

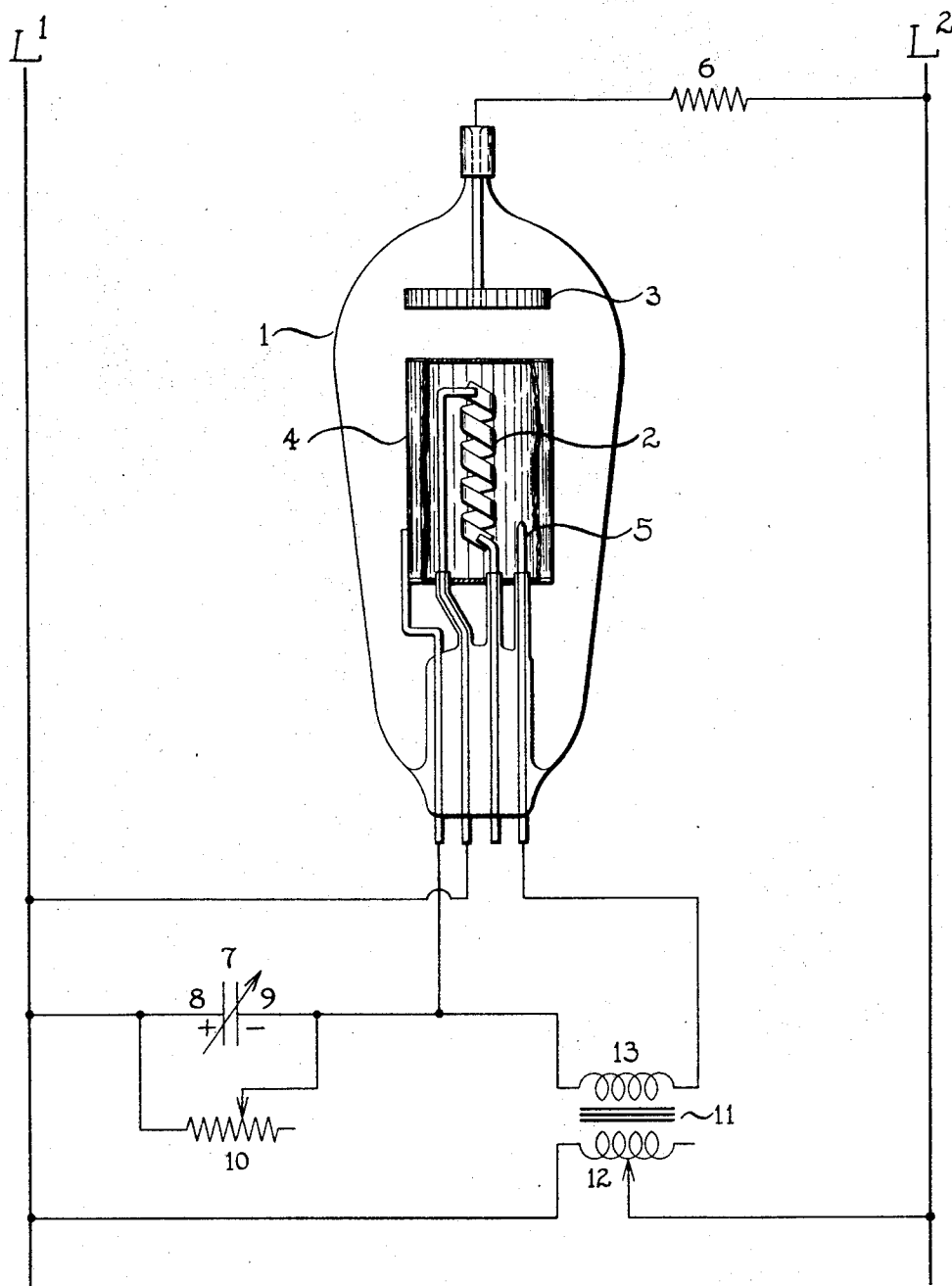
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ELECTRON TUBE

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ELECTRON TUBE

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This invention relates to improvements in gaseous electron discharge tubes of the grid controlled type, and involves a novel control circuit therefor including an additional auxiliary electrode.

forms the subject of my aforementioned application. It will be understood, however, that the invention is capable of various modifications, and its use is not limited to the systems illustrated.

In the use of gaseous grid controlled electron discharge tubes it is often desirable to arrange for a unidirectional current flow in the grid circuit and when the source for supplying the grid circuit is alternating this necessitates the employment of a separate rectifier to prevent the flow of current in the undesired direction. A system showing such an arrangement is illustrated among others in my depending application, Serial No. 455,444, filed May 24, 1930.

Referring to the drawing, 1 is an electron tube which is preferably filled with a gas or vapor at low pressure. Enclosed in the tube is a filamentary cathode 2, which may be of a conventional type. The cathode is arranged with terminals by which it can be connected to a suitable source of electrical energy (not shown) for heating it to the desired temperature. A conventional anode 3 is mounted concentric with and at one end of the longitudinal axis of the cathode. The cathode is surrounded by a preferably concentric cylindrical grid 4. This grid may be in the shape of a solid sheet completely enclosing the cathode except for an area at its upper end adjacent to the anode, of sufficient extent to permit an unobstructed flow of the electron stream. Mounted in the space between the grid and the cathode is an auxiliary small anode 5. It will be obvious that while the discharge between the cathode and the main anode 3 is subject to control by the grid no such control is exerted by the grid upon the discharge to the anode 5. Furthermore the discharge to the anode 5 can have no appreciable effect upon the control efficiency of the grid relative to the main discharge and upon the main discharge directly as long as the cathode is capable of supplying all of the electrons which are required by the two discharge currents provided that the circuits of the two anodes outside of the tube do not effect each others impedance.

Such systems while meeting the requirements under normal operating conditions have the disadvantage that in case of the failure of the cathode in either the grid controlled tube or in the rectifier the system is rendered partly inoperative while the tube which is still intact continues to function and thus may interfere with the proper operation of the system as a whole.

An object of the present invention is to provide a tube having means which obviate the necessity for the employment of a separate rectifier.

Another object is to provide a unitary structure embodying a grid controlled gaseous electron discharge tube and a rectifier.

Another object is to provide such a unitary structure having a single cathode and a unitary vacuum space.

Another object is to provide a combined gaseous grid controlled electron discharge device and rectifier having a common cathode and separate anodes.

Another object is to provide a device of the aforementioned character in which the electron flow to one of the anodes is unaffected by variations of the grid potential.

Another object is to provide a device of the aforementioned character in which the effect of the grid upon the electron flow to one anode is unaffected by the flow of electrons to the other anode.

Another object is to provide a control circuit for a gaseous electron tube whose grid is supplied with a unidirectional voltage from an alternating voltage source.

Various other objects and advantages will hereinafter appear.

The accompanying drawing illustrates my invention as applied to a system of control which

Due to the proximity of the cathode 2 to the auxiliary anode 5 the latter tends to heat up when the tube is in operation; such tendency being increased through shielding of the cathode 2 by the grid 4, which latter largely prevents the heat radiation from the cathode. As a result, the space inside of the grid is heated to a relatively high temperature at which the anode 5 may tend to conduct current in the undesired direction. To prevent this, the anode 5 is preferably made of tantalum or a tantalum alloy whose surface is oxidized, as it has been found that such oxidized tantalum surfaces effectively prevent electron emission from a hot body and thus prevent the reversal of current in the circuit of the auxiliary electrode 5.

Supply lines L^1 and L^2 impress alternating voltage upon the system. Cathode 2 is directly connected to line L^1 , while anode 3 is connected

to line L^2 in series with a translating device 6, the current of which is to be regulated. An adjustable condenser 7 having plates of opposite polarity 8 and 9 is connected between the grid 4 and line L^1 , and is paralleled by an adjustable impedance 10 which is preferably non-inductive. A transformer 11 has an adjustable primary winding 12 which is connected between the lines L^1 and L^2 , and a secondary winding 13 which is connected between the grid 4 and the auxiliary anode 5.

The apparatus functions as follows:

When an alternating voltage is impressed upon the lines L^1 — L^2 the cathode 2 becomes alternately negative and positive with respect to the anode 3, and if the grid has no voltage impressed upon it, current flows through the tube and the translating device 6 during the alternate half cycles when the cathode is negative. These alternate half cycles shall be designated as the "working half cycles" and the other half cycles the "negative half cycles". An alternating voltage is also impressed upon the primary winding 12 of the transformer 11, and the resultant current in said winding induces a corresponding voltage in the secondary winding 13. This secondary winding is so connected that its terminal which is connected to grid 4 is negative with respect to the auxiliary anode 5 during the negative half cycles of the main voltage, and thus a negative charge is accumulated on the plate 9 of the condenser during these half cycles, the charging current flowing from plate 9 through winding 13 to anode 5, cathode 2 and over line L^1 to plate 8. During the succeeding working half cycle, the polarity of the cathode and of the transformer winding reverses and the tube conducts current between the cathode 2 and the anode 3 if it is not prevented from so doing by a negative potential on the grid 4. However, since the impedance of the circuit of winding 13 is asymmetrical due to the unidirectional conduction between the cathode 2 and auxiliary anode 5, the negative charge on the condenser plate 9 cannot flow off through the anode 5, but only through the impedance 10 back to plate 8. By adjustment of this impedance it is possible to adjust the time which is necessary for the negative potential on plate 9 and grid 4 to reach a sufficiently low value to permit current flow between the cathode 2 and the anode 3, and it is thus also possible to adjust the moment during the working half cycle when the tube begins to supply current to the translating device 6. By varying this moment the effective current supplied to the translating device may thus be varied.

It will thus be seen that the auxiliary anode 5 in combination with the cathode 2 serves as a rectifier for the grid charging circuit, while at the same time the current which flows through this auxiliary circuit during the half cycles when no current flows between the cathode 2 and the anode 3, does not directly affect the current flowing between the main electrodes during the working half cycles.

It is obvious that the current supplied through the auxiliary anode may be used in various other ways besides the use shown herein, where

it is employed to charge a condenser, which in turn controls the grid potential.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, a gaseous electron discharge tube having a cathode, an anode, a grid for controlling the current flow between said cathode and anode, and a second anode so located and connected with respect to said first-mentioned anode and grid as not to directly affect the controlling effect of the grid upon current flowing between said cathode and said first-mentioned anode, a source of periodically reversing voltage, and circuit connections including said source, said second anode and said grid to impress upon the latter a voltage derived from said source.

2. In combination, a gaseous electron discharge tube having a cathode, an anode, a grid for controlling the current flow between said cathode and anode, and an auxiliary anode, a source of periodically reversing voltage connected with said auxiliary anode and said grid to impress upon the latter a voltage, said auxiliary anode being located in the discharge space between said cathode and said grid.

3. In combination, a gaseous electron discharge tube having a cathode, an anode, a grid for controlling the current flow between said cathode and anode, and an auxiliary anode, a source of periodically reversing voltage to which said auxiliary anode and grid are connected for supply of an unidirectional voltage to the latter, said auxiliary anode being located adjacent to said cathode and separated from said first-mentioned anode by said grid.

4. In combination, a gaseous electron discharge tube having a cathode, an anode, a grid interposed between said cathode and anode, and an auxiliary anode adjacent to said cathode, and circuit connections including a source of periodically reversing voltage, said second anode and said grid to impress upon the latter a voltage derived from said source, said grid being located outside of the discharge path of the current flow between said cathode and said auxiliary anode.

5. In combination, a gaseous electron discharge tube for supplying current to a translating device, said tube having a cathode, an anode, a grid for controlling the current flow through said tube and an auxiliary anode, and a source of periodically reversing voltage, said auxiliary anode being connected in circuit with said cathode, said source and said grid to impress upon the latter a voltage derived from said source, and said auxiliary anode being located adjacent to said cathode and separated from said first-mentioned anode by said grid.

6. In combination, a gaseous electron discharge tube having a cathode, an anode, a grid for controlling the current flow between said cathode and anode, an auxiliary anode located outside of the discharge path of said anode and a source of periodically reversing voltage connected with said auxiliary anode and said grid to impress a unidirectional potential upon the latter.

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