June 25, 1946. S. H. DODINGTON 2,402,612

ELECTRON DISCHARGE DEVICE

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Fig. 1.

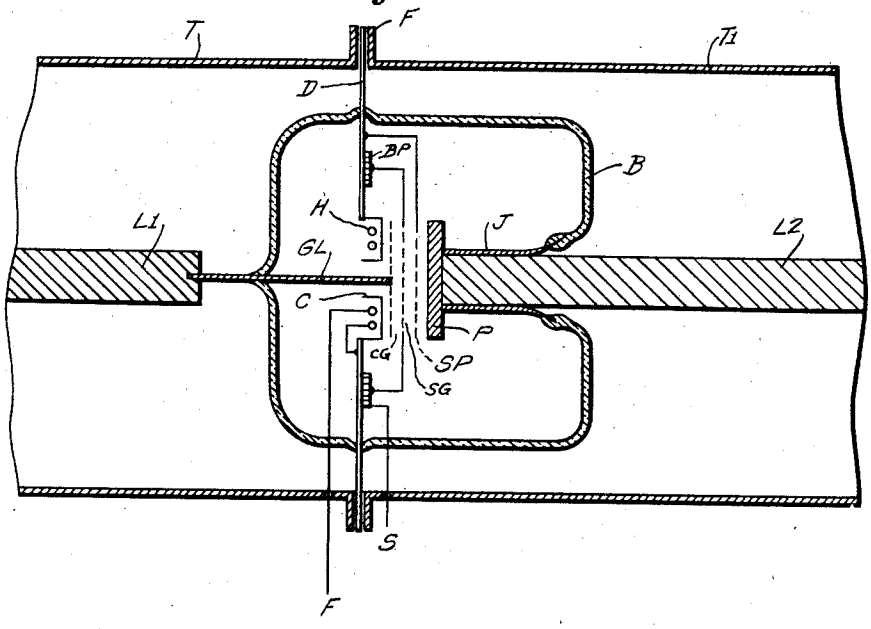
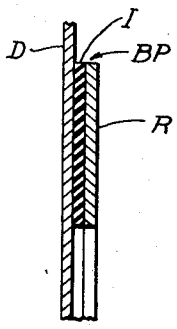


Fig. 2.



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ELECTRON DISCHARGE DEVICE

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11 Claims. (Cl. 250—27.5)

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This invention relates to high frequency electron discharge devices, and more particularly to such devices of the kind which are mounted between two lengths of concentric transmission line.

An object of the invention is the provision of a high frequency multi-grid electron discharge device which, while simple in construction and stable in operation, results in a substantial gain per stage over a considerable bandwidth.

Further objects of the invention are the reduction or substantial elimination of lead inductance insofar as the high frequency circuits are concerned, and the substantially complete isolation of plate and grid circuits without resort to external bypass condensers.

According to the invention, an annular cathode is provided which is secured to or integral with an annular mounting disc, the periphery of which is sealed between two portions of the glass envelope and projects beyond its outer wall. The projecting edge of the mounting disc is secured between the abutting ends of the outer tubular conductors of two sections of concentric transmission line which respectively form part of the grid and plate circuits. The plate electrode is mounted upon a copper sleeve which is connected by a seal to a reentrant portion of the glass envelope, through which sleeve the central conductor of the plate section of transmission line extends to make direct contact with the plate electrode. In the embodiment described the device is constructed as a pentode, the control grid being connected to the inner conductor of the grid section of transmission line and the screen grid to the cathode mounting disc over a bypass condenser located inside the envelope. The suppressor grid is connected directly to the cathode mounting disc inside the envelope.

In the drawing which accompanies and forms part of this specification:

Fig. 1 is a longitudinal cross-section of a device constructed according to the invention; and

Fig. 2 is a partial, enlarged cross-sectional view of a detail of construction.

The cathode C consists of an annular channelled ring which is integral with or bonded to a large disc D, for example of copper, fused between two sections of the glass envelope B. The periphery of the disc D extends beyond the glass envelope B and is welded or otherwise secured between flanges F on the outer tubes T, T_1 of the concentric line sections. The disc D thus constitutes the earth return of the concentric line sections and is therefore a part of both grid and plate circuits, but its reactance even at relatively

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high frequencies will not be excessive. The cathode heater H is located in the channel at the rear of the cathode, one end being connected to the disc D and the other end to a supply lead F which is brought out through the glass envelope B and the tube T as close to the disc D as possible.

The plate electrode P, which comprises a thick disc located in a plane parallel to that of the cathode disc D, is welded to a copper tube or sleeve J which is joined to a reentrant portion of the glass envelope B through a copper-to-glass seal. The end central conductor L_2 of the plate circuit transmission line section extends into the tube J and is in direct contact with the plate P.

Between the cathode C and plate P there are mounted in any suitable manner and in parallel planes transverse to the axis of the structure, a control grid CG, a screen grid SG and a suppressor grid SP. A lead GL for the control grid CG extends through the central aperture in the cathode and is brought out through the envelope and is connected to the central conductor L_1 of the grid circuit transmission line section. As is more clearly shown in conjunction with Fig. 2, the screen grid SG is connected to an annular plate or ring R which is separated from the cathode disc D by a layer of dielectric I so as to constitute a bypass condenser BP for the screen grid. The supply lead S for the screen grid passes through the outer tube T_1 of the plate transmission line section as close to the cathode disc D as possible. The suppressor grid SP is tied directly to the cathode disc D at one or more points inside the envelope. As the majority of the plate capacity is to the suppressor grid, this ensures that the circulating alternating plate current will flow through a minimum impedance common to the grid and plate circuits.

Although one embodiment of the invention has been shown and described for the purpose of illustration, it will be understood that modifications and alterations occurring to those skilled in the art may be made without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. An electron discharge device for the amplification of high frequency waves comprising a first section of concentric transmission line, a second section of concentric transmission line, a glass envelope, an annular cathode connected to an annular disc which is sealed between two portions of said glass envelope and projects beyond the outer wall of said envelope, an anode, a control grid, a screen grid and a suppressor grid

mounted between said cathode and said anode in different planes parallel to the plane of said cathode and anode and transverse to the axis of said sections of transmission line, said cathode, grid and anode electrodes being disposed within said envelope, means securing the projecting edge of said annular disc between abutting ends of the outer tubular conductors of the first and second sections of transmission line, a galvanic connection inside the envelope from said suppressor grid to said annular disc, a conductor lead extending from said control grid through one end of said envelope to the central conductor of said first section of transmission line, and a direct connection between said anode and the end of the central conductor of said second section of transmission line.

2. An electron discharge device according to claim 1 wherein a by-pass condenser for said screen grid is provided within said glass envelope.

3. An electron discharge device comprising a glass envelope, an annular metallic disk, an annular cathode connected to said disk which is sealed between two portions of said glass envelope, an anode disposed in a plane parallel to the plane of said cathode, first and second grid electrodes disposed between said cathode and said anode, said cathode, grid and anode electrodes being disposed within said envelope, a metallic plate inside said envelope adjacent said metallic disk and separated from it by a layer of dielectric, and a conductive connection extending from said second grid electrode to said metallic plate.

4. An electron discharge device comprising a glass envelope, an annular metallic disk, an annular cathode connected to said disk which is sealed between two portions of said glass envelope, an anode disposed in a plane parallel to the plane of said cathode, three grid electrodes disposed between said cathode and said anode in planes parallel to the plane of said cathode, said cathode, grid and anode electrodes being disposed within said envelope, and a direct conductive connection within said glass envelope extending between said annular metallic disk and the grid electrode nearest the anode.

5. An electron discharge device comprising a glass envelope, an annular metallic disk, an annular cathode connected to said disk which is sealed between two portions of said glass envelope and projects beyond the outer wall of said envelope, an anode disposed in a plane parallel to the plane of said cathode, a grid electrode disposed between said cathode and said anode, said cathode, grid and anode electrodes being disposed within said envelope, a first section of concentric transmission line, a second section of concentric transmission line, means securing the projecting edge of said metallic disk between abutting ends of the outer tubular conductors of the first and second sections of concentric transmission line, a conductive lead connected to said grid electrode and extending through the central aperture of said cathode and through the glass envelope to the central conductor of said first section of transmission line, and a conductive connection between said anode and the central conductor of said second section of transmission line.

6. An electron discharge device according to claim 5, further comprising a metal tube, wherein said anode is secured to said metal tube which is sealed to a re-entrant portion of said glass envelope, said central conductor of said second section of transmission line extending into said tube and being in direct electrical contact with said anode.

7. An electron discharge device according to claim 5, further comprising a metal tube, wherein said anode is secured to said metal tube which is sealed to a re-entrant portion of said glass envelope, said central conductor of said second section of transmission line extending into said tube and being in direct electrical contact with said anode, a second grid electrode disposed between the first grid electrode and said anode, a metallic plate inside said envelope adjacent said metallic disk and separated from it by a layer of dielectric, and a conductive connection extending from said second grid electrode to said metallic plate.

8. An electron discharge device according to claim 5, further comprising a metal tube, wherein said anode is secured to said metal tube which is sealed to a re-entrant portion of said glass envelope, said central conductor of said second section of transmission line extending into said tube and being in direct electrical contact with said anode, a second grid electrode and a third grid electrode disposed between the first grid electrode and said anode at different distances from said cathode, and a direct conductive connection within said glass envelope extending between said annular metallic disk and the grid electrode nearest the anode.

9, The combination according to claim 1, in combination with a metal ring parallel to and spaced from said disk, a dielectric layer intermediate said disk and ring, whereby the latter form a condenser between them, and means electrically interconnecting said screen grid to said metal ring.

10. An electron discharge device comprising a glass envelope, a metallic disk extending across and sealed between two portions of said envelope, a cathode having a plane electron emitting surface, supported by said disk within said envelope, an anode having a plane surface, means supporting said anode within said envelope with its plane surface parallel to and spaced from the plane surface of the cathode, first and second grid electrodes, means supporting said grid electrodes intermediate said cathode and anode, a metallic ring in said envelope spaced from and parallel to said metallic disk, a layer of dielectric material intermediate said metallic ring and said metallic disk, whereby said ring and disk form a condenser within the envelope, and means electrically interconnecting said second grid with said metallic ring.

11. An electron discharge device comprising a glass envelope, a metallic disk extending across and sealed between two portions of said envelope, a cathode having a plane electron emitting surface, supported by said disk within said envelope, an anode having a plane surface, means supporting said anode within said envelope with its plane surface parallel to and spaced from the plane surface of the cathode, three grid electrodes longitudinally spaced from one another and positioned intermediate said cathode and anode, and means within said envelope electrically interconnecting that grid electrode nearest the anode with said metallic disk.

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