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H. WALLMAN
PULSE TRANSLATING CIRCUIT
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FIG. 1

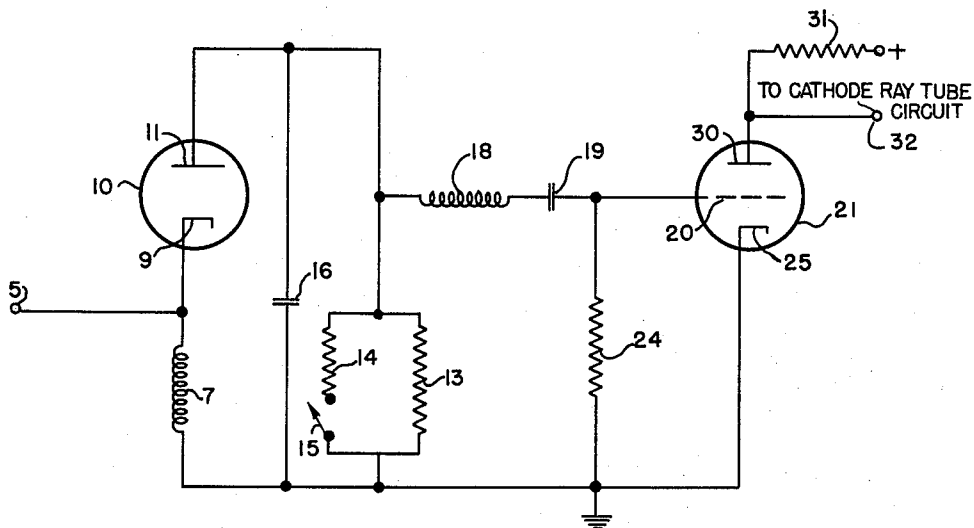
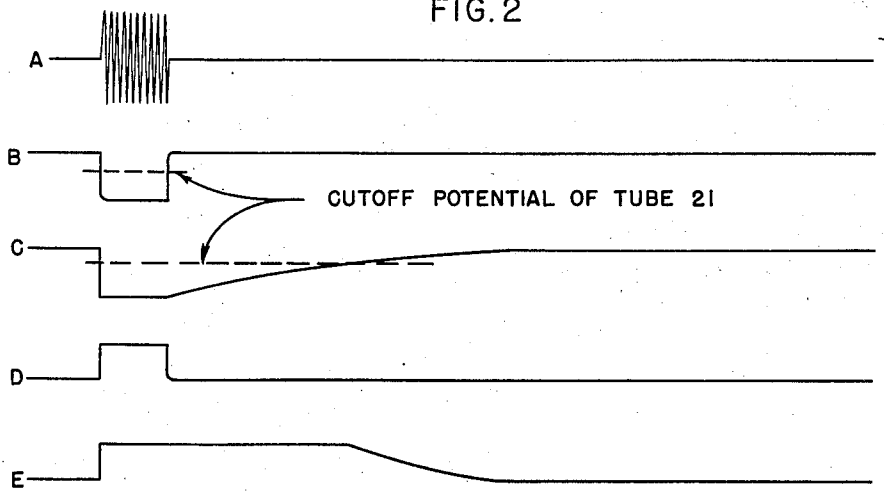


FIG. 2



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PULSE TRANSLATING CIRCUIT

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America as represented by the Secretary of War

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1 Claim. (Cl. 250—27)

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My invention relates in general to electrical circuits and more particularly to those circuits adapted to the detection of pulses of radio frequency energy.

Many applications of radio frequency apparatus require the transmission and reception of electromagnetic energy in extremely short pulses. The received pulses, after being amplified, are demodulated and in many instances the resulting video envelopes are used to modulate the electron beam of a cathode ray tube in such a fashion as to produce a visual representation of the nature of the received pulses.

Either amplitude or intensity modulation of the electron beam may be employed. In the intensity modulated type of visual indication each pulse produces an illuminated spot on the cathode ray tube screen, the size of the spots being proportional to the duration of the video pulses.

Since it often becomes advisable to use pulses of extremely short duration it can be seen that the visible spots of the cathode ray tube may be of such small size as not to afford ready visibility. Hence, the advisability of some means of "stretching" short pulses is clearly indicated.

Accordingly, one object of my invention is to provide a means of increasing the apparent duration of a voltage pulse.

Another object is to provide a pulse "stretcher" adaptable for use with extremely high frequency detector circuits.

These and further objects will be apparent to those skilled in the art upon reference to the following specification, claim, and to the drawings in which:

Fig. 1 is a schematic diagram of one embodiment of my invention; and

Fig. 2 is a simplified representation of certain waveforms present in the circuit of Fig. 1.

Referring now to Fig. 1, radio frequency pulses are applied to terminal 5 and appear across inductive impedance 7. One side of inductor 7 is connected to a point of reference potential, which may be ground potential, and the other side is tied to cathode 9 of a two-element electron discharge device, or diode, 10. Anode 11 of diode 10 is connected to ground through the parallel combination of resistors 13 and 14, switch 15 being inserted in such a fashion as to allow resistor 14 to be cut out of the circuit. The resistors are by-passed by capacitor 16.

To the ungrounded end of resistors 13 and 14 is connected radio frequency choke 18 in series with coupling capacitor 19 through which signals

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are impressed onto control grid 20 of thermionic discharge tube 21. Grid return resistor 24 is connected from grid 20 to ground. Anode 30 is biased positively through load resistor 31 and terminal 32 is tied directly to anode 30.

The circuit shown in Fig. 1 is intended to follow the intermediate frequency stages in a pulse echo radio receiver. Bursts of oscillatory energy modulated with a rectangular envelope are fed to terminal 5. At the intermediate frequency, coil 7 presents a high impedance to the waves. Hence an alternating voltage is set up across coil 7. Diode 10 and its resistance-capacitance load rectify and demodulate this voltage, the principles of such circuits being well known in the art.

Resistor 13 is selected to present a much higher impedance to the flow of current through it than does resistor 14, the ratio of the two resistances being in one embodiment of my invention 40:1. When switch 15 is closed, the parallel combination of the resistances is such as to afford normal demodulation of the pulses received by the system. The fidelity with which the short, sharp pulse envelopes are passed through the detector stage is in a large part a function of the time constant of the discharge path of capacitor 16. For normal operation, the time constant should be quite short in order that the trailing edge of each pulse envelope may be cleanly reproduced. Therefore, when switch 15 is closed, the impedance of the discharge path of capacitor 16 is quite low, being somewhat less than the actual resistance of resistor 14. Hence, the video pulse envelopes are impressed with little alteration on grid 20 of vacuum tube 21 which may be the first in a series of video amplifier stages. Large negative-going signals applied to grid 20 will drive the grid below cut off potential, blocking current flow in the tube and squaring the tops of the output pulses as they appear at terminal 32. Any desired number of amplifier stages may follow tube 21 in order to provide a signal of sufficient amplitude to modulate a cathode ray beam.

When it becomes advisable to "stretch" the pulse presentation on the cathode ray tube screen, switch 15 is opened, thereby greatly increasing the time constant of the discharge path of capacitor 16. The capacitor is charged during the application of a pulse but upon removal of the charging voltage the capacitor is unable to discharge swiftly enough to follow the pulse envelope. Hence, the potential across the capacitor diminishes exponentially for a period of time

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which is considerably longer than the original pulse width. This exponentially decreasing voltage is impressed on grid 20 of tube 21. The output of tube 21, however, is a long pulse with a substantially level top because the tube is held nonconductive for the major proportion of the pulse.

Referring now to Fig. 2, approximately one cycle of each of various waveforms present in the circuit of Fig. 1 is shown. Curve A represents one of the pulses applied to terminal 5. Curve B represents the output of the detector stage with switch 15 closed as it is impressed on grid 20 of amplifier tube 21, the cut off bias of the tube being indicated. This is "normal" operation of the detector. With switch 15 open, "stretching" of the pulse envelope is obtained as shown in curve C. The output of the first video amplifier for normal and "stretched" pulses is shown in curves D and E, respectively.

My circuit represents a distinct improvement over previous pulse "stretchers" in that it is placed directly in the second detector output thereby requiring only a resistor and a switch but no extra tubes. Furthermore, because of the position of the circuit in the amplifier stages, the capacitance of the added resistor and switch produces no adverse effects. A third important advantage lies in the placing of the "stretcher" immediately before the first video amplifier stage in order that the latter may be operated as a limiter as well as an amplifier, thus allowing squaring of the "stretched" pulses.

While there has been described hereinabove what is at present considered to be a preferred embodiment of the present invention, it will be obvious to those skilled in the art that changes and modifications may be made therein without

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exercise of inventive ingenuity. Hence, I claim all such modifications and adaptations as may fall fairly within the spirit and scope of the hereinafter appended claim.

What I claim is:

An electrical circuit for translating input pulses of radio frequency energy, comprising: a detector including, rectifier means, a network in series with said rectifier means, said network including a capacitor and first and second resistors, all connected in parallel, said first resistor having a substantially larger resistance than said second resistor; switch means in series with said second resistor, for enabling the output of said detector to be lengthened in duration when said switch means is open; and amplifier-limiter means connected across said network, for further lengthening the duration of and further shaping into a substantially rectangular form said pulse output, whereby the opening of said switch means will produce an amplified and extended pulse output from said amplifier-limiter means which is suitable for cathode ray tube presentation.

HENRY WALLMAN.

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