

Aug. 8, 1939.

M. GEIGER

2,168,403

SAW-TOOTH WAVE GENERATOR

Filed Sept. 21, 1936

Fig. 1a

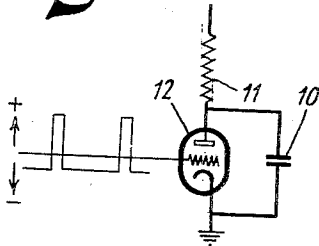


Fig. 1b

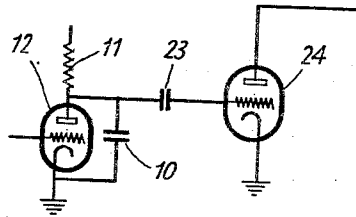


Fig. 2

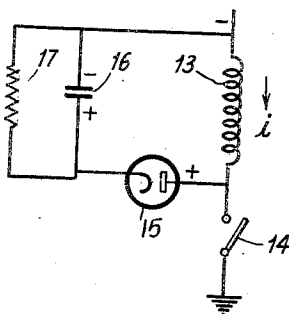


Fig. 3

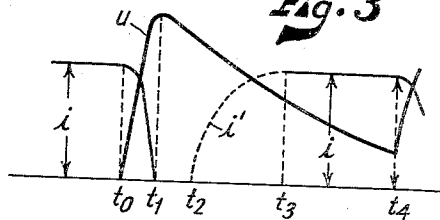


Fig. 5

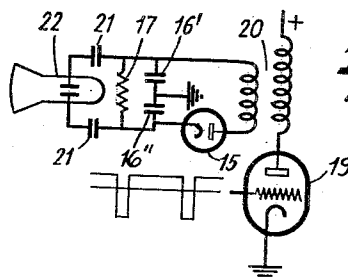


Fig. 6

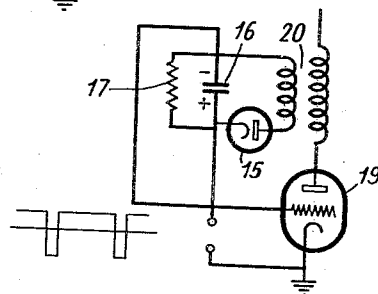
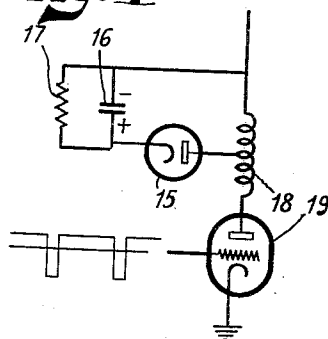


Fig. 4



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2,168,403

SAW-TOOTH WAVE GENERATOR

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Application September 21, 1936, Serial No. 101,781
In Germany September 25, 1935

3 Claims. (Cl. 250—36)

My invention relates broadly to apparatus for producing a serrated or saw-toothed wave form and more particularly to an apparatus whereby electromagnetic energy is produced at definite intervals, which energy charges a condenser, the latter being so connected as to discharge linearly.

It is well known in the prior art to produce a saw-tooth shaped voltage curve by means of a condenser which is charged by a voltage source and after being charged is linearly discharged across a resistor. In these known arrangements, the discharge performance is initiated across a vacuum tube connected in parallel to the condenser. This known arrangement has the disadvantage that it requires a potential source which must have a higher voltage than the amplitude of the desired saw-tooth voltage curve.

In accordance with my invention, a circuit arrangement is proposed with which saw-tooth shaped voltage curves may be produced by means of an auxiliary voltage source whose voltage is much lower than that used in the prior art. The arrangement consists primarily in providing a storage means for magnetic energy which is joined to a switch arrangement and which is connected in series with a rectifier and condenser, the latter having a resistance to provide a discharge path in parallel thereto.

The invention will best be understood by reference to the drawing in which:

Figure 1a shows a known arrangement of the prior art.

Figure 1b shows a modification of Figure 1a.

Figure 2 is a schematic embodiment of my invention.

Figure 3 is a set of explanatory curves.

Figure 4 is an embodiment of my invention; and

Figures 5 and 6 are still further embodiments of my invention.

Referring to Figure 1a, there is illustrated an arrangement known to the prior art. The condenser 10 is charged by a direct voltage source (not shown) which is illustrated by a plus sign and whose negative pole is grounded. The charging takes place across the resistor 11. The voltage at the condenser 10 increases at first in a linear fashion presuming that the tube 12 is blocked. When a positive pulse appears at the grid of tube 12, as illustrated, the tube will conduct and the condenser will discharge across the tube. This arrangement, as has been pointed out, has the disadvantage that it requires a potential source which is to have a higher voltage

than the amplitude of the desired saw-tooth voltage.

Figure 1b shows an amplifier arrangement joined to a saw-tooth wave form generator, such as has been used in the prior art.

Referring to Figure 2, the broad embodiment of my invention is disclosed. A choke coil 13 is connected in series with a switch 14 and a source of potential (not shown) indicated by a plus sign. The choke coil, together with a rectifier 15 and a condenser 16, form a closed series circuit. Connected in parallel with the condenser 16 is a resistance 17 adapted to form a leakage path for charges on the condenser 16. The functioning of the apparatus is as follows: It is assumed at first that the condenser 16 is without charge and that the switch 14 is closed. A direct current having the value i will then pass through the choke coil 13. At the moment t_0 (see Fig. 3), the switch 14 may be opened just interrupting the flow of direct current. By well known electrical phenomena, a voltage appears across the choke coil 13 whose direction is indicated by the plus and minus sign shown. Within the time t_0 to t_1 (see Fig. 3), the current in the coil drops to zero and the voltage u at the condenser 16 assumes a value depending upon the magnetic energy in the choke coil and the capacity of the condenser 16. As a matter of fact, the choke coil together with the condenser form an oscillatory circuit and an oscillation is set up therein which will be disrupted at the end of a quarter cycle due to the blocking effect of the rectifier 15. The condenser then will slowly discharge across the resistor 17 in a linear fashion. At a predeterminable moment t_2 , the current will again be introduced by the choke coil and it should not be increased to too high a value in order to avoid oscillation in the choke coil. At the time t_3 , the current i' has assumed again the value i . At the time t_4 , the current again will be disrupted in the choke coil whereafter a new charging of the condenser will be initiated. Thus there appears at the condenser a rapidly increasing and slowly decreasing saw-tooth shaped voltage wave.

Reference to Fig. 3 should be had in conjunction with the foregoing explanation.

Referring to Fig. 4, a modification of my arrangement is shown. An auto-transformer 18 is used as the magnetic energy storing means and is connected in the plate circuit of tube 19 to the voltage supply source for the plate of the tube. A triode 19 is illustrated which serves the purpose of a switch. Of course, a multi-

grid could just as well be used. The tube 19 is ordinarily conducting and is blocked from time to time by a negative impulse. The secondary of the auto-transformer 18, together with the condenser 16, oscillate for a quarter cycle in the same manner as illustrated in Figs. 2 and 3. An advantage of this arrangement is that the same condenser voltage could be reached, as is reached in Fig. 2, in a shorter period of time, since the duration of the cycle of oscillation performance depends on the induction of the secondary winding of the auto-transformer. Thus a steeper wave front is obtained.

Referring to Fig. 5, a transformer 20 has been substituted for the auto-transformer 18, as illustrated in Fig. 4, and performs the function as magnetic energy storing means. Also, the condenser 16 illustrated in Fig. 4 has been supplanted by two condensers 16' and 16'' which are joined in series and the connection joining them is grounded. This arrangement has the advantage that the series circuit formed by the secondary winding of the transformer 20, the rectifier 15 and the condensers, may be grounded at any desired point. This is especially desirable if a so-called symmetrical voltage wave is to be produced, i. e. a voltage having a saw-tooth form without a direct current component. The voltage set-up across the series connected condensers may be applied to the deflection plates of a cathode ray tube 22, across coupling condensers 21.

Referring to Figure 6, a modification of Fig. 5 is shown wherein saw-tooth formed current is directly produced. The saw-tooth voltage appearing across the condenser 16 is introduced into the grid circuit of the tube 19 so that the plate current of the tube follows a saw-tooth shaped pattern. This is especially advantageous for use with cathode ray tubes which employ the magnetic deflecting means rather than electrostatic deflecting means.

In the prior art the arrangement shown in Fig. 1b, previously referred to, was the arrangement hitherto used for the production of currents for a saw-toothed wave shape. However, my inven-

tion has the advantage of simplicity as regards such an arrangement.

What I claim is:

1. An apparatus for producing waves of a serrated wave form comprising a thermionic tube including anode, cathode and control electrodes, means connected with the control electrode of the tube for blocking the tube at predeterminable intervals, an auto-transformer connected in the plate-cathode circuit of the tube, a series electrical circuit comprising the secondary of the auto-transformer, a rectifier and a storage condenser, and a resistance element joined in parallel to said condenser.

2. An apparatus for producing waves of a serrated wave form comprising a thermionic tube including anode, cathode and control electrodes, means connected with the control electrode of the tube for blocking the tube at predeterminable intervals, a transformer connected in the plate-cathode circuit of the tube, a series circuit comprising the secondary of said transformer, a rectifier and two condensers, a connection joining the connecting element of the two aforementioned condensers to ground and maintaining the connecting point substantially at ground potential, and a resistance element connected in parallel to the two condensers, for linearly discharging said condensers.

3. An apparatus for producing waves of a serrated wave form comprising a thermionic tube including anode, cathode and control electrodes, means connected with the control electrode of the tube for blocking the tube at predeterminable intervals, a transformer connected in the plate-cathode circuit of the tube, a series circuit comprising the secondary of said transformer, a rectifier and a storage condenser, a resistance connected in parallel to said condenser and forming a discharge path therefor, and means for feeding the electrical variations in said aforementioned series circuit to a control element of the vacuum tube.

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