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SIGNAL GENERATOR

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FIG. 1

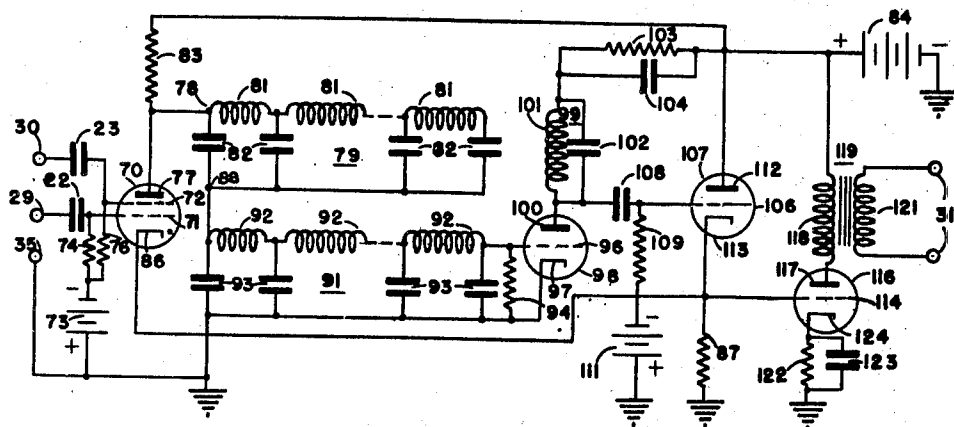
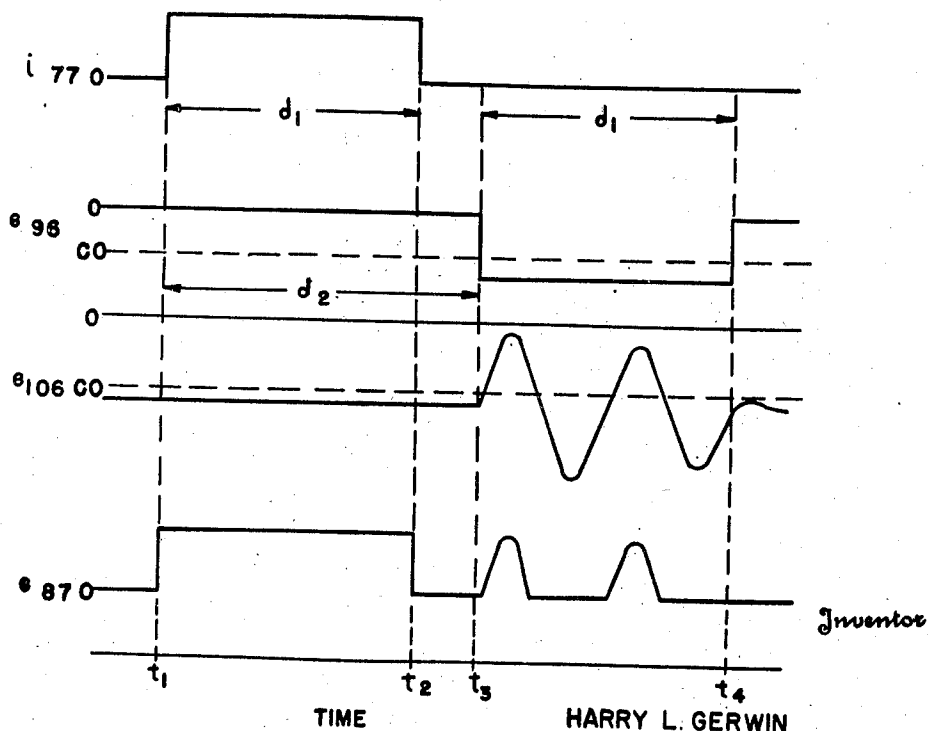


FIG. 2



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SIGNAL GENERATOR

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9 Claims. (Cl. 177-380)

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The invention relates to electrical signal generating circuits.

An object of the invention is to provide novel means for generating a group of electrical signal impulses.

Another object of the invention is to provide novel means for generating electrical impulses in a group comprising an electrical impulse of relatively long time duration and one or more electrical impulses of relatively short time duration.

A further object of the invention is to provide novel means for generating successive electrical impulses comprising single impulses of predetermined time duration and arranged in a predetermined time sequence forming a signal group.

Other objects and features of the invention will appear more fully from the following detailed description when considered in connection with the accompanying drawing. It is to be expressly understood, however, that the embodiment shown in the drawing is designed for purposes of illustration only and not as a definition of the limits of the invention, reference for the latter purpose being had to the appended claims.

In the drawing, wherein similar reference characters denote similar parts throughout the several views:

Fig. 1 is a schematic circuit diagram of an embodiment of the invention;

Fig. 2 shows wave form representative of the voltages at certain parts of the circuit shown in Fig. 1, plotted with respect to time.

Referring now more particularly to Fig. 1, there is shown a schematic circuit diagram of an electrical impulse generator embodying the invention. Switch tube 70 is a tetrode of the gaseous type, such as a screen grid thyatron. The control grid 71 and screen grid 72 are connected to a source of negative voltage 73 supplying a normally blocking grid potential through resistors 74 and 76 respectively. The anode 77 is connected to one terminal 78 of delay network 79. The latter comprises, in the embodiment shown, an artificial transmission line having a plurality of inductors 81 and a plurality of capacitors 82. Also, the anode 77 is connected through a charging resistor 83 to a source of positive voltage 84. The cathode 86 of tube 70 is connected to ground through resistor 87. The other terminal of the artificial transmission line 79 is connected to ground through another delay network shown as artificial transmission line 91 comprising inductors 92 and capacitors 93. Line 91 is terminated in its characteristic impedance at its other end by a resistor 94 connected between control

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grid 96 and cathode 97 of a normally conducting triode switch tube 98. The anode 100 of switch tube 98 is connected through resonant circuit 99 comprising inductor 101 and capacitor 102 to resistor 103 which is shunted by by-pass capacitor 104. The other end of resistor 103 is connected to a source of positive voltage 84. The control grid 106 of mixing tube 107 is coupled to the plate of tube 98 through capacitor 108 and is also connected through resistor 109 to a source of negative bias voltage 111. The plate 112 of tube 107 is connected to a source of positive voltage 84. Cathode 113 is connected to the cathode 86 of tube 70 and to the control grid 114 of amplifier tube 116. The plate 117 of amplifier tube 116 is connected through the primary winding 118 of transformer 119 to a source of positive voltage 84. The input terminals 29 and 30 are connected through capacitors 22 and 23 respectively to the control grid 71 and the screen grid 72 respectively, of tube 70. Input terminal 35 is connected to ground. The output terminals 31 are connected to the secondary winding 121 of transformer 119. Negative grid bias for amplifier tube 116 is developed across resistor 122 connected between cathode 124 and ground. Resistor 122 is shunted by a by-pass condenser 123.

The operation of the invention will be explained first with reference to its quiescent condition. In the quiescent condition, when no voltage is applied to the input terminals 29, 30, 35, the flow of plate current through switch tube 70 is cut off due to the negative potential of control grid 71 and screen grid 72. Artificial line 79 is charged through a high resistance 83 to the potential of voltage source 84. Plate current is flowing through tube 98 due to the fact that the grid 96 is at cathode potential, there being no charge on artificial line 91. The magnitude of the plate current through tube 98 is limited by resistor 103 to a value not in excess of the rated current of the tube. Plate current of tube 107 is cut off by the negative bias supplied by source 111. Resistor 122 is preferably of sufficiently high resistance to bias tube 116 almost to plate current cut-off.

The circuit of Fig. 1 becomes operative when the potentials of the control grid 71 and screen grid 72 of gaseous switch tube 70 simultaneously exceed certain critical values. This condition will occur, for example, when a positive voltage impulse of sufficient magnitude is applied between input terminals 29, 35, and another positive voltage impulse of sufficient magnitude is simultaneously applied between input terminals 30, 35. Said impulses are coupled respectively to the con-

trol grid 71 and screen grid 72 of tube 70, causing tube 70 to conduct plate current. Referring now to Fig. 2, tube 70 starts conducting plate current i_{77} at time t_1 , said plate current being supplied principally by the discharge of artificial line 79. The plate current i_{77} flows through the circuit from terminal 78 of the line 79 through the tube 70 from plate 77 to cathode 86, through resistor 87 and through the impedance of the artificial line 91 to terminal 88 of line 79. The impedance of this circuit is made equal to the characteristic impedance of the line 79. At a later time, t_2 , when line 79 has completely discharged, the plate voltage of tube 70 drops below the minimum value necessary to maintain plate current conduction and plate current flow is cut off abruptly. The magnitude d_1 of the time interval between t_1 and t_2 is determined, in a manner known to those skilled in the art, by the magnitudes of the inductance 81 and capacitance 82 of each section of line 79 and the number of sections composing the line, each section comprising one inductor 81 and one capacitor 82. The flow of current i_{77} through resistor 87 causes a positive voltage impulse of a duration d_1 to be applied to the cathode 113 of tube 107 and to the grid 114 of tube 116. The waveform of the voltage at the grid 114 of tube 116 is shown by curve e_{87} . Similarly, the flow of current i_{77} into artificial line 91 produces a negative impulse of voltage across the line 91. This negative impulse is delayed by an amount of time d_2 as it travels along artificial line 91 to the grid of tube 98. Artificial line 91 thus functions as a delay device and is designed to have a delay time d_2 greater than the duration d_1 of the discharge time of line 79. Consequently, a negative voltage impulse of duration d_1 reaches the grid 96 of tube 98 at time t_3 . The magnitude of the impulse is sufficient to cut off the flow of plate current through tube 98. The abrupt interruption of plate current through tube 98 initiates damped oscillations in resonant circuit 99, beginning at time t_3 . The oscillatory voltage of the resonant circuit is applied through coupling condenser 108 to the grid 106 of tube 107. The voltage waveform at the grid 106 is shown by curve e_{106} . The applied oscillatory voltage is superimposed on the negative D. C. bias from source 111 causing the grid 106 to rise periodically above the plate current cut-off potential during a portion of each positive half cycle of the oscillatory voltage. Thus, short impulses of plate current flow through tube 107 and resistor 87 for a time interval d_1 between t_3 and t_4 . The resulting short voltage impulses at cathode 113 are applied to the grid 114 of tube 116. At time t_4 , the voltage e_{96} of tube 98 rises to zero and tube 98 conducts plate current, thus quickly damping the oscillations of resonant circuit 99.

There is thus produced at the grid 114 of tube 116 a group of voltage impulses as shown by the curve e_{87} , Fig. 3, in which an impulse of relatively long duration is followed by two impulses of relatively short duration. It will be understood that the number of short impulses in each group is determined by the natural frequency of the resonant circuit 99, and the duration d_1 of the relatively long impulse. The number of short impulses in each group is:

$$N = f_n d_1$$

where f_n is the natural frequency of the resonant circuit.

The impulses are amplified by tube 116 and may be applied to the output terminals 31 of the

circuit through an impedance matching transformer 119.

It should be understood that the practice of the invention is not limited to the embodiments illustrated and described but is circumscribed only by the scope and limitations of 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.

I claim:

1. A voltage signal source comprising an artificial line, means for shifting the potential of said line to generate a signal, time delay transmission means receiving said signal, a signal generator, means for initiating the operation of said signal generator responsive to the delayed transmitted signal, and mixer means coupled to said artificial line and to said signal generator.

2. A voltage signal source comprising an artificial line, means for charging said line, means for discharging said line to generate a signal, time delay transmission means receiving said signal, a signal generator, means for initiating the operation of the signal generator responsive to the delayed transmitted signal, and mixer means coupled to said line and to said signal generator.

3. A voltage signal source comprising a first artificial line, means for charging said line, a second artificial line, means for discharging the first line across the second line, a signal generator, means for initiating operation of the signal generator subsequent to initiation of discharge of the first line becoming operative responsively to termination of the signal delivered through the second line from discharge of the first line to terminate operation of the signal generator, and mixer means coupled to the first line and to the signal generator.

4. A voltage signal source comprising a first artificial transmission line, means for charging said line, a second artificial transmission line, means for discharging the first line across the second line, a signal generator, means initiating operation of the signal generator operative responsively to delivery of the signal from discharge of the first line through the second line, and mixer means coupled to the first line and to the signal generator.

5. A voltage signal source comprising a first artificial transmission line, means for charging said line, a second artificial transmission line, means for discharging the first line across the second line, a discrete signal generator, means initiating operation of the signal generator operative responsively to delivery of the signal from discharge of the first line through the second line and becoming operative after a time interval in dependency on termination of the discharge of the first line to terminate operation of the discrete signal generator, and mixer means coupled to the first line and to the signal generator.

6. A voltage signal source comprising a first artificial transmission line, means for charging said line, a second artificial transmission line, means for discharging the first line across the second line, a discrete signal generator operative to supply a plurality of signal pulses, means initiating the operation of the signal generator operative responsively to delivery of the signal from discharge of the first line through the sec-

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ond line, and mixer means coupled to the first line and to the signal generator.

7. A voltage signal source comprising a first artificial transmission line, a second artificial transmission line, means for generating oscillations, means for initiating generation of oscillations responsively to delivery of the signal from discharge of the first line through the second line, and mixer means coupled to the first line and to the signal generator.

8. A voltage signal source, comprising a first artificial transmission line, means for charging said line, a second artificial transmission line, means for discharging the first line across the second line, a discrete signal generator operative to supply a plurality of signal pulses, means initiating the operation of the signal generator operative responsively to delivery of the signal from discharge of the first line through the second line and becoming operative after a time

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interval in dependency on termination of the discharge of the first line to terminate operation of the discrete signal generator, and mixer means coupled to the first line and to the signal generator.

9. Means for generating a group of electrical impulses comprising an impulse of relatively long time duration and one or more impulses of relatively short time duration, including an artificial transmission line, means operative to shift the potential of said line to generate an initial impulse of relatively long time duration, a resonant circuit for generating impulses of relatively short time duration, and means coupling said line to said resonant circuit operative to excite said resonant circuit subsequent to termination of said initial impulse to generate impulses of relatively short time duration, and mixer means coupled to said line and to said resonant circuit.

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