

Nov. 28, 1939.

D. HERMANN

2,181,328

ELECTRICAL WAVE GENERATOR

Filed June 24, 1938

3 Sheets-Sheet 1

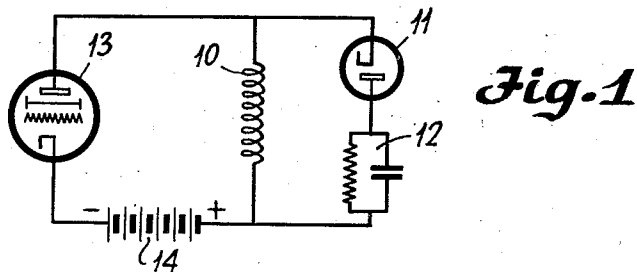
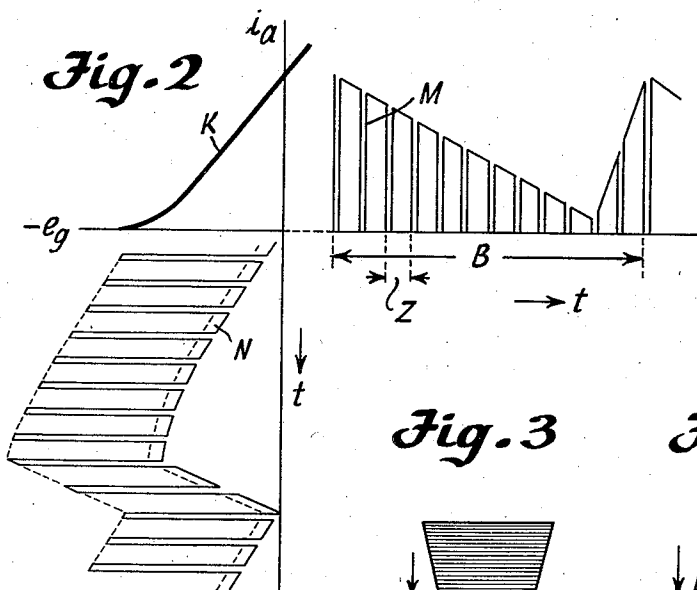


Fig. 3

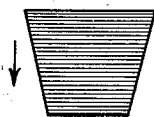
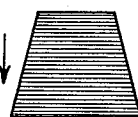
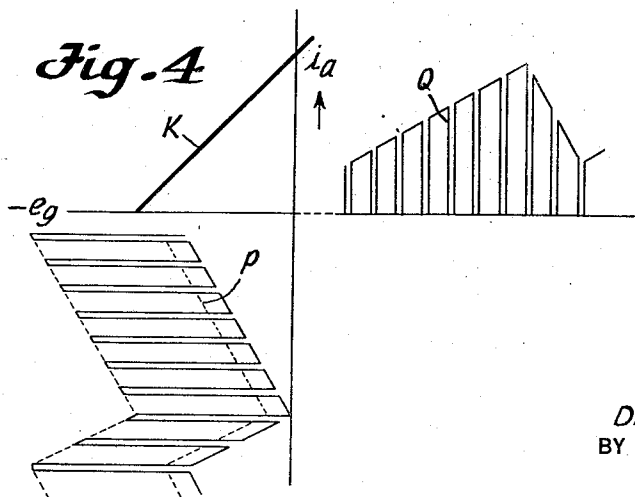


Fig. 5



INVENTOR
DIETRICH HERMANN
BY *H.S. Snover*
ATTORNEY

Nov. 28, 1939.

D. HERMANN

2,181,328

ELECTRICAL WAVE GENERATOR

Filed June 24, 1938

3 Sheets-Sheet 2

Fig. 6

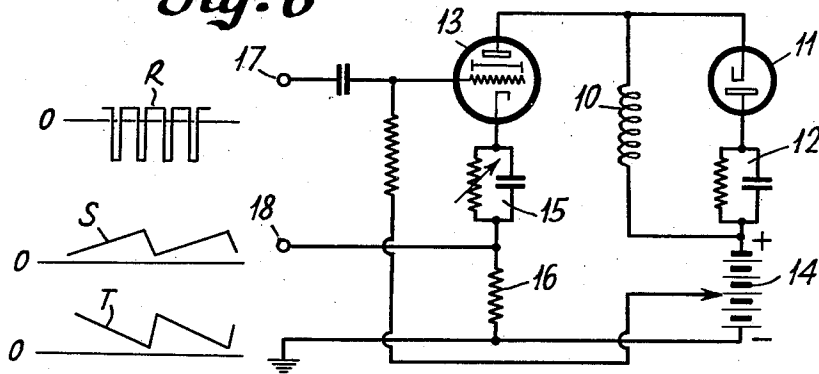


Fig. 7

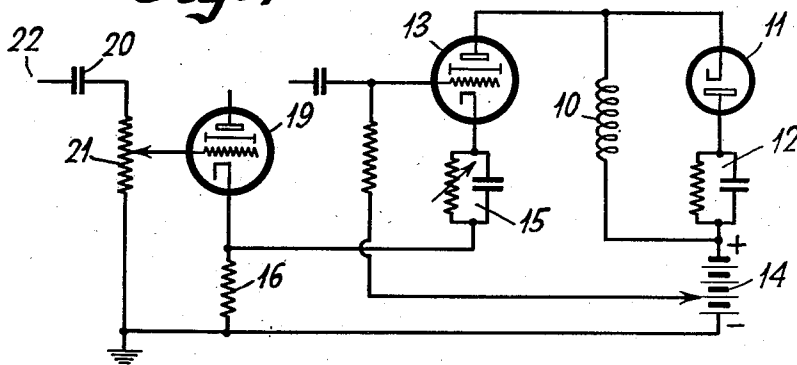
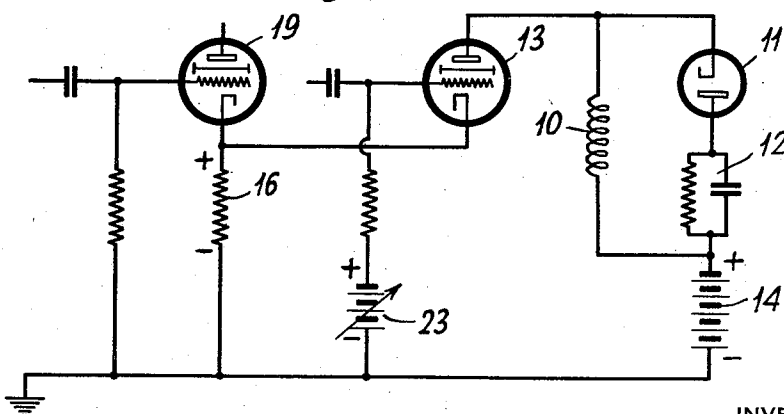


Fig. 8



INVENTOR
DIETRICH HERMANN
BY *H.S. Brover*
ATTORNEYS

Nov. 28, 1939.

D. HERMANN

2,181,328

ELECTRICAL WAVE GENERATOR

Filed June 24, 1938

3 Sheets-Sheet 3

Fig. 9

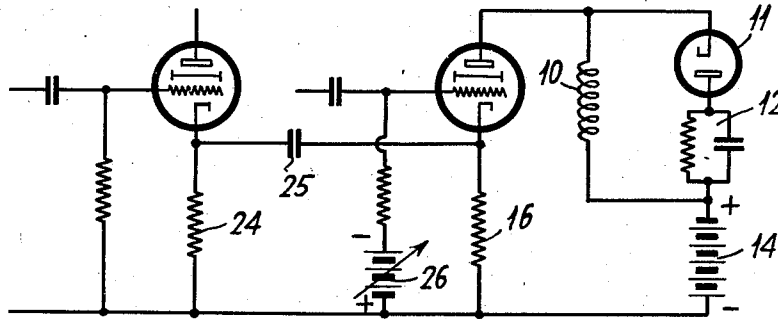


Fig. 10

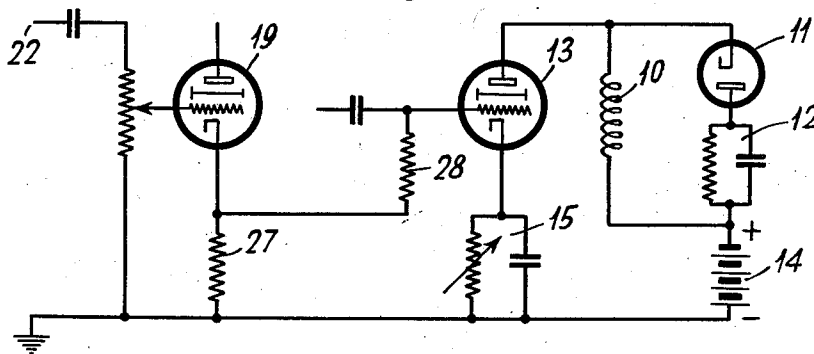


Fig. 11

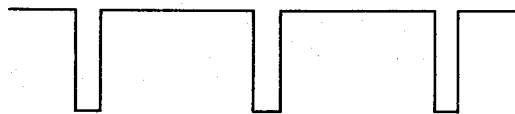
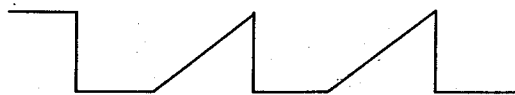


Fig. 12



INVENTOR
DIETRICH HERMANN
BY *H.S. Snover*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,181,328

ELECTRICAL WAVE GENERATOR

Dietrich Hermann, Berlin, Germany, assignor to
Telefunken Gesellschaft für Drahtlose Tele-
graphie m. b. H., Berlin, Germany, a corpora-
tion of Germany

Application June 24, 1938, Serial No. 215,624
In Germany May 11, 1937

6 Claims. (Cl. 250—36)

My invention relates in general to sawtooth generator as shown for instance in co-pending application Serial No. 109,623 filed November 7, 1936 of Robert Andrieu.

The aforementioned application relates to a circuit arrangement which serves for providing by means of cathode rays and in a manner required for certain purposes in television, a trapezoidal picture field on a screen placed at right angles to the mean position of the rays. In television this requirement presents itself, for instance, in receiving tubes in which the face of the fluorescent screen on which the cathode rays impinge is to be viewed, or to be projected while the direction of viewing, or the direction of the projection is to be at right angles to the screen. The identical problem also arises, for instance, in the case of cathode ray image scanners in which by means of a luminous optical objective whose axis is at right angles to the analyzer screen, a luminous optical image of the subject to be televised is to be reproduced on this screen while this screen is to be scanned by means of a cathode ray which in its central position does not impinge the screen at right angles thereto. In all such cases, a trapezoidal image field would be described on the fluorescent screen or analyzing screen when utilizing sawtooth circuits for linear deflection which produce within an image field, line sawtooth-shaped impulses all having the same amplitudes. In order to achieve a rectangular image field it will therefore be necessary to change the line amplitude during each image time period (or in the case of the line skip or interlacing method of scanning during each duration of the line series). With this modulation of the line amplitude by means of the image sawtooth or line series sawtooth, a trapezoidal image field would be obtained on a screen placed at right angles to the mean axis of the cathode rays. In accordance with the aforementioned application, this problem is solved in that the oscillatory circuit containing the deviation coil and consisting preferably of the inductance of the deflecting coil and of its distributed capacity, receives during the long flanks of the sawtooth current waves a potential always of the same sign and which has as such a sawtooth shape with the desired cycle of the trapeze, but which is interrupted at each short flank. According to the aforementioned application, there is utilized among other means a resistance condenser combination forming a closed circuit, together with a detector and the deflection coil, and

having a time constant which is greater than the image duration or line series duration.

In accordance with the present invention, in such circuit the resistance condenser combination has a time constant which is shorter than an image period but greater than a line period, and the plate current of a controlled tube connected with the deflection coil in a second circuit is to vary in a sawtooth like manner with the image cycle (or line series cycle).

My invention will best be understood by reference to the drawings, in which

Fig. 1 shows one embodiment of a sawtooth generator,

Figs. 2, 3, 4 and 5 are explanatory diagrams,

Figs. 6, 7, 8, 9 and 10 are embodiments thereof, and

Figs. 11 and 12 are explanatory curves.

Referring to Fig. 1, there is shown an inductive member 10 having connected in parallel thereto a series circuit comprising a rectifier 11 and a time constant circuit 12, the latter comprising a condenser and resistance combination. The parallel combination of the inductance, rectifier and time constant circuit are connected in the plate cathode circuit of a thermionic tube 13 having anode, cathode and at least one control electrode, the thermionic tube being energized by a source of potential 14.

Referring to Fig. 2, there is shown a set of explanatory curves. The plate current, grid voltage characteristic of the tube is represented by the curve K. Now, if the plate current of the tube 13 varies with the image period, or frame period B, and is interrupted for each short flank of the line sawtooth, the pattern of the plate current will be that shown in Fig. 2 by the curve M. Since the time constant of the resistance-condenser combination 12 is greater than the line period Z or shorter than the image period or frame period B, the potential across the time constant circuit will not follow the current variations during the cycle or period Z but will conform only to the current variations within the very much longer period B. The voltage across the resistance-condenser combination thus varies in a sawtooth like manner during the course of a frame period but owing to the line impulses impressed on the control grid of tube 13 resulting in a potential across coil 10 having a sawtooth pattern with the cycle of the frame period, and which is interrupted for the duration of each short flank of the line sawtooth as explained in my aforementioned copending application. The pattern of the plate current obtained is a 55

function of time and shown at the right of Fig. 2 is achieved as a result of the pattern of the grid potential impressed on the control grid of tube 13, the latter being shown at the left of Fig. 2 and which is plotted with respect to the time coordinate T. The bend of the lower part of the curve K may be utilized for compensating the bend of the image or frame sawtooth curve, and a curve will result, as shown in Fig. 3. In an analogous manner, a voltage pattern impressed on the grid of tube 13 which follows the curve P of Fig. 4, the resultant plate current pattern will follow the curve shown and identified as Q and a trapezium will be obtained as indicated by Fig. 5.

Referring to Fig. 6, there is shown an embodiment of my invention. In this figure, a resistance-condenser combination 15 which has a time constant that is large as compared with the frame frequency is connected to the cathode of the tube 13. Also connected in the cathode circuit, as shown in the figure, is a resistor 16. When the line impulses in accordance with the potential curve R are impressed on the control grid of tube 13, namely at the terminal 17, and when impressing on the terminal 13 an image sawtooth potential relative to ground in accordance with the pattern of the curve S, a trapezium according to Figure 3 will be obtained. But when applying at the terminal 13 an image sawtooth potential according to the curve T, a trapezium according to Figure 5 will be produced. In both cases, the resistance-condenser combination 15 serves for attaining a suitable working point for the control grid of tube 13. Since the coil 10 may be the deflecting coil of the tube, the output occurs across the terminals of this coil.

The mode of construction as shown in Figure 7 shows that the sawtooth shaped potential at the resistor 16 of Figure 6 can suitably be produced in that this resistor is at the same time the cathode resistor of another thermionic tube 19 the control grid of which has the image sawtooth potential applied thereto across a resistance condenser coupling 20, 21, i. e., this potential is applied to the terminal 22. The resistor 21 hereby acts at the same time as voltage divider. For a saw-tooth pattern according to the curve S of Figure 6 existing at the terminal 22, a trapezium according to Figure 3 will be obtained, and for a voltage pattern according to the curve T of Figure 6, a trapezium according to Figure 5 will be produced.

The constant grid biasing potential for the control grid of tube 13 instead of being obtained by tapping the plate potential source 14 as indicated in Figure 6 or Figure 7, may as shown in Figure 8 also be produced by a potential source 23 whose positive end is placed at the control grid of the tube 13. Since the cathode resistance 16 carries a mean direct current causing a potential drop in the sense of the indicated plus signs and minus signs, the required negative grid biasing potential for the tube 13 can be assured in that the potential source 23 is chosen for a value that is lower than the potential drop produced through the resistor by the mean direct current of the tube 19.

It is seen from Figure 9 that by coupling the resistor 13 capacitively to a special cathode resistor 24 of the tube 19, only the alternating voltage part of the image sawtooth potential will be passed to the resistor 13, while the direct voltage part of the image sawtooth potential remaining at the resistor 24 is prevented by the coupling condenser 25 from passing to the resistor 16.

The negative grid bias potential for the tube 13 is therefore produced by a direct potential source 26 whose negative end is placed at the control grid of this tube.

Figure 10 shows a circuit arrangement in which the image sawtooth potential is produced at a part 27 of the grid leak resistor 27, 28 of the controlled tube 13 which is also the cathode resistor of the further tube 19. Since a positive grid biasing potential is hereby also introduced in the control grid circuit of the tube 13, namely that produced by the direct plate current of the tube 19 at the resistor 27, the resistor condenser organ 15 placed in the cathode lead-in of the tube 13 can serve at the same time for producing the necessary positive cathode biasing potential for the tube 13. At the terminal 22 in Figure 10, a sawtooth potential according to the curve S of Figure 6 produces a trapezium according to Figure 5, and a sawtooth potential according to the curve T of Figure 6 forms a trapezium according to Figure 3.

In all modes of construction shown, for the sake of simplification a rectangular pattern of the line impulses was presupposed. But the control potential having line frequency may also be given a sawtooth like pattern according to Figure 12 in place of the rectangular pattern according to Figure 11 as explained at another place, a measure which is suited for decreasing the load of the plate potential source 14. In this case the patterns of the curves M and Q in Figures 2 and 4 respectively will change to a slight degree. The essential feature explained at the aforementioned place, namely the fact that the potential at the RC-organ 12 varies according to a sawtooth curve with the image period is however also retained in the case of a control potential according to Figure 12 because as already pointed out, the time constant of the resistor condenser organ 12 is rendered greater than the line period Z, but shorter than the image period B.

What I claim is:

1. A sawtooth wave generator comprising means for storing electromagnetic energy, a rectifier, a series circuit containing said rectifier and a time constant circuit, the time constant of said latter circuit being greater than the period of deflection of a cathode ray beam, said series circuit being connected substantially in parallel with said electromagnetic storage means, a thermionic vacuum tube having anode, cathode and at least one control electrode and having said electromagnetic storage means connected in the anode-cathode circuit thereof, resistive means connected in the cathode-anode circuit of the said tube, and means for impressing a wave of predetermined wave formation onto a control electrode of said tube.

2. A sawtooth wave generator comprising means for storing electromagnetic energy, a rectifier, a series circuit containing said rectifier and a time constant circuit, the time constant of said latter circuit being greater than the period of deflection of a cathode ray beam, said series circuit being connected substantially in parallel with said electromagnetic storage means, a thermionic vacuum tube having anode, cathode and at least one control electrode and having said electromagnetic storage means connected in the anode-cathode circuit thereof, time constant circuit connected in the cathode-anode circuit of said tube, and means for impressing a wave of predetermined wave formation onto a control electrode of said tube.

3. A sawtooth wave generator comprising means for storing electromagnetic energy, a rectifier, a series circuit containing said rectifier and a time constant circuit, the time constant of said latter circuit being greater than the period of deflection of a cathode ray beam, said series circuit being connected substantially in parallel with said electromagnetic storage means, a thermionic vacuum tube having anode, cathode and at least one control electrode and having said electromagnetic storage means connected in the anode-cathode circuit thereof, resistive means connected in the cathode-anode circuit of the said tube, a source of energy for energizing the anode of said thermionic tube, and means for impressing a sawtooth potential onto said thermionic tube between the cathode of said tube and the negative side of the anode potential source.

4. A sawtooth wave generator comprising means for storing electromagnetic energy, a rectifier, a series circuit containing said rectifier and a time constant circuit, the time constant of said latter circuit being greater than the period of deflection of a cathode ray beam, said series circuit being connected substantially in parallel with said electromagnetic storage means, a thermionic vacuum tube having anode, cathode and at least one control electrode and having said electromagnetic storage means connected in the anode-cathode circuit thereof, resistive means connected in the cathode-anode circuit of the

said tube, and means for impressing a sawtooth shaped control potential across said resistive means.

5. A sawtooth wave generator comprising means for storing electromagnetic energy, a rectifier, a time constant circuit connected serially with the anode of said rectifier, said rectifier and said time constant circuit being connected substantially in parallel with said electromagnetic energy storage means, means for storing energy in said electromagnetic energy storage means, a thermionic vacuum tube having anode, cathode and at least one control electrode, the electromagnetic energy storage means being connected in the anode-cathode circuit of said thermionic tube, means for biasing the anode of said tube relatively to the cathode thereof, a second time constant circuit connected in the anode-cathode circuit of said thermionic tube, a second thermionic tube having anode, cathode and at least one control electrode, means for impressing synchronizing signals onto the control electrode of said second thermionic tube, and means for coupling the anode of said second thermionic tube with the control grid-cathode circuit of the first thermionic tube.

6. Apparatus in accordance with claim 5 wherein said second time constant circuit is variable.

DIETRICH HERMANN.