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GRID CONSTRUCTION OF ELECTRIC DISCHARGE DEVICES

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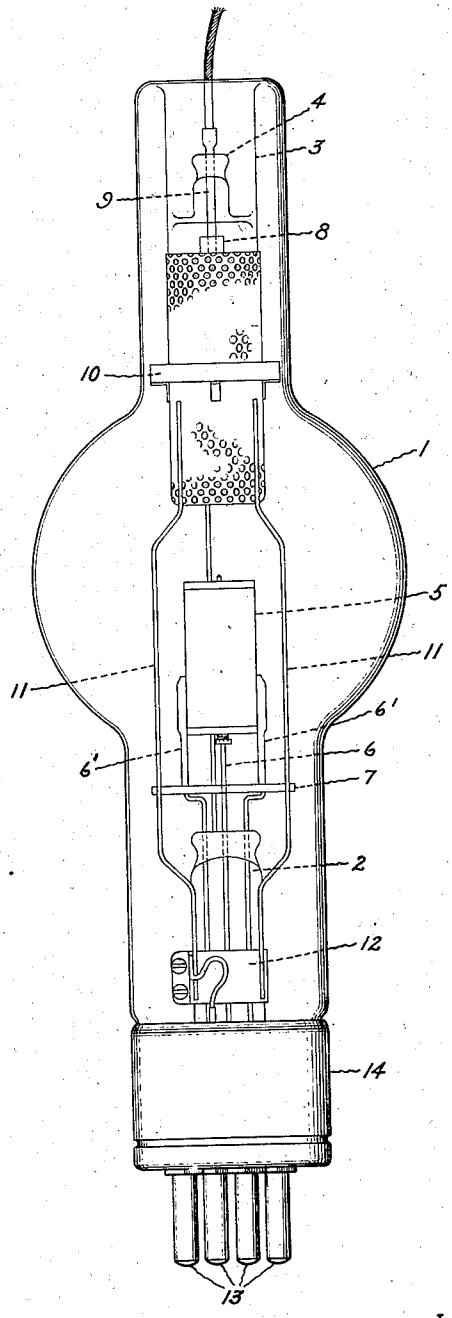

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GRID CONSTRUCTION OF ELECTRIC DISCHARGE DEVICES

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3 Claims. (Cl. 250—27.5)

The present invention relates to electrical discharge apparatus, more particularly to thermionic devices containing an ionizable medium and provided with a source of electrons, a cooperating anode and an electrostatic control member (or grid). The pressure of the medium and the impressed voltages are such that a discharge of arc-like character is produced between the electrodes, the initiation of the discharge being controlled by the bias on the grid. After the arc is started, the grid loses control and under normal conditions can neither modulate, limit nor extinguish the arc. The starting of the arc may be repeated indefinitely because while the discharge cannot be extinguished by the grid, it can be stopped by removing the anode voltage. Upon reapplying this voltage, the grid voltage again determines whether the arc will start and by a continued repetition of this process, the grid voltage can control the average plate current over a period of time. A practical method of obtaining interruption of the plate circuit is to employ alternating current although it will be understood that direct current may also be utilized in case proper circuit interrupting means are employed. Devices of this character have been described by A. W. Hull in an article entitled "Hot cathode thyratrons" in the G. E. Review vol. 32, No. 2, April 1929, pp. 213–223 inclusive. Such devices find utility in circuits where large currents are to be controlled by the application of a very small amount of energy to the grid. The source of electrons may be constituted by a filament which conveniently is energized through a voltage step-down transformer connected to the source of plate current in the case of an alternating current supply. When direct current is utilized, a separate filament energizing battery may be provided for this purpose. The present invention is directed more especially to the configuration and support of the control member in a device of this character.

The grid member is usually positioned near the anode so as the more effectively to control the operation of the arc; the grid support is derived from the anode end of the tube with the grid lead brought out from the same end. In fairly large tubes of this character, it has been found that the initation of the arc does not always occur at the same point in each alternating current cycle notwithstanding the use of a constant alternating current grid bias voltage and in pronounced cases of this sort, the arc may even fail to start during one or more cycles of anode voltage. This erratic behavior is probably due in a large degree to a vacillatory charging-up of the glass walls which offers an arc-restraining influence, independent of that exercised by the grid. The charging-up effect is particularly prevalent in tubes having electrode designs which offer an opportunity for the electrons to strike the glass walls, as for example, when the electron-receiving member is not positioned between the cathode and the envelope. Arc discharge devices in which the glow is unconfined and extends over the entire envelope interior are very susceptible to this effect on account of the abundant opportunity the electrons contained in the glow have to strike the glass. In order to obtain a positive and accurate control of the arc in tubes of this character, it is desirable therefore, to diminish these charges as much as possible so that the entire control will be vested in the grid. This result is accomplished in accordance with my invention by extending portions of the grid to a position near the envelope thereby definitely fixing the potential of the glass or rather, reducing the deleterious effects of the charged glass. The extensions are therefore interposed as a shield between the cathode and envelope, and conveniently may form part of a novel structure for supporting the grid from the cathode end of the tube. The lead from the grid under these conditions may be taken from the same end of the envelope as the cathode lead instead of the anode lead. This is decidedly advantageous in view of the smaller difference of potential residing between the cathode and grid leads than between the anode and grid leads. Further objects and features will be apparent as the specification is perused in connection with the accompanying drawing which illustrates a preferred embodiment of the invention.

In the figure, numeral 1 designates an evacuated envelope terminating at one end in a combined reentrant stem and press arrangement 2. The other end of the envelope terminates in a reentrant stem 3 which is closed by an inverted stem and press 4. The member 3 extends inwardly of the envelope to provide a support for one of the electrodes and takes the form of an open-ended sleeve or skirt (not shown). The cathode, as illustrated, is of the ordinary indirectly-heated type which employs a filament (not shown) positioned within a cylinder 5, preferably coated with an electron emitting material. The lower end of the filament may be connected to a lead-in wire 6 and the upper end secured in any convenient manner to the cylinder 5. The latter is supported from the press 2 by a plu-

rality of metal uprights 6' which also serve to conduct electrical energy to the cathode. A metallic heat shield 7 may be secured to these uprights. The anode 8 consists of a graphite cylinder suspended rigidly from the press 4 by means of a conductor 9. The envelope 1 contains an ionizing medium, for example, mercury vapor or an inert gas such as argon, helium or neon, at a pressure sufficiently high, for example 1 to 100 microns, to support an arc-like discharge at the operating potentials.

The grid member, improved in accordance with my invention, comprises perforated material, preferably nichrome (80% nickel, 20% chromium) and is formed as a cylinder terminating in a perforate closure intermediate the anode and the cathode. The internal diameter of the cylinder is such that the grid fits tightly over the sleeve 3 and closely surrounds the discharge path at the anode end thereof. A flanged metal member 10 may be provided intermediate the ends of the grid and secured thereto in any suitable manner for the purpose of excluding ionization or glow from the annular space between the grid and the envelope. The closed end of the grid is rigidly positioned within the envelope by means of a plurality of equidistantly spaced rods 11 which are welded to the grid at one end. The other end of the rods is joined to a metal band 12 which clamps about the reentrant stem 2. Electrical connections may be taken from the grid, cathode and heater members to external contact pins 13 secured to the base 14. Only three such pins are necessary when cylinder 5 serves as a return for the heater current but another pin 13 and lead wire may be provided in case the upper end of the heater is separate and insulated from the cylinder.

It will be noted that the rods 11 extend over the entire distance between the grid and cathode and are solely interposed between the walls of the envelope and that portion of the discharge path between the perforate closure and the cathode. This configuration of grid structure has been found to be beneficial in the operation of the tube in that the initiation of the arc is positively controlled by the electrostatic field of the grid to the total exclusion of undesirable charges exising on the glass surface. The arc will thus start at the same point in each positive half cycle of the energizing current wave when the alternating current potential applied to the control member remains unchanged; furthermore, the average current output remains substantially constant under these conditions. The fact that the grid members 11 are relatively remote from the cathode and from the discharge path at the cathode end thereof serves substantially to prevent objectionable grid emission. The improved grid construction offers the further advantage in allowing the grid lead to be taken from the cathode end of the envelope instead of the anode end as in the prior art devices. It will be understood that the potential of the grid lead is nearer that of the cathode than the anode so that when the lead is taken from the same end of the envelope as the cathode lead there is less likelihood of undue current leakage and surface arcing.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric discharge device comprising an elongated envelope terminating in remotely positioned stems and containing an anode supported from one of said stems, a cathode supported from the other of said stems, an ionizing medium at a pressure sufficient to support an arc-like discharge between said anode and cathode, an electrostatic control member closely surrounding the discharge path at the anode end thereof and terminating intermediate said anode and cathode, and a plurality of spaced conducting elements supporting said control member from said other of said stems, said elements being solely interposed between the walls of said envelope and the portion of said discharge path between said control member and said cathode and being wholly remote from said discharge path.

2. An electric discharge device comprising an envelope terminating in remotely positioned stems and containing an anode supported from one of said stems, a cathode supported from the other of said stems, an ionizing medium at a pressure sufficient to support an arc-like discharge between said anode and said cathode, a control member closely surrounding the discharge path at the anode end thereof and being supported on said one of said stems, said control member terminating in a perforate closure intermediate said anode and said cathode, and spaced rigid conductors additionally supporting said control member from said other of said stems, said conductors being solely interposed between the walls of said envelope and the portion of said discharge path between said perforate closure and said cathode and being wholly remote from said discharge path.

3. An electric discharge device comprising a member terminating in remotely positioned stems and containing an anode supported from one of said stems, an ionizing medium at a pressure sufficient to support an arc-like discharge between said anode and said cathode, a control member closely surrounding the discharge path at the anode end thereof and being supported on said one of said stems, said control member terminating in a perforate closure intermediate said anode and said cathode, rigid conducting rod members additionally supporting said control member from said other of said stems and being solely interposed between the walls of said envelope and the portion of said discharge path between said perforate closure and said cathode but being wholly remote from said discharge path, and a conductor leading in from the cathode end of the envelope and electrically connected to one of said rod members.

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