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W. G. WAGENER
ELECTRON DISCHARGE DEVICE
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Fig. 1

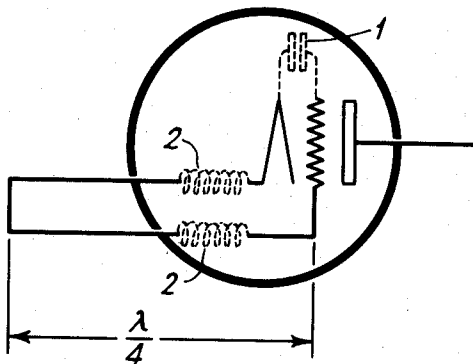


Fig. 2

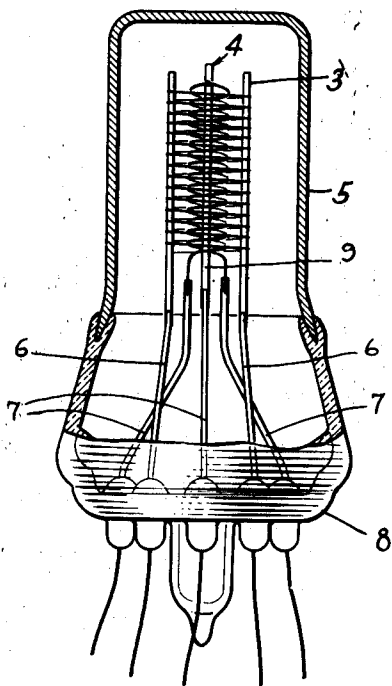
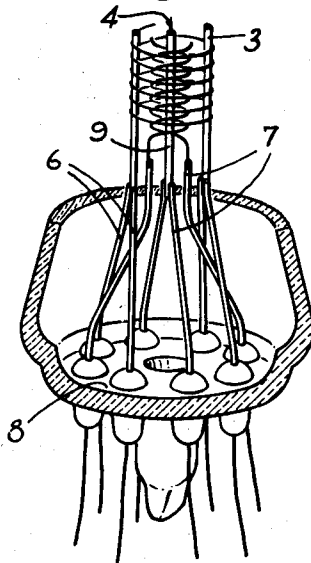


Fig. 3



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ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—27.5)

My invention relates to electron discharge devices for use in circuits of ultra-high frequency, such as 50 megacycles and above.

External circuits of tubes of conventional construction tuned to resonate at ultra-high frequencies are too short for convenient use, and it is particularly difficult to so neutralize undesirable voltages on the electrodes as to obtain stable operation of the tubes.

An object of my invention is to make tubes that are stable in operation and with proper electrical characteristics to make connected resonant circuits of convenient physical length.

The circuits connected to tubes constructed according to my invention may be tuned in the usual way by adjusting the length of the circuits to one-quarter wavelength of the operating frequency, and I have found that the objectionable effects of high inter-electrode capacity and of the usual lumped inductance in the electrode leads may be obviated so that high capacitance and inductance within the tube becomes a sufficiently small portion of the connected circuits as to make it feasible to materially elongate the circuit exterior to the envelope. Further, by decreasing the electrode lead inductance of tubes constructed according to my invention connection of neutralizing circuits to the tube may be simplified and the operation of the tube stabilized.

My invention is defined with particularity in the appended claims and one embodiment is described in the following specification and the accompanying drawing in which

Figure 1 is a diagrammatic representation of a conventional triode and its input circuit;

Figure 2 is a view in section of an electron discharge device constructed according to my invention; and

Figure 3 is a detailed view of the lead-in conductors arranged according to my invention.

In Figure 1 is shown diagrammatically a triode with an input circuit one-quarter wavelength long. The fixed capacity between the cathode and grid is diagrammatically represented by condenser 1, and the inductance in the leads has been represented by coils 2. The relatively large capacitance and inductance in the input circuit introduced by inter-electrode capacity and the lumped inductance in the leads of a tube of conventional construction becomes a considerable proportion of the total of the input circuit, so that the physical length of the circuit exterior to the envelope at ultra-high frequencies becomes too short for convenient use.

To increase the physical length of the quarter

wavelength input circuit I propose according to my invention to reduce the lead inductance 2, and so to reduce the effect of inter-electrode capacity on the input circuit. The inductance 2 may be reduced by bringing the grid and cathode leads closer together, the reduction in the inductance being approximately proportional to the capacity between the leads. The small size of the leads and the minimum spacing imposed by voltage insulation, however, limits the amount of capacity that may be obtained between the leads of conventional tubes. According to my invention leads to two electrodes in a circuit, such as the grid lead and the cathode lead in the input circuit, are divided or stranded into a number of separate conductors and the separate conductors of the two electrodes are interspersed so that each conductor of one electrode is positioned or interposed between two conductors of the other electrode. The conductors 6 connected to the grid 3 and the conductors 7 connected to cathode 4 in the metal envelope, and anode, 5 shown in Figure 2 may conveniently be arranged in a circle, and sealed into a round press 8 as shown in detail in Figure 3. Conductors to the grid alternate, around the circle, with conductors to the cathode. For the triode shown, the conductors to the grid may conveniently be four in number, with two connected to and supporting each grid side rod, and two of the four conductors to the cathode may be connected to the center support rod 9 of the cathode, the remaining two conductors being connected in parallel to the ends of the helical cathode wires.

Alternating current of ultra-high frequency flowing to the grid through the multi-conductor grid lead finds the return circuit in the multi-conductor cathode lead to be juxtaposed in close spaced relationship. Not only is the inductance in the grid and cathode leads reduced to a minimum by their close spaced relationship but the electromagnetic and electrostatic fields of the individual leads are isolated one from the other by the interposed conductors of the opposite side of the circuit.

I have constructed a tube similar to the tube shown in Figure 2 with the anode one-half of an inch in diameter, control grid 3, helically wound, 0.220 inch in diameter, and a double helical cathode 4 0.163 inch in diameter and designed for 3.83 amperes of heating current. When the grid was connected to four lead-in conductors, as shown in Figure 4, and the cathode was connected to four lead-in conductors, the four cathode conductors being evenly divided in the two

sides of the direct current filament circuit, the inductance was found to be about .004 microhenries. The inductance of a single conductor to the grid and to the cathode would be .02 microhenry.

Current flowing to the grid electrode to charge the inter-electrode capacities produces in a conventional tube a voltage drop across the inductance 2 in the grid lead. This voltage drop removes the grid from its source of driving voltage by the amount of the drop and renders the operation of the tube unstable. This voltage drop cannot be neutralized in the usual way because the neutralizing connection can be made to the grid element only through this lead inductance 2. By eliminating inductance 2, stable operation is insured. Another advantage of multiple grid leads disposed according to my invention is that part of the grid leads may be used for the input circuit and the remaining grid leads connected in the neutralizing circuit in such a way as to separate the charging currents so that common voltages built up in the lead inductances do not appear jointly in the output and input circuits. While the grid has been shown connected to four lead-in conductors and the cathode to a similar number of conductors, it is within the scope of my invention to connect the grid and cathode with any desired number of conductors. Preferably the grid conductors equal the number of cathode conductors so that two sets of conductors may be evenly interdispersed in the press of the tube. It will be obvious to those skilled in the art that leads interspersed according to my invention may be employed to minimize screen grid-cathode inductance, or inductance in any circuit including a pair of electrode leads.

The inductance of leads to electrodes in electron discharge devices constructed according to my invention is minimized, allowing the reactance to be more uniformly distributed along the circuits connected to the electrodes.

Leads arranged according to my invention provide circuits connected to electrodes in electron discharge devices operating at ultra-high frequencies of maximum physical length, commensurate with an electrical length of one-quarter wavelength.

I claim:

1. An electron discharge device comprising an envelope, two cooperating electrodes in said envelope, leads to said electrodes, each lead comprising a plurality of conductors sealed in said envelope, each conductor connected with one electrode being interposed between two conductors connected to the other electrode.

2. An electron discharge device comprising an envelope, two electrodes in said envelope, a plurality of conductors connected to each electrode sealed gas-tight in said envelope, said conductors being arranged in a circle, conductors connected to one electrode alternating around the circle with conductors connected to the other electrode.

3. An electron discharge device comprising an envelope, two cooperating electrodes within said envelope, two conductors sealed gas-tight in said envelope and electrically connected to one of said electrodes, a third conductor connected to the other of said electrodes and interposed between the first two mentioned conductors and sealed gas-tight in said envelope.

4. An electron discharge device comprising a tubular metal envelope closed at one end with a glass wall, a grid with two side rods in said envelope, a cathode concentric with and inside said grid, a conductor attached to each of said side rods and sealed gas-tight in said wall, a conductor electrically connected to each end of said cathode, each conductor connected to the cathode being sealed into said wall adjacent the conductors connected to said side rods to increase the capacity between the grid and cathode conductors.

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