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M. GEIGER

2,159,792

RELAXATION OSCILLATION GENERATOR

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Fig. 1

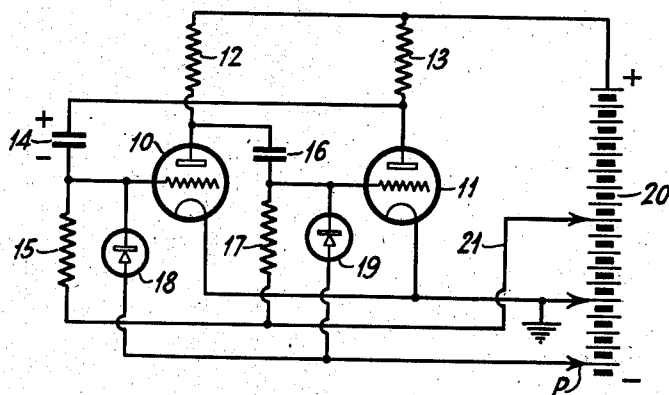


Fig. 2

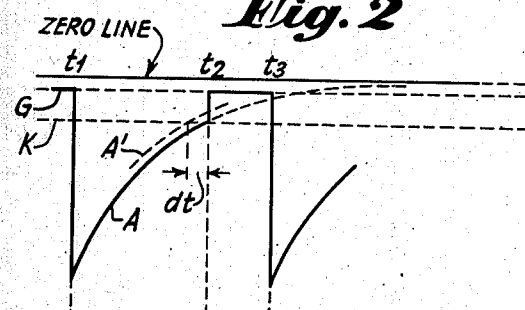


Fig. 3

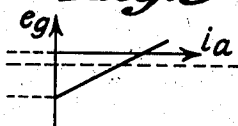


Fig. 4

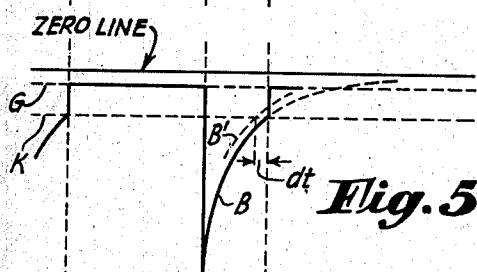
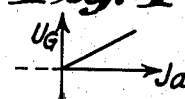


Fig. 5

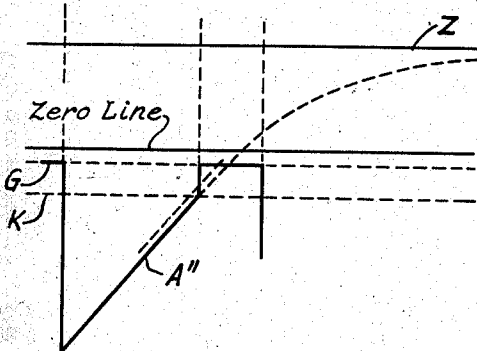


Fig. 6

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RELAXATION OSCILLATION GENERATOR

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6 Claims. (Cl. 250—36)

A multivibrator is known to be a relaxation oscillation generator containing two discharge paths, acting substantially in an alternative fashion, and in which the current passing through each of the two discharge paths is interrupted whenever current appears in the other discharge path. Such relaxation oscillation generators have a resistance-capacity member for each discharge path consisting of a condenser and a resistor connected in series, the one side of said resistance-capacity member being always connected respectively to the other discharge path. The other side of the resistance-capacity member was hitherto connected to the cathode of the respective discharge path. Such relaxation oscillation generators have the disadvantage that the frequency of the relaxation oscillations which they produce is influenced to a comparatively high degree by the so-called disturbance level, i. e. by the disturbances of nearby circuits inductively, or capacitively transmitted to the relaxation oscillation circuit.

In order to avoid this disadvantage the resistance-capacity member of each discharge path instead of being connected to the cathode is placed in accordance with the invention at a point of a potential that is positive relative to the cathode. The sensitivity to disturbances of the relaxation oscillation generator can in this way be decreased to a great extent.

The features of my invention are shown in the accompanying drawing in which:

Fig. 1 shows a circuit diagram of my improved multivibrator.

Fig. 2 shows a curve of the grid potential of one of the tubes of the multivibrator.

Fig. 3 shows the characteristic curve of grid voltage and anode current.

Fig. 4 shows a rectifier current-voltage curve.

Fig. 5 is similar to Fig. 2 and shows a curve of the grid voltage of the other tube of the multivibrator.

Fig. 6 shows a curve of the grid voltage variation in accordance with my invention.

Before elucidating the functioning of the circuit arranged in accordance with the invention, by way of an example of construction, there will now be explained by reference to Figure 1 relating to a multivibrator in the known circuit, the production of relaxation oscillations under the influence of resistance-capacity members connected to the cathodes of the appertaining discharge paths, and the sensitivity to disturbance shall be briefly explained.

In Figure 1, items 10 and 11 designate two

amplifier tubes whose plate circuits contain the resistors 12 and 13, while the cathodes thereof are connected to each other. A condenser is inserted between the anode of tube 11 and the grid of tube 10, and a resistor is placed between this grid and the cathode of tube 10. The condenser 14 and the resistor 15 form the resistance-capacity member for the tube 10. In the same manner, a resistance-capacity member is provided for the tube 11 and which consists of a condenser 16 and a resistor 17. Furthermore, it is assumed that between the control grids of the two tubes and the cathodes a rectifier 18 and 19 respectively be placed together with a bias voltage source represented in Figure 1 by a part of the common battery 20.

In the circuit shown in Figure 1, assume that the resistances 15 and 17 are connected directly between the control electrodes and the cathodes of tubes 10 and 11 respectively; that is, the conductor 21 is connected to ground potential. Assume further that the tube 11 conducts current, and that the condenser 14 has a high charge in the sense of the signs indicated. The grid potential of the tube 10 lies then far below the lower bend of the plate current-grid voltage characteristic. In Figure 2, showing the grid potential of tube 10 as function of the time, a highly negative grid potential is thus present at this moment as indicated at the point t_1 . The grid potential is traced in Figure 2 in the direction downwards from the zero line. The line K corresponds with the value of the potential at which current begins to flow in the tube 10, i. e. corresponding to the lower bend of the curve represented in Figure 3 and showing the dependence of the plate current i_a on the grid voltage e_g . The line G corresponds to the grid potential at which the rectifiers 18, 19 begin to carry current. Assuming that the dependence of the rectifier current J_a on the voltage U_g takes the course shown in Figure 4, the vertical distance of the line G from the zero line corresponds to the voltage of the tap point P of the battery 20 with respect to ground. Beginning with the moment t_1 the condenser 14 will be discharged across the resistor 15 in accordance with an e-function, whose time constant is determined by the capacity of the condenser 14, and by the value of the resistor 15, whereby the grid potential of the tube 10 moves towards the zero value. This e-function is represented in Figure 2 by the curve A whose later part is shown in dotted line. This curve approaches the zero line as an asymptote. In the intersection point of the

curve A with the straight line K the tube 10 begins to conduct current whereby its plate potential decreases owing to the potential drop produced through the resistor 12. Hence, the grid potential of the tube 11 decreases and likewise the plate current of this tube, so that the voltage drop through the resistor 13 will be reduced whereupon the plate potential of the tube 11 increases. This entails a further potential increase at the grid of tube 10, so that the plate current thereof increases still further, and the plate current of the tube 11 drops still further. This relationship of the plate current of each tube to the plate potential of the other respective tube as determined by the circuit, leads to a complete interruption of the plate current in tube 11 while that of tube 10 increases until the grid of tube 10 has only such a low negative potential relative to the cathode of this tube that the rectifier 18 permits the passage of current. From this moment, as indicated at the point t_2 in Figure 2, the grid potential of the tube 10, and also its plate current, remain at first constant. The condenser 16 which was charged during the time t_1 , t_2 will now be discharged beginning at the moment represented at point t_2 in accordance with an e-function whose course likewise approaches the zero line as an asymptote as in the case of the curve A in Figure 2. This is shown in Figure 5 in which the grid potential of the tube 11 is traced from the zero line downwards as function of the time. During the time t_1 , t_2 this grid potential is constant since during this time the rectifier 19 permitted the passing of current. At the moment t_2 the grid potential becomes negative quickly because of the rapid current increase in the tube 10, and, from the moment t_2 on, the said discharge of the condenser 16 takes place in accordance with the e-function B. At the moment that the curve B passes through the line K, which has the same significance as that in Figure 2, current begins to flow in the tube 11 causing an interruption of the plate current in the tube 10 for the same reason as explained in connection with Figure 2. The grid potential of the tube 11 is then again constant from the moment t_3 on, because of the passage of current through the rectifier 19, and the grid potential of the tube 10 again takes its course in accordance with an e-function.

The influence of disturbance potentials at the grids of the tubes can be easily recognized by an inspection of the Figures 2 and 5. Assuming that this disturbance potential consists of short, irregularly appearing voltage impulses of for instance 0.1 volt, the setting in of a discharge current in one of the two tubes, and hence the interruption of the plate current in the other tube, can take place when the curve A or B is still apart from the line K by 0.1 volt. Therefore, in Figures 2 and 5, there is shown at a distance of 0.1 volt above the curves A and B, second curves A', B', whose intersection points with the lines K determine the earliest moment in which the relaxation of the multivibrator can occur under the influence of the disturbance potentials. The disturbance potential can thus have the effect that the time period t_1 , t_2 or t_2 , t_3 will be changed by the value dt . This value, in many cases, will be found to have a disturbing effect, particularly when the multivibrator is used as an impulse generator in a television transmitter.

In accordance with the invention therefore, the resistors 15, 17 are not to be connected to

the cathode of the tubes 10, 11, but to a point of the voltage source 20 that is positive relative to the cathodes of the tubes. This is indicated in Figure 1 by the line 21.

This modification of the circuit has the effect that the curves A and B no longer approach the zero line in Figures 2 and 5 as asymptote, but instead approach a horizontal line Z lying above this zero line. This is shown in Figure 6 for the tube 10. The zero line in Figure 6 corresponds to the cathode potential of the tube 10, and the asymptote of the grid voltage course A'', designated by Z, lies above the zero line to the extent in which the connection point of the line 21 which is dotted in Figure 1 is apart from the cathode potential. Figure 6 shows that the curve A'' intersects the line K at a steeper angle than in the case of the curve A in Figure 2. Accordingly, when assuming a disturbance potential having the same value as was presupposed in Figure 2, a much smaller displacement of the setting-in point of the discharge in the tube 10 takes place. The comparatively high value dt obtained when cathode potential is applied to the resistance-capacity members thus can be appreciably decreased when a potential is applied to the resistance-capacity members which is positive relative to the cathode. The time constant of the two resistance-capacity members, when the time t_1 , t_2 and t_2 , t_3 is to be the same, is to be chosen differently from the case in which the resistance-capacity members have cathode potential.

Various modifications may be made in my invention without departing from the spirit and scope thereof and I desire, therefore, that any such limitations shall be placed thereon as are imposed by the prior art and are set forth in the appended claims.

I claim as my invention:

1. An oscillator for producing a saw-tooth wave form comprising a pair of electron discharge devices each of which includes a cathode, a control electrode, and an anode, means including anode resistances for maintaining said anodes positive with respect to said cathodes, means including electron storage devices for connecting the anode of each discharge device to the control electrode of the other discharge device, a pair of resistances, means for connecting one end of each resistance to said control electrodes, and means for maintaining the other ends of said pair of resistances positive with respect to said cathodes and negative with respect to said anodes.

2. An oscillator for producing a saw-tooth wave form comprising a pair of electron discharge devices each of which includes a cathode, a control electrode, and an anode, means including anode resistances for maintaining said anodes positive with respect to said cathodes, means including electron storage devices for connecting the anode of each discharge device to the control electrodes of the other discharge device, a pair of resistances, means for connecting one end of each resistance to said control electrodes, means for maintaining the other ends of said pair of resistances positive with respect to said cathodes and negative with respect to said anodes, a pair of asymmetric units, and means for connecting said units to said control electrodes and to a source of potential negative with respect to said cathodes.

3. An oscillator for producing a saw-tooth wave form comprising a pair of electron dis-

charge devices each of which includes a cathode, a control electrode, and an anode, means including anode resistances for maintaining said anodes positive with respect to said cathodes, means including electron storage devices for connecting the anode of each discharge device to the control electrode of the other discharge device, and means including a pair of resistances for connecting said control electrodes to a source of potential positive with respect to said cathodes.

4. An oscillator for producing a saw-tooth wave form comprising a pair of electron discharge devices each of which includes a cathode, a control electrode, and an anode, means including anode resistances for maintaining said anodes positive with respect to said cathodes, means including electron storage devices for connecting the anode of each discharge device to the control electrode of the other discharge device, means including a pair of resistances for connecting said control electrodes to a source of potential positive with respect to said cathodes, and means including a pair of asymmetric units for connecting said control electrodes to a source of potential negative with respect to said cathodes.

5. An oscillating circuit for producing a saw-

tooth wave form comprising a pair of electron discharge tubes each including an anode, a control electrode, and a cathode, means including a pair of resistances for connecting said anodes to a source of potential positive with respect to said cathode, a condenser connected between the anode of each tube and the control electrode of the other tube, a resistance connected to the control electrode of each tube, and means for connecting the other end of the control electrode resistances to a potential positive with respect to said cathodes.

6. An oscillating circuit for producing a saw-tooth wave form comprising a pair of electron discharge tubes each including an anode, a control electrode, and a cathode, means including a pair of resistances for connecting said anodes to a source of potential positive with respect to said cathode, a condenser connected between the anode of each tube and the control electrode of the other tube, a resistance connected to the control electrode of each tube, means for connecting the other end of the control electrode resistances to a potential positive with respect to said cathodes, and means including a pair of rectifiers for connecting said control electrodes to a source of potential negative with respect to said cathodes.

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