July 9, 1940. M. GEIGER 2,207,511

OSCILLATION GENERATOR

Filed May 8, 1937

Fig. 1

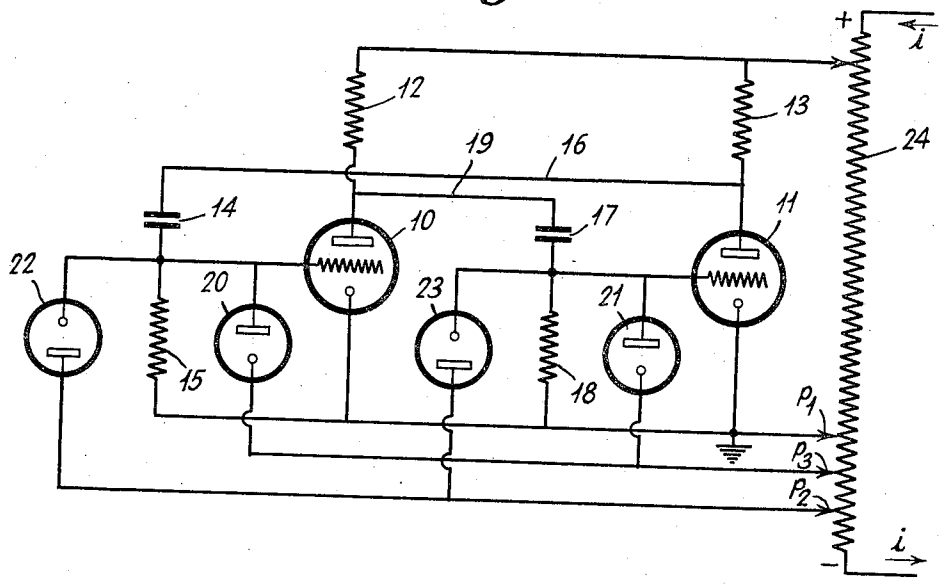


Fig. 2

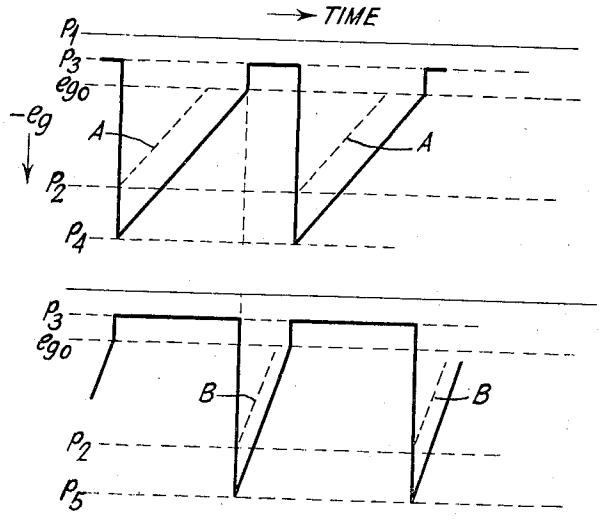
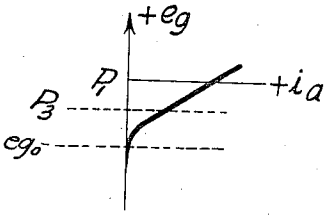


Fig. 3

Fig. 4



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OSCILLATION GENERATOR

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7 Claims. (Cl. 250—36)

This invention relates to oscillation generators and, in particular to oscillators of the relaxation type and the method and means for stabilizing the normal frequency of such oscillators.

Mutivibrators are understood to be relaxation oscillation generators having two discharge paths setting each other in action cyclically, and thus producing oscillations. Each discharge path has a resistance-capacity circuit included therein which is dependent on the voltage conditions which the current produces in the other discharge path, said resistance capacity circuit controlling the initiation of the discharge current in the first mentioned path. Such relaxation oscillation generators can be used with advantage for producing impulses having a constant frequency for television purposes. To this end it is necessary in the first place to operate the relaxation oscillation generator with a constant voltage source such as can be easily done by using suitable voltage control means. Yet, the constancy of the frequency of the produced impulses is also dependent on the grid voltage-plate current characteristic of the discharge paths utilized. The steepness of a tube characteristic changes with the time of operation to a degree such that the impulse frequency varies in an undesirable manner, while the grid voltage value required for just blocking the discharge (lower bend of the plate current-grid voltage characteristic) remains practically invariable.

In accordance with the invention therefore, in such a relaxation oscillation generator, there is connected in parallel to the control grid-cathode path of one or both discharge paths, a detector in series with a direct voltage source, so that with a variation of the characteristic of one discharge path, the grid potential of the other discharge path (equipped with detector) can be maintained at a practically constant minimum value.

It is, therefore, one of my objects to provide method and means for producing a stabilized frequency multivibrator.

Another object of my invention is to provide a multivibrator whose frequency is substantially independent of supply voltage variations.

A still further object of my invention is to provide a thermionic oscillator having a cathode-grid circuit with a linear characteristic connected in parallel with a non-linear characteristic circuit to minimize the effects of voltage variations upon the oscillator's frequency. Yet another object of my invention is to provide a multivibrator of improved characteristics for use in frequency dividing and multiplying circuits such as are employed in frequency measuring systems, television, synchronizing systems, and electrical measuring systems.

Other and ancillary objects will at once be apparent to those skilled in the art upon reading the following description together with the drawing.

In the drawing, Fig. 1 shows a circuit diagram of one embodiment of my invention;

Figs. 2 and 3 are voltage plots to illustrate the operation of my invention and Fig. 4 shows the grid voltage-anode current characteristic of tubes for explaining Figures 2 and 3.

In Figure 1 items 10 and 11 designate two tubes having inserted in their plate circuits a resistor 12 and 13 respectively, and a resistance capacity circuit in each of their grid circuits. The resistance capacity circuit of tube 10 consisting of condenser 14 and resistor 15 is connected to the anode of the other tube 11 across the line 16. The resistance capacity circuit of tube 11, consisting of the condenser 17 and resistor 18 is connected to the anode of tube 10 across a line 19. Each of the grid-cathode paths of tubes 10 and 11 have connected in parallel a detector 20 and 21 respectively, and the anode of the detectors 20 and 21 are connected to the control grid of the tube 10 and 11 respectively, and furthermore, a detector 22 and 23 respectively whose cathode connected to the control grid, and serves according to the invention to bring the grid potential to a practically constant minimum value independently of the shape of the plate current-grid voltage characteristic. A bias potential that is negative relative to the cathodes of the tubes 10, 11 is placed in series with the two detector pairs, said bias potential being obtained by tapping the potentiometer resistor 24. The bias voltage for the detectors 22, 23 hence consists of the voltage drop between the points P_1 and P_2 and that for the detectors 20, 21 consists of the potential drop between the points, P_1, and P_3.

Neglecting for the moment the presence and effect of the detectors 22 and 23, the circuit shown in Fig. 1 operates in such manner that the grid potential of the tube 10 undergoes voltage variations as represented by the full line curve in Figure 2. In this figure the horizontal coordinate represents the time and the vertical coordinate a deviation of the grid potential in the direction that is negative as regards the cathode potential. The cathode potential is designated by P_1 in conformity with Figure 1, and the potential of the control grid at which the detectors 20, 21 permit

the current to pass is designated by P_3. The grid potential at which the plate current in the tubes 10, 11 will just be blocked is designated by e_{go} as shown in Figs. 2, 3 and 4. The minimum value assumed by the grid potential of tube 10 is determined by the voltage drop which the plate current of the tube 11 produces in the resistor 13, and has the value P_4. The grid potential characteristic of tube 11 has a shape similar to that of the tube 10, and is shown in Figure 4. The intervals of constant grid potential of tube 11 correspond to the intervals of the increasing grid potential of the tube 10 and vice versa. The minimum value of the grid potential of the tube 11 is determined according to the conditions at tube 10, by the voltage drop produced at the resistor 12 by the plate current of the tube 10. The minimum value of the grid potential is herein designated by P_5 in Figure 3.

Now, since the voltage drop produced in the resistors 12 and 13 by the plate current of tubes 10 and 11 respectively, depends on the plate current value corresponding to the grid potential P_3, and hence at fixed value e_{go} the voltage drop depends on the steepness of the plate current-grid potential characteristic, also shown in Figure 4, the value P_4 in Figure 2, or P_5 in Figure 3 varies in the course of the life of the tube. Since on the other hand, the time constant of the two resistance-capacity circuits is invariable, there elapses a time between the extinction and the setting-in again of the discharge of the same tube which depends on the value of P_4 or P_5. Therefore, according to the invention, rectifiers 22, 23 are provided permitting the passing of current therethrough at values of the grid potential which are equal to the voltage drop between P_1 and P_2. If the control grid potential for instance of tube 10 has decreased to the value P_2, the total voltage at the rectifier 22 is equal to zero, since the potential difference between grid and cathode of tube 10 has a direction opposite to that of the potential difference between the points P_1 and P_2 at the potentiometer resistor 24. Thus if the grid potential of tube 10 decreases still further, the rectifier 22 permits the passing of current, since now its cathode is negative relative to its anode. Therefore, a further decrease of the grid potential of the tube 10 will be prevented, so that the slow potential displacement to which the control grid of tube 10 is subjected during the flowing of plate current in tube 11, now begins at the voltage value P_2, and not as hitherto without the rectifier 22, at the voltage value P_4, which value depends on the steepness of the grid voltage-plate current characteristic. Consequently, after interruption of the plate current in tube 10, the grid potential varies in the manner shown by the dotted curve A in Figure 2. The functioning of the rectifier 23 in the grid circuit of tube 11 is the same. Thus when using the detector 23, the curves B in Figure 3 represent the voltage wave during the time in which the tube 11 is blocked, and the tube 10 permits passing of current.

If the same impulse frequency is to be produced when using the rectifiers according to the invention as the frequency without these rectifiers, the values of the time constants of the resistance capacity circuits 14, 15, and 17, 18 must be changed such that the curves A and B intersect the line g_{eo} at the same moment as in the case of the grid potential curves drawn in full line.

Having described my invention, what I claim is:

1. A stabilized oscillator comprising a first and a second electron discharge tube, each of said tubes having a cathode, a control electrode and an anode, a resistor connected between the cathode and control electrode of each tube, a potentiometer, resistors connected between the anode of each tube and the potentiometer, a connection between each cathode and the potentiometer, a condenser connected from the connection between the anode and the resistor of the first tube to the control electrode of the second tube, a condenser connected from the connection between the anode and the resistor of the second tube to the control electrode of the first tube, and a plurality of unilateral conducting impedances connected between the control electrode of each tube and the potentiometer.

2. A stabilized oscillator comprising a first and a second electron discharge tube, each of said tubes having a cathode, a control electrode and an anode, resistors connected between the cathode and control electrode of each tube, a potentiometer, a resistor connected between the anode of each tube and the potentiometer, a connection between each cathode and the potentiometer, a condenser connected from the connection between the anode and the resistor of the first tube to the control electrode of the second tube, a condenser connected from the connection between the anode and the resistor of the second tube to the control electrode of the first tube, and two rectifiers of opposite polarity connected between the control electrode of each tube and the potentiometer.

3. A stabilized oscillator comprising a first and a second electron discharge tube, each of said tubes having a cathode, a control electrode and an anode, a resistor connected between the cathode and control electrode of each tube, a potentiometer, a resistor connected between the anode of each tube and the potentiometer, a connection between each cathode and the potentiometer, a condenser connected from the connection between the anode and the resistor of the first tube to the control electrode of the second tube, a condenser connected from the connection between the anode and the resistor of the second tube to the control electrode of the first tube, and nonlinear impedance means connected between the control electrode of each tube and the potentiometer.

4. A stabilized oscillator comprising a first and a second electron discharge tube, each of said tubes having a cathode, a control electrode and an anode, a resistor connected between the cathode and control electrode of each tube, a potentiometer, a resistor connected between the anode of each tube and the potentiometer, a connection between each cathode and the potentiometer, a condenser connected from the connection between the anode and the resistor of the first tube to the control electrode of the second tube, a condenser connected from the connection between the anode and the resistor of the second tube to the control electrode of the first tube, and means connected between the control electrode of each tube and the potentiometer for limiting the potential difference between the cathode and control electrode of each tube to a predetermined maximum value and to a predetermined minimum value.

5. In a two-stage resistance capacity coupled amplifier each stage having an input and output

circuit with capacitative feed-back from the output circuit of the second stage to the input circuit of the first stage of such magnitude to produce self oscillations, the method of stabilizing the frequency of the oscillations which comprises producing a flow of current in parallel with the input circuits upon the occurrence of a potential difference across the input circuits exceeding a predetermined maximum value, and producing a flow of current in parallel with the input circuits upon the occurrence of a potential difference across the input circuit which is below a predetermined minimum value.

6. A multi-vibrator oscillator comprising a pair of space discharge tubes each having cathode, anode and control electrode elements, a connection from each anode to a control electrode of the other tube, said connection including a coupling condenser, a connection between said control electrode and the cathode of each tube, said connection including a grid-leak resistor, a source of potential, an impedance element having its terminals connected across said source of potential, connections from points on said impedance to said anodes and cathodes, and rectifier means connected between like elements of both of said tubes and a point on said impedance intermediate said terminals.

7. A multi-vibrator oscillator comprising a pair of space discharge tubes each including a cathode, an anode and a control electrode element, a connection from the anode of each tube to the control electrode of the other tube, said connection including a coupling condenser, a connection between the control electrode and the cathode of each tube, said connection including a grid-leak resistor, a source of potential connected between the anode and cathode elements of each tube, impedance means for providing a point of voltage intermediate the extremes of said source of potential, and rectifier means connected between the control electrodes of both of said tubes and said point of intermediate voltage.

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