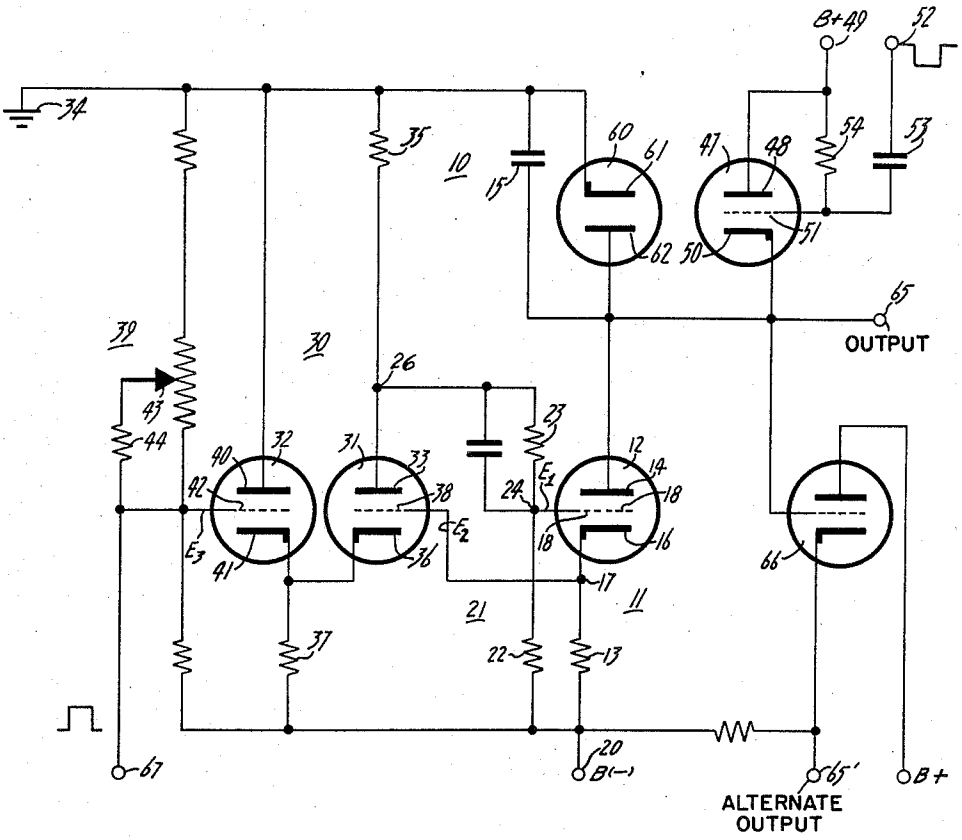
Nov. 8, 1960 P. F. SMITH 2,959,739

ELECTRICALLY VARIABLE SWEEP CIRCUIT

Filed April 24, 1957



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United States Patent Office 2,959,739 Patented Nov. 8, 1960

2,959,739

ELECTRICALLY VARIABLE SWEEP CIRCUIT

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Filed Apr. 24, 1957, Ser. No. 654,793

1 Claim. (Cl. 328—185)

This invention relates in general to waveform generators and in particular to an improved sweep voltage generator.

An object of the present invention is to provide an improved sweep voltage generator.

Another object of the present invention is to provide a sweep voltage generator including a constant current generator which is linear throughout the sweep cycle.

A further object of the present invention is to provide a sweep voltage generator where the reference potential for the generated sawtooth voltage wave is independent of the characteristics of the constant current generator.

A still further object of the present invention is to provide a sweep voltage generator whose sweep rate may be varied rapidly in response to a control voltage.

Other objects of the invention will be pointed out in the following description and claim and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

The single figure is a schematic view of a sweep voltage generator embodying the present invention.

Referring to the drawing, the waveform generator illustrated therein comprises generally a condenser **10** and a constant current generator **11** which includes a cathode follower **12** and resistor **13**. As shown in the drawing, cathode follower **12** comprises a plate **14** connected to terminal **15** of condenser **10**, a cathode **16** connected to resistor **13** at terminal **17**, and a grid **18** for controlling the rate at which charging current flows through cathode follower **12** to condenser **10** in accordance with the bias voltage applied to grid **18**. The other end of resistor **13** is connected to B— terminal **20**.

The bias voltage for grid **18** is obtained from a voltage divider **21** comprising resistors **22** and **23**, grid **18** being connected to common terminal **24** between the resistors. Voltage divider **21** is connected at one end to B— terminal **20** and at the other end to a terminal **26**.

Means are further provided for setting the bias voltage E_1 to a predetermined value to cause the condenser to be charged at a predetermined nominal rate. This means acts to establish the potential of terminal **26** and hence the voltage across voltage divider **21** with the result that bias voltage E_1 applied to grid **18** is determined. As shown, this means comprises a differential amplifier **30** comprising triode amplifier **31** and cathode follower **32**.

Triode amplifier **31** comprises a plate **33** connected to ground terminal **34** through a plate load resistor **35**, a cathode **36** connected to B— terminal **20** through cathode resistor **37** and a grid **38** connected to terminal **17** of the constant current generator **11**. Plate **33** connects to plate resistor **35** at terminal **26** so that the potential of terminal **26** is established by the bias voltage between grid **38** and cathode **36**. Since grid **38** is maintained at some relative constant voltage (determined by terminal **17**), adjustments in grid bias are obtained by adjusting the potential of cathode **36**. The means for adjusting the cathode potential of triode **31** in this instance comprises

potentiometer **39** and cathode follower **32**. Cathode follower **32** comprises a plate **40** which is connected to ground terminal **34**, a cathode **41** which is tied to cathode **36** of triode **31**, and a grid **42** which is connected to movable contact **43** of potentiometer **39** through resistor **44**, potentiometer **39** being connected between B— terminal **20** and ground terminal **34**.

The rate at which condenser **10** is charged may therefore be adjusted by the setting of potentiometer **39**. This is readily seen since the setting of the potentiometer **39** determines grid bias E_3 for cathode follower **32** which, in turn, determines the potential of cathodes **41** and **36**, which establishes grid bias E_2 for triode amplifier **31**. Grid bias E_2, in turn, determines the potential of terminal **26** and hence grid bias E_1 for cathode follower **12**, which controls the rate of current flow to terminal **15** of condenser **10**.

The waveform generator also includes suitable means for controlling the period during which condenser **10** is charged at its nominal rate. Preferably, this means comprises a triode **47** which may be biased to cutoff condition in response to a gating pulse. As shown, triode **47** comprises a plate **48** connected to a suitable source of plate voltage represented by B+ terminal **49**, a cathode **50** connected to terminal **15** of condenser **10**, and a grid **51** connected to terminal **52** through a condenser **53**. Grid **51** is normally biased slightly positively with respect to cathode **50** by means of relatively large resistor **54** connected to B+ terminal **49** so that triode **47** is normally conducting except during the period when a negative gating pulse is applied to terminal **52** to drive the grid **51** to the cutoff condition. As grid **51** reaches cutoff, electron current flows to condenser **10** and causes the potential of terminal **15** to increase in the negative direction to provide the sawtooth voltage wave.

In order to insure that the beginning of each sawtooth voltage wave starts at the same voltage value, terminal **15** of condenser **10** is clamped to ground by diode clamp **60**. Diode clamp **60** comprises a cathode **61** connected to ground terminal **34** and a plate **62** connected to terminal **15** of condenser **10**. Any tendency of terminal **15** of condenser **10** to rise above the potential of terminal **34** due to gating triode **47** causes diode **60** to conduct, thereby preventing such tendency.

It should also be noted that toward the end of each sweep cycle plate **14** of cathode follower **12** becomes more and more negative as a result of the electron current flow to condenser **10**. This tends to reduce the current through cathode follower **12** because plate current in a triode is not substantially independent of plate voltage. This effect is partially compensated for by simple cathode follower action, but still contributes to undesired variations in the nominal constant current through cathode follower **12**. However, since grid **38** of triode amplifier **31** is connected to terminal **17**, bias voltage E_2 decreases. Triode **31** and cathode follower **32**, acting as a differential amplifier, cause bias voltage E_1 of cathode follower **12** to be increased until grid **38** is biased in accordance with the bias potential of grid **42**. As a result, very good linearity is obtained throughout the complete sweep cycle.

Terminal **15** of condenser **10** is also connected directly to an output terminal **65** or, alternatively, to an output terminal **65'** through a cathode follower **66**. The sawtooth voltage wave is obtained from either terminal depending on the external circuitry.

In addition to providing a very simple and inexpensive sweep voltage generator having a relatively good linear sweep characteristic, the circuit shown in the drawing has the prime advantage of being able to rapidly vary the rate at which condenser **10** is charged in response to a control voltage applied to terminal **67**. A control voltage pulse applied to terminal **67** varies the charging current to con-

denser 10, positive voltages causing an increase in current flow through cathode follower 12 and negative voltages a decrease in current flow. This is a decided advantage when it is necessary to rapidly vary the speed at which a cathode spot moves across the face of a cathode ray tube.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to the preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

A waveform generator comprising in combination a condenser, a cathode follower having a plate connected to said condenser, a grid and a cathode adapted to supply charging current to said condenser at a rate determined by the bias voltage between said grid and said cathode, a differential amplifier having a pair of input terminals and an output terminal, means connecting said output terminal to said grid, means connecting one of said input terminals to said cathode, and means for supplying a predetermined control voltage to the other said input terminal.

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