

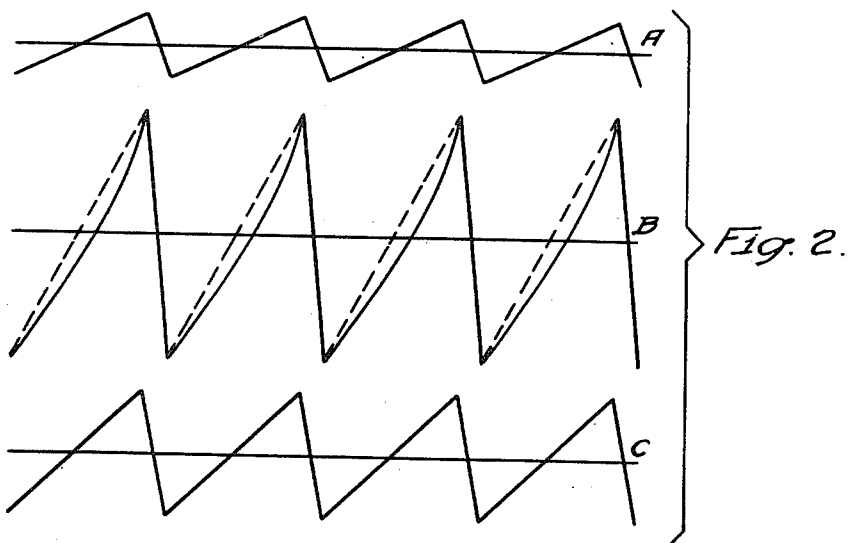
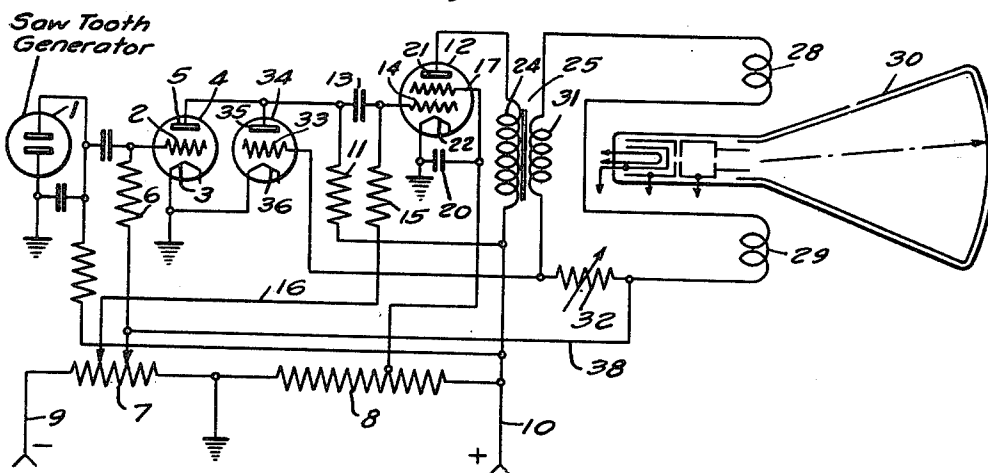
Jan. 21, 1947.

G. W. NAGEL
TELEVISION SWEEP CIRCUITS

2,414,546

Filed Jan. 6, 1942

Fig. 1.



WITNESSES:

E. A. M. Blackey.
H. S. Bantley

INVENTOR

George W. Nagel.

BY

Hyman Diamond.
ATTORNEY

UNITED STATES PATENT OFFICE

2,414,546

TELEVISION SWEEP CIRCUITS

George W. Nagel, Catonsville, Md., assignor to
Westinghouse Electric Corporation, East Pitts-
burgh, Pa., a corporation of Pennsylvania

Application January 6, 1942, Serial No. 425,777

4 Claims. (Cl. 175—335)

1

This invention relates to cathode-ray sweep circuits and, more particularly, to methods and means for improving the deflection of cathode rays for a linear time axis.

In cathode-ray work for various applications, such as wave form analysis or television sweep, it is necessary that the cathode ray shall repeatedly travel across the fluorescent screen horizontally or vertically in one direction at a predetermined constant velocity and shall be caused to return repeatedly after each complete movement to the starting position with a relatively higher velocity. This is generally accomplished by a plurality of symmetrically disposed deflecting plates, or deflecting coils with respect to the longitudinal axis of the tube. When plates are used, the deflection is termed "electrostatic" whereas when coils are used it is termed "electromagnetic." This invention is particularly applicable to the electromagnetic type of deflection. In this type of deflection, an alternating current wave of the so-called saw-tooth type is caused to flow in the deflecting coils, which gives rise to an alternating magnetic flux transversely of the electron stream. The flux must build up relatively slowly at a constant rate during the time period when the cathode ray is moved across the screen and must return rapidly at the end of each complete traversal of the ray.

In practice, it was found difficult to produce a current flow which will create a magnetic field having the above characteristics. A perfectly linear rate of change of current in one direction and a quick change in the other direction is generally adversely affected by the reaction of the magnetic field, that is, the magnetic circuit will tend to distort the wave shape originally applied. Moreover, since in coupling the deflecting coils to the source of the deflecting voltage, it is generally necessary to employ a vacuum tube amplifier of several stages, a certain amount of distortion within the amplifier may also adversely affect the ultimate wave form required for deflection purposes.

The above-mentioned causes are certain sources of distortion. There are numerous other causes which may also produce distortion in one form or another. The system herein disclosed is effective in reducing not only the distortion which is particularly manifest because of the electromagnetic type of deflection and the electromagnetic couplings of certain circuits, but also in reducing any distortion affecting the system whatever its cause may be. In other words causes which affect the system from more remote

2

sources, such as stray magnetic fields, interactions of components etc., are also correspondingly compensated in the ultimate result obtained.

The primary feature of this invention is to eliminate the distortion caused by the magnetic circuit of the deflecting system or by the amplifier itself. To this end, means are provided for coupling the output circuit of the amplifier with a preceding stage in such manner that a voltage of inverse phase may be applied as a corrective voltage component.

A particular advantage of the invention herein described is that the feed-back coupling is so arranged as to leave the input circuit of the amplifier entirely unaffected.

Another feature of the invention is that the feed-back voltage derived from the output circuit is electronically coupled to the amplifier in such manner that the amplifier input circuit is completely isolated from the feed-back circuit and the latter feeds into a high resistance.

Other features and advantages will be apparent from the following description of the invention, pointed out in particularity by the appended claims and taken in connection with the accompanying drawing, in which:

Figure 1 is a simplified diagrammatic view of the electromagnetic deflecting portion of a cathode-ray tube and its associated amplifier circuit including the feed-back circuit in accordance with this invention.

Fig. 2 is a current graph of saw-tooth wave forms showing the input and the output current wave shape with and without the feed-back circuit.

Referring to Figure 1, the ray deflecting system includes a generator for supplying an alternating potential of the desired wave shape and at a particular deflection frequency to the input terminals of an amplifier between the grid 2 and cathode 3 of the vacuum tube 4. The saw-tooth generator shown here by way of example is the elementary gas discharge type connected to the input of the amplifier. Inasmuch as the particular means for generating saw-tooth oscillation is no part of this invention the generator is not considered in detail. It is to be regarded merely as a symbol of a voltage source the proper amplification of which is the primary object of the invention. Other types of generators may take its place as long as the output voltage thereof is of sufficient magnitude to properly excite the input of the amplifier. The amplifier 4 is arranged in a conventional resistance capacity coupling circuit having a grid resistor 6 which

3

terminates at the grid bias source shown here by the voltage divider resistor 7 in series with the resistor 8. Both of these resistors are shown by way of example to represent a source of operating voltages for the vacuum tubes in the amplifier. The junction point between resistor 8 and resistor 7 is grounded and the cathodes of the various tubes returned to this point. Consequently, the voltage with respect to the cathode and the other electrodes of the tubes will have a negative value along the resistor 7 and a positive value along the resistor 8. It is, of course, understood that the operating voltage applied between the conductors 9 and 10 is of suitable polarity and free from alternating components. This is generally obtained in practice from a filtered source of rectified alternating current or from batteries if the system does not derive current from a commercial supply circuit. The heaters for the cathodes in the form of filaments have been omitted since it is well known that a suitable heating current is applied to the filaments which may also be derived from an alternating current source or from batteries.

Continuing with the description of the amplifier, the output of tube 4 between anode 5 and the cathode 3 includes in series with the voltage source, the load resistance 11. The output is capacitively coupled to the input of the following amplifier 12 by means of the condenser 13 which connects to the grid 14 of the tube 12. The grid circuit of the latter includes the grid resistor 15 which returns through lead 16 to a suitable tap on the resistor 7 for initial grid bias purposes. The output tube 12 is of the screen grid type having its screen grid 17 connected to a suitable point on the resistor 8 and by-passed by means of the condenser 20. The output of the tube 12 between anode 21 and cathode 22 includes the primary winding 24 of the output transformer 25. The return terminal of the winding 24 is connected to the highest potential side of the voltage divider resistor 8. The deflecting coils 28 and 29 for the cathode-ray tube 30 are connected in series between terminals of the secondary winding 31 of the transformer 25. This series circuit includes also the resistor 32, the function of which will be described in connection with the operation of the deflecting system. The other elements of the cathode-ray tube are not shown in detail, for the invention is directed only to the deflecting circuit and not to the other ray control electrodes.

One terminal of the resistance 32 is connected to the grid 33 of the coupling tube 34. The latter has its anode 35 connected directly to the anode 5 of the amplifier tube 4. Similarly, cathode 36 thereof connects to the cathode 3 of the amplifier tube 4. By these connections it is seen that both tubes 4 and 34 have a common output circuit having a common load resistance 11. The other terminal of the resistor 32 is connected by means of the conductor 38 to the grid return terminal of the resistor 6 on the voltage divider 7. In this manner, the initial bias which is derived at that point from the voltage drop across the resistor 7 is applied to the grid 2 of tube 4 as well as to the grid 33 of tube 34.

In the operation of the system, it is assumed that the generator 1 applies a linear voltage of saw-tooth wave form to the input circuit of the amplifier, that is, between the grid 2 and cathode 3 of the tube 4. Curve A of Fig. 2 illustrates the wave form of the applied voltage. The amplified output of the tube 4 is impressed on the grid 14 of the output tube 12 causing a voltage of an approximately similar wave shape to be impressed

4

on the primary winding 24 of the transformer 25. In an ideal amplifier, the output wave shape would be the exact replica of the input wave form magnified to the extent of the amplification of the tubes. However, a certain amount of distortion is always present, and the resultant wave form of the current flowing in the secondary winding departs to some extent from the linear saw-tooth wave form of the input voltage.

Further distortion of the output wave form is caused also by the reactance of the deflecting coils 28 and 29. The overall distortion is shown by the curve B of Fig. 2 which illustrates the output of the amplifier. The dotted lines represent the true linearity desired and the curved slope shows the departure therefrom. The current flowing in the deflecting coils 28 and 29 flows also through the resistor 32 and a certain amount of voltage drop will be developed thereacross. The resistor 32 is shown here to be variable in order to adjust it to a value which will give the required amount of voltage to be applied to the tube 34. The voltage so applied will be of opposite phase to the voltage applied to the grid 2 from the generator 1. An amplified output of this voltage will be produced by the tube 34 and appears in the common output circuit comprising the resistance 11. In this manner, the inverse feedback potential is applied in an amplified form to the grid circuit of the tube 12 without affecting the input circuit of the amplifier since it is completely isolated therefrom. The amplified feedback voltage will tend to cancel distortion present in the output circuit and acts as a corrective voltage for the amplified form of the input voltage in order to obtain the desired linearity in the output current. This advantage is obtained to some extent at the expense of reduced signal output. The latter is shown by curve C of Fig. 2. It is observed that the linearity of the rate of change of the voltage is restored although the amplitude of the output voltage is lower than in curve B of Fig. 2. The curves of Fig. 2 are not intended to represent the true ratio of voltage magnitudes which depends entirely on the circuit constants and gain of the particular tubes used in the amplifier. It is the current or voltage wave shape which the invention herein described advantageously corrects and the curves represent the correction obtained in the output circuit of a system for cathode-ray deflection wherein electromagnetic coils are utilized for deflecting purposes.

I claim as my invention:

1. In a cathode-ray deflecting circuit utilizing electromagnetic deflection coils, a vacuum tube amplifier including a plurality of amplifying stages, a source of voltage of saw-tooth wave form coupled to the input circuit between grid and cathode electrodes of the vacuum tube in the first stage of said amplifier, an output circuit from the last stage of said amplifier including said deflecting coils, an auxiliary amplifying tube, the anode and cathode electrodes of which are connected in parallel with the anode and cathode electrodes of said first mentioned tube respectively, and means for impressing on the input of said auxiliary amplifying tube an inverse phase voltage proportional to the current in said coils.

2. In a cathode-ray deflecting circuit utilizing electromagnetic deflection coils, a vacuum tube amplifier including a plurality of amplifying stages, a source of voltage of saw-tooth wave form coupled to the input circuit between grid

5

and cathode electrodes of the vacuum tube in the first stage of said amplifier, an output circuit from the last stage of said amplifier including said deflecting coils, an impedance in said output circuit across which a voltage is developed in proportion to the current in said coils, an amplifier for said voltage including an amplifying tube having an input circuit, the anode and cathode electrodes of which are connected in parallel with the anode and cathode electrodes of said first mentioned tube respectively, and means for impressing said voltage on said input circuit in inverse phase in order to compensate for nonlinearity of current in said coils.

3. In a cathode-ray deflecting circuit utilizing electromagnetic deflection coils, a vacuum tube amplifier including a plurality of amplifying stages, a source of voltage of saw-tooth wave form coupled to the input circuit between grid and cathode electrodes of the vacuum tube in the first stage of said amplifier, an output circuit for the last stage of said amplifier comprising an output transformer having a primary winding connected between the anode and cathode electrodes of the amplifier tube in the final stage of said amplifier, a secondary winding for said transformer, a circuit connected between terminals of said secondary winding including in

6

series said deflecting coils and a resistance whereby a voltage is developed thereacross from the current flowing in said circuit, an auxiliary vacuum tube having anode cathode and grid electrodes, a circuit interconnecting said last mentioned tube with the anode and cathode electrodes of said first mentioned tube, respectively, a grid circuit between grid electrode and cathode thereof, said circuit including said resistance connected with such polarity as to compensate nonlinearity of current in said coils.

4. In a cathode-ray deflecting circuit utilizing electromagnetic deflection coils, a vacuum tube amplifier including a plurality of amplifying stages, a source of voltage of saw-tooth wave form coupled to the input circuit between grid and cathode electrodes of the vacuum tube in the first stage of said amplifier, an output circuit from the last stage of said amplifier including said deflecting coils, an auxiliary amplifying tube, the anode and cathode electrodes of which are connected in parallel with the anode and cathode electrodes of said first mentioned tube respectively, and means for impressing on the input of said auxiliary amplifying tube a voltage of inverse phase proportional to the current in said coils.

GEORGE W. NAGEL.