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VARIABLE TIME BASE GENERATOR

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Fig. 1

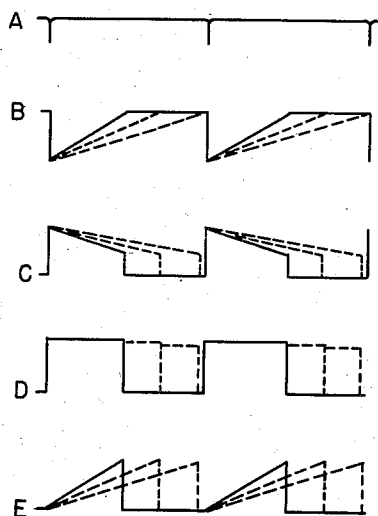
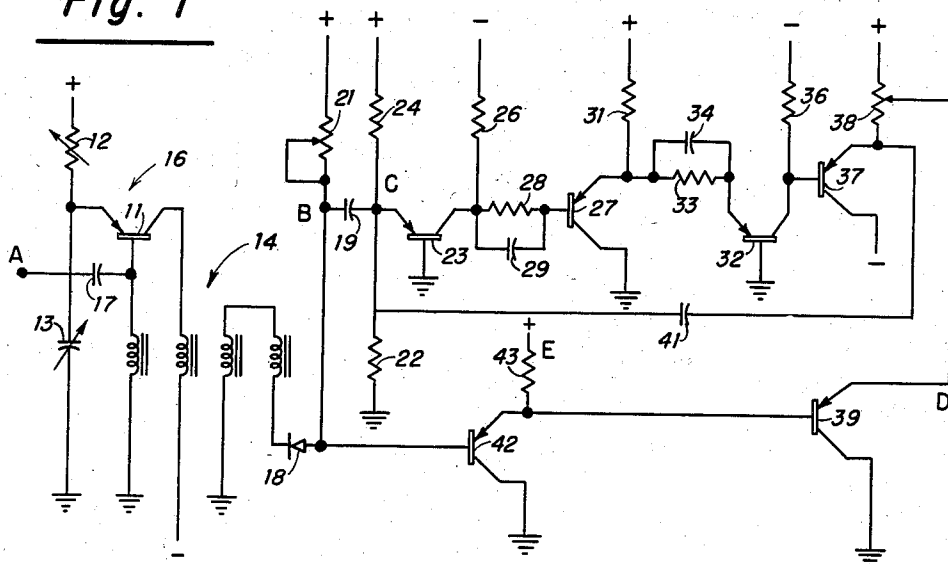


Fig. 2

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VARIABLE TIME BASE GENERATOR

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9 Claims. (Cl. 307—88.5)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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.

This invention relates to variable time base generator circuits and more particularly to variable time base generator circuits of the blocking oscillator type employing transistors and which produce a continuously variable time base voltage for a fixed repetition period and having a constant width insensitive to frequency.

Sweep generators performing this type of operation have been built with vacuum tubes but the problem of obtaining a continuously variable time base voltage as represented by a linear sawtooth has always been difficult to overcome and generally several tubes, with resulting increased power consumption, are required to produce the constant width as well as the linear sawtooth voltage. Other transistor multivibrator circuits have been constructed but these do not maintain the necessary constant pulse-width when the trigger rate is changed and the resulting waveforms need additional shaping to be useful. In addition the sawtooth sweep voltage has too long a retrace time and is non-linear. Co-pending application, Serial No. 474,305, filed December 9, 1954, by Arthur J. Glenn for Transistor Mono-Stable Sweep Generator was designed to overcome these defects by means of a multivibrator arrangement.

The constantly variable time base voltage generator circuit of the present invention overcomes the objections found in the prior art through the use of a blocking oscillator and a diode pick-off arrangement using junction type transistors. A sawtooth-voltage time base representing the full period between trigger pulses is generated by the blocking-oscillator circuit and an amplitude comparator using a diode allows a portion of the period to be selected. Subsequent gates can then be set up to pass the desired waveform.

An object of this invention is the provision of a transistorized blocking oscillator type circuit for use as a time-base generator.

Another object is the provision of a time-base generator which will produce a continuously variable time base for a fixed repetition period.

Another object is the provision of a time-base generator for producing a linear sawtooth sweep voltage of constant width insensitive to frequency.

Another object is the provision of a time-base generator of simple design that is inexpensive in manufacture and reliable in operation.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 shows a diagram of the variable time base generator circuit; and

Fig. 2 shows the voltage waveform curves.

Referring now to Fig. 1, junction-type transistor 11 and the associated components resistor 12, capacitor 13, and transformer 14, form the blocking oscillator 16. Resistor 12 and capacitor 13 are variable so the pulse rate can be adjusted over wide limits.

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The negative triggering impulse waveform (A in Fig. 2) is fed through condenser 17 to the base of transistor 11 which causes a pulse to be developed by the blocking oscillator 16 across transformer 14. At the time of the trigger pulse, a negative voltage pulse is developed across the output winding of transformer 14 and diode 18 conducts. Although not shown, a positive trigger pulse connected to the emitter of transistor 11 produces the same negative pulse on the transformer output winding, causing the diode to conduct. Since the source impedance, i. e., secondary transformer windings, is quite low, capacitor 19 tends to charge to the peak amplitude of the pulse voltage. Thus the magnitude of the charge is a function of the pulse amplitude. When the pulse ceases, the capacitor 19 is charged negatively. Since parallel discharge paths exist, through the back resistance of diode 18 and through the resistor 21, a diode with as high a back resistance possible is used, so that in the practical operation of this circuit, the discharge path back through the diode need not be considered. The negative charge on condenser 19, which remains after the trigger pulse has ended, leaks off through resistor 21 in the other discharge path and is returned to a positive variable voltage. The variable positive voltage and resistor 21 connected to this voltage are the primary timing parameters and the discharge rate of capacitor 19 becomes a function of both the value of resistor 21 and the magnitude of the variable positive voltage. By making either of these variable, the rate of discharge may be controlled and the waveform across capacitor 19 is shown as B in Fig. 2 with the dotted lines representing different values of the voltage or resistance 21. When this voltage reaches ground potential, rising from its negative value because of the capacitor charge following the pulse, it is short-circuited by the diode 18, which is again conducting since the anode is now near zero potential. The voltage now remains at ground potential until the next pulse occurs. It is readily apparent that the sloping portion is constant in amplitude but variable in slope. This rising slope portion is most cases is the useful portion of the waveform, but must be converted to a waveform shaped similar to E in Fig. 2 to be usable for current practical equipment design. The remaining circuitry in this invention is for the purpose of deriving a waveform of shape D to be added to waveform B to obtain the resultant desired waveform E.

A low value of resistance 22 is inserted as shown so that charge and discharge currents will flow through it, developing a voltage waveform shown as C in Fig. 2. It is necessary to detect these points of change, and particularly the discharge period, which is done by successive stages of amplification. The resistor 22 is connected directly to the emitter of a grounded-base junction transistor 23. The function of resistance 22 and the low resistance of the emitter to base of transistor 23 is to detect the period of discharge of the condenser 19. Since the rate of discharge is constant, the current is constant, so that a positive voltage across resistor 22 exists during the discharge period. This voltage is amplified by transistor 23 which is connected as a grounded-base amplifier. The resistor 24 connected to the emitter of transistor 23 is merely a biasing resistance to ensure that the emitter current is proper for the operation of transistor 23 as an amplifier.

Because the time period can vary over such wide limits, and constant operating levels should be sustained, it is necessary to directly couple the output of transistor 23 across resistor 26 to transistor 27. This is done through the network composed of resistor 28 and capacitor 29. This capacitor serves primarily to by-pass the high frequency components of the rectangular waveform of voltage across load resistor 26 direct to the input of transistor 27, whose collector is connected to ground,

and which functions as an isolation amplifier with no gain.

The output voltage developed across load resistor 31 is connected to the emitter of transistor 32 through the coupling network consisting of resistor 33 and capacitor 34. This capacitor serves to pass the high frequency components to the transistor's emitter. The transistor 32 is connected in a conventional grounded-base amplifier arrangement whose output is developed across resistor 36 and the equivalent resistance of the collector-base of transistor 37. Transistor 37 is connected essentially as a high-gain amplifier isolation stage whose output is developed across resistor 38, whose waveform is essentially rectangular as indicated by D in Fig. 2. This is the desired gating voltage which is applied to the emitter of transistor 39 whose collector is connected to ground. Capacitor 41 couples the output of transistor 37 to transistor 23 in a regenerative feedback loop to sharpen up the wavefront. Thus, when waveform B reaches ground potential, the high current through the diode and transformer windings and through resistor 21 causes a voltage to be developed which is further increased in magnitude by the connection of this feedback loop.

Transistor 39 is a second isolation amplifier stage whose collector is connected to ground. It serves to couple the variable amplitude of waveform D to the mixing transistor 42. The waveform B is connected to the base of transistor 42 and essentially a portion of waveform D is connected to the emitter. The mixed output E now results across resistor 43. This is the desired time base, rising from a zero level as a positive sawtooth voltage and returning to it at the end of a desired period. The waveform D is useful as a gating function in related circuit operations where such a device might be employed.

This circuit offers several advantages in that the pedestal upon which the time base exists can be controlled, so that some advantage can be achieved in developing fast time bases. Another advantage of this circuit is that it offers a continuously variable voltage time base operation over the full range of the triggering-pulse period. It is sensitive to frequency and offers excellent possibilities for linear calibration scales.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a variable time base generator, circuit means for producing a voltage going sharply negative with respect to ground upon application of a triggering voltage pulse thereto, and a linear rise back to ground potential, at which the voltage remains until the next triggering pulse is applied, said circuit means comprising a transistorized blocking oscillator including a transformer, a charge-discharge condenser, normally conducting gating means connected to pass negative charges from the secondary winding of said transformer to one plate of said charge-discharge condenser, a variable resistor connecting a positive potential source to said one plate, and an output connection between said gating means and said one plate.

2. In a variable time base generator, circuit means for producing a voltage going sharply negative with respect to ground upon application of a triggering voltage pulse thereto, and a linear rise back to ground potential, at which the voltage remains until the next triggering pulse is applied, said circuit means comprising a junction type transistor, a resistance connecting a positive potential source to the emitter thereof and a capacitor connecting said emitter to ground, a transformer, the primary winding of said transformer connecting the base of said transistor to ground, an intermediate winding on said transformer connecting the collector of said transistor to a

negative potential source, a normally conducting diode, the secondary winding of said transformer connecting the diode to ground, a charge-discharge condenser, one plate of which is connected to said diode, a variable resistor connecting said one plate to a second positive potential and an output connection between said diode and said one plate.

3. The circuit as in claim 2, in which the resistor and capacitor connected to said emitter are adjustable to permit a wide range in the pulse repetition rate.

4. The circuit as in claim 2, in which said diode has a high reverse resistance such that the negative charge on said one plate is discharged through the path of said variable resistor, said variable resistor being adjustable to determine the desired discharge rate of said charge-discharge condenser.

5. A triggered sawtooth generator comprising a capacitor, a source of positive potential, a resistor connecting one side of said capacitor to said source, means for feeding a negative trigger pulse to said one side of said capacitor to store a negative charge therein for linear discharge through said resistor, and means included in said feeding means and effective following said discharge and prior to receipt of a second trigger pulse for maintaining the voltage at said one side of said capacitor at a value not greater than a predetermined potential which is less than the potential of said source.

6. The generator of claim 5 wherein said last mentioned means and said trigger pulse feeding means comprise a normally conducting diode having the anode thereof connected to said one side of said capacitor, the cathode of said diode having a source of potential lower than said first mentioned source, whereby as the capacitor discharges toward said positive potential after reception of a trigger pulse the diode will conduct when the voltage at said capacitor reaches the potential of said cathode.

7. In a variable time base generator triggered by a train of pulses, means responsive to said train and including a series connected capacitor and resistor for generating across said resistor and at the repetition rate of said pulses a sawtooth voltage of constant amplitude having a predetermined slope time, means including a grounded-base junction transistor having said resistor connected to the emitter thereof for detecting said slope time, means responsive to said detecting means connected to the collector of said transistor and for generating a rectangular gating voltage having a duration equal to said slope time, and means connected to the output of said generating means for mixing said sawtooth voltage and said gating voltage.

8. The structure of claim 7 wherein said mixing means comprises a second transistor having an emitter, base and grounded collector, said capacitor coupling the base of said second transistor with the emitter of said transistor, said gating voltage generating means being coupled between the collector of said first mentioned transistor and the emitter of said second transistor.

9. In a device of the class described, a capacitor, resistor, means for alternately charging and discharging said capacitor, through said resistor and means connected to said resistor and capacitor for detecting the discharge time of said capacitor, said detecting means comprising a transistor having an emitter, collector and base, said resistor being connected in the emitter-base circuit of said transistor.

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