Sept. 17, 1946. J. H. O. HARRIES 2,407,742

CONSTRUCTION AND ASSEMBLY OF ELECTRON DISCHARGE TUBES

Filed Sept. 4, 1941 2 Sheets-Sheet 1

Fig.1.

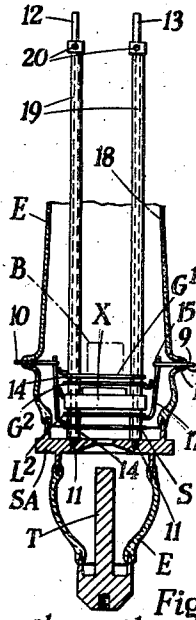


Fig.2.

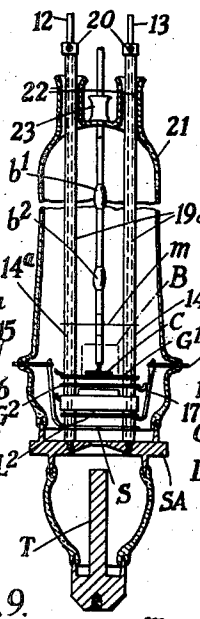


Fig.3.

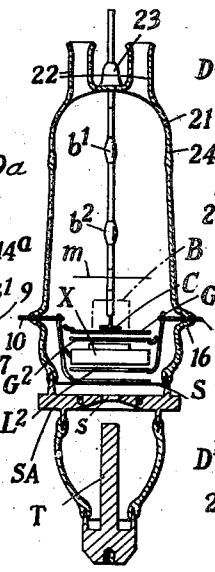


Fig.4.

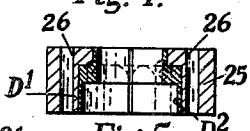


Fig.5.

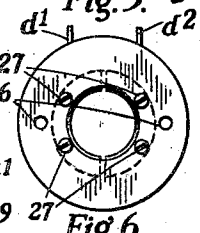


Fig.6.

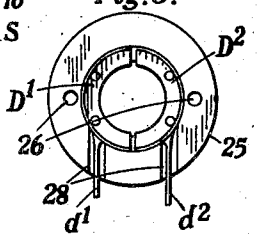


Fig.9.

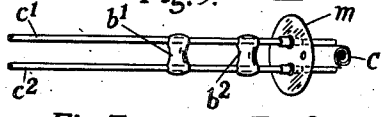


Fig.7.

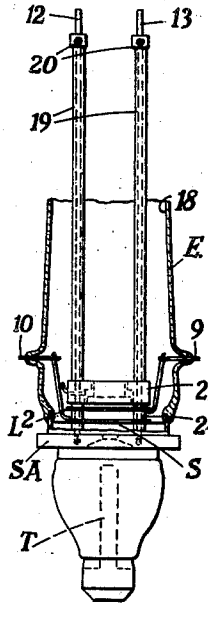


Fig.8.

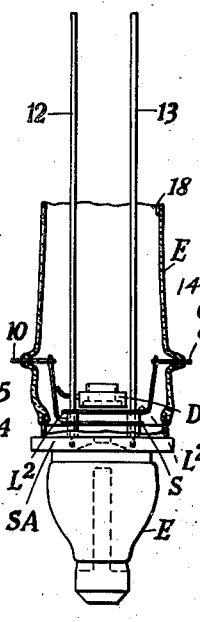


Fig.10.

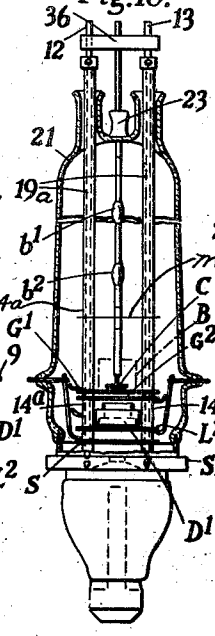
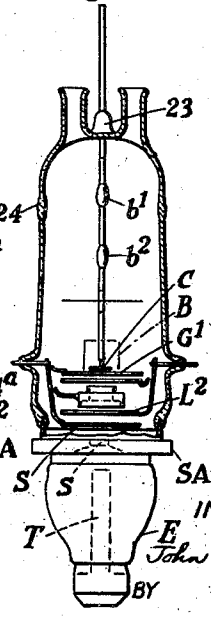


Fig.11.



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Fig.12.

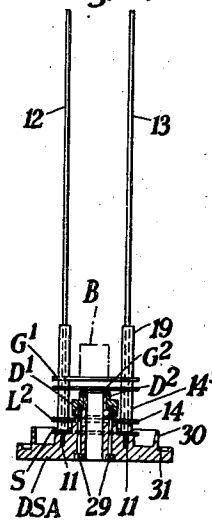


Fig.13.

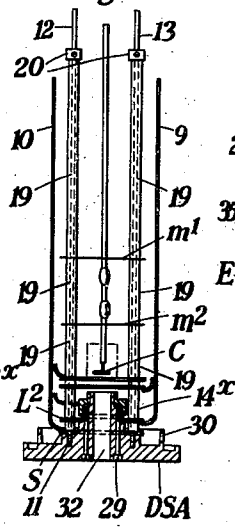


Fig.14.

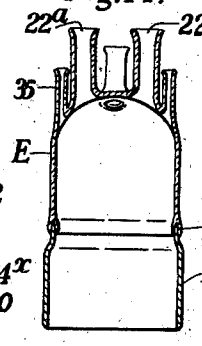


Fig.15.

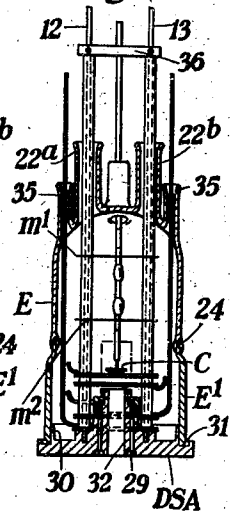


Fig.16.

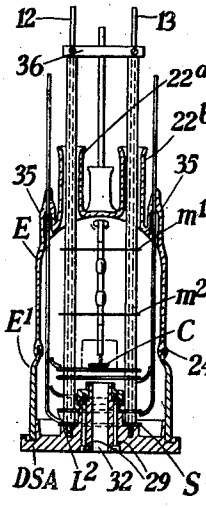


Fig.17.

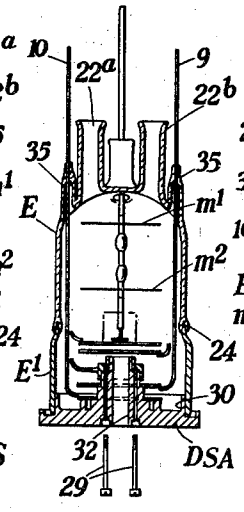


Fig.18.

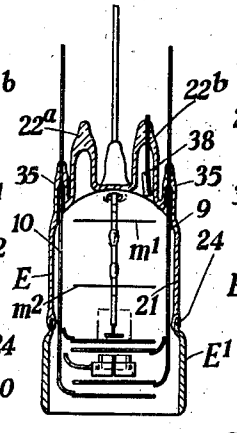


Fig.20.

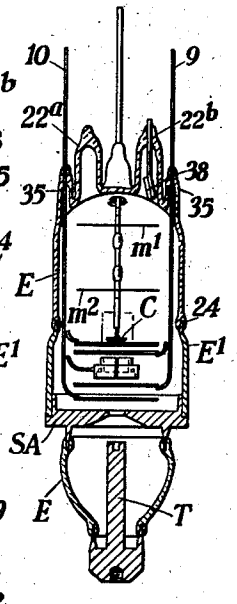


Fig.19.

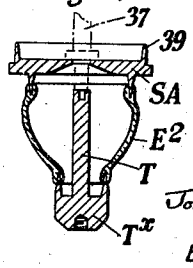
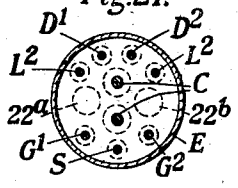


Fig.21.



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UNITED STATES PATENT OFFICE

2,407,742

CONSTRUCTION AND ASSEMBLY OF ELECTRON DISCHARGE TUBES

John Henry Owen Harries, Clapham Park, London S. W. 4, England

Application September 4, 1941, Serial No. 409,589
In Great Britain September 23, 1940

14 Claims. (Cl. 250—27.5)

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This invention relates to the construction and assembly of parts of electron discharge tubes or thermionic valves, and is particularly applicable to, although not limited to, the construction of tubes which operate by producing a beam of electrons such as those set forth in my Patent 2,288,239 and in applications Serial Nos. 409,585 and 409,587, both filed September 4, 1941.

Another application of the invention is to the construction of electron discharge tubes already known in principle, in which a beam or jet of electrons is deflected over a series of contacts. Such tubes may be used as relays or frequency multipliers. In such cases, the beam may be deflected by input currents or voltages applied, for example, to electrostatic deflecting plates or to magnetic deflecting coils, and the output current produced in circuits connected to the contacts upon which the beam impinges. Pulsating currents or amplified currents may be produced in such circuits in accordance with the movement of the electron beam which in turn is proportional to the variation of the deflecting currents or voltages applied to the deflecting plates or coils. Electron discharge tubes of this kind are sometimes known as deflection valves.

A serious difficulty which arises in the construction of such types of electron discharge tube is that of mounting the various electrodes, including the cathode, accelerating grid, and deflection plates, for example, accurately, that is to say, perfectly straight, and in axial alignment. It has now been found that the slightest error in this alignment produces severe aberrations in the desired shape of the beam and produces serious defects in operation of the tube as a whole. Furthermore, with high voltages and considerable powers which are now often used, the commonly used methods of mounting of such tubes are inapplicable. It is found that the only way of obtaining the necessary accuracy is to provide the electrodes with machined support during the process of glass-blowing, and then, when each of the several electrodes is separately supported from the glass envelope of the tube, to withdraw the members which provide the accurate mechanical support. If all the electrodes are mounted on the usual pinch or assembly with mica spacing, serious troubles are encountered due to flash-overs and the evolution of gas so that the length of the life of the tube is often adversely affected. Since the envelope is usually of glass, and the accuracy with which it can be fabricated and with which the electrodes can be mounted if they are supported by the envelope

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alone, is controlled by the accuracy of glass-blowing obtainable, but this accuracy is not nearly good enough for the present purpose, some further provision must be made if a satisfactory practical arrangement is to be obtained. Therefore, the present invention aims at producing an electron discharge tube of the kind referred to above in which the electrodes are aligned to a very high degree of accuracy but are at the same time supported entirely by the glass or like vitreous envelope of the tube.

According to the invention, at least part of the envelope of the tube must be of glass or other vitreous substance so that the electrode supports can be fused in it; each of the electrodes is provided with one or more locating holes which are employed for locating the electrodes and determining their alignment by the use of one or more aligning or guiding members which may conveniently be rigid rods of circular cross-section; the electrodes are spaced from one another by spacing members co-operating with the guide members and lying between each electrode and its neighbour. The guide members are screwed or otherwise supported from a platform during the assembling operation so that they can be readily removed when the assembly is complete and the electrodes have been secured by stiff leads or supports which project through sealing-off stems on the walls of the envelope or on the vitreous part of the envelope into which the stiff leads are sealed by the usual glass-blowing procedure. The guide members and the spacer members have then to be withdrawn through the end or through holes or tubes left open on the envelope so that the electrodes are then left supported from the walls of the envelope extremely accurately in the predetermined positions.

It is convenient to employ a removable jig threaded over the guide members which thereby position the jig, the latter also being withdrawn when the electrodes are secured in position to the walls of the envelope.

In a simple construction, the guide members consist of a pair of circular rods screw-threaded at one end and screwed into the said platform, which in the case of one of the tubes shown hereinafter and constructed in accordance with patent application Serial No. 409,588 filed September 4, 1941 may actually be constituted by the sub-anode located between the output electrode and the suppressor grid or retarding electrode. In any case, the electrodes and their apertures which engage the guide members and the holes in the platform in which these members

are secured, may be made by means of a master jig or master press tools in order to obtain a high degree of accuracy. However, instead of using a permanent part of the tube for the assembling purpose, a dummy platform may be used which is a duplicate of that to be used finally in the tube, the envelope being fixed temporarily in position on the dummy platform while the electrodes are sealed into its wall as described above, whereupon the entire assembly is removed from the guide members and the spacing members and the dummy platform, and is secured by soldering or other convenient means to the actual platform or corresponding electrode which forms a part of the completed tube. In such a case, the part of the envelope adjacent the platform is a metal part which, for registration purposes, fits on a flange or the like first on the dummy platform during assembly, and later on the final platform or sub-anode of the valve. In this case also, the rigid supports and leads for various of the electrodes may run parallel to one another along the tube and taken out at one end, and especially for high frequency working may form part of Lecher wires included in the transmission line. They are then preferably arranged symmetrically with respect to other leads and may be tuned to a different wave length so as to avoid mutual interference. When the tube has a tubular metal portion forming part of the envelope, this may also form part of an electrostatic shield for the leads and electrodes within the tube, and may be in contact with massive metal parts which assist in the cooling of the tube.

It will be appreciated that by use of the invention, it is possible to obtain and maintain a high degree of accuracy of alignment because, as already mentioned, the electrodes and their locating holes may be accurately made by means of a master tool or jig, and because the platform may also be accurately made by similar means. The accuracy of the assembly depends upon the fit of metal parts which may be machined and not upon a glass or other vitreous envelope, for example, fused silica, which cannot be fabricated to a high degree of accuracy. At the same time, however, during operation of the tube, the electrodes are supported from the envelope so that the use of pinches containing closely-spaced wires and mica or steatite spacers and the like, is avoided. It will be appreciated that this is desirable from the point of view of reliabiilty and life of the tube.

In order that the invention may be clearly understood and readily carried into effect, the method of assembly of two main types of tube in accordance with the invention will now be more fully described by way of example with reference to the accompanying drawings, in which:

Figures 1–3, inclusive, are central sections of one type of tube in successive stages of an assembly process embodying the invention;

Figures 4, 5 and 6 are respectively a central section, a top plan and an underneath plan view showing the use of a jig for mounting the deflection electrodes of the different form of tube shown in Figure 11, said tube being of a type shown in patent application Serial No. 409,585, filed September 4, 1941;

Figure 7 shows one of the first stages in the assembly of the tube of Figure 11;

Figure 8 shows a further stage in the assembly of the tube of Figure 11;

Figure 9 is a perspective view of the tube cathode and its support;

Figure 10 shows a still further stage in the assembly of the tube shown in Figure 11;

Figure 11 shows the assembled tube;

Figure 12 shows one of the first stages in the assembly of still another form of tube as illustrated in complete form in Figure 20;

Figure 13 shows a further stage in the assembly of the tube of Figure 20;

Figure 14 shows the tube envelope for the tube of Figure 20;

Figure 15 shows a further stage with the envelope in position;

Figure 16 shows the next stage of assembly of the tube of Figure 20;

Figures 17 and 18 show further successive stages of assembly where the aligning members and the dummy sub-anode are removed;

Figure 19 shows a sub-assembly with the anode mounted on the sub-anode prior to the final stage of assembly;

Figure 20 shows the completely assembled tube represented in Figures 12 to 19, inclusive; and

Figure 21 is a cross-section of the tube of Figure 20 showing the arrangement of the lead-in conductors.

In the drawings, the electrodes of the tubes are shown somewhat diagrammatically, but the method of construction can be described in detail with reference to them. In all of the drawings, the tubes are shown with an output target or anode T, and with a sub-anode SA, the function of which is described fully in patent application Serial No. 409,587 filed September 4, 1941, and which may be maintained at a desired potential to shield the field of the anode T from the other electrodes in the tube.

Referring first of all to Figures 1 to 3, the sub-anode SA which divides the tube into two compartments, is provided with a pair of tapped holes **11**. All the electrodes are provided with a pair of corresponding holes in such positions that they are in alignment with the tapped holes **11** when the parts of the tube are assembled, but these holes in the electrodes are not screw-threaded but are preferably drilled or punched by means of a master jig or press-tool. In Figures 1 to 3, E is the glass envelope, the two parts of which are sealed on to flanges or annular fins extending from opposite sides of the sub-anode SA. Two steel rods of circular section **12**, **13** are screwed into the holes **11**. The electrodes S, L^2, X, G^2 and G^1 are threaded on to the steel rods **12**, **13** and are spaced accurately apart by tubular spacers **14** of suitable material, conveniently brass, also threaded on those rods. The electrode G^1 may be assumed to be a grid finally placed close to the cathode C, as shown in Figures 2 and 3, and maintained at or slightly negative to the potential of the cathode C. G^2 may be regarded as a positive accelerating grid. X may be regarded as a conventional control electrode, such as a modulating grid or deflecting plate, whereas L^2 is a positive electrode, and S a suppressor grid or retarding electrode, as explained in patent application Serial No. 409,587 filed September 4, 1941.

When these electrodes and their spacers have been threaded on to the rods **12**, **13**, they are all held down and secured firmly in position by tubes **19** which are in effect long spacers slipped on to the rods **12** and **13** and pressed down on top of the electrode assembly and there retained in position

by means of collars 20 with set-screws which pinch the rods 12, 13.

In these drawings, the lead-in conductors 9, 10 respectively to the electrodes L^2 and S, are only shown for the sake of clearness, but the lead-in conductors from the electrode X and from the grids G^1, G^2 are similarly taken out through side pips in the wall of the envelope E. In the final state these lead-in conductors serve as the only means of supporting the electrodes, and therefore must be sufficiently rigid. The lead-in conductor 9 for the electrode L^2 has been previously beaded at 15, is welded at the point 15*a* to the lead 17 from the electrode L^2, and is then sealed by glass-blowing through the side stem or pip 16. For welding at the point 15*a*, a long pair of welding electrodes in the form of scissors or tongs, is inserted down from the open top 18 of the envelope E. This procedure is repeated for securing the electrodes S, X, G^1, G^2, and this results in the electrodes being supported rigidly by the lead-in wires 9, 10, of which if necessary there may be more than one for any one electrode, with the result that when the spacers 14 are removed and the steel rods 12, 13 are unscrewed from the sub-anode SA, the electrodes are left accurately aligned and suspended from the glass envelope E.

However, before removing the rods 12, 13 and the spacers 14, 19, it is necessary to seal on to the open end 18 of the bulb a previously prepared glass end 21 seen in Figure 2. This glass end has the cathode supports c^1, c^2 previously sealed into it in accurate position. Details of the cathode assembly are shown in Figure 9. The two conductors c^1, c^2 are accurately secured together and spaced apart by glass beads b^1, b^2; a mica disc *m* is slipped on to assist in holding the supports in the correct position, and then the cathode C, which is a re-entrant flat spiral, as shown in Figure 9 and as set forth in Patent application Serial No. 409,586 filed September 4, 1941, is welded to the end of the supports c^1, c^2, the whole cathode assembly being then sealed into the end wall of the cap 21 as shown in Figure 2. This cap has holes 22 so that it may be dropped on to the top of the entire assembly without disturbing the steel rods 12, 13, the spacers 14, or the electrodes, and when it is sealed on to the open end 18 of the envelope as shown at 24 in Figure 3, it has been arranged that the cathode C is central and correctly spaced from the grid G^1. In order to make certain that the cathode is correctly spaced before the cap 21 is dropped into position, the tubes 19 are removed and tubular spacers 14*a* are substituted as shown in Figure 2, the mica disc *m* then resting on top of them and being held in position by shorter tubes 19*a* also seen in Figure 2, which are retained by the collars 20. Then, of course, the cathode cannot be displaced during the sealing on of the cap 21 at the point 24.

It is at this stage that all the spacer tubes and the two steel rods 12, 13 are finally removed through the tubes 22 which may be merely sealed up; alternatively, however, one of these tubes may be used as the exhausting tube and the other may have a getter support sealed into it.

It will be understood that the above method of assembly depends upon the electrodes being of such a configuration that they may have two holes made in them to receive the steel rods 12, 13. Some electrodes are not readily adaptable for this purpose. Thus, when deflection plates D^1, D^2 are provided, as in the tube of Figure 11 and as set forth in patent application Serial No. 409,585 filed September 4, 1941, they could be furnished with side lugs to receive holes in line with those of the other electrodes, but as the deflection plates consist of a cylinder split into two, they cannot adequately be supported by only two rods, one passing through each half. Such deflection plates, however, can be readily dealt with by a subsidiary jig such as illustrated in Figures 4 to 6. A brass jig 25 is provided with two holes 26 in positions which enable it to slide over the steel rods 12, 13. The jig 25 is bored out centrally to accommodate the two deflection plates D^1, D^2, as seen in Figure 4, and these are held in position by four screws 27, two for each of the plates D^1, D^2. The leads d^1, d^2 to the deflection plates are led out through grooves 28 in the jig 25.

The jig 25 is dropped over the steel rods 12, 13 with the larger part of the plates and the grooves 28 downwards after the electrodes S and L^2 have been assembled as described with reference to Figures 1 to 3. Then the tubes 19 are placed in position and secured by the collars 20. The leads d^1, d^2 are sealed into side pips in the bulb E, as described with reference to the lead 9 in Figure 1. Then, the screws 27 may be removed by a screw-driver inserted into the upper open end of the bulb so as to leave the deflection plates D^1, D^2 no longer attached to the jig 25. The collars 20 and the tubes 19 are removed and the assembly inverted so that the jig 25 can slide down the rods 12, 13 and out at the open end 18 of the envelope E. These two stages of the assembly are shown in Figures 7 and 8. In Figure 8, the three electrodes are in position but the jig 25 removed as just described. The next stage is to thread on to the rods 12 and 13 somewhat longer tubular spacers 14*a* of the length required to ensure the correct spacing of the positive grid G^2 from the upper surface of the deflection plates D^1, D^2. Then the negative grid G^1 with its spacing tubes is threaded on to the rods 12, 13. The tubes 19 are replaced, pressed down, and secured; then the cathode C, with its lead-in conductors c^1, c^2, which, as in the case of Figures 1 to 3, is as shown in Figure 9, is introduced and spaced by the aid of the spacers 14*a*, 19*a* and the mica disc *m*, a temporary jig 36 being used to align the rods 12, 13 at their upper end, and the tube is sealed up and finished as described with reference to Figures 1 to 3. The finished tube ready for exhausting is shown in Figure 11.

Preparatory to assembling the tube, a trial assembly may be made without difficulty by building up the electrodes on a duplicate sub-anode or platform similar to the sub-anode SA but without the glass.

It has already been mentioned that in Figures 12 to 20, the method of assembly is illustrated for a tube having part of the envelope of metal. In the example taken, the central part of the envelope is formed by a piece of copper tubing E^1 (Figures 14 to 20). Also, all the lead-in conductors to the electrodes are taken out at the upper end of the tube, as shown in Figures 15 to 22.

In this case, the electrodes are first built up on a dummy sub-anode DSA which has three steps or shoulders. The lowermost shoulder is shaped to form a temporary bed for the suppressor electrode S. The second shoulder accommodates the electrode L^2, while the third shoulder receives the two deflection plates D^1, D^2, which are temporarily held in position by two screws 29 screwed into the deflecting plates D^1, D^2 from

the bottom surface of the dummy sub-anode DSA. These details are clearly seen in Figures 12, 13 and 15, in which these three electrodes are shown supported on the three shoulders mentioned.

The dummy sub-anode DSA has an upstanding fin or flange 30, and around it a recessed annular groove 31 so placed that the copper tube E' forming the central part of the envelope can be fitted closely around the flange 30 and may be temporarily held in position if necessary by a clamp which can be easily removed. The dummy sub-anode DSA also has a central bore 32 serving as a sight hole to assist in accurate centring of the cathode C.

The successive steps in assembling the parts may now be described. The two steel rods 12, 13 are screwed into the holes 11 provided in the dummy sub-anode as before. The suppressor electrode S is threaded over these rods and bedded on to the lowest shoulder of the dummy sub-anode. Then spacers 14 are threaded on to the rods 12, 13 and the electrode L^2 threaded over the rods 12, 13 and pushed down on to the second shoulder. The deflection plates D^1, D^2, which have no aligning holes, are fitted on to the third shoulder of the dummy sub-anode DSA and are secured in position by the screws 29. Longer spacers are threaded on the rods 12, 13, as seen at 14*x*, and the two grids G^1, G^2 threaded on in turn. In this case, in order to preserve parallelism of the rods 12, 13 and the cathode leads, the spacer tubes 19 are shown in three sections separated by two mica discs m^1, m^2 fixed to the cathode leads, and also having accurately spaced holes punched into them. The upper sections of the tubes 19 are pressed down and the clamping collars 20 tightened up as previously described. The assembly has now reached the condition shown in Figure 13, and it will be appreciated that each of the electrodes has a long leading conductor, examples of which are indicated at 9, 10, and which are all parallel to one another and, of course, stand clear of the tubes 19. These conductors, such as 9, 10, also act as electrode supports in the final condition of the tube and must be rigid. Tungsten rod is a suitable material for them. It is necessary to arrange these lead-in conductors symmetrically and a suitable arrangement is shown in Figure 21, which is a cross-section through the upper part of the tube. In this figure, for convenience the lead-in conductors are given the reference characters of the corresponding electrodes. Thus, the cathode leads indicated by *c* are just above and below the centre line. The deflection electrode leads indicated by D^1, D^2 are at the top, and near them are two leads for the electrode L^2 indicated by that reference letter, while the suppressor grid S has its lead at the bottom in Figure 21, and the grids G^1, G^2 have their leads on either side of it. The input to the tube may be to the electrodes D^1, D^2 and their lead-in wires may form part of the Lecher transmission line referred to above, the symmetrically disposed parallel leads being tuned to different wave lengths. The numerals 22*a*, 22*b* indicate the relative positions of the open tubes shown in Figure 14 in the top wall of the envelope.

This envelope, the upper part of which is of glass with the necessary tubes for the lead-out wires shown at 35, and the tubes 22*a*, 22*b* for the steel rods 12, 13, is then slipped over the assembly on the dummy sub-anode DSA so that the metal tubular part E' fits snugly just outside the flange 30, as seen in Figure 15. A spacing clamp or jig 36 may be applied at this stage to bridge the upper ends of the wires 12, 13, and to maintain them parallel. The cathode C is in position, being spaced by the mica discs m^1, m^2 and the jig 36. While two mica discs are shown, in many cases one disc will give sufficient rigidity. During the sealing of the cathode leads into the glass at the top of the envelope, as shown in Figure 15, the cathode C is held strictly centrally, as may be observed through the sight hole 32, and if necessary play may be left on the mica washers to allow of this.

The next stage illustrated in Figure 16 is to seal in the lead-in conductors at the tubes 35. Then, all the electrodes are rigidly supported from the glass E and in correct alignment with the dummy sub-anode DSA. The next step is to remove the screws 29 at the bottom, unscrew the rods 12, 13 so that the dummy sub-anode DSA can be taken away, and the rods 12, 13 withdrawn. The spacers 14 and tubes 19, which are now released, can be allowed to fall out. This procedure is shown in Figure 17, and Figure 18 shows the structure when the dummy sub-anode has been removed, all the electrodes now being held rigidly in alignment by the lead-in conductors such as 9, 10. The structure is therefore ready for the application of the lower part of the tube which is shown in Figure 19. This consists of the sub-anode proper SA sealed to the lower part E^2 of the envelope, into which the target T has been sealed. The sub-anode SA and target or anode T may be maintained in alinement during the sealing process by the aid of a pin or rod 37 passing through the slot *s* in the sub-anode SA from the top and engaging in a suitable hole in the upper surface of the target T as shown. The pin 37 is withdrawn from the top of the sub-anode. This method may also be employed in assembling the tube shown in Figs. 1 to 11. The sub-anode SA is provided with an annular fin 39 corresponding to the flange 30 of the dummy sub-anode so that the two parts can be connected together and the copper tube E' finally soldered to the sub-anode SA. The tube is then exhausted through the tube 22*a*, and the getter support 38 sealed into the tube 22*b*. The tubular body part E' is preferably silghtly tapered with the object of enabling it to make a better fit with good contact with a ring bearing cooling fins in cases in which air cooling is desired. The outer end T*x* of the anode may be slotted or finned also to increase its surface area for cooling purposes.

I claim:

1. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of alining members to an assembly platform for supporting the envelope of the tube, said members being shaped to co-act with parts of the electrodes to effect alinement of the latter, assembling said electrodes with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes by means of stiff supports to said envelope and subsequently detaching said alining members from said platform and withdrawing said alining members and said distance pieces from the assembly.

2. A method of assembling and alining electrodes in an electron discharge tube having an

envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of alining members to a transverse plate-shaped electrode sealed to the envelope of the tube and serving as an assembly platform, said members being shaped to co-act with parts of the electrodes to effect alinement of the latter, assembling said electrodes with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes by means of stiff supports to said envelope and subsequently detaching said alining members from said plate-shaped electrode and withdrawing said alining members and said distance pieces from the assembly.

3. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of alining members to an assembly platform and shaped to co-act with parts of the electrodes to effect alinement of the latter, detachably fitting the envelope of the tube to said platform, assembling said electrodes with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes by means of stiff supports to said envelope, subsequently detaching said alining members from said platform and withdrawing same and said distance pieces from the assembly and removing said platform from said envelope.

4. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of rods in parallel relationship to an assembly platform for supporting the envelope of the tube, sliding said electrodes over said rods in sequence alternately with tubular spacers surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes by means of stiff supports to said envelope and subsequently detaching said rods from said platform and withdrawing same and said tubular spacers from the assembly.

5. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of rods in parallel relationship to a transverse plate-shaped electrode sealed to the envelope of the tube and serving as an assembly platform, sliding said electrodes over said rods in sequence alternately with tubular spacers surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes by means of stiff supports to said envelope and subsequently detaching said rods from said plate-shaped electrode and withdrawing same and said tubular spacers from the assembly.

6. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of rods in parallel relationship to an assembly platform, detachably fitting the envelope of the tube to said platform, sliding said electrodes over said rods in sequence alternately with tubular spacers surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes by means of stiff supports to said envelope, subsequently detaching said rods from said platform and withdrawing same and said tubular spacers from the assembly and removing said platform from said envelope.

7. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in screwing a plurality of rods in parallel relationship into an assembly platform for supporting the envelope of the tube, sliding said electrodes over said rods in sequence alternately with tubular spacers surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes by means of stiff supports to said envelope, subsequently unscrewing said rods from said platform and withdrawing same and said tubular spacers from the assembly.

8. A method of assembling an electrode and alining same with another electrode in an electron discharge tube having an envelope formed, at least in part, of vitreous material which consists in detachably attaching a plurality of alining members to an assembly platform for supporting the envelope of the tube, securing an electrode in a jig shaped so as to co-act with said alining members, assembling said jig with said alining members to aline the electrode secured in said jig, sealing said electrode by means of at least one stiff support to said envelope and subsequently detaching said jig from said electrode and withdrawing same from the envelope.

9. A method of assembling an electrode and alining same with another electrode in an electron discharge tube having an envelope formed, at least in part, of vitreous material which consists in screwing a plurality of rods in parallel relationship into an assembly platform for supporting the envelope of the tube, securing an electrode in a jig perforated so as to be slideable over said rods, sliding said jig over said rods to aline the electrode secured in said jig, sealing said electrode by means of at least one stiff support to said envelope and subsequently detaching said jig from said electrode and sliding said jig out of engagement with said rods.

10. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of alining members to an assembly platform and shaped to co-act with parts of the electrodes to effect alinement of the latter, detachably fitting the envelope of the tube to said platform, assembling said electrodes with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes by means of stiff supports to said envelope, subsequently detaching said alining members from said platform and withdrawing same and said distance pieces from the assembly, removing said platform from said envelope, and securing to said envelope, in the place of said platform, a transverse plate-shaped electrode of similar configuration to said platform.

11. A method of assembling and alining electrodes in an electron discharge tube having an envelope formed at least in part of vitreous material which consists in detachably attaching a plurality of rods in parallel relationship to an assembly platform, detachably fitting the envelope of the tube to said platform, sliding said electrodes over said rods in sequence alternately with tubular spaces surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes by means of stiff supports

to said envelope, subsequently detaching said rods from said platform and withdrawing same and said tubular spacers from the assembly, removing said platform from said envelope, and securing to said envelope, in the place of said platform, a transverse plate-shaped electrode of similar configuration to said platform.

12. A method of assembling and alining electrodes in an electron discharge tube having an envelope comprising a portion of vitreous material sealed to a tubular metal section which consists in detachably attaching a plurality of alining members to an assembly platform and shaped to co-act with parts of the electrodes to effect alinement of the latter, detachably fitting the metal section of the envelope of the tube to said platform, assembling said electrodes with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes by means of stiff supports to said envelope, subsequently detaching said alining members from said platform and withdrawing same and said distance pieces from the assembly, removing said platform from said envelope and securing by soldering to the metal section of said envelope, in the place of said platform, a transverse plate-shaped metal electrode of similar configuration to said platform.

13. A method of assembling and alining electrodes in an electron discharge tube having an envelope comprising a tubular body and an end cap of vitreous material which consists in detachably attaching a plurality of alining members to an assembly platform for supporting the envelope of the tube and shaped to co-act with parts of the electrodes to effect alinement of the latter, assembling said electrode with said alining members in sequence while maintaining said electrodes spaced by distance pieces also shaped to co-act with said alining members, sealing said electrodes to the vitreous end cap of said envelope by means of stiff supports consisting of lead-in conductors directed parallel to the axis of said envelope and disposed symmetrically with respect to other lead-in conductors and subsequently detaching said alining members from said platform and withdrawing same and said distance pieces from the assembly.

14. A method of assembling and alining electrodes in an electron discharge tube having an envelope comprising a tubular body and an end cap of vitreous material which consists in detachably attaching a plurality of rods in parallel relationship to an assembly platform, detachably fitting the envelope of the tube to said platform, sliding said electrodes over said rods in sequence alternately with tubular spacers surrounding said rods and acting as distance pieces spacing said electrodes, sealing said electrodes to the vitreous end cap of said envelope by means of stiff supports consisting of lead-in conductors directed parallel to the axis of said envelope and disposed symmetrically with respect to other lead-in conductors, subsequently detaching said rods from said platform and withdrawing same and said distance pieces from the assembly.

JOHN HENRY OWEN HARRIES.