Jan. 19, 1943. H. BÄHRING 2,308,908

SAW-TOOTH OSCILLATOR

Filed Aug. 29, 1940 2 Sheets--Sheet 1

Fig. 1

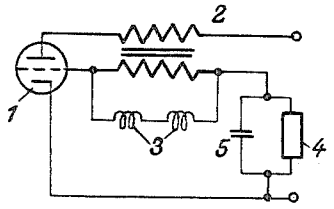

Fig. 2

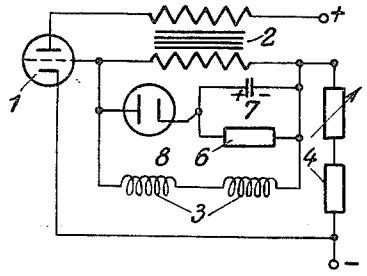

Fig. 3

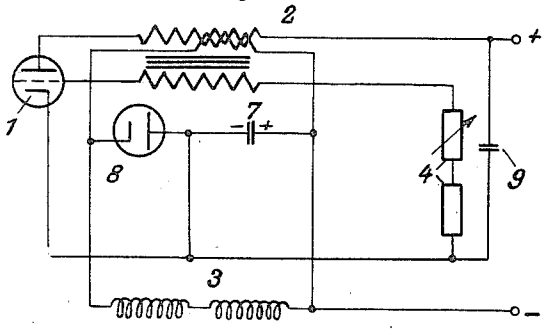

Fig. 4

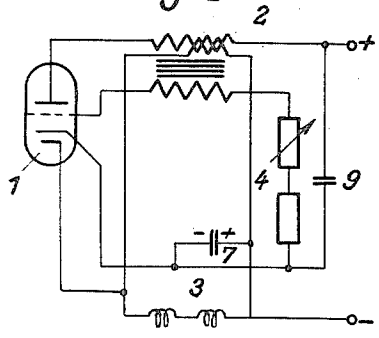

Fig. 5

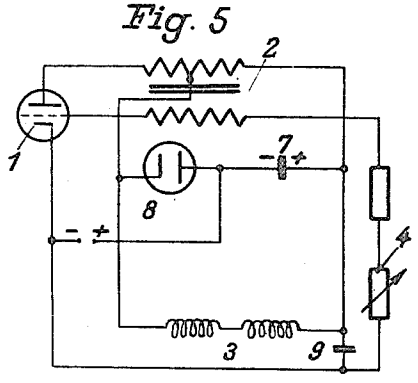

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Fig. 6

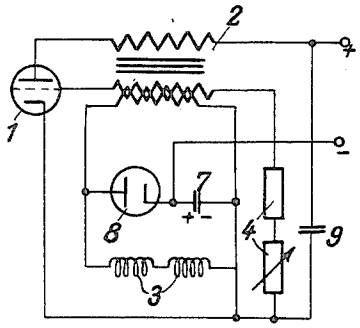


Fig. 7

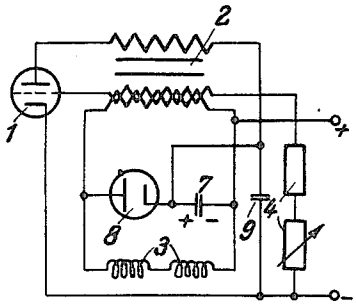


Fig. 8

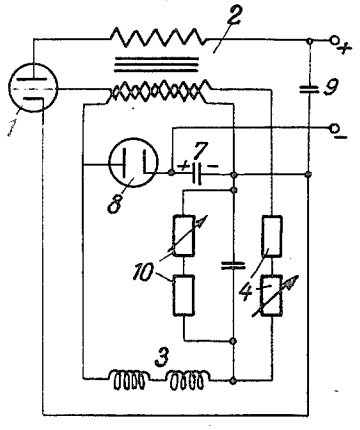
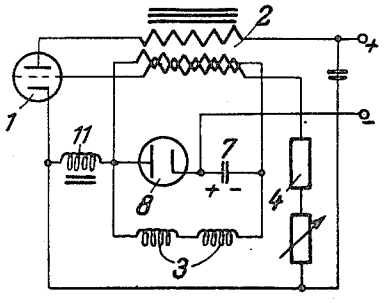


Fig. 9



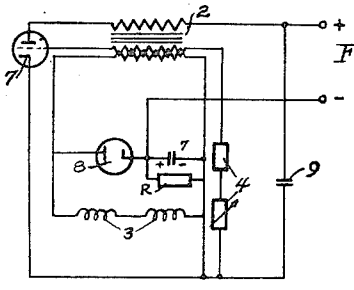


Fig. 10.

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UNITED STATES PATENT OFFICE

2,308,908

SAW-TOOTH OSCILLATOR

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vested in the Alien Property Custodian

Application August 29, 1940, Serial No. 354,743
In Germany September 7, 1939

7 Claims. (Cl. 250—27)

This invention relates to saw-tooth oscillators and is particularly concerned with circuits for producing a saw-tooth current having substantially linear ascending and descending portions. Saw-tooth oscillations of this kind are preferably employed for deflecting the cathode ray of cathode ray tubes used in connection with television or oscillograph devices.

It is an object of the invention to provide a saw-tooth oscillator requiring a very small amount of energy for its operation. It is a further object to improve the type of oscillator known as a transformer coupled oscillator containing a transformer with anode windings and grid windings connected to the anode and grid circuit of an oscillator tube. It is a further object to improve circuit arrangements in which a diode is arranged in parallel to the deflecting coils of the cathode ray tube for making the slope of the saw-tooth oscillations more linear. This diode has a comparatively large power consumption. Particularly when an oscillator of this type is used in receiver circuits it is desirable to devise the circuit in such a manner that the power consumption is as low as possible.

According to the invention the circuit is arranged in such a manner that the biasing potential for the diode is utilized as a part of the anode potential of the oscillator tube. The operating current flows at least through one winding of the transformer, through the generator tube and through the diode. By such an arrangement it is possible to save approximately 50% of the power necessary to operate the oscillator. It is furthermore preferable to arrange a high ohmic resistance in parallel to the biasing condenser of the diode so that a small portion of the current flows through this resistance. The arrangement of this resistance has the advantage that the oscillator is more readily self-starting in its operation.

Other aspects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawings

Fig. 1 shows a circuit of a known transformer oscillator,

Fig. 2 shows a circuit arrangement of a saw-tooth oscillator containing a diode in parallel to the deflecting coils.

Figs. 3 to 10 show circuit arrangements according to the invention.

In order to explain the advantages of the invention reference is made to a known arrangement represented in Fig. 1 containing a so-called saw-tooth current oscillator. The anode and grid of an oscillator tube 1 are connected to two windings of a transformer 2. The grid coil of the transformer is connected to an element consisting of a condenser 5 and a resistor 4. The deflecting coils 3 are arranged in parallel to the grid coil of the transformer. The grid current produces a biasing potential by means of the resistance capacity element 4, 5. The grid cathode space of the tube has a linearizing effect upon the slope of the saw-tooth current in the manner of a diode biased by the element consisting of resistor 4 and condenser 5.

It has been suggested to improve the linearity of the slope by providing a diode 8 having a small internal resistance in parallel to the deflecting coils as shown in Fig. 2. The smoothing condenser 5 of Fig. 1 can be omitted and by a suitable choice of resistors 4 and 6 the result can be obtained that the diode takes over a part of the load. This is of a considerable advantage for the dimensioning of the oscillator tube.

The arrangement of Fig. 2 has however the drawback that the power consumption of the resistor 6 is lost. Furthermore the voltage across elements 6 and 7 must be large in comparison to the voltage drop across the diode in order to produce the desired linearizing effect. A power loss due to the resistor 6 seems therefore unavoidable.

According to the invention the circuit arrangement of Fig. 3 or one of the following figures is used to overcome this drawback. The anode of oscillator tube 1 is connected to the anode winding of transformer 2 and the grid of tube 1 to the grid winding. The deflecting coils 3 are connected to a separate output winding. A diode 8 and a condenser 7 are arranged in parallel to the deflecting coils 3. The biasing resistor 4 is partly adjustable and comparatively large. It is used for adjusting the frequency of the oscillator. A condenser 9 is provided for smoothing the anode current. In this arrangement the operating current flows through the anode winding of the transformer, through the oscillator tube and through the diode. The biasing potential for the diode is therefore used as additional operating anode potential.

As the anode of the diode is directly connected to the cathode of the oscillator tube the two discharge devices can be combined within a single envelope according to Fig. 4. The diode is ar-

ranged within tube 1 and its anode is the cathode of the oscillator tube.

Instead of arranging the diode in the cathode path of the oscillator tube the diode can also be connected in the anode circuit of this tube as shown in Fig. 5. A special output winding is not required in this case. Also in this arrangement the diode and the oscillator tube are arranged in series with regard to their operating potentials. The arrangement of Fig. 5 requires only 50% of the power required by the arrangement of Fig. 2 for the same output current.

Figs. 6 and 7 show two further embodiments of the invention. The deflecting coils are connected in these figures to an additional coil of the grid circuit arrangement having the same sense of winding as the grid coil. Also in this case the anode voltage for the oscillator tube and the voltage produced across condenser 7 are arranged in series aiding relation so that the external anode voltage supply can be lowered accordingly. The arrangements of Figs. 6 and 7 have the advantage that the cathode of the diode does not require an insulated heater circuit because no high tension exists between the filament and the emitting layer.

In order to enable a centering adjustment of the scanning field upon the screen of the cathode ray tube the circuit can be arranged according to Fig. 8. This circuit is similar to that of Fig. 6 with the exception that an adjustable resistance arrangement 10 is provided for changing the ratio between the grid current flowing through the deflecting coils and the diode current.

Fig. 9 shows an embodiment in which the deflecting coils are connected to a separate output winding. The connection between the low potential side of the deflecting coils and the cathode of the diode and with the positive pole of the external voltage source as shown in Fig. 5 is replaced by a connection of the high potential side of the deflecting coils by way of a choke coil 11 to the cathode of the oscillator tube 1.

A further improvement is represented in Fig. 10. Particularly if the coils of the transformer are coupled very close the arrangements shown in Figs. 3 to 9 require an impulse for setting the oscillator circuit into operation. This is necessary because during the heating period of the diode the condenser 7 is not yet charged to its full operating voltage and the grid coil of the transformer is short circuited for alternating currents by way of the diode and the condenser. According to Fig. 10 an additional resistor R is arranged in parallel to the condenser 7 of the diode circuit. This condenser has the effect that during the heating period an auxiliary current flows which is small in comparison with the operating current so that independent of the charging of the condenser and the condition of the diode an oscillation can start. It is preferable to employ an oscillator tube 1 having a shorter heating period than the diode 6. If the oscillation has once started the condenser receives its charge during the operation and the diode takes over its function. The internal resistance of the diode assumes a constant low value during the periods of conductivity. The resistor R can be arranged in similar manner in all circuits of Figs. 3 to 9. It can be preferable to employ a voltage divider instead of a fixed resistor. If a screen grid tube is used for synchronizing purposes the screen grid potential can be taken off from such a voltage divider.

The invention is not limited to the circuit arrangements shown in the figures. It can be employed also in connection with oscillation generators of other types. The use of the invention in connection with transformer oscillators has however the advantage that a simple triode can be used as oscillator tube consuming only a very small amount of energy.

What I claim is:

1. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, means for coupling said anode and said control element to obtain the transfer of energy therebetween, a deflecting coil, means for coupling said deflecting coil with said oscillator tube to produce a flow of sawtooth current through said coil, a diode and biasing means comprising a parallel combination of a resistance element and a condenser for providing said diode with an operating bias voltage connected in series relation, means for connecting said diode and said biasing means in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube, and means for connecting said voltage source and said biasing means in series-aiding relation between said anode and said cathode.

2. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, a transformer for coupling said anode and said control element, a deflecting coil coupled to said transformer to produce a flow of sawtooth current through said coil, a diode and biasing means comprising a parallel combination of a resistance element and a condenser for providing said diode with an operating bias voltage connected in series relation, means for connecting said diode and said biasing means in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube, and means for connecting said voltage source and said biasing means in series-aiding relation between said anode and said cathode.

3. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, a transformer for coupling said anode and said control element, a deflecting coil, means for magnetically coupling said deflecting coil to said transformer to produce a flow of sawtooth current through said coil, a diode and biasing means comprising a parallel combination of a resistance element and a condenser for providing said diode with an operating bias voltage connected in series relation, means for connecting said diode and said biasing means in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube, and means for connecting said voltage source and said biasing means in series-aiding relation between said anode and said cathode.

4. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, means for coupling said anode and said control element to obtain the transfer of energy therebetween, a deflecting coil, means for coupling said deflecting coil with said oscillator tube to produce a flow of sawtooth current through said coil, a diode and biasing means having two terminals and comprising a parallel combination of a resistance element and a condenser for providing said diode with an operating bias voltage connected in series relation, means for connecting said diode and said biasing means in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube having two terminals, means for so

[redacted]

connecting one of said terminals of said biasing means to one of said terminals of said voltage source and the other of said terminals of said biasing means to said cathode that the voltages of said source and said biasing means are in series-aiding relation.

5. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, means for coupling said anode and said control element to obtain the transfer of energy therebetween, a deflecting coil, means for coupling said deflecting coil with said oscillating tube to produce a flow of sawtooth current through said coil, a diode and a condenser connected in series relation whereby an operating bias voltage for said diode is developed across said condenser, means for connecting said diode and said condenser in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube, and means for connecting said voltage source and said condenser in such manner that their voltages are in series-aiding relation.

6. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, means for coupling said anode and said control element to obtain the transfer of energy therebetween, a deflecting coil, means for coupling said deflecting coil with said oscillator tube to produce a flow of sawtooth current through said coil, a diode and a condenser connected in series relation, whereby an operating bias voltage for said diode is developed across said condenser, a resistance element connected to the terminals of said condenser, means for connecting said diode and said condenser in parallel relation with said deflecting coil, a source of operating voltage for said oscillator tube, and means for connecting said voltage source and said condenser in such manner that their voltages are in series-aiding relation.

7. A sawtooth current generator comprising an oscillator tube having an anode, a cathode and a control element, a transformer having a first winding and a second winding for coupling said anode and said control element, a deflecting coil, a diode having an anode and a cathode, biasing means comprising a parallel combination of a resistance element and a condenser for providing said diode with an operating bias voltage connected in series relation with said diode, means for connecting said diode cathode to a point on said first transformer winding, means for coupling said deflecting coil with said cathode of said oscillator tube, a source of operating voltage for said oscillator tube, said voltage source and said biasing means being so connected that their voltages are in series-aiding relation.

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