

Nov. 29, 1949

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2,489,269

MEANS FOR SUPPRESSING SUPERNUMERARY PULSES

Filed May 15, 1940

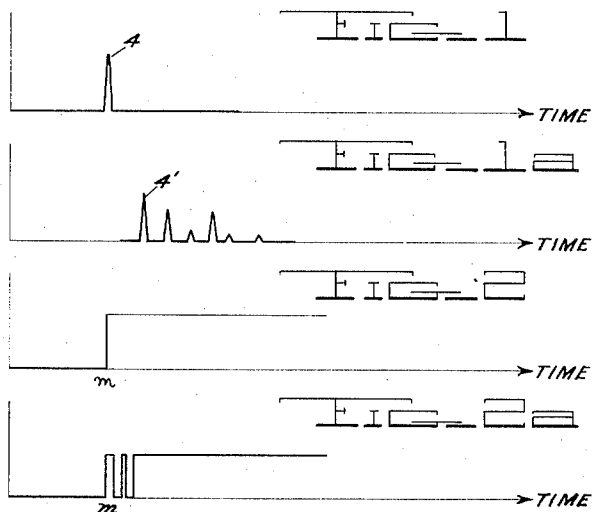
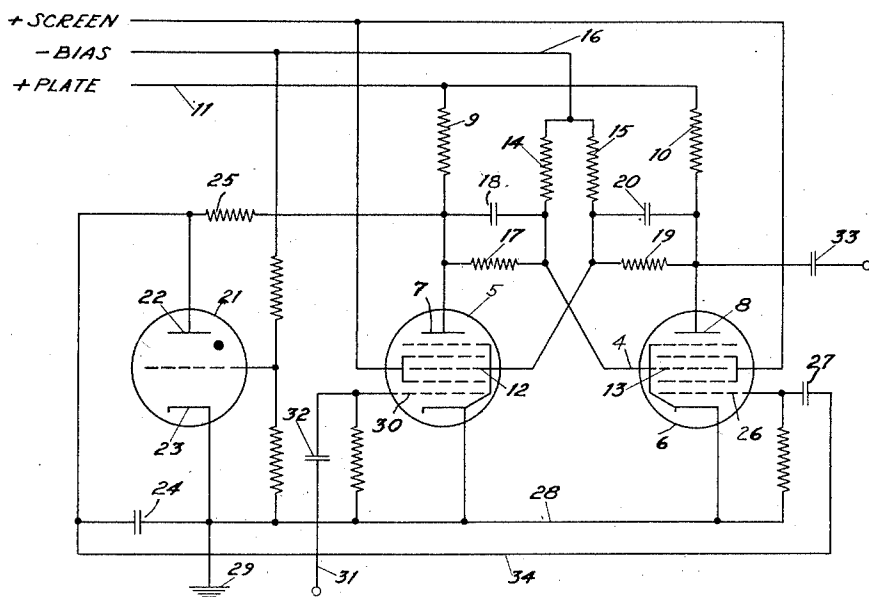


FIG. 3



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2,489,269

MEANS FOR SUPPRESSING SUPERNUMERARY PULSES

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Application May 15, 1940, Serial No. 335,317

9 Claims. (Cl. 250-27)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to radio pulse signaling, and more particularly to means for suppressing supernumerary pulses, such as those arising from echoes, key clicks, and bouncing relay contacts.

The object of this invention is to provide a simple and effective means to prevent interference with a pulse signal by unwanted pulses following the signal.

In the drawings:

Fig. 1 shows graphically a signal pulse as transmitted and Fig. 1a depicts the received pulse followed by echo pulses due to portions of the wave reaching the receiver over paths of different lengths;

Fig. 2 illustrates the closing of a circuit, as by a key or a relay contact, while Fig. 2a represents the result of bouncing of such a contact.

While the present invention is described as used in a receiving circuit, it is to be understood that it may likewise be incorporated in a transmitter circuit to suppress key clicks and the effect of bouncing relays. The desired result is achieved by causing the signal pulse to render the circuit non-responsive to any subsequent pulses for a time interval sufficient to exclude any supernumerary pulses and then automatically return to a responsive condition before the arrival of the next signal pulse.

In many applications of electrical circuits, unwanted effects in the nature of echoes may be obtained. Figs. 1 and 1a illustrate one such condition encountered in practice. Fig. 1 depicts a pulse as sent out by a radio transmitter, while Fig. 1a shows the pattern that is received at a distant point. The transmitted pulse 4 is received as pulse 4' and it is followed by a succession of other pulses due to the arrival of the signal over paths of different lengths. The number and amplitude of the echoes following the pulse 4' may vary with transmission conditions.

Fig. 2 represents graphically the closing of a circuit by a telegraph key or a relay, at the time *m* and Fig. 2a shows the result of a bouncing contact. It is obvious that such conditions are very undesirable in timing and counting devices operated by switches, communication systems employing pulses, etc.

Fig. 3 is a schematic representation of the at present preferred embodiment of this invention. Fundamentally, it is a locked electronic relay of the type shown and described in my co-pending application Serial No. 335,316, filed May 15, 1940, now Patent No. 2,444,429, with automatic means for changing the conductivity conditions of the relay a predetermined time after the beginning

of conductivity in one certain portion of the relay.

The tubes 5 and 6 have their respective anodes 7 and 8 connected through anode resistors 9 and 10 to a common supply 11 of plate current. The grids 12 and 13 are connected through respective grid resistors 14 and 15 to common grid bias supply 16. Resistor 17 in parallel with capacitor 18 connects grid 13 to anode 7 and in like manner resistor 19 in parallel with capacitor 20 connects grid 12 to anode 8. It is thus apparent that the drop of potential across either anode resistor 9 or 10 when the respective tube 5 or 6 is conducting will be applied to the grid 13 or 12 of the other tube to maintain such other tube in non-conducting condition.

An ionization conduction device 21, shown as a gas triode, has its anode 22 and cathode 23 connected to opposite terminals of a storage capacitor 24 that is connected to anode 7 of tube 5 through a time constant resistor 25. The anode-connected side of capacitor 24 is coupled to grid 26 of tube 6 through capacitor 27. The cathodes of all of the tubes 5, 6 and 21 are connected through a common lead 28 to ground 29.

The operation of the above described apparatus is as follows: Assuming tube 5 to be conducting, the potential drop across anode resistor 9 is applied to grid 13 of tube 6 to hold tube 6 in non-conducting condition. When a signal pulse is applied to grid 30 of tube 5 through lead 31 and coupling capacitor 32, the flow of current through tube 5 is stopped and the resulting rise of potential on anode 7 is transmitted through capacitor 18 to grid 13 of tube 6 and makes tube 6 conducting. The consequent potential drop across resistor 10 is applied to grid 12 of tube 5 and holds tube 5 non-conducting. The negative pulse resulting from the drop across resistor 10 when tube 6 becomes conducting is taken off through output capacitor 33.

When tube 5 is made non-conducting, the potential of anode 7 rises and capacitor 24 charges through resistor 25 until the potential on capacitor 24 is built up to a value sufficient to ignite tube 21 which thereupon becomes conducting and discharges capacitor 24. The potential drop across capacitor 24 arising from the discharge of the stored energy through tube 21 is transmitted by lead 34 and coupling capacitor 27 to grid 26 of tube 6 which blocks tube 6 and the resulting rise in potential on anode 8 is transmitted to grid 12 of tube 5 to cause tube 5 to become conducting again. The values of resistor 25 and capacitor 24 are so chosen that tube 6 will con-

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tinue to be conducting during the time interval that any supernumerary pulses might be impressed upon grid 30 of tube 5, but not so long that tube 5 will not be conducting when the next desired signal pulse arrives.

It is thus apparent that the system is responsive to the first pulse only of any series of pulses and hence the output will consist of a single pulse in response to any signal pulse impressed upon grid 30 of tube 5. It is apparent that if a positive pulse is desired in the output, the output capacitor 33 may be connected to the anode of tube 6 as shown. It is to be understood that the showings in Figs. 1 to 2a are illustrative only and not intended to have any significance as to the polarity of the pulse.

In pulse communication systems the circuit may respond to a pulse arriving over any one of the several possible paths, with the result that fading may occur but this will not be observable in the output of my system provided a pulse of sufficient amplitude to trip the circuit is received. The transmitted pulses may be made sufficiently short that there is no overlapping and so the fading due to overlapping of signals having opposing phase relations is eliminated.

The invention herein described and claimed may be used and/or manufactured 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. Pulse signaling apparatus, comprising a first and a second vacuum tube each having at least a cathode, an anode and two grids; a respective anode resistance connecting each anode to a common supply, a respective grid resistance connecting one grid of each tube to a common bias source, a respective resistance and capacitance in parallel connected between the anode of each tube and the said one grid of the other tube whereby either of said tubes is held non-conducting while the other is conducting; an ionization conduction device, having a cathode, an anode and a grid, a resistance connecting the anode of said ionization device to the anode of said first tube, a storage capacitance connected between the anode and the cathode of said ionization device to be chargeable through the resistance connected to the anode of said ionization device, a capacitance connected at one side to another grid of said second tube and at the other side to a point between said storage capacitance and the anode of said ionization device, means connecting all said cathodes to ground, means to apply a pulse to another grid of said first tube, and pulse output means connected to the anode of one of said vacuum tubes.

2. Pulse signaling apparatus, comprising a first and a second vacuum tube each having at least a cathode, an anode and two grids; a respective anode resistance connecting each anode to a common supply, a respective grid resistance connecting one grid of each tube to a common bias source, means to apply to one grid of each said tube the anode potential of the other tube, an ionization conduction device, having a cathode, an anode and a grid, a resistance connecting the anode of said ionization device to the anode of said first tube, a storage capacitance connected between the anode and the cathode of said ionization device to be chargeable through the resistance connected to the anode of said ionization device, a capacitance connected at one side to another grid of said second tube and at the

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other side to a point between said storage capacitance and the anode of said ionization device, means connecting all said cathodes to ground, means to apply a pulse to another grid of said first tube, and pulse output means connected to the anode of one of said vacuum tubes.

3. Pulse signaling apparatus, comprising a first and a second vacuum tube each having at least a cathode, an anode and two grids; a respective anode resistance connecting each anode to a common supply, a respective grid resistance connecting one grid of each tube to a common bias source, means connecting the anode of one said tube to a grid of the other tube whereby the drop across the anode resistance of either tube when such tube is conducting holds the other tube non-conducting; an ionization conduction device, having a cathode, an anode and a grid, a resistance connecting the anode of said ionization device to the anode of said first tube, a storage capacitance connected between the anode and the cathode of said ionization device to be chargeable through the resistance connected to the anode of said ionization device, a capacitance connected at one side to another grid of said second tube and at the other side to a point between said storage capacitance and the anode of said ionization device, means connecting all said cathodes to ground, means to apply a pulse to another grid of said first tube, and pulse output means connected to the anode of one of said vacuum tubes.

4. Pulse signaling apparatus, comprising a first and a second vacuum tube each having at least a cathode, an anode and two grids; a respective anode resistance connecting each anode to a common supply, a respective grid resistance connecting one grid of each tube to a common bias source, a respective resistance and capacitance in parallel connected between the anode of each tube and the said one grid of the other tube whereby either of said tubes is held non-conducting while the other is conducting; means connected to the anode of said first tube to store energy to a predetermined potential in a predetermined time interval when said first tube is non-conducting and said second tube is conducting, means responsive to said predetermined potential to discharge said stored energy, means to apply to another grid of said second tube a negative potential derived from the discharge of said stored energy to render said second tube non-conducting and thereby cause said first tube to conduct, means to apply a negative pulse to another grid of said first tube to render said first tube non-conducting, and pulse output means connected to the anode of one of said tubes.

5. Pulse signaling apparatus, comprising a first and a second vacuum tube each having at least a cathode, an anode and two grids; a respective anode resistance connecting each anode to a common supply, a respective grid resistance connecting one grid of each tube to a common bias source, means connecting the anode of one said tube to a grid of the other tube whereby the drop across the anode resistance of either tube when such tube is conducting holds the other tube non-conducting; means connected to the anode of said first tube to store energy to a predetermined potential in a predetermined time interval when said first tube is non-conducting and said second tube is conducting, means responsive to said predetermined potential to discharge said stored energy, means to apply to another grid of said second tube a negative pulse derived from the dis-

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charge of said stored energy to render said second tube non-conducting and thereby cause said first tube to conduct, means to apply a negative pulse to another grid of said first tube to render said first tube non-conducting, and pulse output means connected to the anode of one of said tubes.

6. Pulse signaling apparatus, comprising a pair of electron discharge devices, means interconnecting said devices whereby when either of said devices is conducting the other thereof is held non-conducting, pulse generating means connected to one of said devices and operative in response to non-conduction by said one of said devices to produce a pulse signal having a predetermined duration, condenser coupling means connecting the output of said last named means to the other of said devices, said condenser coupling means being operative to render said other of said devices non-conducting and said one of said devices conducting in response to the termination of said pulse signal, means to apply a pulse to said one of said devices to change it from a conducting condition to a non-conducting condition, and pulse output means connected to one of said devices.

7. Pulse signaling apparatus, comprising a pair of electron discharge devices, means interconnecting said devices whereby when either of said devices is conducting the other thereof is held non-conducting, a gas tube pulse generating means connected to one of said devices and operative in response to non-conduction by said one of said devices to produce a pulse signal having a predetermined duration, condenser coupling means connecting the output of said last named means to the other of said devices, said condenser coupling means being operative to render said other of said devices non-conducting and said one of said devices conducting in response to the termination of said pulse signal, means to apply a pulse to said one of said devices to change it from a conducting condition to a non-conducting condition, and pulse output means connected to one of said devices.

8. Pulse signaling apparatus, comprising a pair of vacuum tubes, means so interconnecting said tubes that when either one thereof is conducting the other will be held non-conducting, capacitance means so connected to one of said tubes as to charge at a predetermined rate when said one

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of said tubes is held non-conducting, an ionization device connected in shunt with said capacitance means and arranged to discharge the same when the potential across said capacitance means reaches a predetermined value, and condenser coupling means connecting said capacitance to the other of said pair of tubes, said condenser coupling means being operative to render said other of said devices non-conducting responsive to the discharging of said capacitance means, means to apply a pulse to said one of said tubes to change it from a conducting condition to a non-conducting condition, and pulse output means connected to one of said tubes.

9. In combination, a pair of electron discharge devices, means interconnecting said devices to form a trigger circuit wherein when either of said devices is conducting the other thereof is non-conducting, a saw-tooth pulse generator connected to one of said devices operative in response to non-conduction by said one of said devices to produce a pulse signal having a predetermined duration, condenser coupling means connecting the output of said saw-tooth pulse generator to the other of said devices to thereby render said other of said devices non-conducting and said one of said devices conducting in response to the termination of said saw-tooth pulse signal, and means to apply a pulse to said trigger circuit to render said one of said devices non-conducting and said other of said devices conducting.

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