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W. W. EITEL ET AL  
SPACE DISCHARGE DEVICE

2,030,362

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Fig. 1.

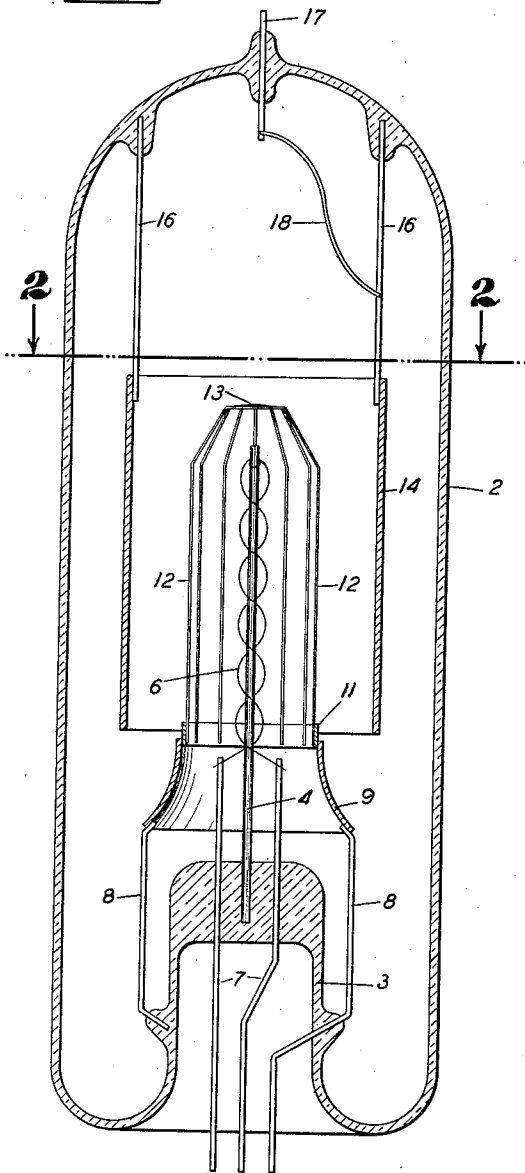


Fig. 2.

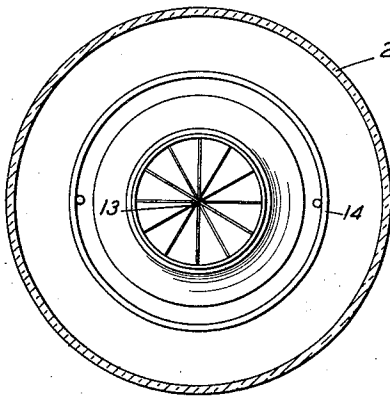


Fig. 3.

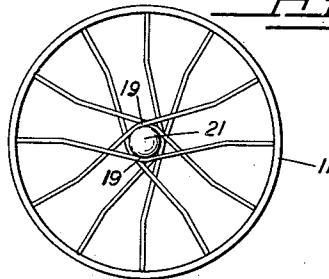
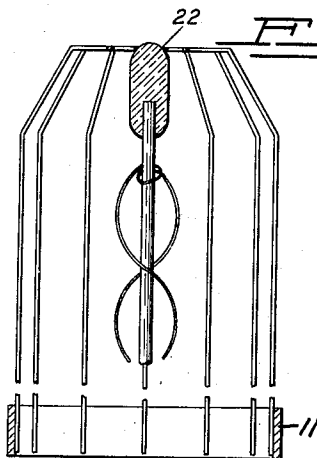


Fig. 4.



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## UNITED STATES PATENT OFFICE

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## SPACE DISCHARGE DEVICE

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5 Claims. (Cl. 250—27.5)

Our invention relates to space discharge devices and particularly to the control element or grid structure for such devices.

One of the objects of our invention is the provision of a self-supporting grid structure.

Another object of our invention is the provision of a grid structure which possesses a high degree of rigidity.

Still another object of our invention is the provision of a grid structure which may be produced expeditiously and economically.

A further object of our invention is to provide a grid having uniform field characteristics and one which minimizes distortion of the electron stream.

Another object is to provide a unique grid mounting.

Other objects of our invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but we do not limit ourselves to the embodiment of our invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawing:

Figure 1 is a vertical sectional view of a space discharge device incorporating the grid structure of our invention.

Figure 2 is a horizontal sectional view taken in a plane indicated by the line 2—2 of Figure 1.

Figure 3 is a plan view of a modified form of supporting means for the grid structure; and

Figure 4 is a vertical sectional view of the structure shown in Figure 3.

Considered broadly, our invention comprises a space discharge device provided with the usual evacuated envelope and containing electrodes suitably mounted therein in cooperative relationship. A third or control element is disposed between the electrodes and comprises a plurality of conductors disposed in spaced relationship about the axis of one of the electrodes, the conductors being fastened to a supporting member at one end, and interconnected at the other.

One of the difficulties encountered in the construction of space discharge devices is the provision of a satisfactory mounting for the control element or grid. Due to its location between the anode and the cathode, it is imperative that the mounting be sufficiently rigid to prevent vibrational movement of the grid proper so as not to cause fluctuating variations in grid to anode capacity which would disturb the balance of the circuits in which the device was operating.

For this reason it is the usual practice to provide the grid with a frame comprising a plurality

of wires suitably anchored or fastened in the tube stem and which serve to support the grid rigidly. The presence of these wires necessarily means that the spacing of the various cooperating elements must be increased to allow room for the supports. These supports also tend, by the large surface exposed, to increase the grid to anode capacity, and at the same time cause an obstruction to the electron flow which causes blank spots, or shadows, on the anode on which few electrons fall. Other portions of the anode may also become overcrowded and overheat.

The improved grid structure of our invention removes these objections; the only wires present being those which actually function as members of the control element. This removal of the support wires allows the elements to be spaced in such relationship as to provide a space discharge device possessing greatly improved characteristics, and provides uniform current densities on the anode.

In greater detail the space discharge device of our invention comprises an evacuated envelope 2, provided at one end thereof with the stem 3. A rod 4 of heat resistant material is secured in the stem and serves as a support for the electron emitting element or filament 6. Leads 7 are provided which are secured to the free ends of the filament and are brought out through the stem adjacent the rod 4.

Secured in the stem are a plurality of risers 8 which carry a ring 9 comprising the supporting base for the grid structure. The grid structure is made up of a metallic band 11 suitably secured, as by means of spot welding, to the ring 9. This band has a plurality of wires 12 secured thereto and extending upwardly so as to lie in spaced radial relationship about the filament 6. The upper ends of the wires 12 converge for a distance and are preferably crossed at a point and secured together by welding.

An anode 14 is provided, which surrounds the grid and filament elements; and supports 16, secured in the envelope 2 and to the anode, are provided for holding the anode in position. A terminal 17, passing through the envelope at the top thereof is connected by a lead 18 to one of the anode supports.

While the grid structure as shown in Figure 1 is self-supporting, it is desirable, in some cases, to provide additional support for this element. Figures 3 and 4 illustrate a means for providing a maximum of rigidity. The wires 12 are disposed as shown in Figure 1 except that where they cross at the top each wire is provided with an

offset portion 19 which, together, provide an aperture 21. The support rod 4 is provided with an insulating projection or bead 22 which is adapted to seat in the aperture, thereby adding the rigidity of the rod to that of the grid structure.

The specific form of grid structure just described possesses marked superiority over the usual types of grid construction in simplicity and ease of construction, in stability against vibrations and in lending itself to improved design of all types of electronic operated devices.

It is to be understood that, while the grid structure of our invention is shown as being incorporated in the familiar form of three-element vacuum tube, our device may be incorporated in any type of device where the control of electron flow is desirable.

We claim:

1. A space discharge tube comprising an envelope having a reentrant stem, a concentric anode, cathode and control electrode contained therein and mounted to have axes common with that of said stem, and support means for said control electrode consisting solely of a plurality of spaced conductive risers separately fused directly to the side wall of said stem.

2. A space discharge tube comprising an envelope having a reentrant stem, a concentric anode, cathode and control electrode contained therein and mounted to have axes common with that of said stem, and support means for said control electrode consisting solely of a plurality of spaced conductive risers separately fused directly to the side wall of said stem, said risers being inserted in the same plane and in equal spaced relationship around said side wall.

3. A space discharge tube comprising an envelope having a reentrant stem, a concentric anode, cathode and control electrode contained therein and mounted to have axes common with that of said stem, and support means for said control electrode consisting solely of a plurality of spaced conductive risers separately fused directly to the side wall of said stem, at least one of said risers passing completely through said side wall at the point of fusion to form an outside connection for said control electrode.

4. A space discharge device having an evacuated envelope and cooperating electrodes therein including a cathode elongated longitudinally of said tube and positioned substantially in the axis thereof, a control electrode enclosing said cathode consisting of a ring support, and a plurality of hairpin-shaped wires having the open ends thereof fastened to said support, and the bends thereof crossing at substantially said axis, said bends being fastened together at said crossing.

5. A space discharge tube having an envelope, an axial cathode therein, an anode surrounding said cathode and a grid concentrically positioned between said anode and cathode, said grid consisting solely of a plurality of hairpin-shaped wires disposed to describe a cylinder and a ring support therefor, the open ends of said hairpins being welded to said support, and the bends crossing and contacting each other above said cathode at said crossing, said bends being fastened together to maintain the straight runs of said hairpins in spaced relation.

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