

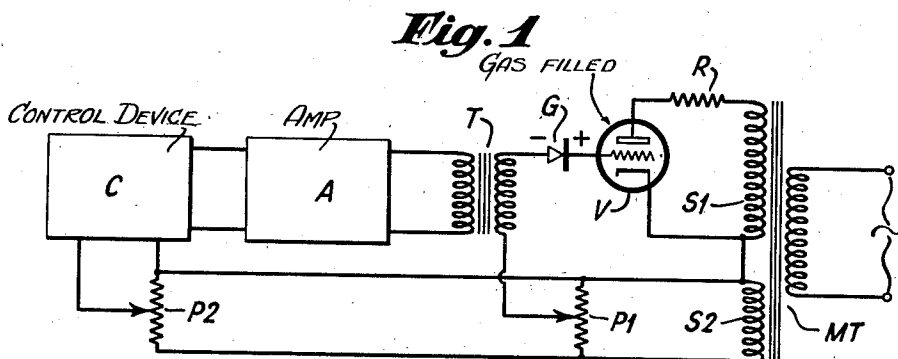
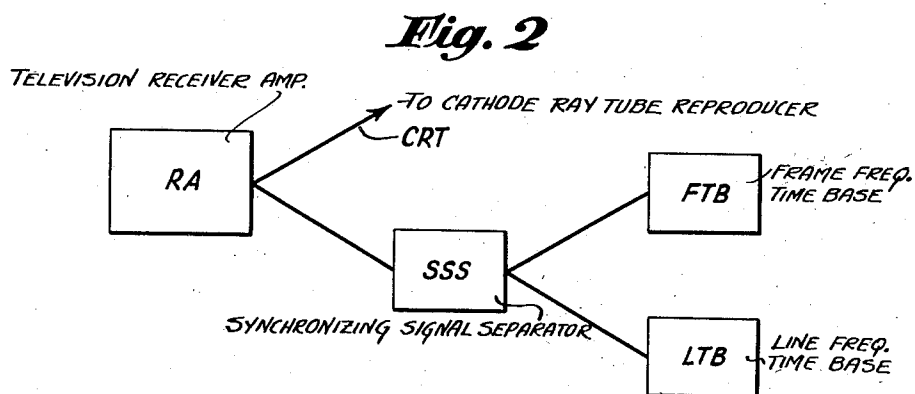
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ELECTRON DISCHARGE TUBES AND CIRCUITS THEREFOR

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ELECTRON DISCHARGE TUBES AND
CIRCUITS THEREFOR

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The present invention relates to gas filled electric discharge tube circuit arrangements and more particularly to such arrangements employing gas filled discharge tubes of the grid controlled type.

An important defect of gas filled grid controlled discharge tubes is that the input impedance at the grid of the tube is, under working conditions, very low and this defect makes it very difficult to achieve substantially pure voltage control, i. e. control without imposing any substantial power load on the control source, especially when the control source is a high impedance source such as the output circuit of a valve amplifier. Thus, in one case, experimentally tested, wherein there was applied to the grid of a gas filled grid controlled discharge tube, an alternating potential in phase opposition to the anode potential and of sufficient magnitude to prevent discharge occurring, it was found that the superimposition on the grid of a component leading the main grid alternating voltage by 90° and of only about 0.3 of a volt in amplitude, was sufficient to trigger the discharge at the commencement of each cycle when said component was derived from a source of about 10 ohms impedance. When, however, there was substituted for the said source a valve amplifier with an output impedance of about 2500 ohms, a component of about 10 volts amplitude was required to trigger the discharge, other conditions remaining unchanged.

The object of the present invention is to provide improved gas-filled grid controlled discharge tube circuit arrangements in which the effective input impedance of the tube in the circuit is increased as compared to known, comparable arrangements.

In order that the invention may be the better understood, the underlying physical phenomena will first be discussed briefly.

The low effective input impedance of a gas filled grid controlled discharge tube is due to the flow of grid current. This current includes two components, namely, a component due to electron flow to the grid when said grid is positive with respect to the cathode and a component due to the flow of positive ions when said grid is negative to the cathode and a discharge occurs over the cathode-anode space. Of these two components the positive ion current is the larger and therefore the more important as a cause of low input impedance. Although the positive ion grid current flows only during the occurrence of the main discharge when the grid is,

of course, in any case incapable of exercising control, the said current is still a cause of trouble when the control source is of a reactive nature, since the voltage due to the grid current is not in phase with said current and may, therefore, encroach upon a part of the cycle where a critical control action is required to take place.

The present invention seeks to reduce the adverse effects of grid current in gas filled grid control discharge tubes and this object is achieved, according to the invention by interposing in the grid circuit a rectifier or other impedance which presents much higher resistance to current flow in one direction than to current flow in the other, said impedance being interposed and so connected as to eliminate or substantially reduce the flow of positive ion current in the grid circuit. The rectifier or the like will, of course, have substantially no effect on the flow of the electronic component of grid current, but, as already stated, this component is smaller than the positive ion component.

At first sight it might appear that the rectifier or the like would be a source of difficulty in that it would tend to prevent the application of negative potential to the grid, but it must be remembered that it is only in the absence of a discharge that grid control can be exercised at all and it is therefore only in such periods that it may be required to apply negative potential to the grid. In the absence of a discharge there is no positive ion grid current and the resistance presented by the grid-cathode path to a source of negative grid potential is therefore very high—so high, in fact, that the high resistance of the rectifier or like impedance in the "blocking" direction is of practically negligible effect in preventing the development of a required negative potential on the grid.

A relay arrangement in accordance with this invention may comprise means for applying to the anode and grid of the tube alternating potentials of the same frequency and of such relative phase and amplitude as normally to prevent a discharge in said tube, and control means for altering the normal relative phase and/or either the normal relative phase or relative amplitude so as to cause a discharge therein; or means may be provided for normally applying to the grid of the tube a negative potential sufficient to prevent a discharge therein and control means for superimposing on said normal negative potential a pulse of positive potential so as to initiate a discharge. Again the tube may form part of a relaxation oscillation generator which is syn-

chronised by applying positive potential pulses to the tube grid periodically.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure 1 is a diagrammatic representation of a tube and circuit made according to my invention, and Figure 2 is a diagrammatic representation of a device for which my invention is particularly suitable.

Referring to Figure 1 which shows a circuit arrangement including a gas filled grid controlled tube V which is employed to control the current through a utilization device or circuit represented by a resistance R, power is fed to the load circuit from an A. C. mains source through a transformer MT having a secondary S₁ in series with the load R and the anode-cathode space of the tube V. The transformer MT has a second secondary S₂ across which is connected a potentiometer resistance P₁. A tap, preferably adjustable, on this resistance P₁ is connected to the grid of tube V through a circuit including in series, the secondary of a control input transformer T and a rectifier G which is conductive in the direction as indicated by the polarity signs, i. e. such as to pass the negative electronic current but "block" the positive ion current. The tap on P₁ is so adjusted that, in the absence of input through transformer T the voltage on the grid of tube V—which voltage is, of course, in phase opposition to that on the anode of the tube—is sufficient to prevent the occurrence of a discharge.

A second potentiometer resistance P₂ is connected across the secondary S₂ and a tap (preferably adjustable) on this resistance applies to any master control device, represented simply by the rectangle C, a suitable voltage from the mains. The master control device C has its output amplified by a valve amplifier A whose output circuit is coupled by transformer T to the input circuit of the tube V. Either the apparatus at C or that at A may include suitable means for changing the phase of the potential passed through so that minimum potential shall be required across the secondary of transformer T to trigger the discharge. Although the resistance of the rectifier G in the blocking direction tends to reduce negative voltage applied to the grid, the said negative voltage, being delivered by the mains through secondary S₂ and the tap on P₁, can be easily increased as may be desired. Signal impulses transmitted through transformer T to trigger the discharge are, however, necessarily in such direction as to drive the grid positive and therefore are not appreciably attenuated by the rectifier G which is conductive in this direction to pass such impulses. This is an obvious advantage as compared to those known arrangements in which an ordinary resistance of high value is connected in series with the grid of a gas filled grid controlled discharge tube.

Another advantage of the invention is that it reduces undesired reaction on the input circuit at the commencement of a discharge. In the absence of the rectifier or the like a sudden flow of positive ion grid current would occur at the commencement of discharge and such a sudden flow is apt to cause disturbances to be fed back through the input circuit to other apparatus connected therewith. For example, consider the case

illustrated in Figure 2 which shows in block diagram form, a television receiver comprising a main receiver amplifier RA, a synchronising signal separator SSS, a frame frequency time base FTB, a line frequency time base LTB and a cathode ray tube reproducer (not shown). The output from RA is fed both to the cathode ray tube reproducer (over circuit CRT) and also to the separator SSS where the picture and synchronising signals are separated to give the frame synchronising pulses (which are fed to LTB). Suppose the television system is of the interlaced scanning type where, of course, the number of lines per frame is a whole number plus a fraction. It is then obviously important that the line and frame time bases LTB and FTB shall not lock in step with one another and operate at frequencies in a whole number ratio. If the time bases employ gas filled grid controlled discharge tubes in relaxation oscillator circuits and the present invention be not employed there is risk of such undesired locking into step of the time bases due to the fact that there is a common input circuit (the output circuit of SSS) and due to the violent pulses of positive ion grid current at the commencement of each discharge. By employing the present invention, however, these violent pulses are avoided and the risk of cross-coupling of the time bases is much reduced. Accordingly less careful filtering in the inputs of the time bases is necessary than would otherwise be the case—an important practical advantage.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. An electron discharge device having an envelope containing a gaseous atmosphere and containing a cathode, grid and anode, a utilization device connected to the anode, means for applying an alternating voltage between said cathode and anode, and means for applying an alternating voltage to said grid 180° out of phase with the first voltage to prevent said device from discharging, and other means for superimposing on said grid a positive voltage sufficiently great to cause said tube to discharge, and means including a rectifier in said grid circuit connected to permit the flow of electronic current and to substantially block the flow of the positive ion current in the grid circuit.
2. An electron discharge device having an envelope containing an ionizable medium, a cathode, grid and anode, an output device connected to the anode, means for impressing an alternating current voltage between said cathode and anode, means for impressing a voltage on said grid 180° out of phase with the voltage on said anode, and means including a phase reversal system connected between said grid and said grid voltage applying means for superimposing on said grid a positive voltage sufficiently high to cause a discharge through said device, a transformer connected between said phase reversal system and said grid and cathode and means including a rectifier connected between said grid and said transformer so poled as to permit the

flow of electronic current and to substantially block the flow of the positive ion current in the grid circuit.

3. In combination an electron discharge device having an envelope containing a gaseous medium, a cathode, grid and anode, an output device connected to the anode, means including a transformer having a primary and a plurality of secondaries, one of said secondaries being connected to said electron discharge device to apply an alternating voltage between said cathode and anode, a potentiometer connected across another of said secondaries and means for connecting said potentiometer to said grid for applying to said grid a voltage 180° out of phase with the voltage of said anode, said last means including a rectifier in series with said grid and so poled as to permit the flow of electronic current and to substantially block the flow of the positive ion current in the grid circuit and other means for imposing on said grid a voltage sufficiently high to cause said tube to discharge.

4. In combination an electron discharge device having an envelope containing a gaseous medium, a cathode, grid and anode, means including a transformer having a primary and a plurality of secondaries, one of said secondaries being connected to said electron discharge device to apply an alternating voltage between said cathode and anode, a potentiometer connected across another of said secondaries and means for connecting said potentiometer to said grid for applying to said grid a voltage 180° out of phase with the voltage of said anode, said last means including only a rectifier in series with said grid and a phase reversal means connected to said other secondary for imposing on said grid a positive voltage sufficiently high to cause said tube to discharge, and a transformer connected between said phase reversal means and said rectifier through which said phase reversal means applies a voltage sufficiently high to cause said tube to break down.

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