

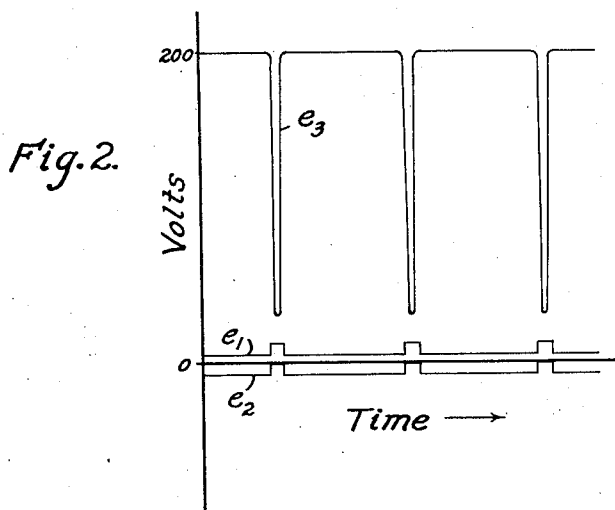
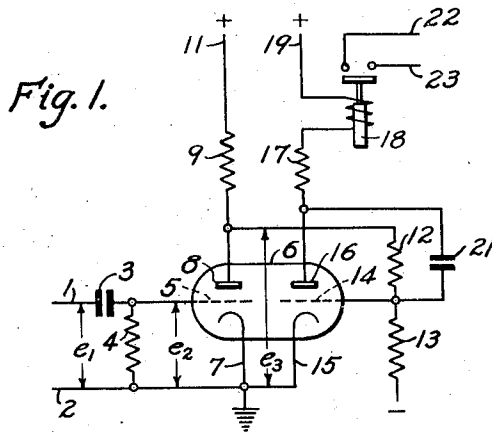
Dec. 21, 1948.

A. A. MACDONALD

2,456,970

CONTROL CIRCUIT

Filed April 19, 1945.



WITNESSES:

James F. Young

INVENTOR

Angus A. Macdonald.

BY

F. W. Layle
ATTORNEY

ATTORNEY

UNITED STATES PATENT OFFICE

2,456,970

CONTROL CIRCUIT

Angus A. Macdonald, Catonsville, Md., assignor to
Westinghouse Electric Corporation, East Pitts-
burgh, Pa., a corporation of Pennsylvania

Application April 19, 1945, Serial No. 589,253

6 Claims. (Cl. 250—27)

1 My invention relates to electric control circuits and, in particular, relates to circuits in which it is desired to cause impression on the input circuit of pulses having a duration which is short compared with the periodic time separating them to produce on the output terminals a voltage which pulsates only slightly. Such an arrangement would be useful, for example, in causing input voltage pulses of the type described to close or open an electromagnetic relay in the output circuit.

One object of my invention is, accordingly, to provide a circuit in which periodic voltage pulses having a duration small compared with the interval separating them produce an output voltage which fluctuates only slightly.

Another object of my invention is to produce an arrangement in which substantially square-topped voltage pulses having a width small compared with the periodic time separating them will produce output voltages which fluctuate only slightly.

Still another object of my invention is to produce a circuit for enabling voltage pulses, having a duration short compared with the periodic time separating them, to effectively operate an electromagnetic relay.

Still another object of my invention is to provide a circuit in which voltages having relatively peaked wave forms shall produce output currents having relatively small fluctuation.

While I have referred to the use of my device in connection with widely spaced pulses or voltage the circuit is also effective in practice when sine-wave and other voltages are impressed on the input terminals.

Other objects of my invention will become apparent upon reading the following description, taken in connection with the accompanying drawings, in which:

Figure 1 is a schematic diagram of an electric circuit embodying the principles of my invention; and

Fig. 2 is a voltage versus time plot useful in explaining the operation of the circuit of Fig. 1.

Referring in detail to Figure 1, my circuit embodies a pair of input terminals 1, 2 adapted to impress voltage through a capacitor 3 and a resistor 4 on the control electrode 5 of an electron tube 6. Cooperating with the control electrode 5 is a cathode 7 connected to the input terminal 2 and to ground and anode 8 connected through a resistor 9 to the positive terminal 11 of a voltage source (not shown), the negative terminal of which is connected to terminal 2. The anode 8

2 is likewise connected through a pair of resistors 12, 13 to the negative terminal of a suitable voltage source (not shown), of which the positive terminal is connected to the terminal 2. The common terminal of the resistors 12 and 13 is connected to a second control electrode 14 which controls current flow between a cathode 15 and an anode 16. The cathode 15 is connected to the terminal 2 and the anode 16 is connected through a resistor 17 and the energizing winding of a relay 18 to the positive terminal 19 of a voltage source having its negative terminal connected to terminal 2. A capacitor 21 is connected between the anode 16 and the control electrode 14. The relay 18 is adapted to control current flow, in ways well-known to those skilled in the art, through any desired circuit connected to the terminals 22, 23.

The circuit of Fig. 1 is particularly useful when voltage pulses of a duration relatively short compared to the time interval separating them, such, for example, as those indicated by the curve e_1 in Fig. 2, impressed on the terminals 1, 2. When no such voltage pulses are being impressed, the potential of the control electrode 5 is substantially that of the cathode 7 and the structure of the tube 6 is such that, under such conditions, a substantial current will flow from positive terminal 11 through resistor 9, anode 8 and cathode 7. The resistors 9, 12 and 13 have a high value compared with the internal impedance between the anode 8 and cathode 7, under such conditions, and, in consequence, the anode 8 is very nearly at the potential of terminal 2. The resistors 12 and 13 are so proportioned that, under the conditions just mentioned, the control electrode 14 is so negative relative to cathode 15 that substantially no current flows through relay 18, resistor 17, anode 16 and cathode 15. The relay 18 is consequently deenergized.

If now voltage pulses of the form e_1 in Fig. 2 are impressed on the terminals 1, 2, they will charge the capacitor 3 in such a sense that its terminal adjacent the control electrode 5 is negative relative to the terminal 1. As soon as the voltage pulse impressed on terminals 1, 2 falls from its peak to its trough value, as indicated in Fig. 2, the voltage impressed by capacitor 3 on control electrode 5 will become negative. By giving the resistor 4 a sufficiently high value, it may be arranged that the charge thus existing on capacitor 3 shall dissipate with relative slowness compared with the periodic time between successive pulses of voltage e_1 . In consequence, the voltage impressed between the cathode 15

3

and control electrode 5 will have the wave form indicated by the curve e_2 in Fig. 2. This voltage constitutes a negative bias for the control electrode 5 during the relatively long periods separating successive pulses of voltage e_1 . The value of the pulses e_1 and the above-described circuit connected thereto are so designed that the negative bias represented by the long trough period of voltage e_2 is sufficient to cut off current flow from the anode 8 to the cathode 7. As a result of this, the voltage of anode 8, which has the wave-form marked e_3 , assumes a value determined by the relative magnitudes of the resistors 9, 12 and 13 and these resistors are so proportioned, in ways obvious to those skilled in the art, that the control electrode 14 becomes sufficiently positive so that current flows readily between the anode 16 and the cathode 15. Current can thus flow from the positive terminal 19 through the winding of relay 18 and resistor 17 to energize and actuate the relay 18. The potential impressed between the anode 8 and terminal 2 is of the character indicated by the curve e_3 in Fig. 2, and comprises long positive voltage crests separated from each other by relatively short troughs which are simultaneous with the positive pulses of the impressed voltage e_1 . The capacitor 21 is given such a value as to act in conjunction with resistor 17 and relay winding 18 to filter out the short voltage fluctuations which the troughs of voltage e_3 would otherwise produce in the current flowing from positive terminal 19 through relay 18. The voltage drop across the resistor 17 is, accordingly, nearly devoid of fluctuations and may be applied to any desired output circuit at will.

It will be noted that the connection of the capacitor 21 between the control electrode 14 and anode 16 provides a very efficient filtering action due to the amplifying effect of the grid and plate action of electrodes 14 and 16. In other words, when the control electrode 14 tends to become more positive, the plate 16 tends to become negative by an amount equal to the voltage amplification of the electrode system 15, 14, 16.

I claim as my invention:

1. In combination with a source of voltage pulses which are of short duration compared with the periods separating them, a pair of output electrodes and a control electrode, means for impressing said voltage pulses through a capacitor between said control electrode and one of said principal electrodes, a source of substantially constant voltage connected to said principal electrodes through an impedance, means for impressing a voltage derived from the potential difference between said principal electrodes on an input circuit, a tube comprising an anode, a cathode and a control electrode cooperating with them, means for impressing the last-mentioned voltage to control current flow between said anode and cathode, an impedance supplied with current from a constant voltage source through said anode and cathode, means for energizing a work circuit by current flowing through the last-mentioned impedance, and a capacitor connected between the last-mentioned control electrodes and said anode.

2. In combination with an input circuit for impressing voltage pulses which are short compared with the time periods separating them, a first pair of principal electrodes and a control electrode associated with them, means for impressing said voltage pulses through a capacitor in series with a resistor on said control elec-

4

trode, a resistor fed through said principal electrodes from a source of substantially constant voltage, means for impressing fluctuations in voltage between said principal electrodes on a second control electrode, a second pair of principal electrodes associated with said second control electrode, a load circuit connecting a second source of substantially constant voltage to said second pair of principal electrodes and a capacitor connected between said second control electrode and a point on said load circuit.

3. In combination with a source of fluctuating voltage having voltage pulses which are short compared with the time periods separating them, a capacitor and a resistance serially connected across said source, a pair of principal electrodes connected to a source of substantially constant voltage through a resistor, a control electrode associated with said principal electrodes and connected to the common junction of said capacitor and first-mentioned resistance, resistance means in series with a source of bias voltage across said principal electrodes, a second pair of principal electrodes connected in series with a work circuit to a source of constant voltage, a control electrode associated with said second pair of principal electrodes connected to a point on the last-mentioned resistance and a capacitance connected between the last-mentioned control electrode and a point on said work circuit.

4. In combination with a source of voltage pulses which are of short duration compared with the periods separating them, a pair of output electrodes and a control electrode, means for impressing said voltage pulses through a capacitor between said control electrode and one of said principal electrodes, a source of substantially constant voltage connected to said principal electrodes through an impedance, means for impressing a voltage derived from the potential difference between said principal electrodes on an input circuit, a tube comprising a cathode, an anode, and a control electrode cooperating with them, means for impressing the last-mentioned voltage to control current flow between the last-mentioned cathode and anode, an impedance supplied with current from a constant voltage source through the last-mentioned cathode and anode, means for energizing a work circuit by current flowing through the last-mentioned impedance, and a capacitor connected between the last-mentioned control electrode and said anode.

5. In combination with an input circuit for impressing voltage pulses which are short compared with the time periods separating them, a first pair of principal electrodes and a control electrode associated with them, means for impressing said voltage pulses through a capacitor in series with a resistor on said control electrode, a resistor fed through said principal electrodes from a source of substantially constant voltage, means for impressing fluctuations in voltage between said principal electrodes on a second control electrode, an anode and cathode associated with said second control electrode, a load circuit connecting a second source of substantially constant voltage to said anode and cathode and a capacitor connected between said second control electrode and said anode.

6. In combination with a source of fluctuating voltage having voltage pulses which are short compared with the time periods separating them, a capacitor and a resistance serially connected across said source, a pair of principal electrodes connected to a source of substantially constant

5

voltage through a resistor, a control electrode associated with said principal electrodes and connected to the common junction of said capacitor and first-mentioned resistance, resistance means in series with a source of bias voltage across said principal electrodes, an anode and cathode connected in series with a work circuit to a source of constant voltage, a control electrode associated with said anode and cathode connected to a point on the last-mentioned resistance and a

6

capacitance connected between the last-mentioned control electrode and said anode.

ANGUS A. MACDONALD.

REFERENCES CITED

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

UNITED STATES PATENTS

10 Number	Name	Date
2,147,781	Ward	Feb. 21, 1939