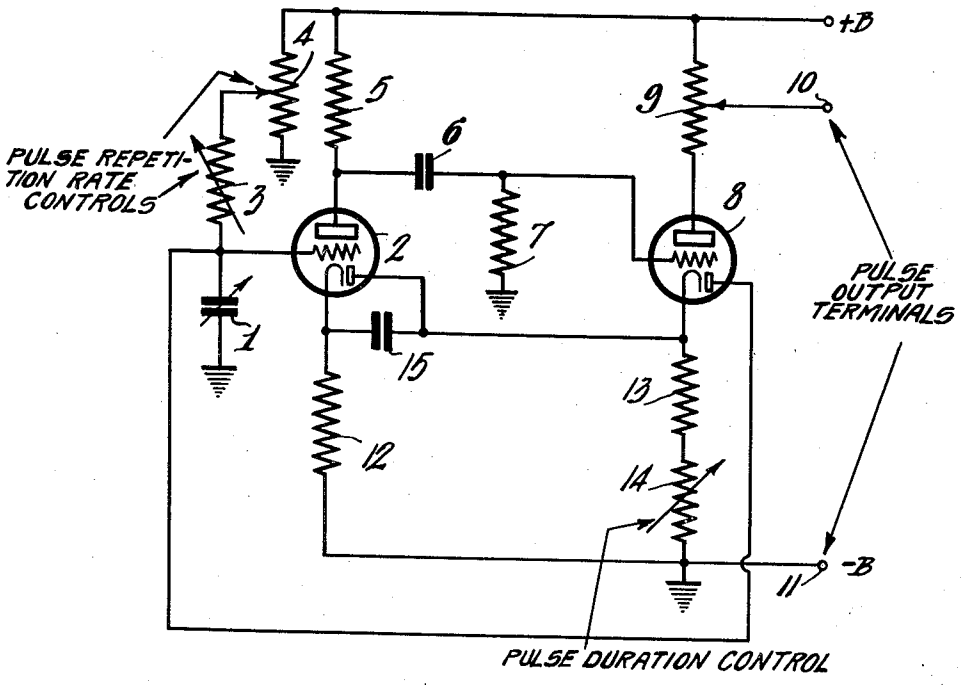
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ELECTRIC IMPULSE GENERATOR

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ELECTRIC IMPULSE GENERATOR

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1

This invention relates to electric impulse generators in which the impulses are generated under the control of a multi-vibrator.

Many impulse generators of the multi-vibrator type have been proposed heretofore for generating substantially rectangular impulses but in most of these devices the duration of the impulses generated and the time intervals between successive impulses are controlled by the time constants of the coupling impedances employed between the valves of the multi-vibrator. The control of the impulse duration and the intervals between the pulses by the coupling impedances imposes an undesirable restriction on the range of pulse duration and impulse intervals that can be obtained and it is accordingly the main object of the present invention to provide an improved impulse generator of the multi-vibrator type in which the control of the impulse duration and time intervals are less dependent on the time constants of the coupling impedances.

According to the invention an impulse generator is provided comprising a multi-vibrator having a first valve and a second valve which are so arranged that when one of said valves is conducting the other valve is non-conducting, a capacity arranged to be charged from a source of voltage and associated with the control electrode of said first valve, an impedance arranged in the cathode circuit of said second valve and a unilaterally-conducting device associated with the cathode of said second valve and said capacity, the arrangement being such that said first valve remains non-conducting until the voltage across said capacity rises to a predetermined value when said first valve becomes conducting and said second valve becomes non-conducting and the fall of cathode potential of the latter valve causes said unilaterally-conducting device to become conducting and to discharge said capacity.

With such an arrangement the duration of the impulses can be adjusted without altering the time intervals between the impulses and also said time intervals can be adjusted without altering the duration of the impulses. Furthermore, it is possible to vary the duration of the impulses and their time intervals over a very wide range; for example, it is possible to make the ratio of impulse duration to time interval greater than unity or to make the ratio of the order of $^1/_{10000}$. Further, both the impulse duration and the time intervals between pulses can be larger; for example, the duration of the impulses may be as large as $^1/_{25}$ of a second and the time intervals may be as large as 10 seconds.

2

In order that the said invention may be clearly understood and readily carried into effect, it will now be more fully described with reference to the accompanying drawing which illustrates the circuit of an impulse generator constructed according to the preferred form of the invention.

As shown in the drawing, the reference numeral 1 indicates a condenser, one plate of which is earthed and the other plate of which is connected to the control electrode of a valve 2 forming the first valve of a multi-vibrator and to one end of a variable resistance 3, the other end of which is connected to a variable tapping point on a resistance 4. One end of the resistance 4 is earthed and the other end is connected to the positive terminal of a source of anode current for the valve 2. The anode of the valve 2 is connected through a resistance 5 to the positive terminal of the source of anode current and via a condenser 6 and leak resistance 7 to the control electrode of the second valve 8 of the multi-vibrator. The anode of the valve 8 is connected through a resistance 9 to the positive terminal of the source of anode current and a tapping point on the resistance 9 is connected to a terminal 10 which, together with the terminal 11 connected to the negative pole of the source of anode current constitute the output terminals of the generator. The cathode of the valve 2 is connected to the negative pole of the source of anode current through a resistance 12 whilst the cathode of the valve 8 is connected to said negative pole through a resistance 13 and a variable resistance 14 in series. The cathodes of the two valves are also coupled in the manner shown through a condenser 15.

Due to the provision of the resistances 12, 13 and 14 each valve 2 and 8 functions in operation as a cathode follower. Each valve 2 and 8 is provided with an auxiliary anode, as shown, which forms, with each cathode of the respective valves a diode section, the auxiliary anode of the valve 2 being connected in the manner shown to the plate of the condenser 15 which is connected to the cathode of the valve 8, whilst the auxiliary anode of the valve 8 is connected to the plate of the condenser 1 which is connected to the control electrode of the valve 2.

The operation of the circuit shown is as follows: Assuming that the valve 2 is suddenly rendered non-conducting, the rise in anode potential of this valve will be communicated to the control electrode of the valve 8 so causing this valve to conduct and the potential of its cathode will rise. This rise in the potential of the

cathode of valve 8 causes the diode of valve 8 to become non-conducting, but causes the diode of valve 2 to conduct to hold the cathode potential of valve 2 positive so holding valve 2 non-conducting. In this condition the condenser 1 will be charged from the source of anode current and the rise in potential across the condenser will be applied to the control electrode of valve 2 and to the anode of the diode section of valve 8. When the charge across the condenser reaches a predetermined value the valve 2 will be rendered conducting causing the anode potential of the valve 2 to fall, this fall in potential being communicated to the valve 8 so as to render the triode section of this valve non-conducting. The cathode potential of the valve 8 also falls with the fall of potential of the control electrode of the valve 8 and to such an extent that the diode section of the valve 8 is rendered conducting and the condenser 1 is discharged via this diode section mainly at a rate dependent on the values of the resistances 13 and 14. Discharge of the condenser 1 causes the potential of the cathode of valve 8 to fall and also causes the control electrode potential of the valve 2 to fall with the result that the anode potential of the valve 2 rises, such rise in potential being communicated to the control electrode of the valve 8. After a predetermined time the potential of the cathode of the valve 8 falls sufficiently low for the triode section of the valve 8 to be rendered conducting. When the valve 8 is thus rendered conducting the triode section of the valve 2 is rendered non-conducting since the cathode of valve 2 is maintained at the potential of the cathode of valve 8 as its associated diode which is connected to the cathode of the valve 8 is rendered conducting, whereas since the diode section of the valve 8 is at this stage non-conducting, the control electrode of the valve 2 is disconnected from the cathode of valve 8. The condenser 1 then recommences to charge and the cycle repeats itself.

The time taken for the condenser 1 to be charged to a sufficient extent to render the valve 2 conducting controls the time intervals between the generated impulses and can be adjusted by adjusting the resistances 3 and 4. The resistance 3 can be a coarse or range control for this purpose whilst the resistance 4 can be a fine control. The time taken for the valve 2 to be rendered non-conducting after having been rendered conducting determines the duration of the generated impulses and this time can be controlled by variation of the resistance 14. The output amplitude of the generated pulse is dependent of the values of the resistances 3 and 4 and also of the condenser 15 and if the resistance 13 is large compared with the resistance 12 the output amplitude can be made substantially independent of the value of the resistance 14. Since the duration of the impulses and their time intervals are substantially proportional to the magnitude of the condenser 1, the duration of the impulses and their time intervals can be altered whilst keeping their ratio substantially constant by varying the capacity of the condenser 1. In operation of the circuit the valves 2 and 8 should not be permitted to take grid current.

If desired, the generator according to the invention can be employed to generate an impulse having a constant duration but a repetition period which is varied or controlled by a control potential. In such a case the positive end of the resistance 3 may be connected to the cathode of a

cathode follower instead of being connected to the resistance 4 and the control potential may be applied to the control electrode of the cathode follower. Such a generator can be employed where the repetition period is required to follow some variable frequency. In such a case the difference between the two frequencies can be caused to control a potential charge so as to provide a control potential for application to said cathode follower to cause the repetition frequency of the generated impulses to follow said variable frequency.

I claim as my invention:

1. An impulse generator comprising a first valve and a second valve each having a cathode and a control grid and which are connected to form a multivibrator so that when one of said valves is conducting the other valve is non-conducting, a capacity connected in the input circuit of said first valve between its control grid and its cathode, means for applying a direct-current charging voltage to said capacity, an impedance connected in the cathode circuit of said first valve, a second impedance connected in the cathode circuit of said second valve, a capacitor coupling the cathode of the first valve to the cathode of the second valve, and a unilaterally-conducting device connected between the cathode of said second valve and the high potential side of said capacity with the anode of said device connected to said high potential side whereby said first valve remains non-conducting until the voltage across said capacity rises to a predetermined value when said first valve becomes conducting and said second valve becomes non-conducting and the fall of cathode potential of the latter valve causes said unilaterally-conducting device to become conducting and to discharge said capacity.

2. The invention according to claim 1 wherein means is provided for varying the rate of charging of said capacity for changing the pulse repetition rate.

3. The invention according to claim 1 wherein means is provided for varying the rate of discharging of said capacity for changing the pulse duration.

4. An impulse generator comprising a first valve and a second valve each having a cathode and a control grid and which are connected to form a multivibrator so that when one of said valves is conducting the other valve is non-conducting, a capacity connected in the input circuit of said first valve between its control grid and its cathode, means for applying a direct-current charge to said capacity through a resistor, the cathode circuits of each of said valves having a resistor therein to provide a cathode follower action, a unilaterally-conducting device connected between the cathode of said second valve and the high potential side of said capacity whereby said first valve remains non-conducting until the voltage across said capacity rises to a predetermined value when said first valve becomes conducting and said second valve becomes non-conducting and the fall of cathode potential of the latter valve causes said unilaterally-conducting device to become conducting and to discharge said capacity, and a second unilaterally-conducting device and a capacity connected in parallel with each other and each also connected between the cathodes of said valves so that when said second valve is conducting said second unilaterally-conducting device is also conducting to maintain the cathode of the first valve at a potential such that the first valve is non-conducting.

5. An impulse generator comprising a first valve and a second valve each having a cathode and a control grid and which are connected to form a multivibrator so that when one of said valves is conducting the other valve is non-conducting, a capacity connected in the input circuit of said first valve between its control grid and its cathode, means for applying a direct-current charging voltage to said capacity, an impedance connected in the cathode circuit of said second valve, and a unilaterally-conducting device connected between the cathode of said second valve and the high potential side of said capacity whereby said first valve remains non-conducting until the voltage across said capacity rises to a predetermined value when said first valve becomes conducting and said second valve becomes non-conducting and the fall of cathode potential of the latter valve causes said unilaterally-conducting device to become conducting and to discharge said capacity, and wherein the cathodes of said first and second valves are coupled together via a capacity, and a second unilaterally-conducting device is provided which is connected between the cathode of said first valve and the cathode of said second valve, whereby when said second valve is conducting said second unilaterally-conducting device is also conducting so as to maintain the cathode potential of said first valve at such a value that said first valve is held non-conducting.

6. The invention according to claim 5 wherein means is provided for varying the rate of charging of said capacity for changing the pulse repetition rate.

7. The invention according to claim 5 wherein means is provided for varying the rate of discharging of said capacity for changing the pulse duration.

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