March 29, 1949. W. W. MARSH ET AL 2,465,385

ELECTRODE ARRANGEMENT FOR ELECTRON DISCHARGE DEVICES

Filed Oct. 6, 1945

FIG. 1.

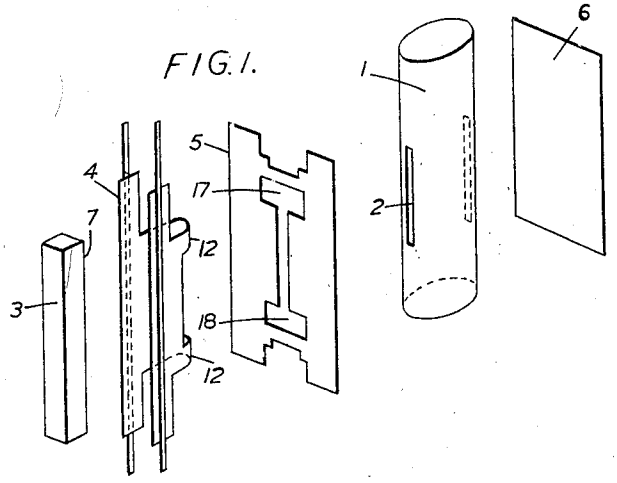



FIG. 2.

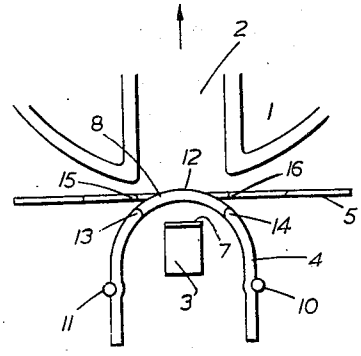



FIG. 3.

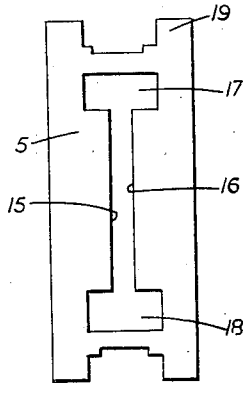



FIG. 4.

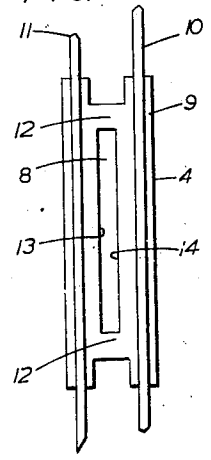
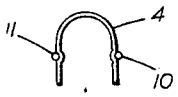



FIG. 5.

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Patented Mar. 29, 1949 2,465,385

# UNITED STATES PATENT OFFICE

2,465,385

## ELECTRODE ARRANGEMENT FOR ELECTRON DISCHARGE DEVICES

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Application October 6, 1945, Serial No. 620,816
In Great Britain September 1, 1944

Section 1, Public Law 690, August 8, 1946
Patent expires September 1, 1964

7 Claims. (Cl. 250—27.5)

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This invention relates to electron discharge devices and is concerned with improvements in the design and construction of electron control electrodes for such devices.

In some kinds of electron discharge devices, particularly those employing the principle of electron velocity modulation, electrodes used for controlling the electron stream take the form of pieces of metal having a suitably shaped aperture or apertures therein instead of the more usual wire grid form. Such electrodes are, however, generally called "grids" for convenience.

In certain of these devices, the spacing between two of these control grids may be extremely small, for example, of the order of two to five thousandths of an inch, and considerable trouble is often experienced from short-circuits between adjacent grids caused by distortion resulting from the heating and cooling which occurs during manufacture and subsequent operation. The principal object of the present invention is to overcome this difficulty by designing the electrodes so that distortion due to heating and cooling does not tend to cause them to touch.

The invention will be described in terms of an embodiment which is an electron velocity modulation device in which a co-axial resonator is excited by directing a beam of electrons of blade-like form through an elongated slot in the resonator. The device is of the kind described generally in United States patent specification No. 2,320,860.

The device is illustrated in the accompanying drawings in which:

Figure 1 shows an exploded view of the part of the device, not including the supporting or fixing means, and showing only the detail necessary to make the invention clear. The manner of assembling and operating the device can follow any suitable known practice;

Figure 2 shows a transverse section of part of Figure 1 to a larger scale with the elements in their proper relative positions;

Figure 3 shows a view of the accelerator grid; and

Figure 4 shows the control grid to the same scale as Figure 3, but before it has been formed into the shape indicated by the sectional view of Figure 5, which is drawn to approximately double the scale of Figures 3 and 4. The scale of Figure 2 is approximately four times that of Figures 3 and 4.

The device comprises a co-axial resonator 1 having in the walls a slot 2 through which is directed an electron beam generated by an electron gun comprising a thermionic cathode 3, a control

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grid 4, and an accelerator grid 5. The electrons after passing through the resonator 1 may be collected on a plate 6. The cathode 3 consists of a metal tube of rectangular cross section containing a heating element (not shown), and coated with emissive material preferably only on the surface 7 which faces the control grid 4. The cathode may take any other suitable form.

In Figure 2, the resonator 1 is only shown fragmentarily to save space, and the collecting plate 6 is not shown at all. This figure is intended to show clearly the details concerned in the invention.

As shown in Figure 4, the control grid 4 is constructed from a metal sheet of generally rectangular form having a longitudinal slot 8 cut out of the centre. Four short lugs 9 are formed at the ends of the sheet and two parallel supporting wires 10 and 11 are welded to the sheet. The sheet is then bent into the semi-circular form shown in the sectional view of Figure 5. In this way there are formed two semi-circular bands 12 at the ends of the slot, which project beyond the edges 13, 14 of the slot 8. This is clearly seen in Figure 2.

The accelerator grid 5 shown in Figure 3 consists of a thin flat metal sheet having a longitudinal I-shaped slot cut in the centre. The edges 15, 16 of this slot are arranged to be adjacent to the edges 13 and 14 of the control grid as shown in Figure 2. The transverse end slot portions 17 and 18 of the I-shaped slot are provided to clear the projecting semi-circular band portions 12 of the control grid 4, so that the edges 15 and 16 may be arranged very close to the edges 13 and 14 as shown in Figure 2. The semi-circular portions 12 project through the slots 17 and 18, and in this way contact between the two electrodes is prevented. Lugs 19 are provided at the ends of the sheet for locating the accelerator grid in the usual mica supports (not shown).

The forming of the control grid 4 by bending it round in the manner explained provides a degree of stiffening which prevents it from bowing inwards or outwards when heated so that it will not tend to come into contact with either of the adjacent electrodes.

The cathode 3, control grid 4 and accelerator electrode 5 may be mounted between two mica sheets (not shown) in the usual way. The wires 10 and 11 pass through corresponding holes in these sheets, and the lugs 19 through slots. It will be noted from Figure 2 that owing to the form of the control grid 4, these holes and slots will be well separated so that there will be no

danger of cracking of the mica between the holes and slots.

The edges 13, 14, 15 and 16 are the effective portions of the corresponding electrodes and have to be spaced apart by a very short distance, perhaps a few thousandths of an inch. It will be seen that the rounded form of the control grid results in a large separation between the two electrodes except just close to the effective edges, and provided the clearance slots 17 and 18 are made sufficiently large, the chances of accidental contact between the electrodes are much reduced. If, further, the spacing between the edges 15 and 16 were made slightly greater than that between the edges 13 and 14, then distortion causing one electrode to move into the plane of the other might even occur without producing any contact.

It will be understood that the invention is not limited to the device which has been used for illustration. It may be employed in any electron discharge device having two adjacent electrodes which are liable to come into accidental contact.

What is claimed is:

1. An electrode structure for an electron discharge device comprising two metal electrodes, one of said electrodes being bent into a substantially cylindrical arc and having an aperture through the curved surface thereof, the other of said electrodes having an aperture therein, said electrodes being mounted with said apertures in alignment and with portions of said aperture lying in the same plane, portions of said electrodes other than the edges of said apertures being removed from each other.

2. An electrode structure for an electron discharge device comprising first and second electrodes, the first of said electrodes being bent into a substantially cylindrical arc and having a slot through the curved surface and also portions extending beyond the plane of said slot, the second electrode having therein an aperture in the form of a slot with clearance areas at the ends of said slot corresponding to said portions of said first electrode, said electrodes being mounted with said slots in alignment and with said portions of the first electrode projecting through said clearance areas.

3. An electrode structure for an electron discharge device comprising first and second sheet metal electrodes, the first of said electrodes being bent into a substantially cylindrical arc and having a longitudinal slot through the curved surface and also portions extending beyond the plane of said slot, the second electrode having therein an aperture in the form of a slot with clearance areas at the ends of the slot corresponding to said portions of the first electrode, said electrodes being mounted with said slots in alignment and with said portions of the first electrode projecting through said clearance areas.



4. An electrode structure according to claim 3 in which said second electrode is provided with an aperture in the form of a slot slightly larger than the slot in said first electrode with clearance areas at the end of the slot corresponding to said portions of said first electrode.

5. An electron discharge device comprising a first grid electrode of substantially semi-cylindrical form having a longitudinal slot cut through the curved surface, a second plane grid electrode having a slot cut therein and mounted adjacent to the convex surface of the first electrode, said two slots being symmetrically opposite one another, the second electrode also having cut therein apertures corresponding to projecting portions of the first electrode so disposed as to permit the said projecting portions to extend through the first electrode without touching it, and electron-emitting means spaced from said first electrode on the side remote from said second electrode for directing a beam of electrons through the said slots.

6. An electron discharge device according to claim 5 in which said electron-emitting means comprises a cathode composed of a hollow metal tube placed inside the first electrode and having an electron emitting area arranged parallel and opposite to the slot in the said electrode, and heater means disposed inside said tube for heating the said tube.

7. An electron discharge device of the electron velocity modulation type according to claim 4 further comprising a co-axial resonator having a transverse slot cut therethrough disposed beyond the said grid electrodes, and collector means arranged adjacent the transverse slot for collecting the electrons after passing through the said resonator.

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