May 29, 1956 R. F. CASEY 2,748,271

SWEEP CIRCUIT

Filed April 26, 1952

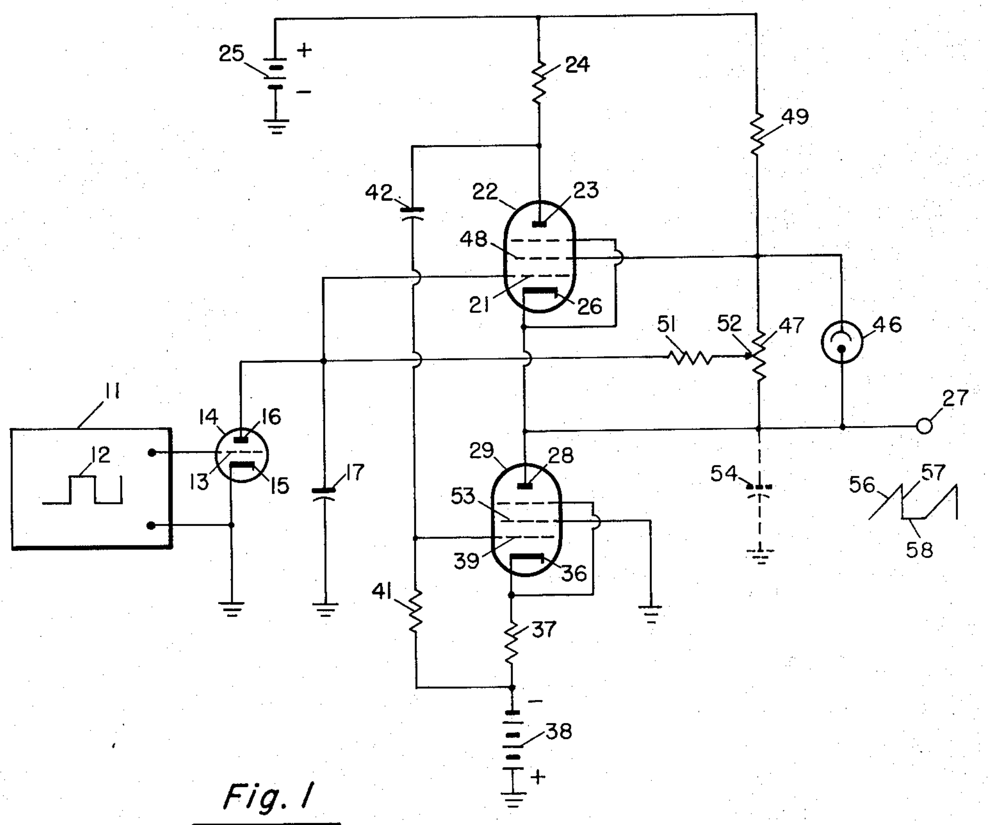

Fig. 1

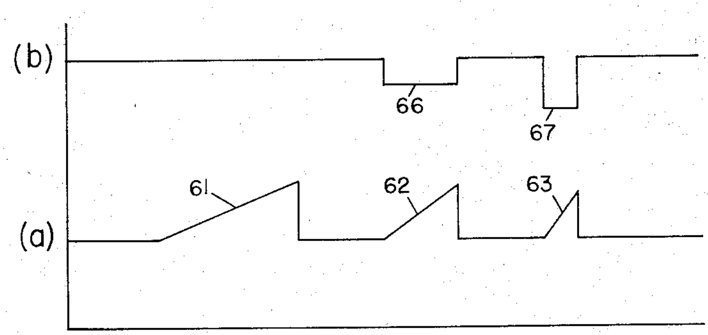

Fig. 2

INVENTOR.
ROBERT F. CASEY
BY Darby & Darby
ATTORNEYS

United States Patent Office 2,748,271
Patented May 29, 1956

2,748,271

SWEEP CIRCUIT

Robert F. Casey, Pompton Plains, N. J., assignor to Allen B. Du Mont Laboratories, Inc., Clifton, N. J., a corporation of Delaware

Application April 26, 1952, Serial No. 284,608

7 Claims. (Cl. 250—27)

This invention relates to electrical signal generating circuits and particularly, though not exclusively, to circuits for producing sawtooth shaped sweep signals useful for causing an electron beam to scan a phosphor screen in a cathode ray tube.

Electrical signal generators inherently have stray capacitance across their output load impedances. At higher signal frequencies, therefore, the output impedance becomes effectively reduced, since a capacitance offers a lower impedance to higher frequencies than to lower frequencies. This change in load impedance with respect to frequency is undesirable since it tends to cause changes in the output signals when the frequency thereof is varied. The stray capacitance across the output load impedance is particularly undesirable when a constant current type of output device such as a pentode tube is employed since the stray capacitance is not constant in the higher signal frequencies, and thus derogates the constant current desideratum of the pentode load tube. The present invention overcomes these undesirable effects.

An object of the invention is to provide a sweep generating circuit having improved linearity and faster sweep speeds.

Another object is to provide a signal generating circuit having a constant output load impedance.

Another object is to provide a circuit to compensate for the current drawn by stray capacitance, thus maintaining a constant current through the output tube.

Other objects will be apparent.

In the drawings,

Figure 1 of the drawing is a schematic diagram of an electrical circuit incorporating a preferred embodiment of the invention; and

Figure 2 shows wave forms which occur in the circuit of Figure 1.

A source 11 of input signals 12 is connected to a control electrode 13 of a discharge tube 14 having a cathode 15 which is grounded and an anode 16 which is connected to a sawtooth wave forming condenser 17. Anode 16 is also connected to a control electrode 21 of a cathode follower output tube 22 having an anode 23 connected through an impedance 24 to a source 25 of voltage having positive polarity. Tube 22 has a cathode 26 connected to an output terminal 27 and to an anode 28 of an output load tube 29 having a cathode 36 connected through a resistance 37 to a source 38 of voltage having negative polarity. The load tube 29 also has a control electrode 39 connected through a resistance 41 to the voltage source 38 and through a capacitance 42 to the anode 23 of the cathode follower tube 22 and a grounded screen grid 53.

A constant voltage device 46 and a potentiometer 47 are connected in parallel between the output terminal 27 and a screen grid 48 in the cathode follower tube 22. A resistance 49 is connected between the screen grid 48 and the source 25 of voltage. A resistance 51 is connected between a tap 52 on the potentiometer 47 and the sawtooth wave forming condenser 17. A stray capacitance 54 exists between the output terminal 27 and the ground.

The signal generating circuit comprising the discharge tube 14, the sawtooth wave forming condenser 17, the cathode follower tube 22, the constant voltage device 46 and associated components, is fully described in copending application, Serial No. 284,611 by the same inventor and assigned to the same assignee.

Briefly, this part of the circuit operates as follows: Normally the discharge tube 14 is in a conductive state, thereby maintaining the sawtooth wave forming condenser 17 in a discharged condition. When the input signal 12 becomes negative in polarity, the discharge tube 14 ceases to be conductive and the condenser 17 begins to charge from the voltage source 25 through the resistances 49, 47, and 51. As the condenser 17 is charging, a positive voltage is developed thereacross, which voltage is applied to the control electrode 21 of the cathode follower tube 22. The cathode follower tube 22 produces at its cathode 26 and hence at the output terminal 27, a positive voltage 56. The linearity of the output signal 56 is improved by the constant voltage device 46 as is fully described by the above-mentioned copending application.

When the input signal 12 ceases to be of a negative polarity, the discharge tube 14 returns to its conductive state, thereby quickly discharging the condenser 17 and causing the output signal to return in a negative direction 57 to its zero or quiescent value 58. The positive portion 56 of the output signal may be used as an active deflection sweep signal for an electron beam in a cathode ray tube whereas the negative portion 57 may be used as the return sweep.

At low sweep repetition rates or frequencies, the stray capacitance 54 provides no problem; at higher frequencies, however, the stray capacitance 54 provides a conductive path for output signals in shunt with the output load impedance. Thus, the output load impedance becomes reduced at the higher sweep frequencies and therefore, the current through the output tube 22 is no longer constant since the current in the stray capacitance is increased. The present invention overcomes this undesirable effect of the stray capacitance 54 as follows:

The resistance 24 connected in series with the anode 23 of the cathode follower tube 22, provides an anode load impedance for this tube. Current through tube 22 will cause a voltage to be generated in the anode load impedance 24, which voltage is applied through the capacitance 42 to the control electrode 39 of the output load tube 29. If, for example, the output signal is of sufficiently high frequency, or repetition rate, so that current from this signal tends to flow through the stray capacitance 54, thereby causing more current to flow in the cathode follower tube 22, then a negative signal will be developed in the anode load resistance 24, which negative signal, being coupled to the control electrode 39 of the output load tube 29, will cause this tube to have a relatively higher impedance whereupon this load tube will draw less current through the cathode follower tube 22.

The reduced amount of current drawn through the cathode follower tube 22 by the load tube 29 compensates for the increased current drawn through the cathode follower tube 22 by the stray capacitance 54, so that the total current through the cathode follower tube 22 tends to remain constant.

Thus in spite of the effect of the stray capacitance 54, the invention achieves a constant output load impedance, and hence a constant current through the output load impedance and through the cathode follower tube 22. This allows the signal generator to be used at much higher frequencies than would otherwise be possible, and provides a more linear output signal than would be otherwise obtainable. The invention performs automatically and is self-adjusting, since any change of current in the cathode follower tube 22, due to an undesirable charging current in the stray capacitance 54, is automatically corrected or compensated by a corresponding decrease of current in the output load tube 29. This automatic action occurs mainly at higher signal frequencies, as is necessary, and does not occur appreciably at lower signal frequencies. At intermediate signal frequencies, the action occurs to the extent necessary to provide the proper correction so as to cause a constant load impedance.

In Figure 2, (*a*) represents output signals, at the output terminal 27, having a relatively slow sweep 61, a medium speed sweep 62, and a relatively fast sweep 63, and (*b*) represents the corresponding control signals which are applied to the control electrode 39 through the condenser 42 from the anode 23, for a relatively slow sweep (no control signal), a medium speed sweep 66, and for a relatively fast sweep 67. It will be noted that the control signals have relatively greater magnitudes for the higher speed sweep signals. It also will be noted that the control signals have substantially rectangular shapes, due to their being derived from the current which flows into a capacitance from a linearly increasing voltage source.

For a square wave input signal as is indicated by the numeral 12, the output sweep signal will have non-sweep portions as is indicated by the numeral 58. If the input signal 12 comprises relatively narrow positive portions, then the output signal will comprise recurrent sawtooth waves without any appreciable non-sweep portion 58. The stray capacitance 54 becomes discharged, after every sweep, through the output load tube 29.

Although the above discussion has referred to tubes 22 and 29 it does not in any way limit those tubes to pentodes which are shown in the drawing, this because it is obvious that triodes would also function in the manner described. However, pentodes are preferable particularly as the load tube 29. When a pentode is connected in the manner shown for tube 29, it tends to act as a constant current device due to the fixed potential existing between its screen and its cathode. A constant current device of this type acting as at cathode load for a cathode follower such as tube 22 maintains a more nearly constant current through the tube thus allowing it to operate along a more linear portion of its operating characteristic curve.

Tube 22 may also be connected as a pentode acting as a constant current device. The use of a pentode so connected as the output tube, maintains the current through that output tube at a more constant value thus achieving a still more linear response.

While a preferred embodiment of the invention has been described, various modifications thereof will be apparent to those skilled in the art, which will fall within the scope of the invention. The scope of invention is defined in the following claims.

What is claimed is:

1. A signal generating circuit comprising a saw-tooth wave forming condenser, a voltage source connected to charge said condenser, means to vary the charging rate thereof, a cathode follower circuit having an input electrode connected to said saw forming condenser and an anode and a cathode, an impedance connected to said anode, a load impedance connected to said cathode and comprising an electronic load tube having a control electrode and having a cathode and an anode to which load connections are made and a capacitance effectively in shunt across said last-named anode and cathode, means connected to supply current thorugh said cathode follower circuit and said cathode load impedance, and signal coupling means connected between said anode of said cathode follower and said control electrode of said load tube.

2. A signal generating circuit comprising a saw-tooth wave forming condenser, a voltage source connected to charge said condenser, means to vary the charging rate thereof, a cathode follower circuit having an input electrode connected to said saw forming condenser and an anode and a cathode, an impedance connected to said anode, an electronic load tube having an anode connected to said cathode and having a control electrode and a cathode, a capacitance between said anode and cathode of said load tube, means connected to supply current through said cathode follower circuit and said load tube, and signal coupling means connected between said anode of said catohde follower and said control electrode of said load tube.

3. A signal generating circuit comprising a discharge tube having an anode, a cathode, and a control grid, a source of keying signals connected to said control grid, a saw-tooth wave forming condenser connected between said anode and said cathode, a source of voltage, a variable impedance connected between said voltage source and said anode, an output electronic tube having a control electrode connected to said anode and an anode and a cathode, an anode load impedance connected between said last-named anode and said voltage source, a load tube having an anode connected to said last-named cathode and having a control electrode and a cathode, a capacitance effectively between said anode and cathode of said load tube, and a condenser connected between said anode of said output tube and said control electrode of said load tube.

4. The circuit in accordance with claim 2, in which said load tube is a pentode type connected to have a substantially constant current characteristic between its anode and cathode with respect to the voltage thereacross, the current therein being variable in accordance with the voltage applied to its control electrode.

5. In a signal generating circuit having inherent stray capacitance, a circuit compensating for the current taken by said stray capacitance, comprising: a cathode follower output tube, a load tube connected in series with said output tube and acting as the cathode load impedance for said output tube; said output tube comprising an anode, a control grid to receive input signals, and a cathode, said load tube comprising an anode, a control grid, and a cathode; a connection from said load tube anode to the cathode of said output tube, an output terminal in said connection, a source of operating potential connected across said series-connected tubes; means for applying signals of adjustable repetition rate to said control grid of said output tube; means sensitive to the current taken by said stray capacitance, said means including an impedance connected between said anode of said output tube and said source of potential; and means energized by said sensitive means to compensate for the current taken by said stray capacitance, said energized means including a capacitor connecting said anode of said output tube to said control grid of said load tube.

6. The circuit of claim 5 wherein said load tube is a pentode connected to maintain a constant current through said output tube whereby said sensitive and energized means cause said constant current to divide between said load tube and said stray capacitance in a ratio determined by said repetition rate.

7. The circuit of claim 6 wherein said output tube is a pentode connected to further maintain a constant current through said output tube to assure operation along the linear portion of its operating characteristic.

References Cited in the file of this patent

UNITED STATES PATENTS

2,180,364	Norton	Nov. 21, 1939
2,266,516	Russell	Dec. 16, 1941
2,462,024	Johnson	Feb. 15, 1949
2,583,345	Schade	Jan. 22, 1952
2,594,104	Washburn	Apr. 22, 1952