March 10, 1964 G. J. SCOLES 3,124,754

A.C. INPUT PULSE GENERATOR USING SUCCESSIVELY DISCHARGED PULSE FORMING NETWORK

Filed Nov. 9, 1959

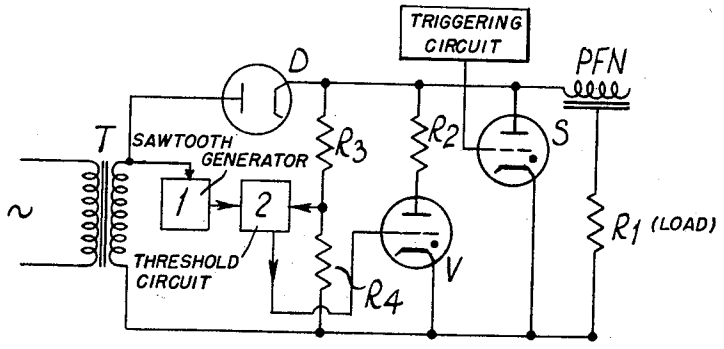

Fig. 1

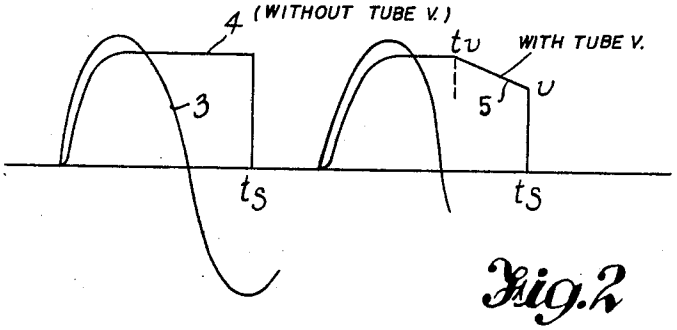

Fig. 2

INVENTOR

GRAHAM JOHN SCOLES

ATTORNEY

United States Patent Office 3,124,754 Patented Mar. 10, 1964

3,124,754

A.C. INPUT PULSE GENERATOR USING SUCCESSIVELY DISCHARGED PULSE FORMING NETWORK

Graham John Scoles, Bowdon, England, assignor to Associated Electrical Industries (Manchester) Limited, a company of Great Britain

Filed Nov. 9, 1959, Ser. No. 851,757
Claims priority, application Great Britain Nov. 10, 1958
7 Claims. (Cl. 328—65)

This invention relates to pulse generating circuits and is concerned with circuits of the kind in which a pulse-forming network is periodically charged relatively slowly and is then rapidly discharged through a discharge circuit to generate pulses.

In such circuits the charging of the pulse forming network may not be uniform with the result that the pulses generated during discharge may vary in magnitude.

It is an object of the present invention to provide a circuit capable of providing output pulses of a constant magnitude which can be regulated irrespective of small variations of the magnitude of the charging voltage.

The present invention comprises a pulse generating circuit of the kind in which a pulse-forming network is periodically charged relatively slowly and then rapidly discharged through a discharge circuit to generate pulses, wherein an auxiliary discharge circuit is provided to discharge a portion of the energy in the pulse-forming network prior to the generation of a pulse, together with means for controlling the time interval between the initiation of the discharge of the auxiliary discharge circuit and the discharge of the main discharge circuit and the discharge of the main discharge circuit in accordance with the voltage across the pulse forming network so that the network has discharged to a substantially constant value when the main discharge occurs.

In carrying out the invention the auxiliary discharge circuit may discharge the pulse-forming network through a resistance of controllable magnitude.

In order that the invention may be more fully understood reference will now be made to the drawing accompanying this specification, in which

FIG. 1 shows one embodiment of the invention, and

FIG. 2 shows waveforms associated with FIG. 1.

Referring now to FIG. 1 there is shown therein a pulse modulation circuit comprising a pulse-forming network PFN which is arranged to be charged through a diode D from the secondary of a transformer T the primary of which is connected to an A.C. supply. At a predetermined point in the A.C. cycle network PFN is discharged by the triggering of a switching device S which is shown in the figure as a hydrogen thyratron although other forms of switching device could equally well be used. Network PFN discharges into a load represented by resistor R1. The pulse-forming network can be designed so that a substantially rectangular pulse is produced on discharge.

In accordance with the invention an auxiliary discharge circuit is also provided and in the embodiment illustrated this comprises a discharge device V, for instance a hydrogen thyratron, connected in series with a resistor R2 across switching device S. Discharge device V is discharged prior to the discharge of device S and means are also provided for determining the time interval during which the discharge of V is effective. This time interval may be made dependent on the magnitude to which the network is initially charged so that the final voltage on the network when device S is triggered is constant and thus an output pulse of constant magnitude is obtained.

One arrangement for determining the instant of triggering of discharge device V is shown in FIG. 1 and this comprises a potential divider chain formed of two resistors R3 and R4 in series connected across the pulse-forming network and load and a negative-going saw-tooth waveform generator 1. The output of generator 1 is applied to a strobing circuit 2 together with a reference potential derived from the junction between resistors R3 and R4. One form of strobing circuit 2 is described in our British patent specification No. 789,608. Strobing circuit 2 operates to generate a trigger pulse for discharge device V at the instant when the magnitude of the negative-going waveform generated in 1 has reached the value of the reference potential. The phase of the saw-tooth waveform generated in 1 can be adjusted relative to the input to transformer T. It will thus be realised that for a given phasing of generator 1 the instant at which a trigger pulse is produced from strobing circuit 2 will depend on the magnitude of the reference voltage and hence on the magnitude of the voltage to which PFN has been charged.

Referring now to FIG. 2 reference 3 indicates the output waveform of transformer T and reference 4 indicates the voltage across the pulse-forming network in the absence of the operation of the auxiliary discharge device. It will be seen that the pulse forming network is charged up to its peak value in approximately the first quarter cycle of the A.C. input and due to diode D holds this value until the operation of discharge device S at instant t_s whereupon the full voltage to which the pulse-forming network has been charged is made available for the output pulse.

The second cycle of the waveform shown in FIG. 2 illustrates the change in output voltage due to the operation of the auxiliary discharge circuit. Generator 1 and strobing circuit 2 produce a trigger pulse to cause device V to become conductive at instant t_v and this causes the pulse-forming network to discharge at a slow rate through resistor R2 as indicated by the line 5 and by the instant t_s at the time when the main discharge circuit is triggered this waveform has fallen to a value v and this value will be substantially constant for each pulse so that constant amplitude pulses will be generated.

In operation of the circuit the pulse-forming network can be initially charged to a value greater than the value of the pulse finally required and the instant of the discharge of the auxiliary discharge circuit will automatically adjust itself relative to the instant of discharge of the main discharge circuit so that an output pulse of constant magnitude is obtained. The magnitude of the final voltage on the pulse-forming network at the instant of the main discharge can be controlled by a number of parameters. Thus the time interval between the triggering of the two discharge devices can be held constant and the magnitude of discharge resistor R2 can be varied. This would normally be adjusted initially, after which the automatic control would be used to alter the timing. Alternatively, the timing can be varied by adjustment of the reference potential applied to strobing circuit 2 by control of resistor R3 and/or resistor R4 or by adjustment of the phase of the output of saw-tooth generator 1. Each of these quantites will control the magnitude of the final pulse.

If desired the cathode of discharge device V can be taken to a voltage intermediate between the pulse-forming network and earth so that when discharge device S is fired the voltage across V reverses and so ensures its deionisation. One advantage of this is that device V need then not be rated to withstand such a high voltage.

It will be realised that while the invention has been described with reference to an A.C. charging circuit it is equally applicable to a D.C. charging circuit in which the pulse forming network would be discharged periodically at the pulse recurrence frequency. Furthermore, other means than the one illustrated can equally well be used for controlling the instant of firing of discharge device C.

What I claim is:

1. A pulse modulation circuit comprising a pulse forming network, means for charging said pulse forming network, a main discharge circuit for rapidly discharging said pulse forming network through a load circuit to generate a pulse, an auxiliary discharge circuit connected in parallel with said main discharge circuit for discharging a portion of the energy in the pulse forming network prior to the generation of a pulse, and means for controlling the time interval between the initiation of the discharge of the auxiliary discharge circuit and the discharge of the main discharge circuit to maintain a substantially constant voltage across the pulse forming network when the main discharge circuit is triggered.

2. A pulse modulation circuit comprising a pulse forming network, means for charging said pulse forming network, a discharge circuit periodically triggered for rapidly discharging said pulse forming network to generate a pulse, an auxiliary discharge circuit for absorbing a portion of the energy in the pulse forming network prior to the generation of a pulse, and means for triggering said auxiliary circuit when the pulse forming network reaches a predetermined voltage during charging and before the main discharge so that the voltage on said network immediately prior to discharge through the main discharge circuit is constant.

3. A pulse modulation circuit comprising a pulse forming network, alternating current charging means for charging said pulse forming network, a discharge circuit for rapidly discharging said pulse forming network to generate a pulse at predetermined instants in the alternating current cycle, an auxiliary discharge circuit for discharging a portion of the energy in the pulse forming network prior to the generation of a pulse, a sawtooth waveform generator for generating a sawtooth waveform in synchronism with, and of controllable phase relative to the alternating current supply to said charging means, a strobing circut for providing a trigger pulse to trigger said auxiliary discharge circuit when said sawtooth waveform reaches a reference level corresponding to a predetermined maximum voltage across the pulse forming network.

4. A pulse modulation circuit comprising a pulse forming network, alternating current charging means for charging said pulse forming network, a discharge circuit for rapidly discharging said pulse forming network to generate a pulse, an auxiliary discharge circuit for discharging a portion of the energy in the pulse forming network prior to the generation of a pulse, a generator for generating a sawtooth waveform in synchronism with, and of variable phase relative to the alternating current supply to said charging means, a potential divider chain connected across said pulse forming network, a strobing circuit arranged to compare the potential of the sawtooth waveform generated by said generator with the potential of a tapping point on said potential divider chain and to generate a trigger pulse when said potentials are equal.

5. A pulse modulation circuit comprising a pulse forming network, means for charging said pulse forming network, a main discharge circuit for rapidly discharging said pulse forming network through a load circuit to generate a pulse, an auxiliary discharge circuit connected in parallel with said main discharge circuit for discharging a portion of the energy in the pulse forming network, a resistance included in said auxiliary discharge circuit for absorbing said portion of said energy, and means for triggering said auxiliary discharge circuit when the voltage across the pulse forming network reaches a predetermined value prior to the triggering of the main discharge circuit.

6. A pulse modulation circuit according to claim 5, in which said resistance is of variable magnitude to control the magnitude of said portion of said energy which is absorbed.

7. A pulse modulation circuit comprising a pulse forming network, a load circuit, means for charging said pulse forming network, an auxiliary discharge circuit for partially discharging said pulse forming network, a main discharge circuit for discharging said pulse forming network through said load circuit, means for triggering first the auxiliary discharge circuit and then the main discharge circuit and means for controlling the auxiliary discharge in accordance with the voltage produced across the pulse forming network to produce a substantially constant voltage at the time the main discharge circuit is triggered.

References Cited in the file of this patent

UNITED STATES PATENTS

2,543,445 Doolittle ---------- Feb. 27, 1951