

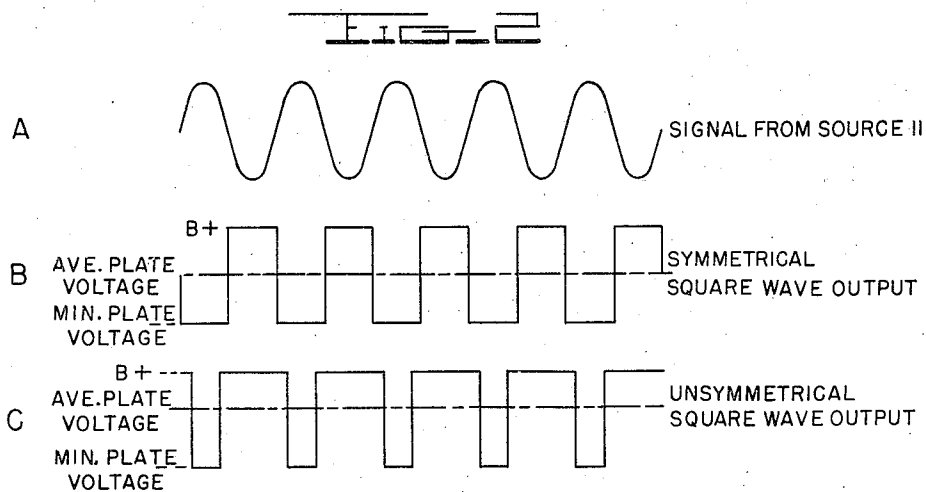
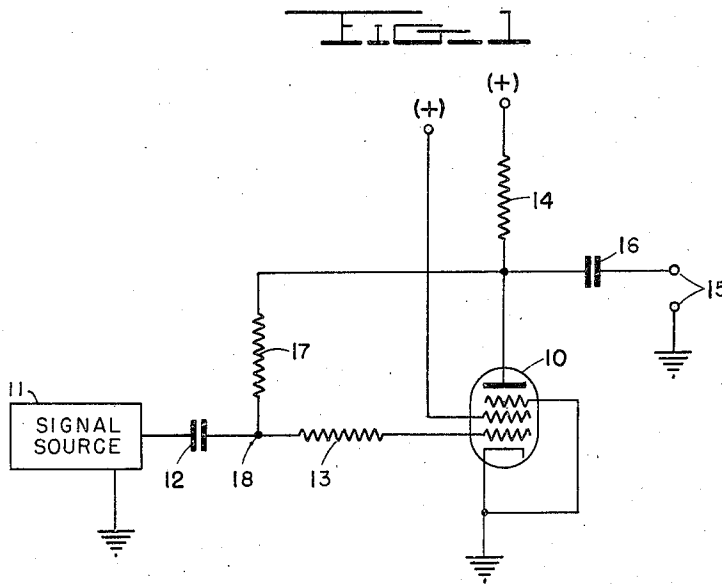
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C. H. SMITH, JR., ET AL

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ELECTRONIC SIGNAL SHAPING CIRCUIT

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Inventors
CARL HARRISON SMITH JR.
MILTON L. KUDER

McHayer

By

Attorney

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ELECTRONIC SIGNAL SHAPING CIRCUIT

Carl Harrison Smith, Jr., Arlington, Va., and
Milton L. Kuder, Washington, D. C.

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This invention relates to electrical signal generating systems and in particular to systems for producing symmetrical square-wave signals over a wide frequency range and independent of variations in power line voltage.

In many of the present forms of electrical square-wave signal generator systems, a sinusoidal signal having the frequency of the desired square wave signal is first generated and then applied to a clipping stage or stages where the crests of the sinusoidal signal are "clipped" off. For biasing considerations in the clipper stages it has usually been necessary with previous systems to maintain the amplitude of the sinusoidal signal applied thereto substantially constant otherwise a non-symmetrical square wave output is obtained. To maintain such a degree of constancy in prior systems despite fluctuations such as in supply voltage, special oscillator control tubes or a regulated power supply were required.

Accordingly it is an object of the present invention to provide a signal generating system for producing symmetrical square wave signals independently of fluctuations in the voltages supplied thereto.

Another object of the present invention is to provide in a square wave signal generator system employing a clipper tube, bias adjusting means for the clipper tube maintaining symmetrical square wave signal output.

Other and further objects and features of the present invention will become apparent upon a careful consideration of the accompanying description and drawing.

Fig. 1 is a schematic diagram, partly in block, of a typical embodiment of the features of the invention.

Fig. 2 is a series of waveforms taken to illustrate more fully the operation of the circuit of Fig. 1 and the method of maintaining a substantially symmetrical square wave voltage output.

In accordance with the fundamental concepts of the present invention a signal generator device for producing square wave signals is provided in which a symmetrical square wave output is maintained over a wide frequency range despite variations in voltages supplied thereto. Broadly, a reference frequency signal of a sinusoidal character is provided to control the operation of the system. This sinusoidal signal is then applied to a clipper tube where the positive and negative crests are removed. Bias for the clipper tube is supplied in part from the plate circuit thereof through a bias transfer network. This bias is varied automatically in dependency on the shape

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of the output square wave to maintain a central clipping region resulting in the production of symmetrical square wave signals.

With reference to the particular embodiment of Fig. 1, a clipping tube 10 is employed as an over-driven voltage amplifier obtaining its grid drive voltage from a signal source 11 through a coupling capacitance 12. Signal source 11 is preferably adapted to produce a sinusoidal signal having a frequency equal to that of the desired square wave output signal. Where it is desired that the frequency of the square wave be variable over a frequency range, the signal source 11 must be capable of covering that frequency range. The amplitude of the sinusoidal signal is preferably constant, however the clipper circuit will operate satisfactorily despite wide variations of input signal amplitude and frequency such as would accompany fluctuations in the supply voltage.

The anode of tube 10 is returned to a source of positive voltage through anode load resistance 14. Voltage fluctuations at the anode of tube 10 are coupled to the output terminals 15 through a coupling capacitance 16 and the ground return lead.

Bias for the control grid of tube 10 is obtained in part from the positive supply through anode load resistance 14 and grid coupling resistance 17 and in part from the capacitance 12 which becomes charged as a result of grid current flow in tube 10 during a portion of the sinusoidal input signal.

The sinusoidal signal from source 11 as represented by waveform A of Fig. 3 drives clipper tube 10 to alternate conditions of heavy anode circuit conductivity and anode circuit cut-off. The positive crests of the input signal drive the control grid of tube 10 positive with respect to the cathode resulting in control grid conduction and consequent loss of signal voltage across limiting resistance 13 to produce the flattened out negative portions of waveform B, Fig. 2. On the opposite half cycles of the driving signal the clipper tube 10 is driven to a condition of anode circuit cut-off to produce the flattened positive portions of waveform B.

From waveform B it is evident that the circuit as thus far described will produce a symmetrical square wave, having equal durations of the negative and the positive flattened out portions only when the bias of tube 10 is critically adjusted so that the average grid potential is midway between that required for anode current cut-off and for zero bias condition and is brought about by the action of resistance 17 to offset the charg-

ing of capacitance 12 during the periods of grid current flow. When the average bias voltage of tube 10 is not equal to this mid-value, an unsymmetrical waveform may be produced such as that of C, Fig. 2 in which the lower flattened portions are of shorter duration than the upper flattened portions.

To minimize fluctuations in the average bias voltage for tube 10 as a result of variations in the amplitude of the signal from source 11 and attendant alternation in the average grid current drawn by tube 10, the grid coupling resistance 17 is returned to the anode of the tube. Resistance 17 is purposely made large so as to operate with capacitance 12 as an integrator circuit to hold to a minimum the amount of the output square wave fed back to the junction point 18 yet permit flow of a unilateral charging current for capacitance 12 to counteract the charging thereof due to the flow of grid current within tube 10. In typical operation, an increase in the amplitude of the signal from source 11 would tend to raise the portion of the input signal of waveform A utilized for the production of the square waveform and consequently shorten the conductivity period of the tube 10. Such operation would result in the production of the unsymmetrical square wave signal of waveform C having a raised average level. This distortion of the signal is counterbalanced by the action of the connecting path between point 18 and the anode of tube 10. The attempted rise in average potential at the anode of tube 10 raises the potential towards which capacitance 12 charges during the time interval that the control grid of tube 10 is non-conductive and hence tends to adjust the bias to restore the desired condition in which the central portion of the signal from source 11 causes the production of the output square wave.

Satisfactory operation of the apparatus of the invention constructed in accordance with the schematic diagram of Fig. 1 was realized with an output signal from source 11 variable over the frequency range of 2000 to 50,000 cycles per second and over the amplitude range of 20 to 200 volts with the following circuit constants:

Electron tube—Type 6SH7
Anode voltage supply—250 v.
Capacitance 12—0.25 microfarad
Resistance 13—100,000 ohms
Resistance 14—22,000 ohms
Resistance 17—4.5 megohms

From the foregoing discussion it is apparent that considerable modification of the features of the present invention is possible and while the device herein described and the form of apparatus for the operation thereof constitutes a preferred embodiment of the invention it is to be understood that the invention is not limited to this particular device and form of apparatus and that changes may be made therein without departing from the scope of the invention as defined in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A generator device for producing symmetrical square wave electrical signals, comprising; a signal generator device for producing sinusoidal signals of variable amplitude having frequency

correspondence with the frequency of the desired square wave signals, a clipper circuit comprising an electron tube having anode, cathode, and control grid electrodes suitable for overdriven amplifier operation, an anode voltage supply for said tube, coupling means transferring the sinusoidal signal to the control grid electrode of said electron tube in sufficient amplitude to consecutively drive said electron tube to anode current saturation and anode current cutoff, said coupling means comprising a series-connected combination of a capacitive element and a resistive element whose free end is connected to the grid electrode of said electron tube, an output circuit operatively connected to the anode electrode of said electron tube and to the anode voltage supply therefor, and a resistive element operatively connected between said output circuit and the input circuit for feed-back to said input circuit of a voltage proportional to the average voltage existing in said output circuit whereby an average voltage of substantially zero volts is maintained in the input circuit at a point between the series connected capacitive element and the resistive element and whereby the square-wave voltage signals developed in the output circuit is maintained substantially symmetrical despite frequency and amplitude fluctuations of said applied sinusoidal signals.

2. A generator device for producing symmetrical square wave signals comprising a sine wave signal generator, a clipper circuit fed by said sine wave generator comprising, an electron tube having an anode, a cathode, and a grid, a source of anode supply potential, a load impedance connecting said anode to said supply potential, means including a series resistance coupling the output of said sine wave generator to the grid of said tube, a second resistance connecting the anode of said tube to the grid thereof through said series resistance, a condenser disposed within the grid circuit of said tube in an integrating relationship with said second resistance, said second resistance and said condenser cooperating to change the grid bias on said tube in response to changes in average anode potential on said tube and in a sense corresponding to the sense of anode potential changes.

3. A clipper circuit comprising an electron tube having an anode, a cathode, and a grid, a source of anode supply potential, a load impedance connecting said anode to said supply potential, a pair of serially connected resistance elements connecting the anode of said tube to the grid thereof, a condenser, one plate of which is connected to the junction of said resistance elements, the other plate of said condenser serving as an input terminal to the circuit, one of said resistance elements and said condenser cooperating to change the grid bias on said tube in response to changes in average anode potential on said tube and in a sense corresponding to the sense of anode potential changes.

CARL HARRISON SMITH, JR.
MILTON L. KUDER.

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