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2,391,927

ELECTRON DISCHARGE DEVICE

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Fig. 1.

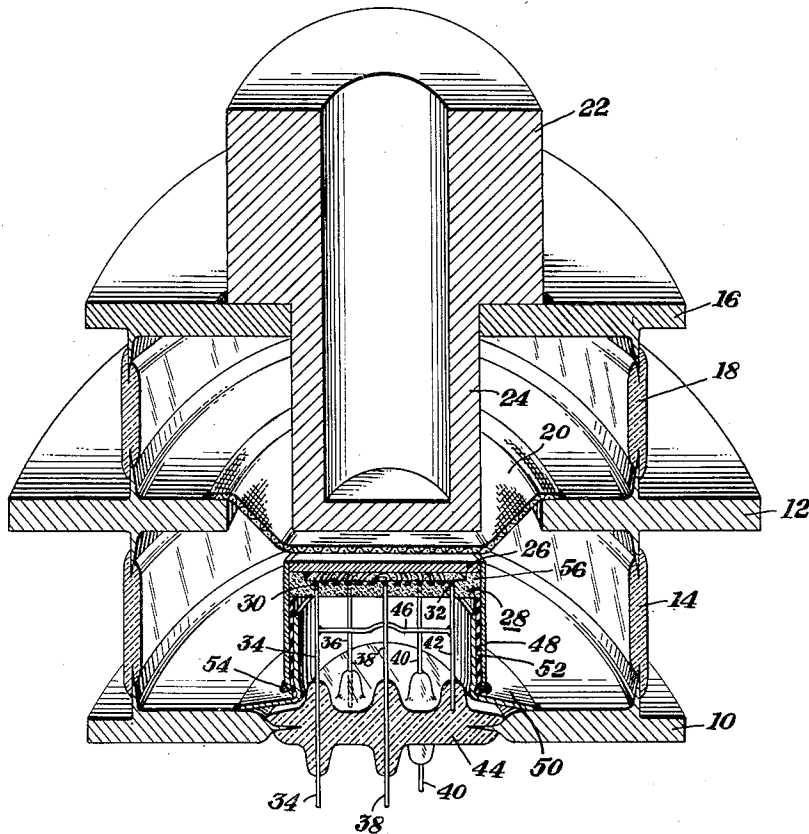


Fig. 2.

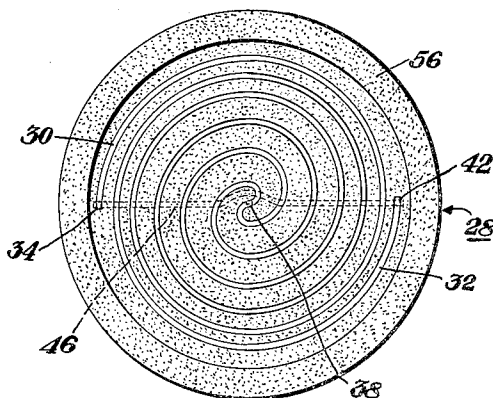
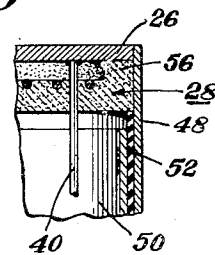


Fig. 5.



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ELECTRON DISCHARGE DEVICE

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6 Claims. (Cl. 250—27.5)

This invention relates to improvements in electron discharge devices, and more particularly to a vacuum tube structure adapted to operate at high frequencies.

An object of this invention is to provide an improved ultra-high frequency triode.

Another object of this invention is to provide a more compact ultra-high frequency, high power vacuum tube than heretofore proposed.

A further object of this invention is the provision of a vacuum tube with an improved hollow anode structure.

An additional object of this invention is to provide an improved indirectly heated cathode structure for electron discharge devices.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed.

The invention has been illustrated in its preferred embodiment in the accompanying drawing wherein:

Fig. 1 is a vertical cross-sectional view in partial perspective of a preferred embodiment of a vacuum tube in accordance with the present invention;

Fig. 2 is an enlarged top plan view of the cathode heater structure shown in Fig. 1; and

Fig. 3 is a partial enlarged cross-sectional view of a detail of the cathode structure.

In the preferred embodiment of the present invention illustrated in the drawing, the tube is built up on a metal base 10 in the form of a disk having an opening in its center. A second metal disk 12 also having an opening in its center is spaced from the disk 10 by means of an insulating annulus 14, which may be glass sealed to suitable extensions on the two disks. A third disk 16 also having a hole in its center is spaced from and supported by the disk 12 by a second insulating annulus 18, which also may be formed of glass and sealed to extensions on the two disks in a manner known to the art.

About the central opening in the disk 12 is placed a screen forming a grid 20, while over the central opening of the disk 16 is placed a hollow metal cylinder 22 having a closed cylindrical extension 24 passing through the opening, the bottom of this extension being spaced adjacent to the grid 20 to form the active anode surface. The main part of the cylinder 22 is sealed to the outer surface of the disk 16, and it will be seen that this cylinder, together with the disk 16, the glass portion 18, the width of the disk 12 and the glass por-

tion 14, form part of the vacuum tube envelope. Below the grid structure 20 is positioned the cathode in the form of a metal disk 26 coated with some suitable emissive material and resting on a ceramic or other insulating plate 28. This plate may have imbedded in it a pair of heater coils 30 and 32, spirally interwound, as more clearly indicated in Fig. 2. A lead 34 may be connected to the outer end of the coil 30, a common lead 38 to the center common point of the two heater wires, and lead 42 to the outer end of the heater coil 32. The leads 34 and 38 pass through an insulating support 44 sealed within the central opening of the base disk 10 and serve, at the same time, to support the ceramic plate and its superimposed cathode disk 26 in proper spaced relation with the grid 20. Other wires such as 36 may be used to give additional support but they need not pass through the insulating base 44. As seen in Fig. 3, still another lead wire 40 passing through the insulating base 44 may pass upwardly through the ceramic plate 28 and make contact with the metal disk 26 to afford a D. C. cathode lead. The two outer ends of the heater wires 30 and 32 may be interconnected by any suitable means such as a transverse lead wire 46, which then effectively connects the two heater filaments in parallel. The metal disk 26 is preferably supported out of contact with the heater wires, as by the annular ring 56 on the upper surface of the ceramic plate, and may be attached to this rim in any suitable manner (not shown).

Depending from the periphery of the metal disk 26, I provide a cylinder 48 of some suitable metal foil which, if the device is to be used with high or ultra high frequencies, may be spaced from a flanged metal sleeve 50 by a cylinder 52 of mica or other insulating material. The flanged portion of the sleeve 50 may be welded or otherwise attached to the metal base 10, the aforedescribed construction thus forming between the cathode 26 and this metal base a series condenser structure. Means such as a spring ring 54 may be used to press the foil 48 against the insulating sleeve and the attached metal sleeve.

A vacuum tube constructed in the manner described above will be relatively simple of manufacture, will be compact and provides a design which readily lends itself to high frequency operation. The anode structure provides not only a peripheral surface for use with a coaxial line element but also a central space which may receive a lead in the form of a removable plug. Of course, the outer surface of the main cylindrical portion 22 may be finned or otherwise broken up

to provide for additional anode cooling. The grid and cathode disks also lend themselves to ready connection with coaxial line structures. The use of metal foil 48 provides a simple built-in condenser structure, and at the same time this metal foil will not tend to conduct heat away from the cathode disk 26. No cathode shell giving rise to possible undesired capacitances is necessary, and attention is also directed to the fact that by reason of the heater construction, the maximum amount of cathode heat can be supplied with a minimum of loss. The heater structure may be most advantageously utilized if the heater coils, as more clearly shown in Fig. 2, are wound with a closer spacing near the periphery of the cathode disk, where heat losses would be greater, than near the center. If the internal condenser structure between the cathode and the outer disk 10 is not desired, the metal foil 48 may be readily galvanically connected thereto as will be obvious to those skilled in this art. The exhaust tube (not shown) may be formed in either of the annular envelope portions or in through the bottom seal.

Accordingly, while I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. Electron discharge device comprising three longitudinally spaced-coaxial disks each having a hole in its center, a first annulus of insulating material sealed between and spacing two of said disks, a second annulus of insulating material sealed between and spacing one of said two disks and the third disk, a grid covering the opening in the center disk, a hollow metal cylinder having an elongated closed end of smaller diameter than said cylinder covering the opening in one of the outer disks with its closed end adjacent to but spaced from one side of said grid, means sealing the opening in the other outer disk, a cathode adjacent to but spaced from the other side of said grid, and means supporting said cathode from said sealing means, said cathode comprising an insulating disk, heating coils imbedded in said insulating disk, and a metal disk supported on

said insulating disk, and said cathode-supporting means comprising lead wires attached to said heating coil and to said metal disk and extending outwardly through said sealing means.

2. Electron discharge device comprising three longitudinally spaced, coaxial disks each having a hole in its center, a first annulus of insulating material sealed between and spacing two of said disks, a second annulus of insulating material sealed between and spacing one of said two disks and the third disk, a grid covering the opening in the center disk, anode means closing the opening in one of the outer disks and adjacent to but spaced from one side of said grid, means sealing the opening in the other outer disk, an insulating plate, heating coils carried by said plate, a metal disk carried by said plate but out of direct contact with said heating coils, and lead wires attached to said heating coil and metal disk and extending outwardly through said sealing means supporting said metal disk and insulating plate adjacent to but spaced from the other side of said grid.

3. The combination according to claim 2, in combination with a cylinder of metal foil attached at one end about the periphery of said metal disk and extending toward said other outer disk.

4. The combination according to claim 2, in combination with a cylinder of metal foil attached at one end about the periphery of said metal disk, and means coupling said cylindrical foil to said other outer disk.

5. The combination according to claim 2, in combination with a cylinder of metal foil attached at one end about the periphery of said metal disk, and capacitative means coupling said cylindrical foil to said other outer disk.

6. The combination according to claim 2, in combination with a cylinder of metal foil attached at one end about the periphery of said metal disk and extending toward said other outer disk, a metal cylinder attached at one end to said other outer disk and extending toward said insulating plate inside of said cylindrical foil, an insulating cylinder intermediate said cylindrical foil and said metal disk, and means pressing said cylindrical foil against said insulating cylinder and metal cylinder forming with them a condenser between the metal disk and said other outer disk.

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