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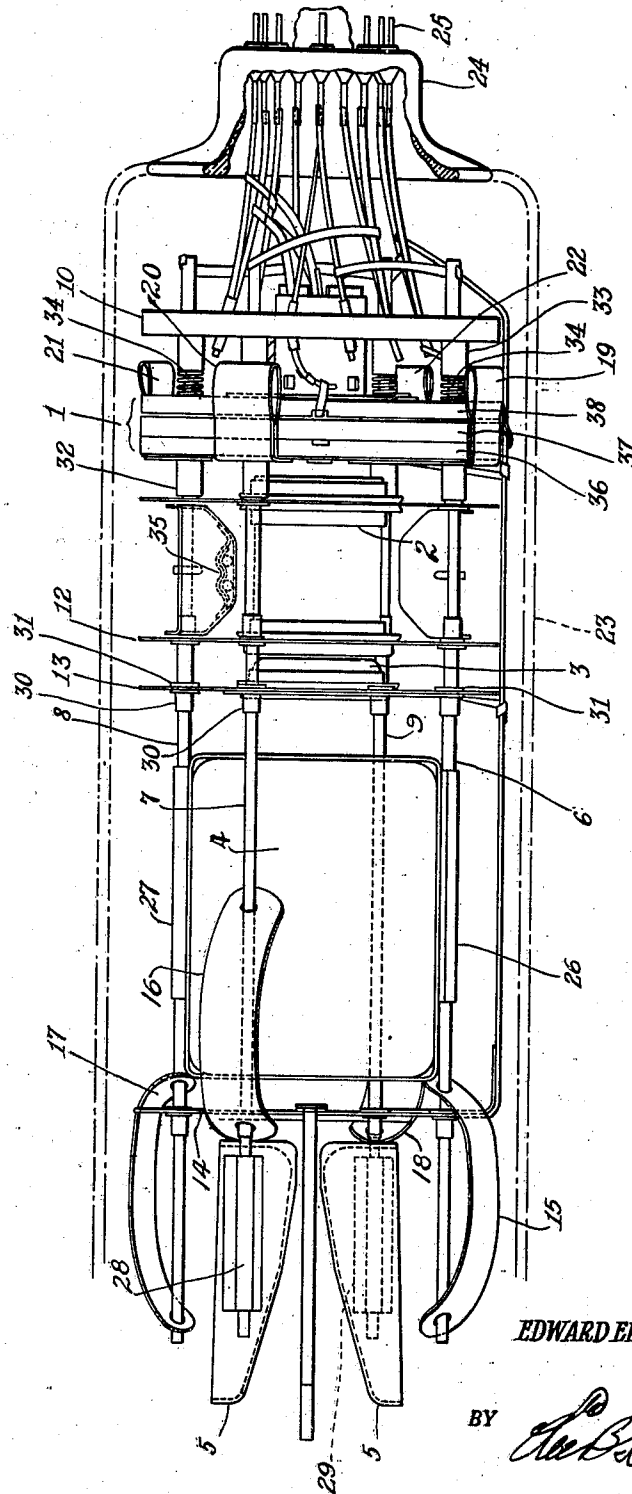
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CATHODE-RAY TUBE

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4 Sheets-Sheet 1

Fig. 1.



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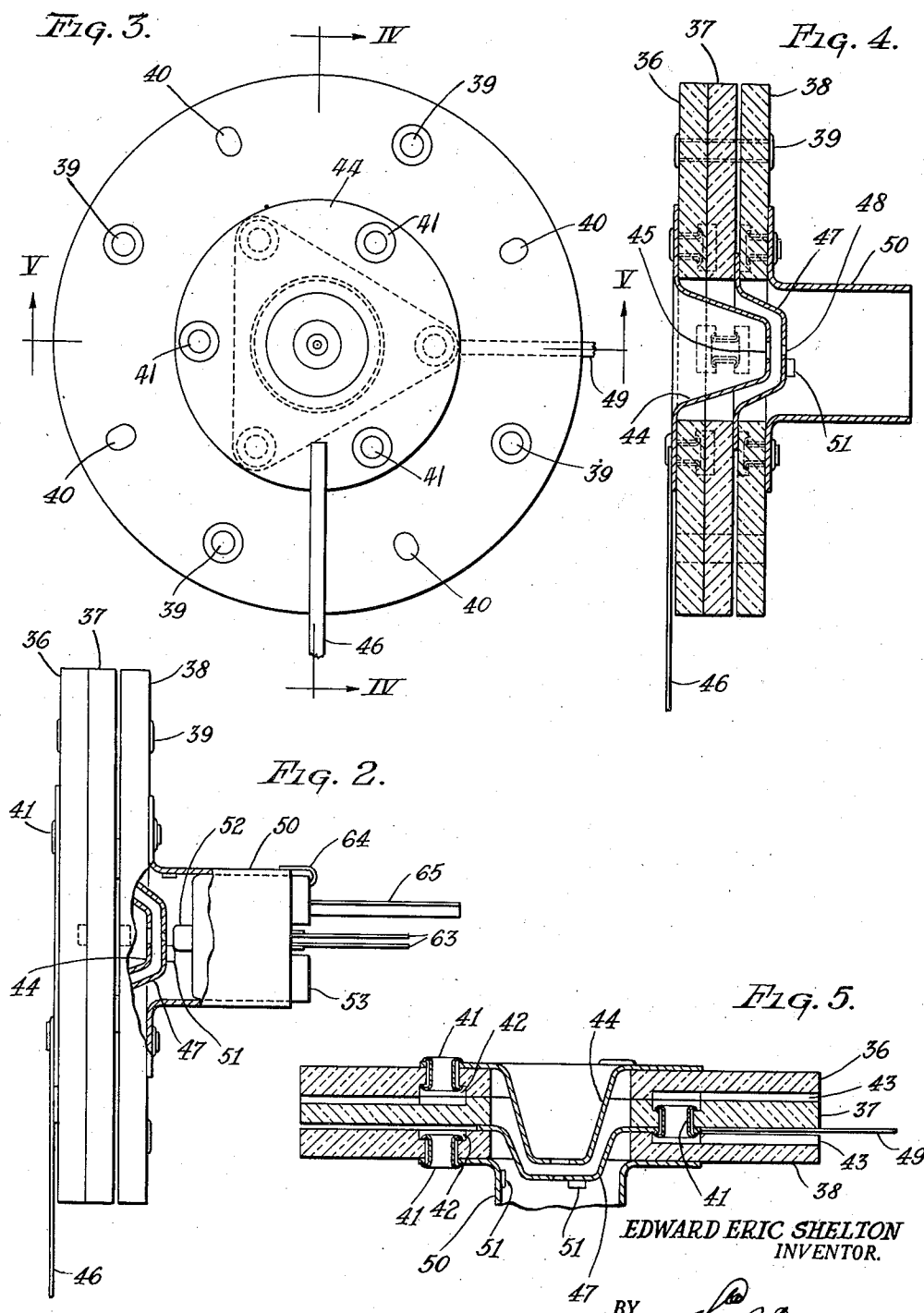
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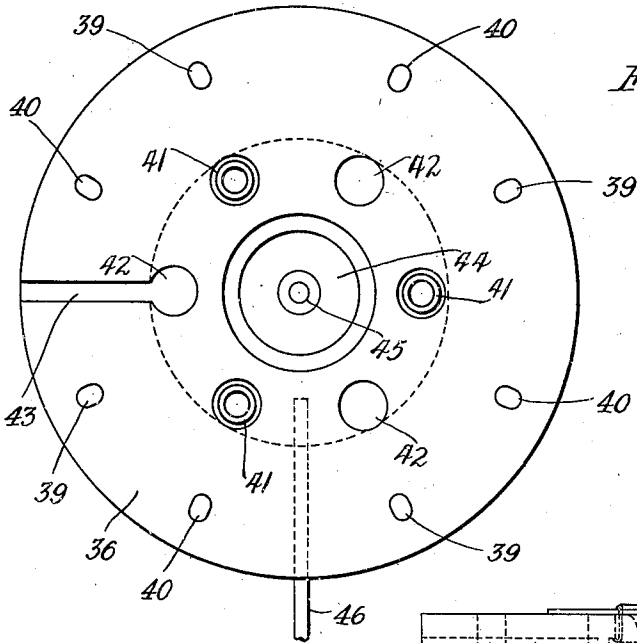


Fig. 6.

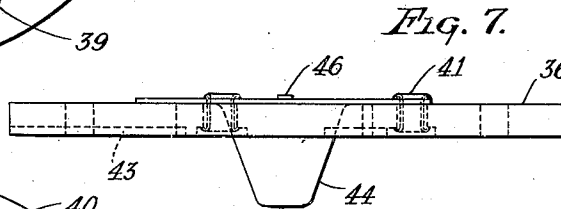


Fig. 7.

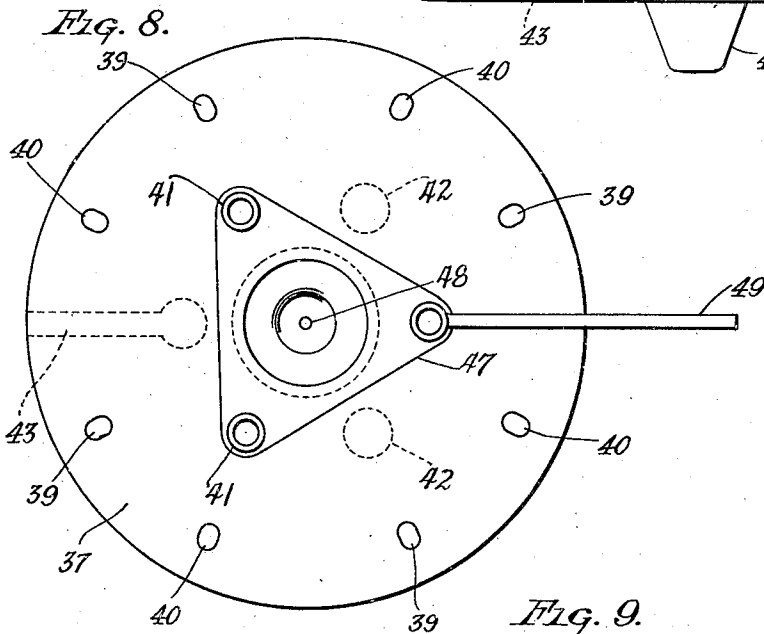
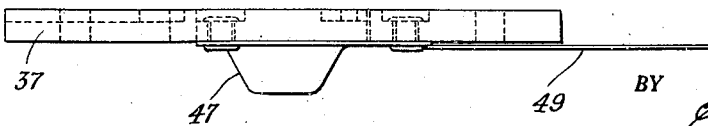


Fig. 8.

Fig. 9.



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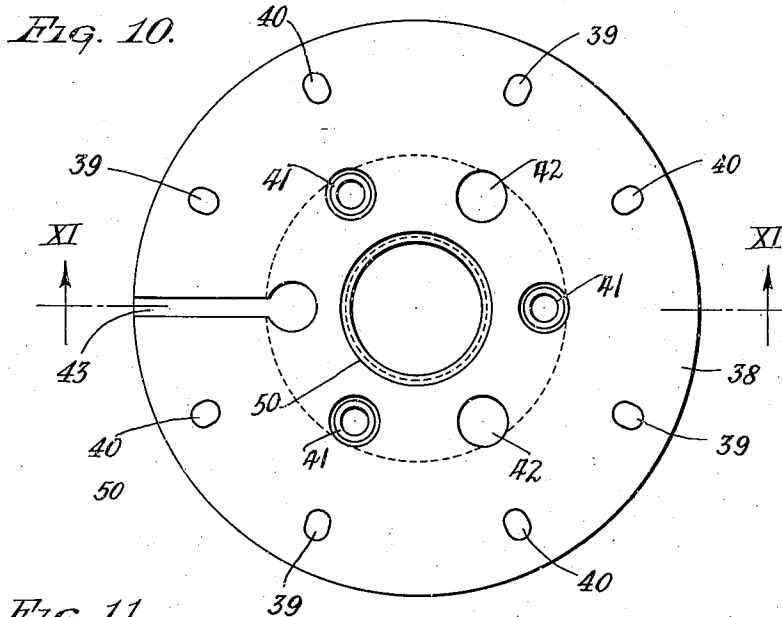
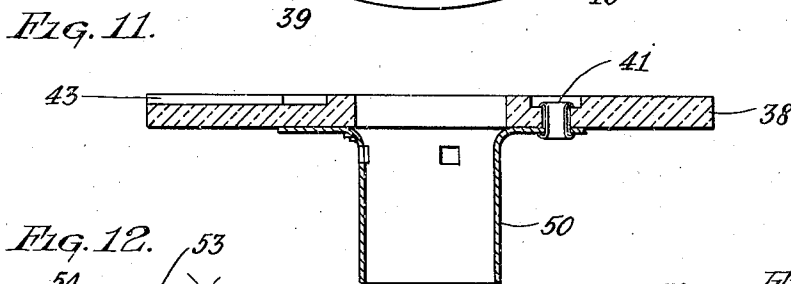
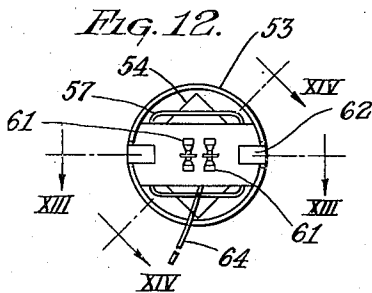
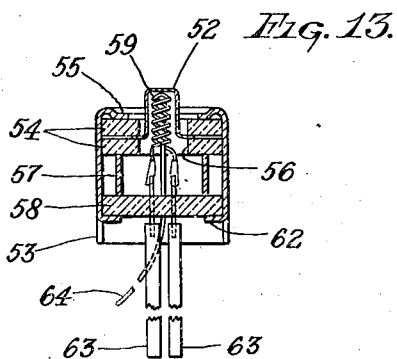
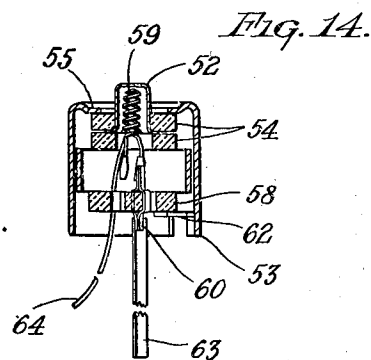
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4 Sheets-Sheet 4



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2,458,962

CATHODE-RAY TUBE

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In Great Britain October 18, 1944

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Patent expires October 18, 1964

8 Claims. (Cl. 250—27.5)

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This invention relates to cathode-ray tubes and has for its object to provide an improved electron gun of the prefabricated unit type.

According to the present invention, the cathode, the first anode, and any electrodes between the cathode and the first anode (e. g. the modulator or grid), are each separately mounted on a rigid insulating block and the separate blocks are secured directly together to form an electron gun unit. The separate electrodes may be secured to their respective blocks by eyelets (tubular rivets) and the separate blocks may be similarly secured together.

Preferably the cathode proper is slidable within a tubular metal member or sleeve which is secured to the cathode mounting block, so that after assembly of the unit the separation between the cathode and the next electrode can still be adjusted. Advantageously the cathode-proximate surface of said next electrode is located within the tubular member and the latter is provided with windows to enable direct inspection of the separation between the proximate surfaces.

Conveniently the cathode and the first anode are carried on opposite end surfaces of the blocks of the electron gun unit. When the gun unit comprises only one further electrode, the latter can with advantage be mounted on the cathode-proximate surface of its mounting block. To facilitate the provision of a connecting lead to any one of the intermediate electrodes, a channel is provided in one or both of the block interfaces to receive such connecting lead (wire or strip).

For simplicity in manufacture, the mounting blocks for the several electrodes are identical and preferably consist of pressed ceramic bodies in the form of parallel-faced annular discs. The blocks may also be provided with recesses in the faces which are to be interfaced in the electron gun unit, so that at these interfaces the heads of the eyelets employed to secure the several electrodes are accommodated in recesses either in the block with which they are associated or in the adjacent block.

In the electron gun unit according to the present invention, the component slidable within the tubular sleeve secured to the cathode mounting block preferably comprises an open ended tubular sheath within which the cathode proper is mounted on thermally insulating members such as ceramic washers. Thus for instance in one form, one end of the sheath is provided with an returned flange against which abuts a ceramic washer. The indirectly heated cathode passes through this washer and has a base flange which

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is clamped between the first washer and a second ceramic washer. The cathode heater is carried by a separate ceramic support which is separated from the second ceramic washer by a spacer of suitable dimensions. The assembly within the sheath is secured by bending over lugs or tabs formed by incisions made in the free end of the sheath. It is preferred that the cathode connection be made to the tubular sleeve so that the two ceramic washers clamping the cathode provide the thermal insulation for the cathode whereas the electrical insulation from the remaining electrodes is provided by the cathode mounting block to which the tubular sleeve is attached, and which is not subjected to the same high temperature as the two ceramic washers.

In order that the invention may be more readily understood reference will now be had to the accompanying drawings which show a preferred embodiment by way of example and in which:

Figure 1 is a side view of the complete electrode assembly including the electron lenses and the deflection plates.

Figure 2 is a side view, partly broken away, of the electron gun assembly.

Figure 3 is a view looking on the left-hand side of Figure 2.

Figure 4 is a section along the line IV—IV of Figure 3.

Figure 5 is a section along the line V—V of Figure 3.

Figure 6 is a view of the cathode side of the insulating plate carrying the first anode.

Figure 7 is a top plan view of Figure 6.

Figure 8 is a view of the cathode side of the insulating plate carrying the grid.

Figure 9 is a top plan view of Figure 8.

Figure 10 is a view of the anode side of the insulating plate carrying the cathode.

Figure 11 is a section along the line XI—XI of Figure 10.

Figure 12 is a view of the cathode assembly looking from the right-hand side of Figure 2.

Figure 13 is a section along the line XIII—XIII of Figure 12.

Figure 14 is a section along the line XIV—XIV of Figure 12.

Referring first to Figure 1, the electrode assembly comprises an electron gun consisting of cathode, grid and first anode indicated as a whole by the reference numeral 1, electron lenses 2 and 3, and pairs of plates 4 and 5 for the "Y" deflection and "X" deflection respectively. The electrodes are all carried by four longitudinal electrode supporting rods 6, 7, 8 and 9 which at the

end beyond the electron gun are anchored in a ceramic end plate 10 and are otherwise located by mica spacing plates 11, 12, 13 and 14. The leads from the various electrodes are taken to pins 25 sealed in a pressed glass base 24 to which the main glass envelope 23 of the tube is sealed. Adjacent the "X" and "Y" deflection plates 4 and 5 the electrode assembly is supported against the wall of the tube 23 by means of flat spring members 15, 16, 17 and 18 which are provided near their ends with apertures through which pass the supporting rods 6, 7, 8 and 9. Adjacent the electron gun 1, the electrode assembly is supported against the glass envelope 23 by means of metal spring members 19, 20, 21 and 22 which are clamped between one end face of the electron gun assembly 1, and spacing members 32 positioned on the supporting rods 6, 7, 8 and 9.

The "Y" deflection plates 4 are secured on the supporting rods 6 and 8 respectively by means of sleeves 26 and 27 embracing these rods. Similarly, the "X" deflection plates 5 are secured by sleeves 28 and 29 embracing the rods 7 and 9. The mica spacing plates 11 to 14 are secured in the desired position on the rods 6 to 9 by means of sleeves and rings 30, 31 engaging the rods on either side of the mica plates. The previously mentioned ceramic spacing tubes 32 which clamp the supporting springs 19, 20, 21 and 22 to one face of the electron gun unit 1, are interposed between this unit and the mica plate 11. The clamping action is ensured by means of springs 34 which are interposed between the other face of the electron gun assembly 1 and ceramic spacing tubes 33 abutting against the ceramic end plate 10. The electrode supporting rods also carrying the usual gettering arrangement indicated generally at 35. The electron gun assembly indicated as a whole at 1 in Figure 1 comprises in the example shown the cathode, the grid and the first anode which are separately mounted on individual ceramic plates 36, 37 and 38 respectively. The electron gun assembly and the components are shown in greater detail in Figures 2 to 11 to which reference will now be made.

Each of the ceramic plates 36, 37 and 38 is provided with a series of spaced holes 39 to receive rivets whereby the three plates after their electrodes have been attached are riveted together to form the unit, this operation being performed for example in a four point eyeletting press with a centering jig to retain the electrodes co-axial. Each plate has moreover a series of holes 40 to receive the electrode supporting rods 6, 7, 8 and 9 (Figure 1). The individual electrodes are each secured to their respective plates 36, 37 and 38 by means of three rivets 41, which may be inserted by means of a three point eyeletting press and the heads of which are received in recesses 42. It will be noted from Figure 5 that on one side of a plate the head of the rivet is received in a recess formed on that side of the plate whereas on the other side the head projects from the surface of the plate, but is received in a corresponding recess provided in the adjacent plate. For simplicity in manufacture all the plates 36, 37 and 38 are identical and each is provided with a radial slot 43 extending outwardly from one of the rivet receiving recesses 42 to accommodate the lead wire to the electrode which is secured by the rivet in the said recess 42. As shown, each plate has the form of a parallel-faced annular disc.

The first anode 44 is a cup-like member with a

circular flange which is attached to the face of the disc 36 remote from the cathode, the lead wire 46 to this first anode extending radially adjacent the same face of the disc 36. The base of the cup is provided with an aperture 45 for the passage of the controlled electron beam. The grid is a cup-shaped member 47 with a triangular flange which is secured to that face of the plate 37 which is adjacent the cathode. The base of the cup 47 constituting the grid is provided with an aperture 48 in alignment with the aperture 45 in the first anode 44 for the passage of the electron beam. The lead wire 49 to the grid 47 is accommodated between the plates 37, 38 in the recess 43 provided in the latter. It will be noted from Figures 2, 4 and 5 that the base of the cup 47 constituting the grid lies in a plane beyond the outer face of the disc 38, i. e. that face which is remote from the first anode. The cathode is carried by the plate 38 in a cylindrical sleeve 50 provided with a flange which is secured to the outer face of the plate 38. The cathode proper is adjustable coaxially within the sleeve 50, and the wall of the tube is provided with four windows 51 distributed equally around the periphery of the tube so that the relative positions of the cathode proper and the grid can be directly observed.

The cathode unit which is slidable within the sleeve 50 consists of the cathode proper 52 which is a hollow cylinder closed at one end and accommodates the heating filament 59. The cathode unit is carried by a sheath 53 the external diameter of which matches the internal diameter of the sleeve 50 (Figure 2). The cathode 52 projects at one end from the sheath 53 and at this end the sheath has an interned flange 55 defining the central aperture through which the cathode 52 passes. The inner end of the cathode 52 is clamped between a pair of ceramic washers 54 each having a square aperture 56. These washers are held in clamping relationship to the base of the cathode 52, by means of a metal spacing member 57 and a ceramic plate 58 which is secured in position by lugs 62 bent in from the open end of the sheath 53. In this way the assembly consisting of the ceramic washers 54, the spacing member 57 and the ceramic plate 58 is secured between the flange 55 and the lugs 62. The filament 59 is supported from the plate 58 by yoke members 60 which pass through holes 61 in the plate 58 and are clamped to the plate 58. Heating current leads 63 are attached to the outer ends of these yoke members 60. A lead 64 is attached to the base of the cathode 52 and, as seen from Figure 2, is secured to the cathode sleeve 50 so that the latter is at the same potential as the cathode proper 52. The external lead to the cathode is constituted by the strip 65 shown in Figure 2.

It will be seen that the electron gun arrangement according to the invention comprises an insulating plate for each electrode, the individual electrodes being separately attached to their insulating plates and thereafter the insulating plates being secured together to form the unit which can be mounted as a whole in the complete electrode assembly. It will furthermore be noted that in the cathode construction the ceramic washers 54 which support the cathode 52 and provide the thermal insulation for the cathode do not have to furnish any electrical insulation since they extend between the cathode and the surrounding metal sheath 53 and the sleeve 50 which are at cathode potential. The electrical insulation of the cathode 52 is afforded by the

insulating plate on which the cathode unit is supported.

The dimensions of a typical set of electrodes for the gun assembly as shown in the drawings are as follows:

Anode:	Millimeters
Thickness of metal-----	0.5
Depth of cup-----	10
Hole diameter-----	2
Grid:	
Thickness of metal-----	0.2
Depth of cup-----	5
Hole diameter-----	0.75
Cathode:	
Diameter of cylinder-----	3
Anode—grid spacing (proximate faces)----	1
Cathode—grid spacing (proximate faces)---	0.4

With this geometry of the electron gun, the voltages applied to the electrodes with respect to the cathode may be 500 to 5,000 volts on the anode and -1 to -100 volts on the grid.

I claim:

1. An electrode assembly for an electron gun unit of a cathode ray tube comprising a first parallel-faced electrically insulating annular block disk member to support an electrode having a central aperture and a plurality of spaced holes symmetrically arranged around the central aperture, each such hole being countersunk on one side of the disk to receive the head of a fastening rivet, an electrode embodying an active portion extending into the central aperture and an encircling anchoring portion with the latter portion shaped to extend over the symmetrically disposed holes of the disk and to lie flat against the face of the disk on the side opposite the countersunk ends of the holes, a rivet through each hole to fixedly secure the anchoring portion of the electrode to the disk with the rivet head on the end away from the anchoring portion fitting down in the countersunk hole to be flush with or below the disk surface, a second annular block disk identical in construction with the first disk and serving to support a second electrode in predetermined position and extending into its central aperture and spaced relation relative to the electrode on the first disk, each disk having countersunk recesses symmetrically disposed around the central aperture to be opposite the rivet holes and to accommodate any rivet heads not flush with or below the associated disk surface, so the disks may be assembled in close surface-to-surface relation without interference from the rivets that anchor the electrodes to the disk.

2. An electrode assembly for a cathode ray tube as in claim 1, comprising additionally a third annular block disk, a tubular shell anchored thereon coaxially with the central aperture, and a cathode within said tubular shell.

3. An electrode assembly as in claim 2 in which each annular block disk is provided with two sets

of symmetrically disposed openings which will be in alignment with those of the other disks in the assembled gun unit, means extending through one set of openings for securing the disks in fixed relation, and the other set of openings being aligned to accommodate supporting posts for the electron gun.

4. An electrode assembly for a cathode-ray tube according to claim 2, wherein the cathode is slidable within a tubular metal member which is secured to the cathode mounting block, and the cathode-proximate surface of the electrode adjacent the cathode is located within the tubular member within which the cathode slides and windows are provided in the tubular member to enable direct inspection of the separation between the proximate surfaces of the cathode and said adjacent electrode.

5. An electrode assembly for a cathode ray tube according to claim 2, wherein the cathode and the first anode are carried on opposite end surfaces of the blocks of the electron gun unit.

6. An electrode assembly for a cathode ray tube according to claim 2, wherein each insulating block has a radial channel in an interface, and the electrical connection to an electrode carried on a block face which is an interface in the assembled electron gun unit is constituted by a conductor accommodated in a channel in one of the block interfaces.

7. An electrode assembly for a cathode ray tube as claimed in claim 2 wherein the electrodes are mounted on the blocks by eyelets (tubular rivets) and the blocks are recessed so that at interfaces the heads of the eyelets are accommodated in the recesses, one head of each eyelet being in the block with which the eyelets are associated and the other head of each eyelet being in the adjacent block.

8. An electrode assembly for a cathode ray tube as claimed in claim 2 wherein the cathode is an indirectly heated hollow body, and supporting means for the cathode including a supporting and surrounding housing at cathode potential, and ceramic washers secured within the housing and serving as thermally insulating supports for the cathode.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,185,807	Gabor et al.	Jan. 2, 1940

FOREIGN PATENTS

Number	Country	Date
519,111	Great Britain	Mar. 18, 1940