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W. W. EITEL ET AL

2,430,218

ELECTRON TUBE WITH SECONDARY EMISSIVE GRID

Filed March 21, 1944

2 Sheets-Sheet 1

Fig. 1

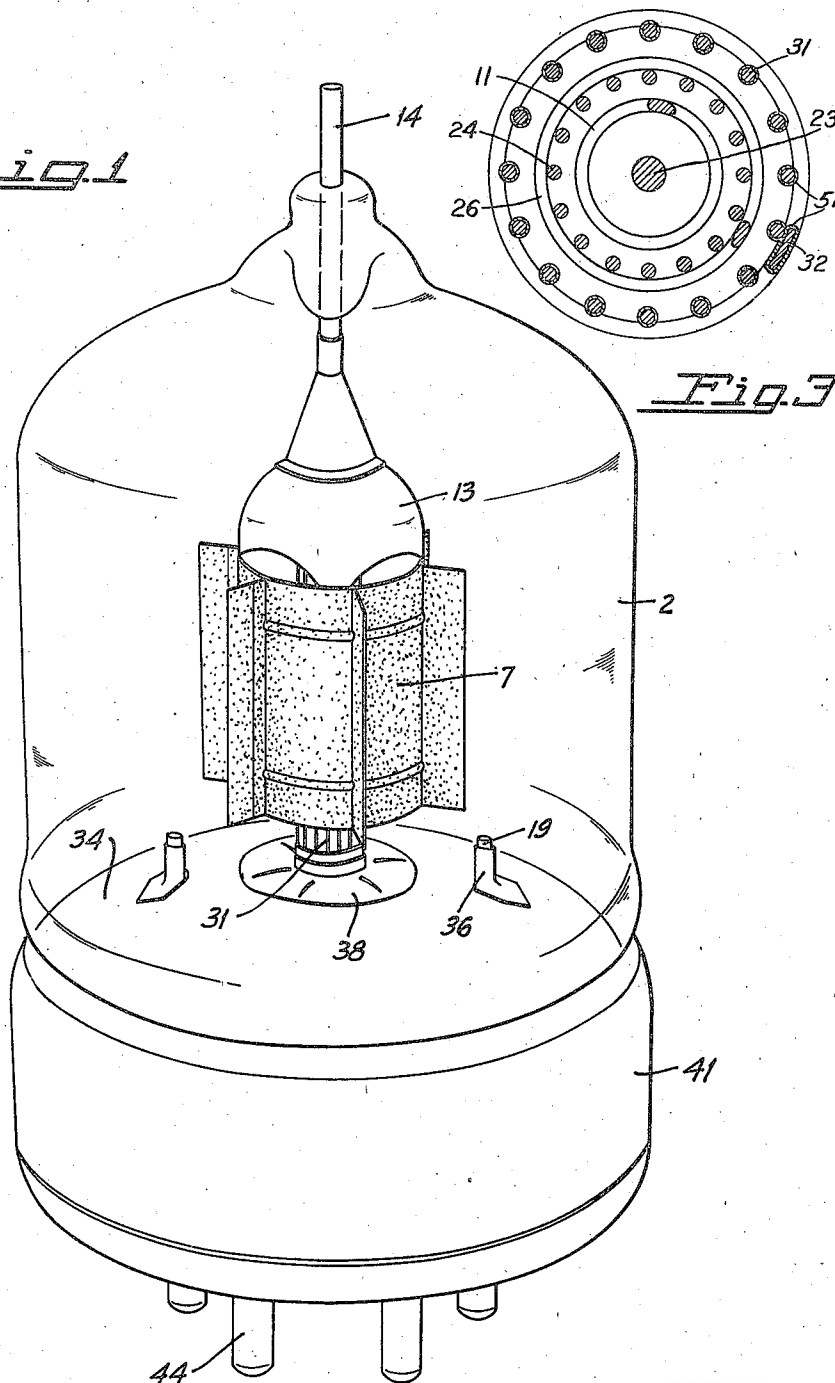


Fig. 3

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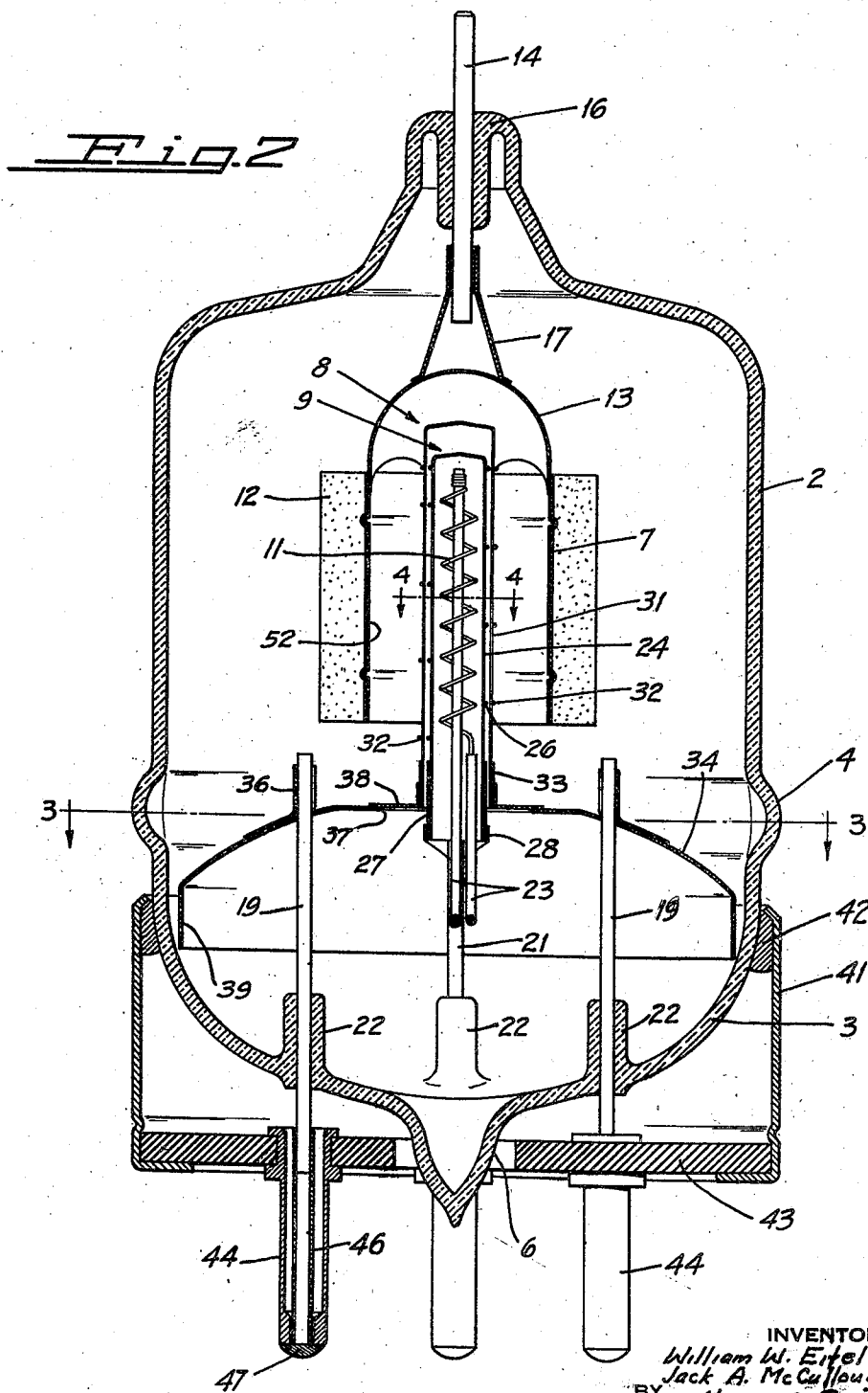
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ELECTRON TUBE WITH SECONDARY
EMISSIVE GRID

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Application March 21, 1944, Serial No. 527,474

3 Claims. (Cl. 250—27.5)

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Our invention relates to multi-grid tubes and more particularly to tetrodes.

An object of our invention includes the provision of an improved combination of electrodes having special properties with regard to electron emission.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of our invention. It is to be understood that we do not limit ourselves to this disclosure of species of our invention as we may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawings:

Figure 1 is a perspective view of a tube embodying the improvements of our invention; and

Figure 2 is a vertical sectional view of the same.

Figure 3 is an enlarged detail sectional view showing the cathode and grids, taken in a plane indicated by line 4—4 of Figure 2.

In terms of broad inclusion, our tube comprises a sectional envelope, a tubular anode in the envelope, a seal joining the envelope sections in a plane transverse to the axis of the anode, conductor means connected to the anode and supported by a section of the envelope lying at one side of the sealing plane, a cathode and pair of grids extending within the anode, and conductor means connected to the cathode and grids and supported by a section of the envelope lying on the opposite side of the sealing plane. The two grids, functioning as control and screen grids, are interposed between the cathode and plate with the elements of one grid radially aligned with those of the other grid. The electrical characteristics of our multi-grid tube are further improved by incorporating electrodes having special properties regarding electron emission.

In greater detail, and referring to the drawings, our tube comprises a vitreous envelope of glass or the like having an upper section 2 and a lower section 3 fused together along a seal 4 in a plane transverse to the longitudinal axis of the envelope. Prior to sealing together, the envelope sections are cup-shaped, each having an open end for convenience in assembling the internal parts. Exhaust tubulation 6 is preferably arranged at the center of the lower section.

The multi-grid tube illustrated is a tetrode having four electrodes including an anode 7, screen grid 8, control grid 9 and cathode 11. These electrodes are concentric about an axis lying normal to the plane of seal 4. Anode 7 is tubular in form, preferably cylindrical, with heat

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radiating fins 12. It is open at the bottom and preferably closed at the top by a cap 13 welded to the rim. This cap protects the upper end of the envelope against bombardment and also functions as part of the mounting for the anode.

Anode 7 is mounted on a lead-in conductor or lead 14 sealed to and supported by upper envelope section 2 at seal 16. This lead projects into the envelope along the axis of the electrodes, terminating short of cap 13. A conical bracket 17 completes the support and has its diverging end welded to cap 13 and its converging end welded to lead 14.

The remaining electrodes are all supported by lower envelope section 3. As shown in Figures 2 and 3, cathode leads 18, screen grid leads 19 and control grid lead 21 are vertically disposed in a circle projecting into the lower end of the envelope through seals 22. Leads 19 are spaced on opposite sides of center and control grid lead 21 is arranged opposite cathode leads 18.

Cathode 11 may be of any suitable type or construction, but preferably comprises a helical filament of thoriated tungsten wire secured at top and bottom to conductive supports or brackets 23. These brackets have upturned arms terminating adjacent the end of the filament and outturned legs welded to the ends of cathode leads 18.

Control grid 9 is preferably of cage-type construction comprising longitudinal or vertical wire bars 24 held by a helical wire winding 26, which grid elements terminate in a base ring 27. This inner grid projects into the anode along with the cathode and is supported by a strap 28 welded to base ring 27 and to an angle bracket 29 which in turn is welded to lead 21.

Screen grid 8 is also of cage-type construction comprising longitudinal bars 31 held by a helical winding 32, which grid elements terminate in a base ring 33. Mounting for this outer grid is provided by a metallic shield member 34 secured to leads 19 by bracket pieces 36 and having a central aperture 37 registering with grid ring 33. A collar 38 welded to the shield and to ring 33 connects these parts.

Shield 34 extends transversely of the electrodes and is substantially coextensive with the cross-sectional area of the envelope. It is preferably shaped like an inverted pan with a peripheral flange 39 spaced close to the inner surface of the envelope. By this arrangement the conductors in the lower part of the tube are effectively shielded from the anode.

The base for the tube comprises a metallic ring 41 secured to the envelope by cement 42 and car-

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rying an insulating disk 43 from which prongs 44 project. These depending prongs are coaxially aligned with the leads and are hollow to receive lead extension sleeves 46 which are soldered to the prong tips at 47. This basing provides a compact arrangement with short direct connections from the prongs to the leads entering the envelope.

Still another feature of our invention is that screen grid 8 is non-emissive; this property being preferably obtained by a protective layer or coating 51 to eliminate primary and secondary electron emission. The coating is preferably formed by making the electrode of a tantalum-tungsten alloy and treating the same to produce on the surface a layer including tantalum and tungsten and oxygen, in accordance with the teachings in our copending application Serial No. 527,294, filed March 20, 1944. A non-emitting screen grid has special significance in a multi-grid tube. Secondary emission (electrons knocked out by impact) is usually the worst offender, because this occurs even if the grid is operating cold enough to alleviate primary (thermionic) emission. Eliminating electron emission from the screen grid materially improves the electrical characteristics of the tube for certain kinds of service, since no electrons can flow from the screen grid to other electrodes. In this combination the control grid 9 is preferably of a material, such as platinum, which exhibits secondary emission; secondary electrons from the control grid being desirable because it adds to the plate current. Plate 7 may be of any suitable material, such as tantalum.

In certain cases it is also desirable to provide a protective coating 52 on the inside of anode 7. The absence of primary and secondary electrons from the anode also has special significance in a multi-grid tube, as it eliminates the need of a suppressor grid. In other words, the tetrode has the characteristics of a pentode. A non-emitting anode also eliminates negative resistance effects in the tube. In this case the plate is preferably made of a tantalum-tungsten alloy and treated in

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accordance with the teachings of our above mentioned application.

We claim:

1. A tetrode comprising an anode, a cathode, a control grid, and a screen grid, the control grid having better secondary electron emissive properties than said screen grid.
2. A tetrode comprising an anode, a cathode, a control grid, and a screen grid, the control grid being secondary electron emissive and the screen grid being substantially non-emissive.
3. A tetrode comprising an anode, a cathode, a control grid, and a screen grid, the control grid being secondary electron emissive and the screen grid being resistant to emission of both primary and secondary electrons.

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