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VACUUM TUBE IMPULSE PATTERN PRODUCER

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Fig. 1

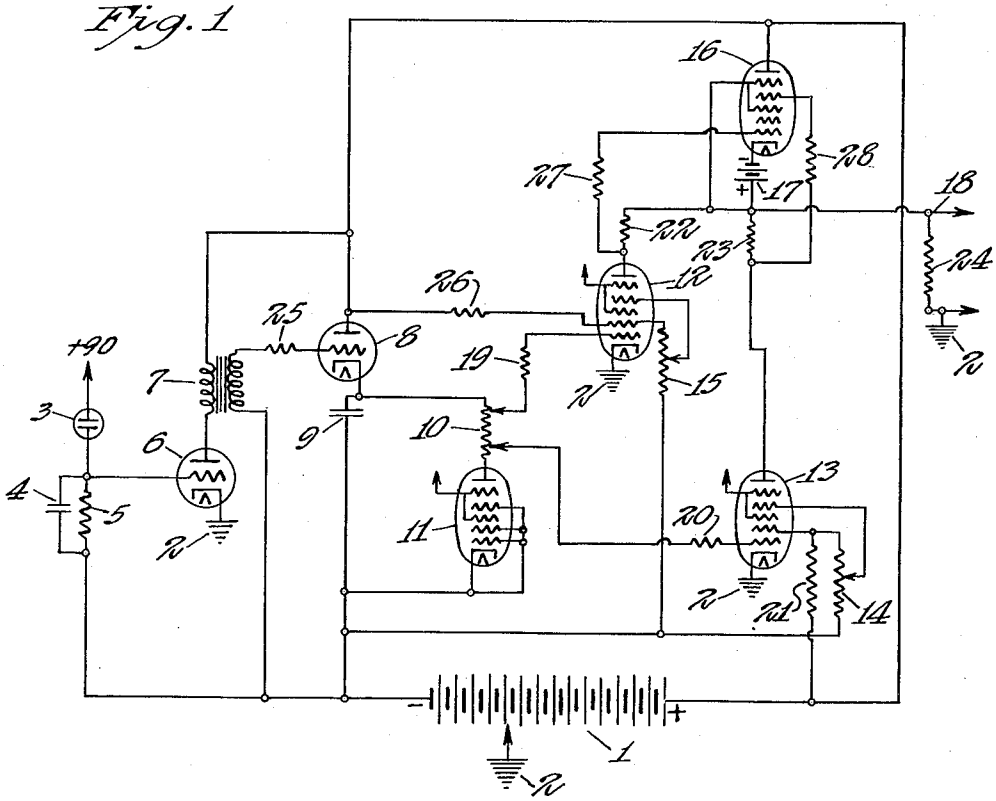
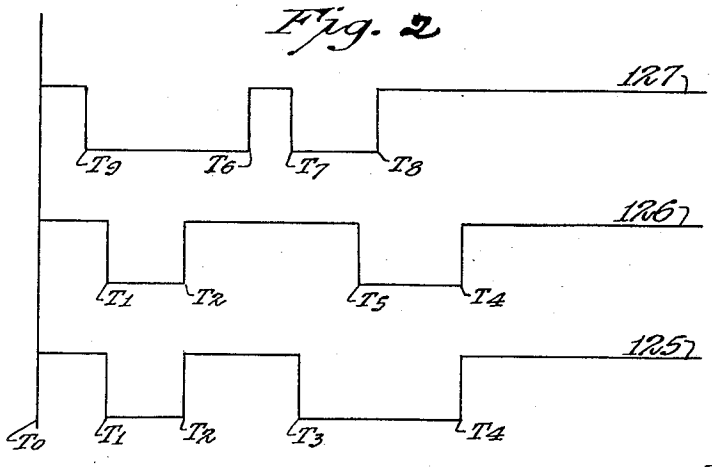


Fig. 2



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VACUUM TUBE IMPULSE PATTERN PRODUCER

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8 Claims. (Cl. 250—27)

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This invention relates to vacuum tube impulse pattern producers, and more particularly to vacuum tube circuit means for producing desired signal patterns for a signalling system.

This application is a division of my U. S. Patent No. 2,421,022 entitled "Duration Impulse Receiver" issued May 27, 1947.

Various circuits have been proposed for producing signal patterns of impulses and spacings of desired duration. In telephone ringer circuits, rotary contacts driven by a constant speed motor have been used. In another circuit the discharge RC time element of a condenser has been proposed to control mechanically movable contacts. Due to inertia effects, movable contacts cannot be used in producing signal patterns at high speeds.

In the art of multiplex telegraphy, unit vacuum tubes conductive at time displaced intervals have been used, the signals from these tubes modulating the transmission medium. Such modulation is accompanied with difficulties in view of the fact that a load common to the output circuit of all of said tubes has in the past been used. As the conductivity of these unit tubes sometimes overlap, two or more unit tubes may be modulating the transmitter simultaneously instead of the desired one. Such cross modulation of unit tubes renders the signal produced of poor quality.

It is one of the objects of this invention to provide a high impedance load for a plurality of unit vacuum tubes conductive at time displaced intervals whereby this deleterious cross modulation may be kept at a minimum.

Another object is to provide a vacuum tube load device, having a plurality of grids in the path of an electron stream, and means for controlling the potential of one of said grids by current flowing in one of said unit tubes and a second of said grids by current flowing through a second of said unit tubes.

Another object is to provide a signal pattern producer, said pattern comprising impulses of desired duration and spacings of desired time length.

Another object is to provide a producer of a signal pattern having steep wave fronts without use of excessive amplification.

These and other objects will become apparent from the claims, description and figures in which:

Fig. 1 illustrates an impulse pattern producer embodying my invention and,

Fig. 2 shows signal patterns which may be produced by Fig. 1.

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Referring to Fig. 1, I have shown a means for producing time displaced impulses of variable duration and spacing, comprising a means for producing a source of voltage varying in magnitude, and a plurality of vacuum tubes each of said tubes being conductive between different magnitudes of said voltage, for producing the patterns of signal voltages such as shown in Fig. 2.

The source of variable voltage consists of a "neon tube oscillator" comprising the series connection of a "B" battery 1, a gas discharge device 3, and the parallel connection of condenser 4 and resistance 5. The grid of vacuum tube 6 is connected to the positive terminal of resistance 5. The output circuit of tube 6 can be traced from the positive terminal of battery 1, primary of transformer 7, plate impedance of tube 6, to the ground 2 terminal of battery 1. The grid of vacuum tube 8 is connected through resistance 25, and the secondary of transformer 7 to the negative terminal of battery 1. The output circuit of tube 8 can be traced from the positive terminal of battery 1, through plate impedance of tube 8, potentiometer 10, the plate impedance of vacuum tube 11 to the negative terminal of battery 1. Vacuum tube 11 is a screen grid tube and has a high A. C. plate impedance. It is shown as a pentagrid converter tube having its first, second, and fourth grids connected to its cathode and its third and fifth grids connected together internally and to battery 1 at a more positive point than its cathode. Condenser 9 is connected between the cathode of tube 8 and the negative terminal of battery 1.

Vacuum tubes 12 and 13 are conductive to plate current at different magnitudes of voltage across condenser 9. Various types of vacuum tube circuits conductive to input voltages between predetermined magnitudes are known. I prefer to use the pentagrid converter type as described in my U. S. Patent No. 2,435,579 issued February 10, 1948. The first grid of tube 13 is connected through resistance 20 to a point on potentiometer 10. Its anode grid is connected to the positive terminal of battery 1 through resistance 21, and to the negative terminal of battery 1 through voltage divider 14. Its cathode is connected to ground 2. Its screen grid is connected to a terminal of battery 1 more positive than ground. Its fourth grid is connected to an intermediate point on voltage divider 14.

Similarly vacuum tube 12 has its first grid connected through resistance 19, to potentiometer 10 near the cathode of tube 8. Its cathode is

connected to ground 2. Its anode grid is connected through resistance 26 to the positive terminal of battery 1, and through voltage divider 15 to the negative terminal of battery 1. Its fourth grid is connected to an intermediate point on voltage divider 15.

Since tubes 12 and 13 both have high A. C. plate impedances it is essential to efficiency that the load in their output circuits be of high A. C. impedance also. This load consists of a vacuum tube 16 which may be of the pentagrid converter type. Its cathode is connected to the negative terminal of battery 17. Its first grid is connected through resistances 27 and 22 to the positive terminal of battery 17. Its anode grid may be left disconnected. Its third and fifth grids are connected together internally and to the positive terminal of battery 17. Its fourth grid is connected through resistances 28 and 23 to the positive terminal of battery 17.

The output circuit of tube 12 can be traced from the positive terminal of battery 1, plate impedance of tube 16, battery 17, resistance 22, plate impedance of tube 12 to the ground terminal of battery 1.

The output circuit of tube 13 can be traced from the positive terminal of battery 1, through the plate impedance of tube 16, battery 17, resistance 23, plate impedance of tube 13, to the ground terminal of battery 1. Resistance 24 is connected between outgoing line 18 and ground 2.

The operation of Fig. 1 in producing signal patterns such as shown in Fig. 2 is as follows. Gas discharge device 3 breaks down at a frequency depending on the constants of the neon oscillator circuit charging condenser 4 and impressing a positive potential on the grid of tube 6, causing a surge of current through the primary of transformer 7 and a positive potential of brief duration to be impressed on the grid of tube 8 through resistance 25. Condenser 9 is charged through the plate impedance of tube 8.

When condenser 9 is fully charged a positive potential is impressed on the first grids of tubes 12 and 13, rendering them non-conductive to plate current. The reason that tube 13 is non-conductive to plate current when a positive potential is impressed on its first grid through resistance 20 is that a large current flows from the positive terminal of battery 1 through resistance 21, to its anode grid and cathode, producing a large voltage drop across resistance 21, a portion of which voltage drop is applied to its fourth grid by voltage divider 14.

As condenser 9 discharges through potentiometer 10 and the plate impedance of tube 11 the first grid of tube 13 assumes a slightly negative potential with respect to its cathode. The voltage drop across resistance 21 is decreased, and the fourth grid of tube 13 assumes a positive potential with respect to its cathode. The fourth grid of tube 13 being positive and its first grid slightly negative a current passes from the positive terminal of battery 1, through the plate impedance of tube 16, battery 17, resistance 23, the plate impedance of tube 13, to the ground terminal of battery 1, until its first grid is sufficiently negative to block current. The voltage drop across resistance 23 becomes more than the voltage of battery 17. The fourth grid of tube 16 becomes negative with respect to its cathode, and its plate impedance becomes very high. The cathode of tube 16 becomes further negative with respect to positive terminal of battery 1, resulting in a decrease of current through resistance 24 and lowering of potential of line 18, which lowering is hereinafter referred to as a negative impulse. It is therefore apparent that when either of tubes 12 or 13 are highly conductive the potential of line 18 is lowered, that is a negative impulse is impressed on line 18. When both tubes 12 and 13 are in a blocked condition, the potential of line 18 is approximately that of the positive terminal of battery 1, since under that condition the plate impedance of tube 16 is very small, all of its grids being positive, and a large current flows in the circuit comprising positive terminal of battery 1, plate impedance of tube 16, battery 17, resistance 24, ground 2. Line 18 constitutes a transmission medium for transmitting a signal to a utilization circuit, such as for example, a receiver of the type shown in Fig. 2 of my U. S. Patent No. 2,421,022, of which this case is a division. The duration of this negative impulse depends on where the fourth grid of tube 13 is connected to voltage divider 14. If it is connected to the lower portion of voltage divider 14 the first grid of tube 13 must be further negative to block current producing a voltage drop across resistance 21 and tube 13 is conductive to plate current for a shorter period such as shown in pattern 125 of Fig. 2 between T1 and T2. If on the other hand the fourth grid of tube 13 is connected to the upper portion of voltage divider 14, tube 13 is conductive to plate current over a greater magnitude of voltage variation of its first grid, producing a negative impulse such as shown in pattern 127 of Fig. 2 between T9 and T6. It is apparent that desired patterns such as shown in Fig. 2 can be produced across line 18 and ground by keying the points where the fourth grids of tubes 12 and 13 connect to their respective voltage dividers 15 and 14, and the point where the first grid of tube 12 connects to potentiometer 10.

To further clarify the operation of my invention the specific values of one of the circuits used in tests will be described. It will be understood, however, that my invention is not limited to the specific values of circuit elements, or to elements of the same order, but only as defined in the appended claims.

The positive terminal of battery 1 was plus 175 volts with respect to ground. Its negative terminal was minus 150 volts. Battery 17 was 22½ volts. Vacuum tubes 11, 12, 13, 16 were 2A7. Tube 6 was a 27. Tube 8 was a 2A5 connected as a triode. Gas tube 3 was an 874. Transformer 7 was a small audio transformer. Resistances 19, 20, 25, 27, 28 were ten megohms each. Resistances 21, 22, 23, 26 were 100,000 ohms each. Resistance 24 was a quarter megohm. Resistance 5 was two megohms. Resistance 10 was three 50,000 ohm resistors connected in series (total resistance 150,000 ohms). Potentiometers 14, 15 were ten megohms each. Condenser 4 was .05 microfarad. Condenser 9 was .006 microfarad. Each time gas tube 3 broke down condenser 9 was charged as a result of the positive pulse impressed on grid of tube 8 from secondary of transformer 7 through resistance 25. As condenser 9 discharged tube 13 would first become conductive and then block. Tube 12 would then become conductive and then block. As a result two negative impulses were impressed on line 18, the duration of each impulse being readily regulated by varying its corresponding potentiometer (14 or 15). The dura-

tion of each of these impulses was measured by various well known types of impulse receivers. One type of impulse receiver used for such measurements is described in my U. S. Patent No. 2,399,668 issued May 7, 1946.

It is obvious that my invention may take widely different forms from those illustrated without departing from its spirit, and it is to be limited in scope only as defined in the following claims.

What I claim is:

1. In a signal pattern producer of a plurality of impulses and spacings of desired different duration for controlling a signal impressed on a line, a plurality of vacuum tube valves each having an anode and a cathode, means for rendering the anode cathode path of a first of said valves conductive for a first portion of a signal period, means for rendering the anode cathode path of a second of said valves conductive for a second portion of said signal period, a load for said valves, said load comprising a vacuum tube having a plate, cathode electrode and a plurality of grids, a positive biasing source, a plurality of resistances, means for connecting said biasing source, a first of said resistances in the common circuit of said plate, said cathode electrode, a first of said grids, the anode and cathode of a first of said valves, means for connecting said biasing source, a second of said resistances in the common circuit of said plate, said cathode electrode, a second of said grids, the anode and cathode of a second of said valves, and a line connected to said cathode electrode.

2. In a vacuum tube circuit, a plurality of vacuum tube valves, means for varying the current in each of said valves with a different signal, each of said valves having an anode and a cathode, a load for said valves, said load comprising a vacuum tube having a plate, cathode electrode and a plurality of grids, a first resistance connected in the common circuit of said plate, said cathode electrode and a first of said grids, a second resistance connected in the common circuit of said plate, said cathode electrode, and a second of said grids, means for connecting said plate, cathode electrode and said first resistance in the circuit of said anode and said cathode of a first of said valves, means for connecting said plate, cathode electrode, and said second of said resistances in the circuit of said anode, and said cathode of a second of said valves.

3. In an impulse producer for controlling a signal impressed on a transmission line, a source of input voltage variable at a predetermined rate, a vacuum tube having a plate, an anode grid, and a plurality of control electrodes, a load in the circuit of said plate, a load in the circuit of said anode grid, means for applying said voltage to a first of said control electrodes to permit current to flow through both of said loads, means for applying a portion of the voltage variations produced across said load in the circuit of said anode grid to a second of said control electrodes to block current in said plate circuit, as said input voltage increases beyond a predetermined magnitude, and a transmission line connected to said plate load.

4. In an impulse producer for controlling a signal impressed on a transmission line, a source of input voltage variable at a predetermined rate, a vacuum tube having a plate, an anode grid, and a plurality of control electrodes, a load in the circuit of said plate, a load in the circuit of said anode grid, means for applying said voltage to a first of said control electrodes to permit current to flow through both of said loads, means for applying a portion of the voltage produced across said load in the circuit of said anode grid to a second of said control electrodes to block current in said plate circuit as said input voltage increases beyond a predetermined magnitude, means for varying the magnitude of said portion to vary the duration of said impulse, and a transmission line connected across said plate load.

5. An impulse producer for controlling a signal impressed on a transmission medium, comprising: a source of input voltage variable at a predetermined rate, a vacuum tube circuit having a plate, cathode source of electrons, anode electrode, a first grid control means for controlling space current from said cathode source to said plate and said anode electrode, a second grid control means for controlling space current from said cathode means to said plate, an anode load in the circuit of said anode electrode, means for applying said voltages to said first grid means to permit current to flow through both of said loads, means for applying a portion of the voltage variations across said anode load to said second of said grid means to block current through said plate load for input voltages above a predetermined magnitude, and a transmission medium connected across said plate load.

6. An impulse producer for controlling a signal impressed on a transmission medium, comprising: a source of input voltages variable at a predetermined rate, a vacuum tube circuit having a plate, cathode source of electrons, anode electrode, a first grid control means for controlling space current from said cathode source to said plate and said anode electrode, a second grid control means for controlling space current from said cathode means to said plate, a plate load, an anode load in the circuit of said anode electrode, means for applying said voltages to said first grid means to permit current to flow through both of said loads, means for applying a portion of the voltage variations across said anode load to said second of said grid means to block current through said plate load for input voltages above said predetermined magnitude, means for varying said portion to vary the duration of said impulse, and a transmission medium connected to said plate.

7. In an impulse pattern producer for controlling a signal impressed on a transmission medium, a source of input voltage variable at a predetermined rate, a plurality of units, each comprising a vacuum tube having a plate, an anode grid, and a plurality of control electrodes, a load in the circuit of said plate, a load in the circuit of said anode grid, means for applying said voltage to a first of said control electrodes to permit current to flow through both of said loads, means for applying a portion of the voltage produced across said load in the circuit of said anode grid to a second of said control electrodes to block current in said plate circuit as said input voltage increases beyond a predetermined magnitude, said load in the circuit of said plate comprising a second vacuum tube having a plate, cathode electrode, a plurality of grids, and a plurality of resistances, means for connecting a first of said resistances in the common circuit of a first of said grids, said plate, cathode electrode of said second tube, and the plate circuit of a first of said units, means for connecting a second of said resistances in the common circuit

of a second of said grids, said plate, cathode electrode of said second tube and the plate circuit of a second of said units, and a transmission medium connected to said cathode electrode.

8. In an impulse pattern producer for controlling a signal impressed on a transmission medium, a plurality of thermionic valves, means for rendering each of said valves conductive at time displaced intervals, each of said valves having an internal impedance, a load for said valves, said load comprising a vacuum tube device having a plate, cathode and a plurality of grids, means for controlling the potential of a first of said grids with a first of said valves, said means comprising a resistance connected in the common circuit of said plate, cathode, a first of said grids and said internal impedance of a first of said valves, means for controlling the potential of a

second of said grids with a second of said valves, said last means comprising a second resistance connected in the common circuit of said plate, cathode, a second of said grids and said internal impedance of a second of said valves, and a transmission medium connected to said cathode.

OLIVER T. FRANCIS.

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