 30 are separated from each other in the form of a taper that firmly locks the ears with respect to the spacer plate.

The mandrel 17 is provided with an end portion 40 of smaller cross section than the intermediate portion of the mandrel. This results in a displacement of the inner walls of tubular portion 28 of the anode from the mandrel at a portion thereof at which a weld to a lead-in is made. This displacement prevents inclusion of the mandrel in the weld.

The rounded surface 11 of the base facilitates threading the anode ears 29, 30, and an end portion of the cathode 22 through the apertures in the spacer plate 18. The spacer plate normally is planar thus providing a clearance between a central portion thereof and the surface 11 when the plate is loosely placed on the surface and engages only edged portions thereof. When force is applied to the cathode and anode to cause end portions thereof to enter the apertures in the plate, the plate responds in flexure of its central portion toward the central and lower surface portion of surface 11. This flexure is advantageous in two respects. It flexibly absorbs the force with which the electrodes are inserted into the apertures in the plate thereby preventing damage to the electrodes. It also serves to funnel the end portions of the electrodes into their respective apertures, thus avoiding damage to the spacer plate.

The jig of the invention may also be used for mounting electrode elements of an electron tube having more than two electrodes. For example, in Figure 6 is shown an end view of a mount having three electrodes. In this instance no mandrel is required for the third electrode since it will be properly positioned in the mount when the side rods 41, 42 thereof engage appropriate apertures in the spacer plates of the mount.

As shown in Figure 5 the mandrel 16*a* may be provided with a longitudinally disposed flat surface 43 suitably oriented with respect to the electrode assembly. For example, the flat surface 43 may be caused to face a grid side rod 42 as shown in Figure 6. This is advantageous for several reasons. The arrangement disposes the seam 44 of the cathode sleeve adjacent the flat surface and in line with support members of the mount such as side rods 41, 42. This places the seam 44 in a radial position from which least electron flow occurs from the cathode in a completed electron tube. The seam therefore has reduced effect on the electron flow. If the cathode were disposed so that the seam forms part of the major emitting surface of the cathode, erratic operation of the finished device might occur due to the longer time required to heat the seamed portion than other portions of the cathode.

As shown in Figure 1, the mount to be assembled also includes an insulating spacer plate 45 and a stem 46. The stem has an exhaust tubulation 47 and a plurality of lead-ins 48, 49, 50, 51 and spaced studs 52, 53. The lead-ins 48, 49 are designed for connection to the anode 26 and cathode 22, respectively. The lead-ins 50, 51 are provided for a cathode heater, not shown. The studs 52, 53 serve to space the stem 46 a predetermined distance from the plate 45 during the mounting operation. In addition stud 52 is provided with an end portion adapted to extend into aperture 54 in the plate 45 for orienting the stem rotationally in a predetermined manner with respect to the electrode assembly. Lead-ins 48, 49, 50, 51 are preformed so that when the stem is properly oriented rotationally and longitudinally with respect to the electrode assembly, the lead-ins extend relatively close to the electrodes to which they are to be connected.

The operation of assembling a mount with the aid of the jig of the invention involves first placing spacer plate

18 on the base 10 with the mandrels 15, 16, 17 extending through the apertures 19, 20, 21 in the plate and with the plate resting on raised edge portions of the upper surface 11 of the base 10. Cathode sleeve 22 is then threaded on mandrel 16 and pushed downward with sufficient force to cause the sleeve to enter aperture 20 through the free space referred to before herein provided between the aperture wall and the mandrel 16. The tab 24 is then forced into groove 23 to be flush with the surface of the mandrel. Thereafter, anode 26 is fed to the jig with the mandrels 15, 17 thereof entering tubular portions 27, 28 of the anode. The anode is pushed downward until the ears 29, 30 thereof pass through the apertures 19, 21 in plate 18 and engage the knife edged elements 31, 32. This causes a splitting of the ears referred to resulting in a firm locking thereof to the plate. The force exerted on the cathode sleeve and the anode is sufficient to flex the plate 18 to facilitate entrance of the electrodes referred to in the apertures therein. The mandrels 15, 17 are sufficiently long to extend upwardly of the cathode and anode when said electrodes are positioned thereon as aforementioned. This permits the spacer plate 45 to be placed over the mandrels referred to with the mandrels extending through apertures in said plate and slightly beyond the face of said plate remote from said electrode.

The relatively longer middle mandrel 16 extends appreciably above the mandrels 15, 17 and serves to engage the inner wall of tubulation affixed to stem 46 when said stem is next placed in position. The placement of the stem on the jig involves rotating the stem until the end of the lug 52 thereon enters locating aperture 54 in plate 45. When this lug enters aperture 54, the stem is pushed downwardly until lug 53 and the horizontal portion of lug 52 as viewed in Figure 1 abuts against the upper face of plate 45. When this abutment takes place the stem is properly spaced longitudinally from the electrode assembly.

When the stem is properly positioned rotationally and longitudinally with respect to the electrode assembly as aforementioned, the lead-ins 48, 49, 50 and 51 are adjacent the tube elements to which they are required to be welded. Lead-in 48 is actually in contact with an upper end of anode 26, while lead-in 49 is brought into contact with cathode tab 24 by bending the tab out of the groove 23 toward the lead-in. This bending action on the cathode tab is facilitated by the supplementary groove 25 into which a finger of the operator may be extended for suitably engaging and removing the tab from its groove. A heater wire, not shown, will have its ends disposed close to the lead-ins 50, 51 with which they may be manually brought into contact.

When the lead-ins are thus in contact with their respective tube parts, they are welded together in well known manner.

After the welding operation is completed, the finished mount may be readily removed from the jig.

While the above described mounting procedure may involve a diode, essentially similar steps are performed when a triode or other type of electron tube mount is assembled. And when the middle mandrel is provided with a longitudinal reference surface for engaging the seam of a seamed cathode sleeve, the mounting operation is essentially similar.

It will thus be apparent from the foregoing that I have provided an advantageous jig for aiding a mounting operation of electron tube parts to form a tube mount. All critical factors involved in the mounting operation are automatically determined by the jig. For example, the electrodes are correctly spaced from each other and automatically fixed in the mount in proper relation with respect to each other and the stem. Furthermore the cathode is automatically oriented so that its seam has a minimum effect on the electron flow in a finished tube

and its tab is shielded from harm during the mounting operation.

It will be obvious to persons skilled in the art that the examples shown and described herein do not exhaust all embodiments of the invention and it is accordingly desired that modifications within the spirit of the invention be included within the scope of the appended claims.

I claim:

1. Means for facilitating the assembly of electron tube parts to form a mount, comprising a base having two ends, one of said ends being flat and adapted to rest on a flat support, the other end having an inwardly curved surface provided with recesses disposed in a predetermined array, mandrels supported in said recesses and adapted to receive tube parts including an insulating spacer plate having apertures for receiving tube parts in snug fits in predetermined space relation, said curved surface being adapted to receive said plate and flex the same for facilitating entrance of said tube parts in said apertures in the plate.

2. A jig adapted to the said assembly of electron tube parts including a flat insulating spacer plate having apertures therein spaced from the edge thereof and a plurality of electrodes, said jig comprising means including a curved surface having raised edged portions adapted to support edge portions of said plate only, and means for orienting said electrodes in predetermined space relation whereby said electrodes are adapted to be disposed in line with said apertures, whereby said curved edges are adapted to flex said plate in response to a forced entry of said electrodes into said apertures for facilitating said entry.

3. Means adapted to facilitate the assembly of electron tube parts including a plurality of electrodes, two spacer plates and a stem having an exhaust tubulation, said means comprising a plurality of fixed mandrels adapted to receive said parts, one of said mandrels being adapted to receive said stem and one of said electrodes and said spacer plates, the others of said mandrels being spaced from said one of said mandrels and adapted to receive said spacer plate and the others of said electrodes, and a knife-edged element adjacent one end of one of said others of said mandrels adapted to fix one of said others of said electrodes to one of said plates.

4. A jig adapted to facilitate the assembly of electron tube parts to form a mount, said jig comprising a base having plurality of sides and recesses in one of said sides, mandrels extending from said recesses, said mandrels being narrower than said recesses, whereby tube parts are adapted to extend into said recesses adjacent said mandrels, said mandrels having a cross-section adapted to engage apertures in an insulating spacer plate forming one of said parts, and means within one of said recesses adapted to lock another one of said parts to said plate, said means comprising a knife edged element.

5. A jig for aiding the assembly of electron tube parts including a tabbed cathode sleeve to form a mount, comprising fixed means for receiving said sleeve, said means having a groove for receiving said tab, whereby said tab is preserved from deformation during said assembly, said means having an additional groove merging with said first mentioned groove, whereby said tab is adapted to be bent manually out of said first mentioned groove for further processing.

6. A jig adapted to aid the assembly of electron tube parts including a tabbed cathode sleeve having a lock seam extending from the inner wall of said sleeve, a grid having side rods, and a stem having lead-ins extending therethrough, said jig comprising fixed elongated means adapted to receive said sleeve, said means having a longitudinal groove in a side thereof adapted to face one of said lead-ins and receive the tab on said sleeve, for preventing deformation thereof during the assembly of said parts, said means having an additional groove merging with the first mentioned groove adapted to

facilitate manual engagement of said tab for disposing it against one of said leads, said means having a reference surface spaced from said groove and additional groove and adapted to dispose said seam in face relation with respect to one of said side rods whereby said reference surface is adapted to orient said cathode sleeve for improved electron emission therefrom.

7. A jig adapted to aid the assembly of electron tube parts including a stem having an exhaust tubulation therein and a plurality of electrodes and two spacer plates to form a mount, said jig comprising a base, a plurality of mandrels extending from one face of said base and disposed in a symmetrical array with respect to one of said mandrels, said one of said mandrels being substantially longer than the others of said mandrels, said mandrels being adapted to receive said spacer plates and electrodes in predetermined space relation, said one of said mandrels being adapted to extend into said exhaust tubulation whereby said stem is aligned with said electrodes.

8. Means adapted to facilitate the assembly of electron tube parts including a stem having an exhaust tubulation, lead-ins extending through said stem, and spacer lugs fixed to one face of said stem, and a plurality of electrodes and two spacer plates, said means comprising a fixed mandrel adapted to receive said spacer plates and one of said electrodes and adapted to extend into said exhaust tubulation, and additional fixed mandrels adapted to receive said spacer plates and others of said electrodes, and stop means at one group of adjacent ends of said mandrels adapted to engage one of said spacer plates, said mandrels being adapted to support the other of said spacer plates in engagement with said spacer lugs, whereby said means is adapted to align and suitably space said electrodes from each other.

9. A jig adapted to facilitate the assembly of electron tube parts said parts including a stem having an exhaust tubulation therein, two spacer plates and a plurality of electrodes having tubular components, said jig comprising elongated fixed means adapted to receive said plates and said tubular components and said exhaust tubulation in predetermined lateral space relation, and means having a knife edge at one end of said fixed means adapted to deform a portion of one of said electrodes for fixing said one of said electrodes to one of said plates.

10. A jig adapted to facilitate the assembly of electron tube parts including at least one spacer plate and an electrode having an ear formed of two-ply material, said jig comprising fixed means adapted to receive said electrode and said plate, and fixing means disposed at one end of said fixed means adapted to spread said two-ply material for fixing said electrode in said plate.

11. A jig adapted to facilitate the assembly of electron

tube parts including at least one insulating spacer plate having an aperture therein and an electrode having a tubular portion, said jig comprising a base having a surface adapted to support said plate, a mandrel fixed to said base and having a cross-section adapted to extend into said tubular portion for guiding an end of said tubular portion through said aperture, and means in said base at one end of said mandrel adapted to deform an end portion of said tubular portion extending beyond a surface of said plate for fixing said tubular portion in said plate.

12. A jig adapted to aid the assembly of electron tube parts including an anode having tubular ears made of two plies of metal and an insulating spacer plate having apertures disposed in a predetermined array for receiving said ears, to form a mount, said jig comprising a base having a surface provided with recesses therein disposed in said array, mandrels extending from said recesses, said mandrels having a cross-section to provide a free space between the walls of the recesses and the mandrels, whereby said surface is adapted to receive said plate with said apertures aligned with said recesses and said recesses are adapted to receive end portions of said ears when extended through said apertures, and means within one of said recesses adapted to fix said ears to said spacer plate, said means comprising wedge-shaped members in said recesses adapted to engage said ears on extension thereof into said recesses, for spreading said two plies of metal for locking said anode to said plate.

13. A jig adapted to fix to each other two electron tube parts, said jig comprising a base, said base having an annular recess in a surface thereof, means extending axially of said recess adapted to receive one of said parts, said recess being adapted to receive an end portion of the other of said parts, and means within said recess having a knife edge adapted to spread said end portion for fixing said end portion to said one of said parts.

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