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VOLTAGE CONTROL CIRCUIT

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Fig. 1.

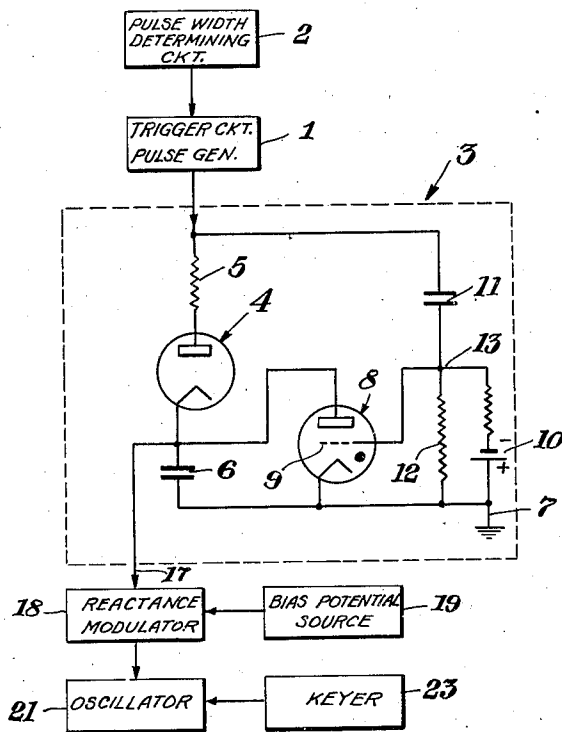
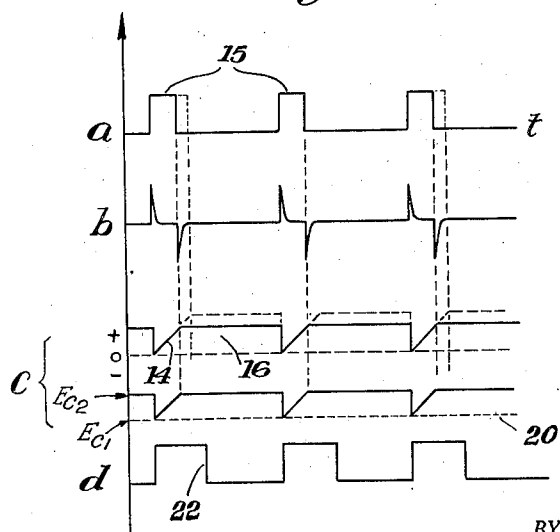


Fig. 2.



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VOLTAGE CONTROL CIRCUIT

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7 Claims. (Cl. 250—36)

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This invention relates to voltage controls, and more particularly to circuits for providing direct current voltages in accordance with a primary controlling voltage.

Numerous applications come to mind when given voltages are required to be provided in response to some primary or controlling voltage. One such application may be found in connection with the control of frequency in a reactance tube modulated oscillator.

In a circuit of this type, the tunable circuit of the oscillator ordinarily incorporates as part of its circuit reactance a variable portion in the form of a so-called reactance tube. By applying a suitable controlling voltage to the grid or grids of the reactance tube the current in the plate circuit of the tube may be made to vary its phase relationship with respect to that of the tunable circuit of the oscillator, giving the same effect as though a variable inductance or capacitance were connected in the oscillator circuit. The frequency of the oscillator is thus controllable by means of a signal on the grid of the reactance tube.

It is an object of this invention to provide a circuit for furnishing a voltage in response to a primary or controlling voltage of a given character.

It is another object of this invention to provide a circuit wherein a variation in the amplitude of the output voltage may be obtained in response to and in accordance with the variable width of input control voltage pulses.

It is another object to provide means for converting a controlling voltage wave into a biasing voltage for a reactance modulator.

It is a further object to provide means for furnishing a biasing voltage to a reactance modulator, the value of which is a function of the variation with respect to time within a given period of the controlling voltage.

In accordance with my invention, I provide a trigger circuit for generating pulses which is energized from circuits adapted to control or determine the width of the pulses generated in accordance with a given variable, such as signal frequency. The pulses thus obtained are used to control a so-called bias generator which includes a capacitance, the charging and discharging of which is timed by the pulses and the resulting voltage of which is applied to the grid of a reactance tube. This, added to the voltage from a fixed bias potential source results in an overall bias for the tube and is effective in determining the plate current of the reactance modulator,

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whereby the frequency of the oscillator may be varied as noted hereinabove. The oscillator is arranged to be keyed off during the period when the change in the biasing voltage for the modulator takes place, and becomes operative again when the biasing voltage has assumed its final value.

These and other features and objects will become apparent, as reference is had to the following detailed description to be read in connection with the accompanying drawings, in which:

Fig. 1 is an illustration partly in block and partly in schematic form of a circuit in accordance with my invention; and

Fig. 2 is a graphical illustration showing the steps of operation.

Referring to Fig. 1, the controlling or primary voltage pulses in accordance with graph *a*, Fig. 2 may be obtained from a trigger type circuit pulse generator 1, which is being energized and controlled from a pulse width determining circuit 2. The pulse width determining circuit may be any one of a number of suitable devices which, by their voltage output, control the width of the pulses generated by the trigger circuit 1. An example of such a circuit has been described in the copending application of E. Labin, and S. Frankel, Serial No. 556,742, filed October 2, 1944, wherein a series of starting and stopping pulses are obtained for the actuation of a trigger circuit, separated by a time interval which is a measure of the radio frequency to which a receiving circuit is tuned at a given moment during a panoramic type frequency scanning cycle. The trigger circuit to which these actuating starting and stopping pulses are applied, may be of the type known as the Eccles-Jordan trigger circuit which, in itself is known in the art and need not be described here in detail. It may suffice at this time to state that this type of circuit may be actuated by a sharply defined starting pulse of a given polarity to provide a constant voltage which is terminated abruptly as a so-called stopping pulse also sharply defined but of opposite polarity, is applied to the circuit, the output of the trigger circuit being in the form of square topped pulses as in graph *a*. These pulses are applied to a bias voltage generating circuit indicated at 3. As the leading edge of these pulses (graph *a*) is applied to a diode 4 over a resistor 5, the diode is rendered conductive as the applied pulse voltage is positive and the cathode of the diode is at zero or ground potential. The pulses are thus able to charge a capacitor 6 for the period of their duration. Since the capacitor 6 is connected to ground

at 7, and since for the duration of the pulses (graph *a*), the diode 4 may be considered a perfect conductor between the resistor 5 and the condenser 6, the condenser 6 acts as an integrating circuit in respect to the applied pulses.

In order to be able to charge the condenser 6 anew with every pulse, there has been provided a circuit for clearing the condenser of any charge thereon that may have been due to any preceding pulse. This circuit is comprised of a gas triode 8, the plate of which is connected to the junction of the cathode of the diode 4 with the condenser 6, and the cathode of which is also connected to ground at 7. The conductivity of this triode is controlled by means of a grid 9 which is fixedly biased to a negative potential from a source 10. A circuit also has been provided for differentiating the pulses of graph *a*, consisting of a condenser 11 and a resistor 12 in series connecting the output terminal of the trigger circuit 1 to ground 7. The differentiating voltage pulses due to the leading and trailing edges of the pulses of graph *a*, respectively, which may be obtained across the resistor 12 are shown in graph *b* where in the leading edge of the square pulses result in sharply defined positive and the trailing edges in sharp negative pulses.

The grid 9 of the triode 8 is connected to the junction point 13 between the condenser 11 and the resistor 12, whereby the differentiating pulses serve to reduce to a greater or lesser extent the negative bias maintained on the grid 9 due to the source 10. The bias for the triode 8 is chosen in such a way as to render the tube conductive when the positive differentiating pulses are applied, while the negative pulses only serve to increase the negative bias and therefore do not affect the conductivity of the triode. As soon as the conductivity of the triode has been interrupted, that is, restored to its normal state, the condenser 6 will be charging up due to the pulses of graph *a* being applied thereto through the now conductive diode 4. The condenser 6 will charge up substantially exponentially in accordance with the portion 14 of graph *c*. The voltage of the condenser will continue to increase in this exponential manner for the duration of the pulses 15 (graph *a*). As soon as any of the pulses 15 are terminated, the voltage on the condenser assumes the constant value indicated at 16 in graph *c* and continues substantially at this value until the condenser is again able to discharge to ground upon conductivity being established through triode 8 when a positive differentiating voltage pulse (graph *b*) is applied to the grid 9 when the next pulse 15 occurs. It is thus apparent that the voltage obtainable from the condenser over a connection 17 is directly controlled by the width of the pulses 15 applied through the diode 4. The variation of the voltage on the condenser 6 with the width of the pulse 15 has been indicated by the broken lines connecting two different widths of the pulses 15 with their respective voltage levels in graph *c*. The condenser voltage which is shown to be of positive polarity in graph *c* is applied to a reactance modulator circuit 18 which normally is fixedly biased to a negative potential from a bias potential source 19. This negative bias for the reactance modulator is indicated by the broken line 20 at the value E_{c1} in graph *c*. As the voltage obtained from the condenser over the connection 17 is added to the bias E_{c1} from the source 19, the voltage values at any one time are added algebraically, resulting in a final bias having the value E_{c2} for the reactance modu-

lator. Since the modulator 18 is connected to control the tuning circuit and thereby the frequency of an oscillator 21, the oscillator, for the period during which the bias voltage from the condenser 6 may be changing, that is at least for the duration of the pulses 15, may be keyed off by pulses of the type shown at 22 in graph *d*, which may be supplied by a keyer circuit 23.

It may be seen that, in accordance with the above description, any primary control condition which may be made to result in pulses 15 indicating by different widths a variable controlling factor, may be made to produce a voltage of an amplitude value corresponding to the width of these controlling pulses.

Although I have shown and described a specific apparatus for carrying out the method of my invention, it will be understood that the apparatus may be modified without departing from the scope of the invention. Particularly, it is pointed out that while the invention has been described in connection with a frequency control circuit as indicated by the reactance modulator and oscillator 20, other applications may readily occur to one skilled in the art for the voltage generating circuit 3 controlled by the trigger circuit 1. It will be understood, therefore, that the form herein shown and described is to be regarded as illustrative of the invention only and not as limiting the objects thereof.

I claim:

1. A radio system for controlling the frequency of an oscillator in response to and in accordance with controlling pulses of varying widths, comprising a trigger circuit for generating pulses of varying widths, a source of primary potential for controlling the width of said pulses operatively associated with said trigger circuit, means for establishing a voltage in accordance with the time of application thereto of a given primary voltage connected to receive said controlling pulses, means connecting said means for establishing to said trigger circuit operatively controlled by said pulses, means for returning said means for establishing to zero voltage with the beginning of each pulse, an oscillator, and a reactance modulator for controlling the frequency of said oscillator connected to receive the voltage of said means for establishing.

2. A radio system for controlling the frequency of an oscillator in response to and in accordance with controlling pulses of varying widths, comprising a trigger circuit for generating pulses of varying widths, a source of primary potential for controlling the width of said pulses operatively associated with said trigger circuit, means for establishing a voltage in accordance with the time of application of a given primary voltage connected to receive said controlling pulses, means connecting said means for establishing to said trigger circuit operatively controlled by said pulses, means for returning said means for establishing to zero voltage with the beginning of each pulse, an oscillator, a reactance modulator for controlling the frequency of said oscillator connected to receive the voltage of said means for establishing, and means for supplying keying voltages to said oscillator for keying the same off for at least the duration of said controlling pulses.

3. An electrical system for providing a final voltage proportional to the varying widths of control pulses comprising means for simultaneously integrating and differentiating said control

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pulses to obtain separate outputs thereof, means for applying said differentiated output to reduce said integrated output to a given amplitude at the beginning of the application of said pulse to said integrating means, a load circuit, and means for applying said integrated output to said load circuit.

4. An electrical system for providing a final voltage having an amplitude proportional to the varying widths of control pulses comprising a storage means, means for applying a portion of said control pulses to said storage means, means for differentiating a portion of said control pulses to obtain a differentiated output thereof, discharge means for said storage means, and means for energizing said discharge means with said differentiated output, whereby the energy in said storage means is reduced to a given level, a load circuit and means for applying the energy of said storage means to said load circuit.

5. An arrangement according to claim 4, wherein said discharge means comprises a gas-filled electron discharge device.

6. An arrangement according to claim 5, wherein said means for differentiating comprises a resistance-capacitance network.

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7. An electrical system for providing a final voltage having an amplitude proportional to the varying widths of control pulses comprising a storage means, a rectifier circuit, means for charging said storage means with said control pulses through said rectifier circuit, a gas-filled electron discharge device coupled across said storage means, said device comprising a control electrode, means for differentiating said control pulses, to obtain an output thereof, means for applying said differentiated output to said control electrode whereby said device discharges said storage means to a given level.

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