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C. P. MAJKRZAK

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ELECTRON GUN

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Fig. 1

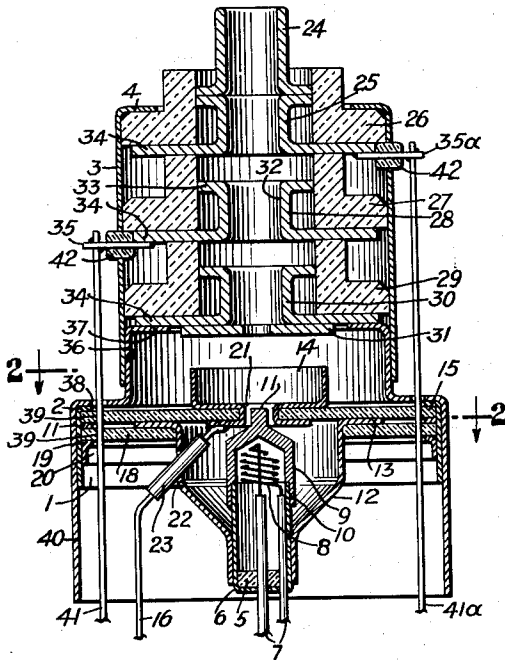


Fig. 3

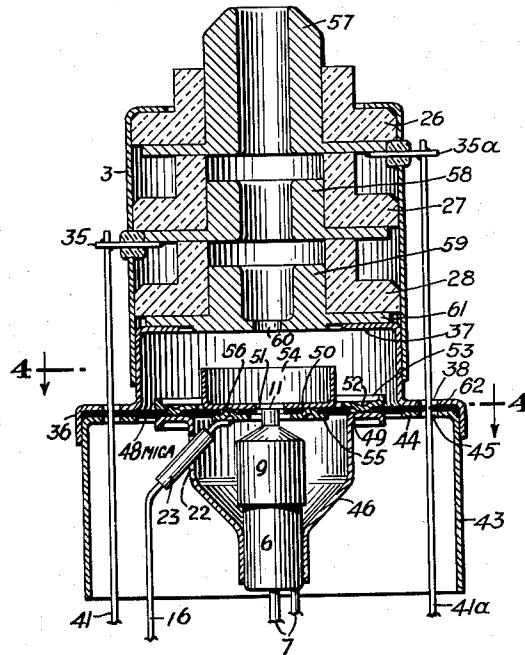


Fig. 2

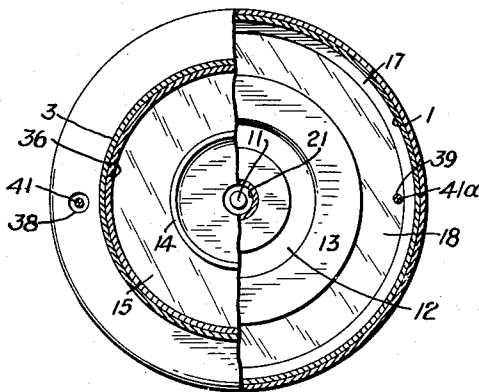


Fig. 4

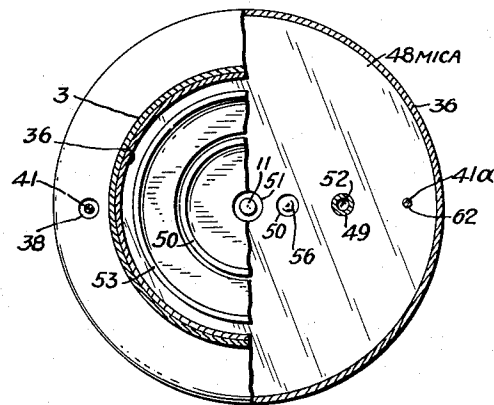
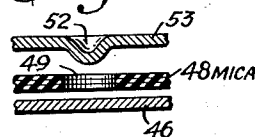


Fig. 5



INVENTOR  
CHARLES P. MAJKRZAK  
BY *Leroy P. Lantry*  
ATTORNEY

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## ELECTRON GUN

Charles P. Majkrzak, Newark, N. J., assignor to International Telephone and Telegraph Corporation, a corporation of Maryland

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This invention relates to electron guns, and more particularly to the mechanical structure and assembly of the electron gun.

The basic problem found in prior arrangements of electron guns is that of holding an accurate alignment, both axial and spaced, of a number of insulated electrodes of particular shapes.

Having in mind this basic problem, it is an object of my invention to provide a construction of electron guns that lends itself to accuracy and to ease of fabrication and assembly.

Another object of my invention is to provide in the electron gun construction and arrangement that creates self-alignment for both the accelerating electrode sub-assembly and the cathode sub-assembly without an undue amount of jiggling.

Still a further object of my invention is to provide a means of joining the two sub-assemblies into a final assembly that will require a minimum of skill to obtain accuracy and a production line quantity output.

The above-mentioned and other features and objects of this invention and the manner of attaining them will be best understood by reference to the following description of embodiments of this invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a longitudinal cross-section view of an electron gun in accordance with the principles of this invention;

Fig. 2 is a traverse cross-section view along line 2—2 on Fig. 1;

Fig. 3 is a longitudinal cross-section view of an electron gun showing a modified form of the invention;

Fig. 4 is a traverse cross-section view taken along line 4—4 in Fig. 3; and

Fig. 5 is an exploded view in cross-section of a detail in Fig. 3.

Referring to Figs. 1 and 2 of the drawing, one of the embodiments of my invention is shown which allows for accurate alignment of parts without an undue amount of jiggling and expensive machinery. The ease of assembly is achieved by the fact that the electron gun is constructed in two main sections, namely the cathode section and the accelerating electrode section. The cathode section has a housing member 1 cylindrical in shape with an inwardly extending flange 2. The accelerating electrode section also has a housing member 3 cylindrical in shape with an inwardly extending flange or shoulder 4, but having a smaller cross-section than that of housing member 1.

In assembling the cathode section, it is first desired to make a cathode sub-assembly by inserting a ceramic washer 5 into a small metallic cylinder 6 through which the filament leads 7 are brought by means of apertures therein. These leads are connected to the filament coil 8 by means of soldering, brazing, or any other suitable method. Concentric with this arrangement is then placed a cathode element 9 which is spot welded or brazed to cylinder 6 such that one of the filament leads 7 is welded or brazed at the same time to the interior of cylinder 6, such as at point 10. The cathode element 9 has its

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thermionic emitting surface located on a nipple, hereafter referred to as the emitting surface 11. This sub-assembly is next positioned in and welded or otherwise secured to an annular shell 12.

A focusing electrode 14 in cup shape is secured to a ceramic washer 15, and a lead 16 is connected thereto. The ceramic washer 15 is sandwiched between flange 2 and an annular element 17 spot welded or brazed to housing member 1.

To complete the assembly of the cathode section a section ceramic washer 18 having a larger interior diameter than ceramic washer 15 is sandwiched between the element 17 and a flange 19 of a ring 20 welded or brazed to housing member 1. This sandwiching is accomplished in such a manner that the annular flange 13 of shell 12 is gripped between ceramic washers 15 and 18 to hold the cathode element in proper alignment with aperture 21 located in ceramic washer 15. The focusing electrode lead 16 is brought out through aperture 22 in the annular shell 12, the lead 16 being protected against shorting by ceramic sleeve 23. A small amount of jiggling is required to properly align cathode element 9 and its accompanying emitting surface 11 when the annular flange 13 is being sandwiched between ceramic washers 15 and 18.

Still referring to Figs. 1 and 2 the electrode assembly contained in housing 3 will now be described. Nozzle-shaped tip 24 is spot welded or brazed to a third accelerating electrode 25 and then slipped into housing member 3 on top of a ceramic spacer 26. Following this is ceramic spacer 27, a second accelerating electrode 28, another ceramic spacer 29, followed by a first accelerating electrode 30 to which is spot welded or brazed a metallic focusing disc 31.

The electrodes 25, 28, and 30 are of sheet stock either stamped, punched, or turned. Each electrode has a central "flue" portion 32 terminating in end flanges 33 and 34 disposed radially thereof. The flange 34 is of greater dimensions than flange 33 so as to function as a lateral projection. The outer diameter of ceramic spacers 26, 27, and 29 is such that the spacers are received snugly in the housing member 3, while the interior dimension is such that the smaller end flange 33 of the electrodes 25, 28, and 30 is received snugly therein. It should also be noted that the outer dimension of ceramic spacers 26, 27, and 29 is larger than the dimension of electrode lateral flange 34. Therefore, the snug fit of the ceramic spacers 26, 27, and 29 against housing member 3 plus the snug fit of the end flanges 33 of electrodes 25, 28, and 30, in ceramic spacers 26, 27, and 29 hold said electrodes in proper axial and spaced alignment.

In the process of inserting electrodes 25 and 28 in housing member 3, small stiff lead wires 35 and 35a are secured, as by spot welding, to the lateral projections of the electrodes prior to inserting next element. Each lead wire is brought out of housing member 3 through an insulator 42.

To accomplish a completed assembly a stepped cylinder 36 having an inwardly extending flange 37 is used. The smaller end of the cylinder 36 is telescoped into housing member 3, such that flange 37 is flush against the projection 34 where it is spot welded to member 3 to hold firmly the electrodes 25, 28, and 30 in desired alignment.

Housing member 1 is then received in the larger end of the stepped cylinder 36 care being taken to line up apertures 38 in the tread portion of stepped cylinder 36 with apertures 39 in ceramic washers 15 and 18. Housing member 1 is then placed against the tread portion of stepped cylinder 36 and spot welded or brazed to riser portion 40 of stepped cylinder 36. To complete the as-

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sembly leads 41 and 41a are disposed through apertures 38 and 39, and from there to lead wires 35 and 35a.

Figs. 3, 4, and 5 illustrate another form of this invention wherein the same reference characters are employed for identical parts as described in the foregoing embodiment.

In this embodiment cathode housing member 43 comprises a cylindrical shell having an inwardly extending flange 44 that contains apertures 45 for leads 41 and 41a. Resting upon the flange 44 is a sheet of mica 48 containing two series of apertures 49 and 50, also a central aperture 51 to expose emitting surface 11, and openings for alignment with openings 45 for passage of leads 41 and 41a. Annular shell 46 of the cathode assembly is secured in position by nipples 52 contained in an annular ring 53 extending through apertures 49 and spot welded. A focusing electrode 54 is held concentric to emitting surface 11 by an annular disc 55 containing nipples 56 which protrude through apertures 50 to which the electrode is secured by spot welds.

Housing member 3 and the ceramic spacers for the accelerating electrodes are identical to those used in the first embodiment. However, the third accelerating electrode 57 is a solid screw machine part shaped as shown in drawing. The second accelerating electrode 58 is similar to the second accelerating electrode 28 in Fig. 1 except that it is a screw machine part. The ceramic spacers 26, 27, and 29 and accelerating electrodes 57 and 58 are disposed in alternate manner and provided with the connections 35 and 35a.

First accelerating electrode 59 is a screw machine part that is provided with a reduced interior dimension 60 for concentrating the electron beam. The lateral flange projection 61 is recessed to receive flange 37 to which it is welded. This unit is then telescoped with housing member 3, aligning apertures 38 with lead wires 35 and 35a and pressure applied prior to spot welding or brazing which then holds electrodes 57, 58, and 59 in spaced and axial alignment.

The housing member 43 is inserted into the larger end of stepped cylinder 36 and apertures 38, 62, and 45 are aligned. When this alignment is completed pressure is applied and the units are joined by spot welding or brazing. The pressure produced by the flange 44 and tread portion of stepped cylinder 36 clamps the mica sheet 48 in place, thereby providing the proper alignment between cathode element 9 and the accelerating electrodes 57, 58, and 59.

The focusing electrode potential is applied through lead 16, while the first accelerating electrode, 30 in the first embodiment and 49 in the second embodiment, is at ground potential through the stepped cylinder 36. Potentials of progressively higher values are applied through electrode leads 41, 35 and 41a, 35a to the second and third accelerating electrodes, respectively.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. Therefore, this description is made only by way of example and not as a limitation to the scope of my invention.

I claim:

1. In an electron gun, a cathode assembly comprising a cathode, a cylindrical shell, means supporting said cathode in said shell including an insulating element in the form of a sheet having apertures therethrough, means carried by said shell to support said element in position crosswise thereof, an annular plate disposed on one side of said insulating sheet, an annular shell to support said cathode on the other side of said sheet and means connecting said annular shell through certain of said apertures to said annular plate with said cathode exposed through still another of said apertures, a focusing electrode closely adjacent to said cathode and means extending through apertures in said sheet to secure said focusing electrode thereto in concentric relation to said cathode.

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2. An electron gun comprising a first housing member, a cathode, means supporting said cathode in said first housing member, a second housing member, a plurality of accelerating electrodes, means supporting said electrodes in alignment in said second housing member and means connecting together in a telescoping manner said first and second housing members to align said electrodes and said cathode, the means supporting said cathode including a sheet of insulating material having apertures therethrough, an annular plate disposed on one side of said insulating sheet, an annular shell to support said cathode on the other side of said sheet and means connecting said annular shell through certain of said apertures to said annular plate with said cathode exposed through still another of said apertures.

3. An electron gun according to claim 2, further including a focusing electrode disposed closely adjacent said cathode, and means extending through apertures in said sheet to secure said focusing electrode therethrough in concentric relation to said cathode.

4. An electron gun comprising a first housing member, a cathode, means supporting said cathode in said first housing member, a second housing member, a plurality of accelerating electrodes, means supporting said electrodes in alignment in said second housing member, and means connecting together in a telescoping manner and in tandem relation said first and second housing members to align said electrodes and said cathode, said plurality of electrodes each including a lateral projection and means supporting said electrodes in alignment including insulating spacers one each disposed between the projections of adjacent electrodes and between at least one of said adjacent electrodes and the wall of said second housing member, said first housing member comprising a shell and the means supporting said cathode including an insulating element and means carried by said shell to hold said element in position crosswise of said shell, said means carried by said shell including an inwardly extending flange, an annular element disposed laterally of said shell, said insulating element being in sheet form sandwiched between said flange and said annular element having apertures therethrough, a focusing electrode, means extending through certain of the apertures in said sheet to secure said focusing electrode therethrough in concentric relation to said cathode, and means employing others of said apertures to support said cathode.

5. An electron gun comprising a first housing member having a first diameter and including an inwardly protruding end portion, a cathode, means supporting said cathode axially of said first housing member disposed crosswise said first housing member in contiguous relation to said protruding end portion, a second housing member having a second diameter and including a shoulder portion at one end thereof, a plurality of accelerating electrodes, insulating means disposed between adjacent ones of said electrodes and between one of said electrodes and said shoulder portion for positioning said electrodes axially of said second housing member, said first diameter being greater than said second diameter, and a connecting member to connect together said first and second housing members in an in line arrangement therewith, said connecting member including a first portion parallel to the axis of said housing members having an inwardly protruding end, a second portion parallel to the axis of said housing members and a portion transverse to the axis of said housing members interconnecting said first and second portions, said first portion engaging the inner surface of said second housing member and said second portion engaging the outer surface of said first housing member to align the axes of said housing members and thereby align said electrodes with said cathode.

6. An electron gun according to claim 5, wherein the inwardly protruding end of said first portion engages one of said electrodes to cooperate with said insulating spacers

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and said shoulder portion to hold said electrodes in alignment with said cathode.

7. An electron gun according to claim 5, wherein said means supporting said cathode includes a sheet of insulating material, the transverse portion of said connecting member and the inwardly protruding end portion of said first housing member cooperating to secure said sheet of insulating material in position crosswise said first housing member.

8. An electron gun comprising a first housing member having an inwardly protruding end portion, a cathode, means supporting said cathode axially of said first housing member disposed crosswise said first housing member in contiguous relation to said protruding end portion, a second housing member having a shoulder portion at one end thereof, a plurality of accelerating electrodes, insulating means disposed between adjacent ones of said electrodes and between one of said electrodes and said shoulder portion for positioning said electrodes axially of said second housing member, and a connecting member to connect together said first and second housing members, said connecting member including a first portion parallel to the axis of said housing members having an inwardly protruding end, a second portion parallel to the axis of said housing members and a portion transverse to the axis of said housing members interconnecting said first and second portions, said first portion engaging the inner surface of said second housing member and said second portion engaging the outer surface of said first housing member to align the axis of said housing members and thereby align said electrodes with said cathode, said means supporting said cathode including a sheet of insulating material, the transverse portion of said connecting member and the inwardly protruding end portion of said first housing member cooperating to secure said sheet of insulating material in position crosswise said first housing member, said sheet of insulating material including a plurality of apertures therethrough and said means supporting said cathode further includes an annular plate disposed on one side of said sheet of insulating material, an annular shell to support said cathode on the other side of said sheet and means connecting said annular shell through certain of said apertures to said annular plate with said cathode exposed through still another of said apertures.

9. An electron gun according to claim 8, further in-

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cluding a focusing electrode disposed closely adjacent said cathode and means extending through other apertures in said sheet to secure said focusing electrode thereto in concentric relation to said cathode.

10. An electron gun according to claim 5, wherein said means supporting said cathode includes a first disc of insulating material having an axial aperture therethrough, a first inwardly protruding member carried by said first housing member, said disc being sandwiched between said first inwardly protruding member and said inwardly protruding end portion for positioning thereof, a second disc of insulating material, a second inwardly protruding member carried by said first housing member, a flanged cylinder with the outwardly extending flange thereof sandwiched between said first and second discs, said second inwardly protruding member cooperating to hold said second disc in position crosswise said first housing member and means to support said cathode in said flanged cylinder in alignment with said axial aperture.

11. An electron gun according to claim 10, further including a focusing electrode carried by said first disc in concentric relation with respect to said axial aperture.

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