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ULTRA SHORT WAVE TUBE CIRCUIT

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Fig. 1

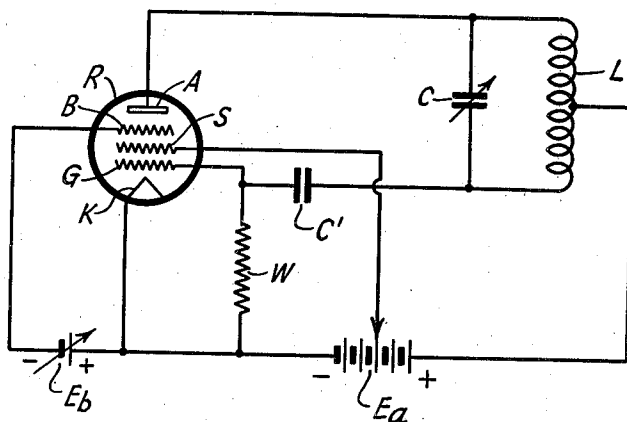
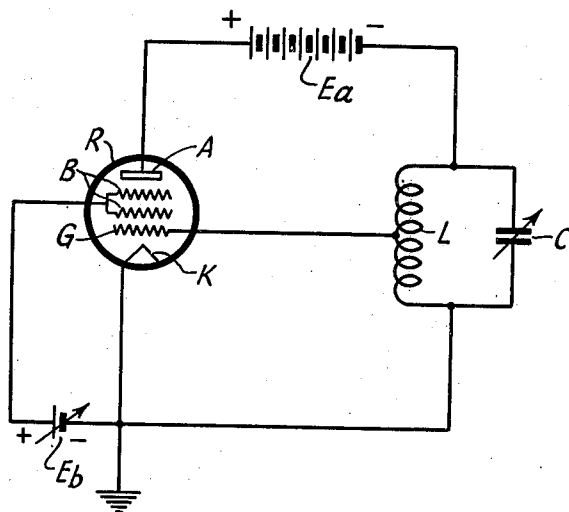


Fig. 2



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ULTRA SHORT WAVE TUBE CIRCUIT

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4 Claims. (Cl. 250—36)

This invention relates to an ultra short wave radio system, and has more particularly to do with a device for the improvement of tube operation in cases where the electron transit time in the discharge space is of consequence.

It is known that in ultra high frequency applications, especially in the familiar retardation field circuits, the time during which the electrons remain in the space between electrodes, determines the frequency of the generated or the respectively amplified or rectified oscillations in the tube. Further, it is known that in the conventional hook-ups where the discharge tube is operated with positive plate and negative or only slightly positive grid, the working efficiency of the tubes in the ultra high frequency range is considerably lowered due to the electron transit time. Above all the ability to start oscillations is reduced. In order that a feed-back may take place one condition, for example, is that the grid and the plate potentials be out of phase by about 180°. When the electron transit time becomes comparable to the period of the generated oscillations it affects the proper phase relations and thereby reduces the ability to oscillate, eventually causing the circuit to become inoperative. In a similar manner the electron transit time can also have an unfavorable effect in amplifiers or receivers.

The electron transit time is determined by the velocity of the electrons and by the separation of the electrodes along the discharge path. Since the separation of the electrodes is generally fixed, the only remaining possibility is to regulate the electron transit time by changing the velocity of the electrons. In the retardation field circuits this is accomplished by changing the retardation electrode or the grid-plate potential or both. The changing of the working potentials of the electrodes, the control electrode, and the collecting electrode, is not always desirable, because this postulates the shifting of the operating point or respectively the changing of efficiency.

According to this invention, the electron transit time between two electrodes of the tube is brought to a definite value by introduction of potentials through one or several auxiliary grids placed between the two electrodes.

My invention will now be described in more detail, reference being made to the accompanying drawing in which

Figure 1 is a circuit diagram which is referred to in developing the basic idea of the invention, and

Fig. 2 is a circuit diagram showing a preferred embodiment of the invention itself.

Fig. 1 shows a tube R in a conventional feed-back circuit. First, let it be assumed that this tube contains only the cathode K, the control grid G, and the anode A. The oscillating circuit LC is connected across the grid and anode while the cathode is connected to a tap on coil L. The anode is given a suitable positive bias from the battery E_a while the grid becomes self-biased by selecting proper values for the grid condenser C' and resistor W. This hook-up, while reliable at longer waves, fails as soon as the wave length is shortened, and the reason for this resides among others in the electron transit time between the grid G and the anode A. According to this invention the electron transit time between the electrodes can be extended to a full period of the oscillations so as to establish a phase relation of 360°. In this manner it is possible to restore the same relations which prevail when the electron transit time is negligible as compared to the period of oscillations. To realize this idea an auxiliary grid B is introduced between the control grid and the anode, and is given an adjustable potential from a source E_b. The auxiliary grid B is preferably, but not necessarily, negatively biased. In place of a single auxiliary grid B two or more grids can be provided, because among other things it is more practical to let the electrons cover a longer path at moderately reduced velocity than a shorter path at highly reduced velocity. Two auxiliary grids at a definite distance one from the other with a moderate positive bias will act the same way as a single negatively biased auxiliary grid.

When the electron transit time appears only slightly troublesome, and provided that the tube contains a screen grid between the control G and the anode A, changes in electron transit time may be made to a limited extent by a change in the screen grid potential without substantially altering the operation of the tube. In order to effect greater changes in the electron transit time it is necessary to provide additional auxiliary grids B even in case of a screen grid tube. When, for the purpose of suppressing secondary emission, a suppressor grid is placed between the screen grid and the anode it can be used likewise to control the electron transit time.

The application of this idea is not limited, however, to the circuit shown by the example, nor to oscillators in particular, but can be applied with same results to amplifiers and rectifiers.

As a possibility, for instance, it may be desired

to make the electron transit time between the control grid and anode one-half of the period of the working frequency. In a feed-back circuit this would require a change of polarity of the coupling member which may be of advantage in circuit applications. In Fig. 2 is illustrated a so-called three point circuit to which the same reference letters apply as in Fig. 1. The two auxiliary grids B are provided and are adjustably biased either negative or slightly positive with respect to the cathode. The biasing potential is obtained from source E_b. The electron transit time between the control grid G and anode A is made equal to a half cycle so that the tap connection to coil L for the cathode and control grid must be the reverse of what is shown in Fig. 1. Under these conditions one side of the oscillating circuit may be grounded.

Various modifications of my invention may be suggested by the foregoing description. They are, nevertheless, to be comprehended within the scope of the claims.

I claim:

1. An ultra high frequency oscillator comprising an electron discharge tube having a cathode, an anode, a control grid and an auxiliary electrode between the cathode and anode, a resonant circuit having a point therein connected to said cathode, a circuit connection from a different point in said resonant circuit through a direct current source of potential to said anode, a connection from said control grid to a point in said resonant circuit having the same phase as the point to which said anode is connected, and means for applying to said auxiliary electrode a potential of such magnitude as to retard the flight of electrons between the control grid and the anode in such degree that the electron transit time becomes substantially one half the period of the natural oscillation period of said resonant circuit.

2. An ultra high frequency oscillator comprising an electron discharge tube having a cathode,

an anode, a control grid and an auxiliary electrode between the cathode and anode, a resonant circuit having a point therein connected to said cathode, a circuit connection from a different point in said resonant circuit through a direct current source of potential to said anode, a connection from said control grid to a point in said resonant circuit having the same phase as the point to which said anode is connected, and means for applying to said auxiliary electrode a potential of such magnitude as to produce anode current variations which are oppositely phased with respect to the coincident grid potential variations, said phase opposition being determined by virtue of the fact that the electron transit time is made commensurate with a semi-cycle of the oscillations generated.

3. An ultra high frequency oscillator system comprising an electron discharge tube having a cathode, an anode, a control grid and at least one additional grid, a resonant circuit having two points therein which are maintained in phase agreement, one of said points being connected to said anode and the other of said points having an alternating current path to said control grid, a connection from said cathode to a third point in said resonant circuit, an anode potential source in circuit between said cathode and anode, and means including a source of potential suitably applied between the cathode and said additional grid or grids for sufficiently retarding the flight of electrons in said tube so that anode current variations are maintained in opposite phase relation to the coincident control grid potential variations, and the electron transit time is made equal to a half cycle of the oscillations generated.

4. A system in accordance with claim 3 and having said anode potential source connected between said anode and said resonant circuit, and having a metallic connection between said control grid and a point in said resonant circuit.

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