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A. C. STOCKER

2,110,245

DEFLECTING CIRCUIT

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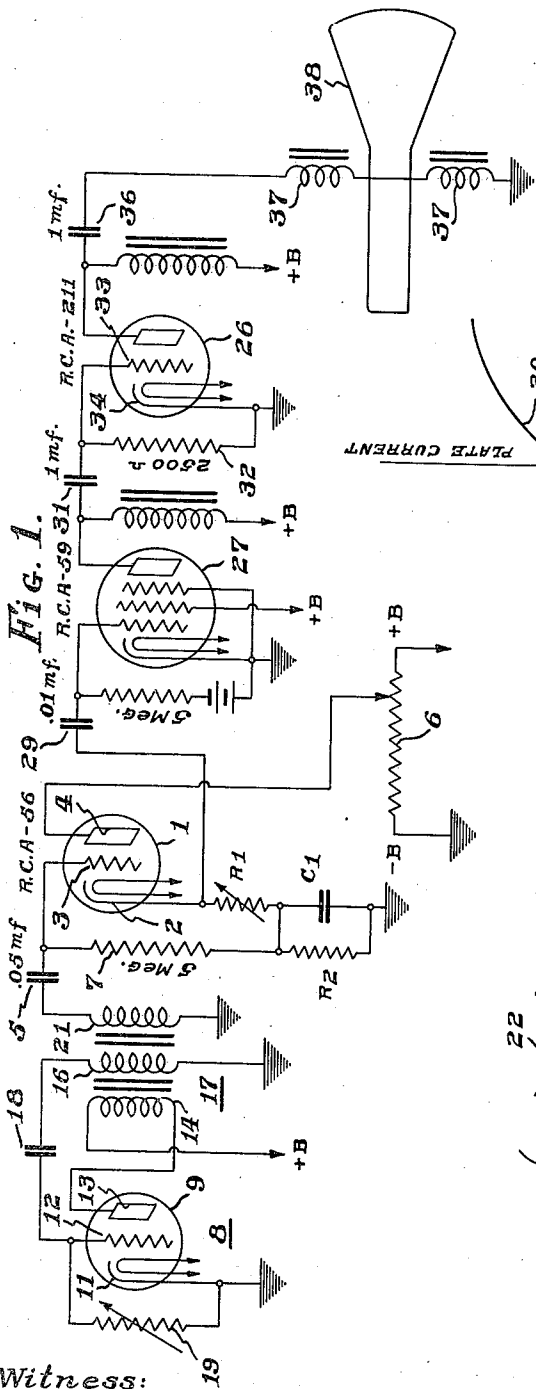


Fig. 1.

Witness:

F. M. Harris

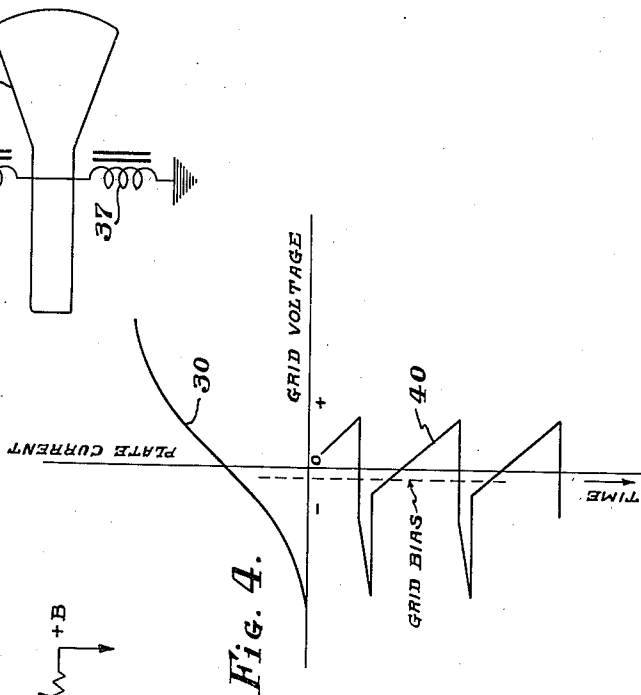


Fig. 4.

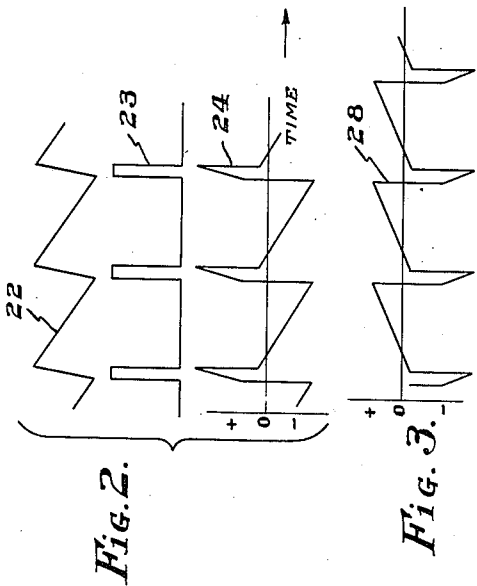


Fig. 2.

Fig

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DEFLECTING CIRCUIT

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6 Claims. (Cl. 250—36)

My invention relates to deflecting circuits for cathode ray tubes and particularly to deflecting circuits for producing a deflecting field of saw-tooth wave form.

5 One of the problems encountered in designing deflecting circuits, especially deflecting circuits for use in television receivers, is that of obtaining a deflecting current or voltage of sufficient amplitude without employing too many amplifier tubes.

10 It is, accordingly, an object of my invention to provide a cathode ray tube deflecting circuit which includes the minimum number of amplifier tubes and which supplies a deflecting field of the desired amplitude.

A further object of my invention is to provide an improved deflecting circuit for operating an output tube by driving its grid positive.

15 A further object of my invention is to provide an improved method of and means for producing a voltage of saw-tooth wave shape.

20 A still further object of my invention is to provide an improved circuit for generating a voltage having a saw-tooth component and having an impulse component which is in the positive direction.

25 In the preferred embodiment of my invention I connect a condenser in the cathode lead of an electric discharge tube and charge the condenser in a short period of time and discharge it during a comparatively long period of time whereby a saw-tooth voltage appears thereacross. This voltage is supplied to an output tube through an amplifier stage whereby the input circuit impedance of the output tube may be made low enough to permit driving the grid of said output tube positive, thereby obtaining maximum output.

30 The input circuit of the output tube must have low impedance if the tube is operated in this way because during the period its control grid is positive the input impedance of the tube drops to a comparatively low value. Therefore, in order to maintain the input circuit impedance of the output tube substantially constant, it is necessary to connect a low impedance grid resistor across the input electrodes of the tube.

35 It is because of the necessity for a low impedance input circuit that a tube so operated cannot be connected directly across a saw-tooth generating circuit of the type commonly employed, a circuit of this type being shown in Fig. 22 of French Patent No. 738,475 having a délivré date of October 17, 1932. If a single amplifier stage were inserted between such a saw-tooth 40 generating circuit and the output tube, the phase

of the voltage applied to the grid of the output tube would be wrong as will be apparent from the description which follows.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawing, in which

Figure 1 is a circuit diagram of a cathode ray tube deflecting circuit embodying my invention,

Fig. 2 is a group of curves which are referred to in explaining my invention,

Fig. 3 is a curve showing the character of the voltage impressed upon the grid of the output tube, and

Fig. 4 is a characteristic curve of the output tube and a curve of input voltage.

Referring to Fig. 1, the horizontal deflecting circuit of a television receiver is illustrated. It comprises an electric discharge tube 1 which may be of the three-electrode type having a cathode 2, a control grid 3, and an anode 4. A positive voltage is applied to the anode 4 from any suitable direct current source which is exemplified by the voltage divider 6. Between the cathode 2 and ground there are connected a resistor R_1 and a condenser C_1 whereby the condenser C_1 may be charged through the tube 1 and the resistor R_1 . The condenser C_1 is shunted by a resistor R_2 which has a high resistance as compared to the resistance of resistor R_1 , whereby a charge on the condenser will leak off gradually there-through. In the input circuit of the tube 1, a grid resistor 7 is connected between the grid 3 and the lower end of the resistor R_1 . If preferred, the lower end of grid resistor 7 may be connected directly to the cathode 2.

40 It will be apparent that, if positive voltage impulses are applied periodically through a condenser 5 to the grid 3, the plate impedance of the tube will be lowered sufficiently for the duration of a positive impulse to permit the condenser C_1 to be charged from the direct current source 6 to produce the steep portion of a saw-tooth voltage across the said condenser. At the end of a positive voltage impulse, the plate impedance of the tube 1 becomes very high and the condenser C_1 gradually discharges through the resistor R_2 to produce the gradually sloping portion of the saw-tooth voltage. The plate impedance of the tube 1 is high during the period between positive impulses because of the negative bias supplied by the grid leak detector action of the condenser 5 and resistor 7.

45 The positive voltage impulses may be supplied from any suitable source such as a relaxation

oscillator 8. The particular oscillator illustrated is a blocking oscillator which includes an electric discharge tube 9 having a cathode 11, a grid 12 and a plate 13. The plate circuit of the tube 9 is coupled to the grid circuit of the tube through the windings 14 and 16 of a transformer 17. The transformer winding 16 is connected in series with a grid condenser 18 which becomes charged periodically to block the tube 9. A grid resistor 19 is connected between the grid 12 and the cathode 11 whereby, after the tube has been blocked, the condenser 18 discharges through the resistor 19 to permit the beginning of the next blocking cycle. In the specific embodiment being described, the oscillator was adjusted to supply 7290 impulses per second.

The voltage impulses produced by the oscillator 8 are impressed upon the grid 3 of the electric discharge tube through a third winding 21 of the transformer 17 and through the coupling condenser 5.

As a result of the periodic positive voltage impulses being impressed upon the grid 3, the condenser C_1 is charged for a period corresponding to the duration of the positive impulse and is discharged for a period corresponding to the interval between positive impulses, whereby a voltage appears across the condenser C_1 which has the wave form indicated by the curve 22 in Fig. 2. The voltage appearing across the resistor R_1 has the wave form indicated by the curve 23 in Fig. 2, while the combined voltages appearing across R_1 and C_1 have the wave shape indicated by the curve 24. It will be noted that the impulse component of the voltage wave, that is, the voltage appearing across resistor R_1 , is in the positive direction.

Since the impulse component is in the positive direction, the combined voltage appearing across resistor R_1 and condenser C_1 may be supplied to an output tube 26 through a single amplifier stage including an amplifier tube 27, and the voltage impressed upon the grid of the output tube will have the polarity indicated by the curve 28 in Fig. 3. This is the polarity which is required for best operation where deflecting coils are employed, because the grid of the output tube should be driven negative at the end of the gradually sloping portion of the saw-tooth in order that the output tube shall be driven close to cut-off whereby a high voltage will appear across the deflecting coils to give a fast return line.

The amplifier tube 27 may be of any suitable type, the one in the circuit illustrated being a vacuum tube of the pentode type which has its input circuit coupled across the resistor R_1 and the condenser C_1 by means of a coupling condenser 29 and a connection through ground. The output circuit of the tube 27 is coupled to the input circuit of the output tube 26 through a coupling condenser 31.

Since it is desired to drive the grid of the output tube positive in order to obtain maximum output, a resistor 32 of comparatively low resistance is connected between the grid 33 and the cathode 34. In one embodiment of the invention this resistor was given a value of approximately 2500 ohms, this value being considerably lower than the input impedance of the tube during the time that its grid is driven positive. During the period the grid of the tube is positive, its input impedance may be of the order of 8000 ohms. In this connection it may be noted that the coupling condenser 31 and the grid resistor 32 have a grid leak detector bias-

ing action so that the output tube actually has a small negative bias on the grid 33.

Referring to Fig. 4, the curve 30 shows the static characteristic of the output tube 26. The voltage applied to the grid 33 is represented by the curve 40. As will be seen by referring to this figure, the grid 33 of the tube 26 is swung over substantially the entire straight portion of the characteristic curve. Since this causes the input impedance of the tube 26 to drop from a very high value when the grid is negative to the comparatively low input impedance mentioned above, it is necessary that the low impedance resistor 32 be connected across the input electrodes of the tube for the purpose of maintaining the impedance of the input circuit of the output tube substantially constant. It will be apparent that such a low impedance input circuit cannot be connected directly across a saw-tooth generating circuit. Thus, at least one amplifier stage must be inserted between the saw-tooth generating circuit and the output tube. By utilizing my invention a single amplifier stage transfers the deflecting voltage to the input circuit of the output tube with the proper polarity.

The output circuit of the output tube 26 is coupled through a coupling condenser 36 to the deflecting coils 37 of a cathode ray tube 38.

In some cases it may be preferred to employ a screen grid tube in place of the three-element tube 26 in the output stage of the deflecting circuit. In that case, because of the high plate impedance of the screen grid tube, the peaking resistor R_1 may be omitted and the saw-tooth component only of the deflecting wave impressed upon the grid of the output tube.

While the values of R_1 , R_2 , and C_1 are not critical, the following values have been found to be satisfactory in the embodiment illustrated: R_1 of the order of 5000 ohms, $R_2=60,000$ ohms and $C_1=.015$ microfarad.

From the foregoing description it will be apparent that various modifications may be made in my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are necessitated by the prior art and set forth in the appended claims.

I claim as my invention:

1. In combination, means for generating positive voltage impulses periodically, a condenser, a resistor, an electric discharge tube of the high vacuum type having a control grid and a plate-cathode space path, means for charging said condenser through said space path with a unidirectional charging current in response to one of said voltage impulses being impressed upon said grid, and means for discharging said condenser through said resistor whereby saw-tooth voltage waves are produced periodically across said condenser, the discharging circuit including said resistor being substantially non-inductive.

2. The invention according to claim 1 characterized in that a peaking resistor is connected in series with the cathode-anode space path of said electric discharge tube and said condenser.

3. In a cathode ray tube deflecting circuit, an electric discharge tube of the high vacuum type having a cathode, a control grid and an anode, a condenser connected between said cathode and ground, a resistor shunted across said condenser, means for maintaining said anode at a positive potential with respect to ground whereby said condenser is charged through said tube in response to positive voltage impulses being im-

pressed upon said grid, means for maintaining said grid negative during the periods between said positive impulses, an amplifier tube having an input circuit, and means for impressing the voltage appearing across said condenser upon said input circuit.

4. The invention according to claim 3 characterized in that a peaking resistor is connected in series with the cathode-anode space path of said electric discharge tube and said condenser and between said cathode and ground, and further characterized in that the resistance of said peaking resistor is low compared with the resistance of said shunting resistor.

5. In a circuit for producing a flow of saw-tooth current through an inductance coil, an electric discharge tube having a cathode, a control grid and a plate, a condenser connected between said cathode and ground, a resistor connected across said condenser, means for applying a steady positive voltage to said plate whereby periodic positive impulses impressed upon said grid cause a saw-tooth voltage to appear across said condenser, an output tube having an output circuit for coupling to said coil and having input electrodes, including a control grid, shunted by an input resistor, and an amplifier tube having an input circuit connected across said condenser

and having an output circuit coupled across said input resistor, said input resistor having a resistance value which is low compared with the input impedance of said output tube when its control grid is driven positive.

6. In a circuit for producing a flow of saw-tooth current in an inductance coil, an electric discharge tube having a cathode, a control grid and a plate, a peaking resistor and a condenser connected in series between said cathode and ground, a resistor connected in shunt to said condenser, means for applying a steady positive voltage to said plate whereby periodic positive impulses impressed upon said grid cause a saw-tooth voltage to appear across said condenser and an impulse voltage to appear across said peaking resistor, an output tube having an output circuit for coupling to said coil and having input electrodes, including a control grid, shunted by an input resistor, and an amplifier tube having an input circuit connected across said peaking resistor and said condenser and having an output circuit coupled across said input resistor, said input resistor having a resistance value which is low compared with the input impedance of said output tube when its control grid is driven positive.

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