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M. H. KANNER

2,496,543

CONTROLLED WIDTH PULSE GENERATOR

Filed June 27, 1944

FIG-1

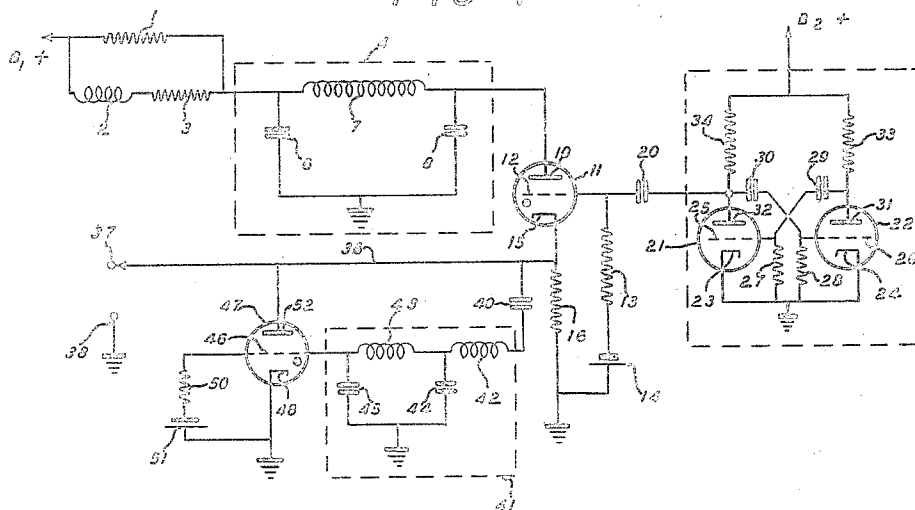
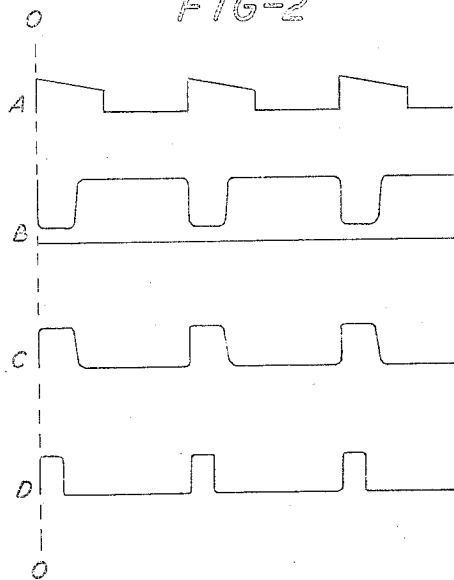


FIG-2



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CONTROLLED WIDTH PULSE GENERATOR

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Application June 27, 1944, Serial No. 542,343

3 Claims. (Cl. 250-27)

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This invention relates to a communication system and particularly to a system for generating voltage pulses having a duration under accurate control with the pulses themselves having steep sides. In the operation of many communication systems, rectangular voltage pulses having steep leading and trailing sides are necessary and in such instances the duration of the pulse may also have to be necessarily accurate. Thus, in many systems, pulses having a duration of the order of one microsecond or less are required to permit large peak power without exceeding the average power requirements of the system. In pulses having such short time duration, the slope of the two sides of the pulse must be steep in order that the pulse as a whole may be considered as generally rectangular.

Referring to the drawing, Fig. 1 illustrates an embodiment of the invention, while Fig. 2 shows some voltage curves illustrating the operation thereof.

The invention in general provides for the application of two time-displaced pulses to the control and anode electrodes of an electron discharge device whereby the conducting period of said discharge device may remove as much of the original pulse as may be desired and leave a remaining pulse having the desired characteristics.

In Fig. 1 a source of B+ potential is applied through a load resistor 1 connected across a series combination of inductance 2 and resistance 3 to a pulse-forming network 4. Pulse-forming network 4, as shown, is a type having condensers 6 and 8 on opposite sides of inductance 7, the condensers having one common terminal grounded as shown. Such pulse-forming networks are well known and one type is illustrated and described in the application of J. C. Street, Serial No. 479,660 filed March 18, 1943. Other types of pulse-forming networks may be used. The output of network 4 is applied to anode 10 of an electron discharge device 11. Electron discharge device 11 has a control grid 12 which may be biased through a resistance 13 and battery 14 connected between the grid and ground. Cathode 15 of tube 11 may be connected to ground through a suitable load resistor 16. As shown here, tube 11 is of the gas-filled type, such as the so-called thyatron.

Grid 12 is connected through a blocking condenser 20 to a generator of rectangular waves such as a multivibrator, for example. Thus, the multivibrator may consist of two vacuum tubes 21 and 22 having their cathodes 23 and 24

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grounded. Control grids 25 and 26 are connected to ground through grid resistors 27 and 28, respectively, and through blocking condensers 29 and 30 to anodes 31 and 32, respectively. Anodes 31 and 32 may be connected through suitable load resistors 33 and 34 to a suitable source of B+ potential. The multivibrator shown herein is adapted to generate waves having the general shape shown in A, the time duration of these waves being controlled by the time constants of the grid circuits, all as well known.

Electron discharge device 11 is connected as a cathode follower with 16 functioning as the load resistor. From the high terminal of this load resistor a line 36 goes to an output terminal 37, 33 being the other grounded output terminal. Line 36 is connected through a blocking condenser 40 to a delay circuit 41, which may be of any suitable type. As shown, this is an artificial transmission line consisting of inductances 42 and 43 connected in series with grounded condensers 44 and 45 being connected on opposite sides of inductance 43. Such artificial lines are well known in the art and may be constructed to provide accurate delays for voltage pulses. Such delays may be of the order of a fraction of a microsecond up to several microseconds and even longer, the delay being determined by the constants of the line as well as the number of sections.

The output of delay line 41 is fed to control grid 46 of an electron discharge device 47. Electron discharge device 47 has its cathode 48 grounded and between grid 46 and cathode 48 there may be provided a grid resistor 50 and bias battery 51. Line 36 is connected directly to anode 52 of electron discharge device 47.

The multivibrator is adapted to generate generally rectangular voltage waves, as shown in curve A. Such voltage waves may be taken off from one of the anodes here shown as anode 32 and applied through blocking condenser 20 to control grid 12 of electron discharge device 11. The repetition rate of the multivibrator will determine the repetition rate of the final pulse output and may be varied within wide limits in a manner well known to the art.

The positive pulse of the multivibrator output when applied to grid 12 causes electron discharge device 11 to break down, assuming that there is a potential impressed across from the anode to the cathode. By having the anode potential in the form of pulses generated by pulse-forming network 4, a more accurate control over the action of the system is obtained. Preferably re-

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sistance 16 in the cathode circuit of electron discharge device 11 is of such a value as to constitute a characteristic impedance for pulse network 4. When such a relationship is established, maximum efficiency results. It is assumed that the value of the various resistances between B+ and anode 10 is such that gas tube 11 will be extinguished upon the expiration of the pulse from network 4. This will be caused by the drop through the resistances and inductances being sufficiently great so that the potential across tube 11 will be insufficient to support ionization.

The pulse output applied to anode 10 may thus assume the shape shown in curve B. During the coincidence of the pulse voltage applied to anode 10 and the positive pulse applied to control grid 12, there will be a pulse passing through load resistor 16. Curve C shows the voltage pulse which would appear across resistance 16 in the absence of any additional connections to this load resistance. It is understood that curves B and C are not necessarily drawn to scale and the shape of the voltage curves depends in some measure upon whether tube 11 saturates or not. Under some conditions the voltage curve across load resistor 16 and in the absence of the rest of the connections thereto might be approximated by a curve similar to B. In any event, a pulse does appear across load resistor 16. Assuming that the pulse is positive as shown in curve C, then the pulse is immediately applied across electron discharge tube 47. On the other hand, grid 46 of this tube is biased so that tube 47 will not conduct until the delayed pulse appears on the grid thereof. When this occurs, tube 47 will conduct and form a substantially short circuit across resistance 16 for a predetermined time interval.

The time duration of the pulse at output terminals 37 and 38 will naturally be determined by the amount of delay in delay line 41, assuming that this delay is less than the duration of the pulse across resistor 16. Since the delay due to network 41 may be accurately controlled, it is evident that the duration of the output pulse shown in D is subject to careful control. The steep sides of the pulse generated by the sudden breakdown of tubes 11 and 47 will make for steep pulse sides.

It is clear that pulse-forming network 4 may be omitted if desired. In that case, if tube 11 is a gas discharge device, then the drop through suitable resistors will be relied upon to extinguish the tube so that grid 12 may re-establish its control. Tube 11 need not necessarily be a gas discharge device but may instead be a vacuum tube. If tube 11 is a vacuum tube, it may be used either with or without pulse-forming network 4.

Control grid 12 of tube 11 may be pulsed either by the multivibrator shown or by any other suitable source. In the event that tube 11 is a gas discharge device, the steepness of the pulse applied to control grid 12 is not important, providing that it is steep enough to cause a sharp trigger action. However, in the event that tube 11 is a vacuum tube, then the pulse shape impressed upon control grid 12 does become important since this will determine the shape of the output pulse across load resistor 16. By having the combination of pulse forming network 4 and a multivibrator operate upon a grid control gas tube, exceedingly sharp output pulses may be obtained.

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Similarly, tube 47 may be a vacuum tube if desired. However, as with tube 11, a gas tube, when broken down, provides a low resistance path and this is an advantage. It is also possible to reverse the grid and plate connections of tube 47 so that the delayed pulse is applied to the plate while the undelayed pulse is applied to the control grid. However, the arrangement shown is preferred since delay line 41 attenuates the pulse.

What is claimed is:

1. A pulse-forming system comprising an electron discharge device having a cathode, control grid and anode, an anode circuit including a delay line, means for applying control pulses to said control grid at predetermined intervals, causing conduction through said tube at predetermined intervals to generate output pulses, a resistance through which the current of said tube passes and across which said output pulses appear, a second electron discharge device having an anode control grid and cathode connected across said resistance in a direction to tend to cause current flow through said second device upon existence of an output pulse, connections including a delay line between said resistance and said second device control grid to apply said delayed output pulses thereto, and an output circuit between the anode and cathode of said second device.

2. A pulse generating system comprising a grid control gas tube, said gas tube having a cathode, control grid and anode, a load resistor in the cathode circuit of said gas tube, a delay line connected in the anode circuit of said gas tube, means for applying grid potentials at periodic intervals, said potentials being sufficient to cause tube breakdown, said load resistor having pulses formed therein, a second gas tube having a cathode, control grid and anode, means for connecting said anode and cathode of said second tube across said load resistor so that said pulses tend to cause space current through said second tube, a delay line connection between the control grid of said second tube when its grid is driven positive and one terminal of said load resistor so that said pulses tend to drive said second grid positive after an interval established by said delay line, and an output circuit between the anode and cathode of said second device.

3. The system of claim 2 wherein the voltage supply source of the control grid of said first tube is a first pulse generator and wherein the plate voltage supply for said first tube is a second pulse generator that cooperates with said first pulse generator, said two pulses having durations longer than that of the desired output pulse.

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Deceased.

REFERENCES CITED

The following references are of record in the file of this patent:

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