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GASEOUS DISCHARGE APPARATUS

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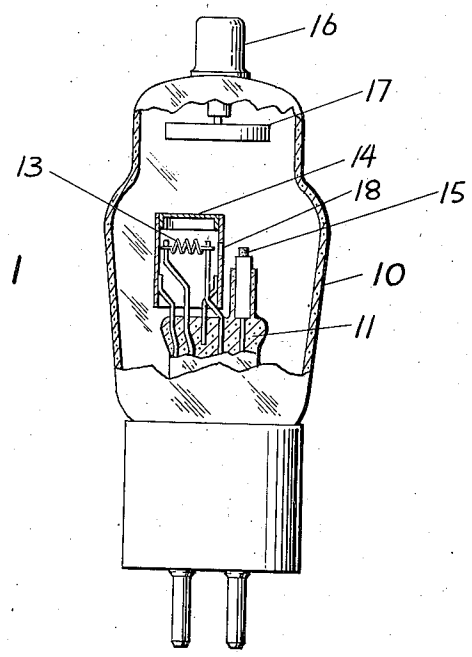


FIG. 1

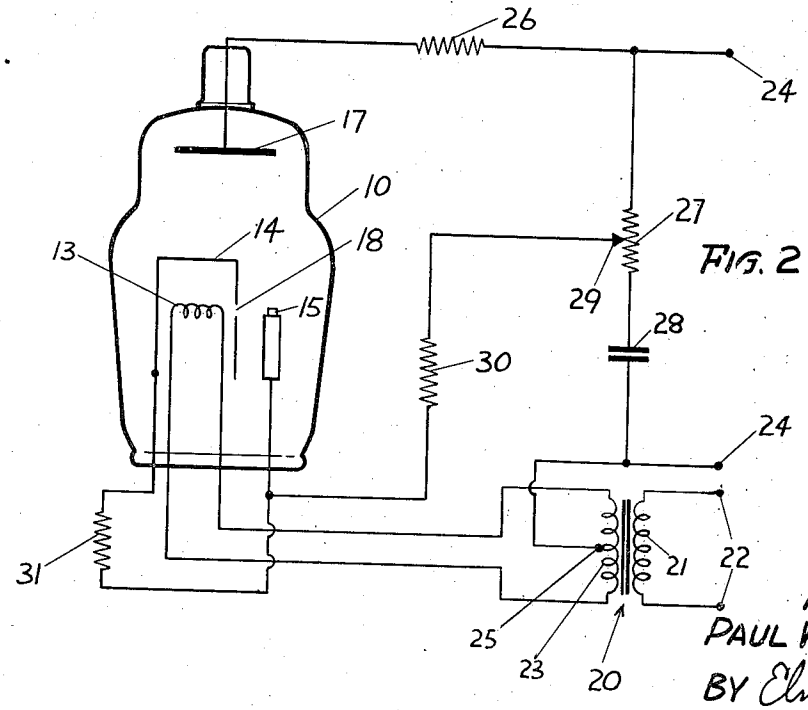


FIG. 2

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GASEOUS DISCHARGE APPARATUS

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4 Claims. (Cl. 250—27.5)

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This invention relates to gaseous discharge apparatus and more particularly to a gaseous discharge device and circuits therefor adapted to control the flow of current over a wide range of values.

Gaseous discharge devices of the type to which the invention relates are commonly provided with a grid for controlling the time of initiation of the discharge. The grid is maintained sufficiently negative to prevent the discharge until the desired instant when, by the application of a positive voltage to the grid, the discharge is initiated. Once started, the discharge cannot be stopped by again applying a negative bias of a practically attainable value due to the formation of an ion sheath about the grid. To stop the discharge, the anode voltage is usually removed. When the tube is used to control alternating current, the voltage is removed on alternate half-cycles. The grid thus regains control of the initiation of the discharge during the next succeeding cycle of alternating current when the A.-C. voltage is applied in a direction in which the tube is conductive. By varying the point in the half-cycle at which the grid is energized, the current flowing through the tube may be varied.

In such constructions it may happen that a sufficient number of electrons will pass through the foramina of the grid and be drawn to the anode at a sufficient velocity to ionize the gas in the tube. In this event, the gases within the tube being ionized, the grid loses control for the remainder of the alternation and thus a larger portion of the half wave of voltage across the tube is applied through the external circuit and accordingly more current is supplied to the load during this half wave than was intended.

Furthermore it is usually necessary to limit the pressure of the gases within the envelope to the order of one mm. or less of mercury. Higher pressures in a grid controlled tube are usually undesirable due to the greater tendency of the gas to become ionized prior to the energization of the grid, thus causing the grid to lose control of the initiation of the discharge. The higher gas pressures, however, are known to be desirable in that they tend to prevent the deterioration of the cathode and other electrodes.

It is among the objects of the present invention to provide a gaseous discharge device of the type described in which the control of the energization of the discharge is reliably maintained by the control electrodes throughout the entire half wave of applied voltage.

A further object of the invention is to permit

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the utilization of higher gas pressures in gaseous discharge devices of the type described without losing reliable control by the grid.

The above and other objects and features of the invention will be fully apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawing in which:

Fig. 1 is a view, partly in section, of a gaseous discharge tube constructed in accordance with the invention; and

Fig. 2 illustrates diagrammatically a tube and operating circuit constructed in accordance with the invention.

The tube illustrated comprises an envelope 10 containing an ionizable gas at a pressure sufficient to permit a gaseous discharge, said gas being preferably argon at a pressure of from 2 to 4½ mm. of mercury. An inwardly projecting stem having a press 11 has sealed herein lead-in conductors and supporting elements for a cathode 13, a grid 14 and an auxiliary electrode 15. The other end of the envelope is provided with a cap 16 through which extends a lead-in conductor and support for an anode 17. The grid 14 comprises a cylindrical member entirely surrounding the cathode 13 and having the end thereof between the cathode 13 and the anode 17 completely closed. A single opening 18 is provided in the cylindrical wall of the grid 14, which opening may be of the order of 0.1 in. and the auxiliary electrode 15 is positioned adjacent this opening. Preferably the cathode 13, the opening 18 and the active end of the auxiliary electrode 15 are in alignment.

In the operation of the construction described in the foregoing, during that half wave of alternating current when the polarity of the voltage is applied in a direction in which the tube is conductive, the electric field is applied in such a direction that there is little or no tendency for electrons emitted by the hot cathode 13 to be drawn through the opening 18. The few electrons that may escape through this opening at a time when a negative bias is applied to the grid 14 and to the auxiliary electrode 15 are too few in number to sufficiently ionize the gas in the envelope 10 to initiate a gaseous discharge. If at the point at which it is desired to initiate the discharge the negative bias upon the grid 14 is removed and the auxiliary electrode 15 is driven positive relative to the cathode 13, then electrons will be drawn through the opening 18 in sufficient number to ionize gas. The anode 17 being at a higher potential than the auxiliary electrode 15,

the electrons on escaping from the interior of the grid 14 through the orifice 18 will be drawn to the anode 17 and the discharge initiated between the main anode 17 and the cathode 13.

The cathode 13 may be of the directly or indirectly heated type and may be supplied with heating current from a transformer 20 having its primary winding 21 connected across the terminals 22 of a suitable alternating current source, such as a 110 volt A.-C. supply line, and its secondary winding 23 connected across the heating filament of the cathode 13. The anode-cathode circuit may be connected across the terminals 24 of a suitable source such as 220 volt A.-C. supply line. One of the terminals 24 is connected to a center tap 25 on the secondary winding 23 of the filament transformer 20, and the other terminal may be connected to the anode 17 through a resistor 26 which may have a resistance of the order of 40 ohms. A phase-shifting network comprising a resistor 27 and a condenser 28 is connected across the terminals 24. The resistor 27 may have a resistance of the order of 50,000 ohms and a variable tap 29 on the resistor 27 is connected jointly to the grid 14 and the auxiliary electrode 15 through a resistor 30 which may be of the order of two megohms. A resistor 31 of the order of one megohm is provided in the connection between the grid 14 and the auxiliary electrode 15.

In the operation of the circuit, when the alternating potential applied across the terminals 24 is in a direction in which the tube is conductive, that is when the cathode 13 is negative and the anode 17 is positive, a phase-shifted voltage is applied to the grid 14 and the auxiliary electrode 15, the degree of the phase shift being adjustable by the variable tap 29. During the early portion of the alternation the grid 14 and the auxiliary electrode 15 are driven sufficiently negative to prevent the escape of electrons through the orifice 18. At a predetermined point during the alternation, which point in determined by the degree of phase shift of the voltage applied to the grid 14 and the anode 15, the grid 14 and the auxiliary electrode 15 are driven positive permitting the flow of electrons through the orifice 18, thus initiating the discharge through the tube. The point at which the discharge is initiated may be varied over the entire duration of the positive half-wave of potential on the anode 17. The tube is accordingly adapted to permit the control of the current through the external circuit from zero to the maximum average anode current which the tube is designed to carry.

While there has been herein described a preferred embodiment of the invention, other embodiments within the scope of the appended claims will be obvious to those skilled in the art from a consideration of the form shown and the teachings hereof.

What is claimed is:

1. A gaseous discharge device comprising an envelope containing an ionizable gas, a cathode and an anode supported in spaced relation in said envelope, a grid surrounding said cathode and providing an imperforate shield on the side thereof between said cathode and anode, said grid having a perforation in a lateral wall thereof, and an auxiliary electrode spaced from said perforation for initiating a gaseous discharge between said cathode and anode.

2. A gaseous discharge device comprising an envelope containing an ionizable gas, a cathode and an anode supported in spaced relation in said envelope, a grid surrounding said cathode, said grid having a restricted opening providing a discharge path between said cathode and anode, and means adjacent said opening for initiating a gaseous discharge therethrough.

3. A gaseous discharge device comprising an envelope containing an ionizable gas, a cathode and an anode supported in spaced relation in said envelope, a cylindrical grid of sheet metal surrounding said cathode and said cylindrical grid being closed at the end thereof between said cathode and anode and having a perforation in the cylindrical wall thereof, and an auxiliary electrode spaced from said perforation for initiating a gaseous discharge between said cathode and anode.

4. A gaseous discharge device comprising an envelope containing an ionizable gas at a pressure of 2 to 4.5 centimeters, a cathode and an anode supported in spaced relation in said envelope, a grid surrounding said cathode and providing an imperforate shield on the side thereof between said cathode and anode and having a perforation in a lateral wall thereof, and an auxiliary electrode spaced from said perforation for initiating a gaseous discharge between said cathode and anode.

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