Nov. 25, 1958 G. C. SUMMERS 2,862,104

COMPENSATED GATE CIRCUIT

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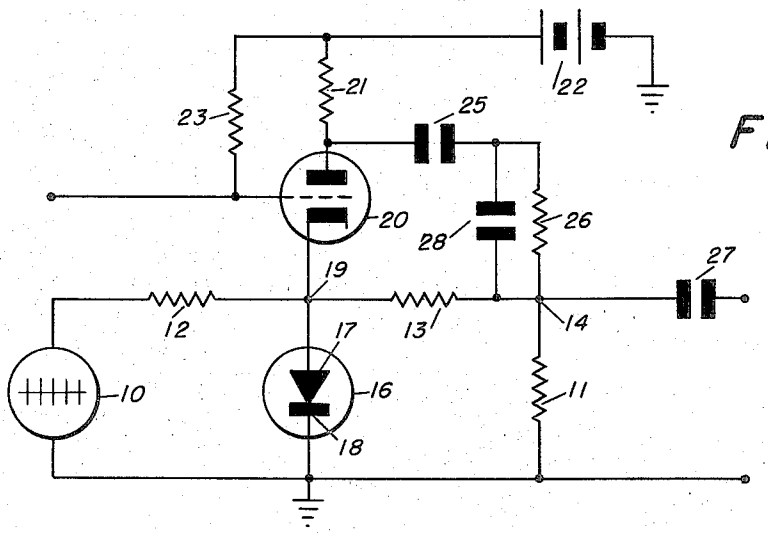


FIG. 1.

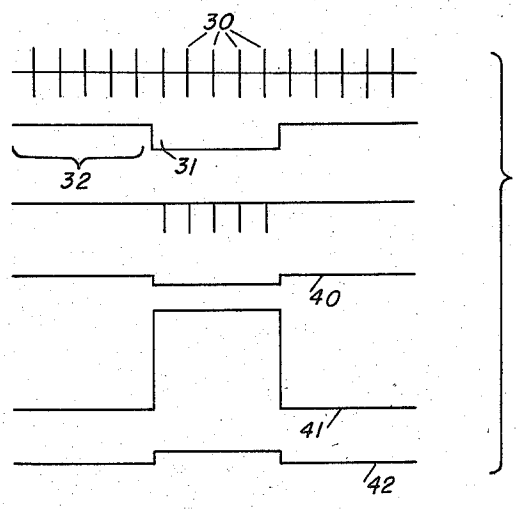


FIG. 2.

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COMPENSATED GATE CIRCUIT

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6 Claims. (Cl. 250—27)

This invention relates to electronic gates and more particularly to a compensated electronic gate in which switching transients are eliminated. In many applications it is common to pass pulses through electronic gates which, when the gate is closed, will not reach succeeding circuits but when the gate is open, permit the pulses to pass on to the succeeding circuits. The present invention is an improvement over the gate circuit disclosed in Patent No. 2,597,796 to Hindall.

In accordance with the present invention there is provided a compensated gating circuit which has a diode connected to ground at the cathode thereof and connected at the anode thereof to the cathode of a normally conducting grid controlled vacuum tube, which tube may be made non-conducting by application of a switching pulse thereto. An impedance means is provided for applying pulses to the juncture between said diode and the cathode of said vacuum tube and for connecting said juncture to an output terminal. A load impedance connected at a first terminal thereof to the anode of the vacuum tube and to a voltage supply source at a second terminal thereof completes a D. C. path through the tube and diode. A compensating circuit connected between said first terminal and said output terminal has an impedance which is high compared to the impedance to ground from said output terminal for application of a voltage to said output terminal which concomitantly varies the potential level at said output terminal in such a way as to oppose the changes which occur when conductivity of said vacuum tube is varied.

For further objects and advantages of the invention and for a more complete understanding thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a circuit diagram of the present invention; and

Fig. 2 is a graph of voltages at various points in the circuit of Fig. 1 as pulses are applied thereto.

Referring to Fig. 1, there is provided a system in which signals from a source **10** selectively are to be passed to an output circuit including output impedance **11**. The upper terminal of source **10** is connected by way of a pair of resistances **12** and **13**, connected in series, to output terminal **14** and to the upper end of output resistance **11**. The lower terminals of source **10** and resistance **11** are connected to ground. A diode **16** is connected at its anode **17** to the juncture intermediate resistors **12** and **13** and is connected at its cathode **18** to ground. A vacuum tube such as a triode **20** is connected at its cathode to the juncture **19**. The anode of tube **20** is connected by way of load resistor **21** to the positive terminal of a source **22** of plate supply. The control grid of tube **20** is connected by way of resistor **23** to a source of positive potential such as the anode supply **22**.

In accordance with the present invention, an additional circuit is provided including a condenser **25** and a resistor **26** connected in series between the anode of tube **20** and

the output terminal **14**. By providing the latter circuit, variations in the potential at the output terminal **14** as may be caused by switching transients may be eliminated.

In operation a series of pulses **30** are applied to the circuit from source **10**. It is desired to permit only those pulses such as appear during the interval of a control pulse **31** to be passed to the output terminal **14**. At the same time it is desirable that no additional transients or pulses appear at the output terminal **14** by reason of switching transients introduced by the beginning and the end of negative gating waveform **31**.

During the interval **32** tube **20** is conducting by reason of the positive voltage on its grid so that a relatively large anode current flows through battery **22** and through diode **16**. When the diode **16** is conducting, its impedance is very low, of the order of 300 ohms, for units such as are presently available. If resistors **12** and **13** are made relatively large, for example in the order of 33,000 ohms, then the diode **16** effectively shunts the pulses during interval **32** so that they do not appear across output impedance **11**. However, when control gate **31** is applied to the grid of tube **20**, the current flow through tube **20** is terminated and the negative portions of the pulses **30** appearing during interval **31** will then be transmitted without substantial attenuation to output terminal **14** and will appear across resistor **11**. The positive half of the latter pulses however are shunted effectively by reason of the low forward impedance of the diode **16**.

The abrupt change in the conductivity of tube **20** coincident with the onset of gate waveform **31** ordinarily will produce a transient in the cathode of tube **19** which would, unless compensated, appear at the output terminal **14**. More particularly, the flow of anode current from tube **20** through the diode having a relatively low resistance ordinarily would produce a voltage at the cathode of about 5 volts relative to ground. The latter voltage, of course, will depend upon the magnitude of the current flow through tube **20**. When the latter current is terminated by application of waveform **31**, the cathode of tube **20** tends to seek ground level generally as shown by line graph **40**, Fig. 2. At the same time the voltage at the anode of tube **20** rises abruptly to the value of battery **22** as shown by line graph **41**. By provision of the circuit including condenser **25** and resistor **26**, a voltage opposite in sense to the change in cathode voltage is applied to terminal **14** so that as the cathode of tube **19** approaches ground, thus tending to lower the potential of point **14**, an equal and opposite voltage derived from the anode of tube **20** as the latter voltage rises is applied to point **14** to maintain point **14** at a constant potential. The latter voltage, i. e., a portion of the anode voltage, is shown by line graph **42**. Thus only voltage changes due to the pulses **30** which appear or occur in the interval spanned by pulse **31** will be transmitted through the output condenser **27** to succeeding circuits.

In a modification of the invention, the condenser **25** may be eliminated whereupon a relatively small current flowing through resistors **26**, **13** and **12** would result in a slightly different voltage at point **14**, but potential at point **14** may be maintained constant during application of a switching gate **31** to the tube **20**.

A small condenser **28** connected in parallel with resistor **26** may be used to compensate for very sharp transients at the switching instants. Adjustment preferably will be made in the size of this condenser to optimize performance for the complete elimination of switching transients. Condenser **28** preferably will have an impedance which in general bears approximately the same ratio to the stray capacity to ground of the circuit as viewed from point **14** as resistor **26** bears to the sum of resistors **12** and **13**.

The stray or shunt capacity may be of the order of 50 or 60 micromicrofarads, the specific value being in general different for each circuit. In the present case, as shown below, the ratio of

$$R26/R12+R13=\frac{3,900,000}{66,000}\cong 60$$

Therefore condenser **28** would be of the order of one or two micromicrofarads.

In one embodiment of the invention, circuit components with the following values and types were used:

Diode **16**	6BQ7 (½ diode connected).
Triode **20**	6BQ7 (½).
Resistors **12** and **13**	33,000 ohms.
Resistor **11**	3.9 megohms.
Resistor **21**	27,000 ohms.
Resistor **23**	1 megohm.
Resistor **26**	3.9 megohms.
Condenser **28**	1–5 or 6 micromicrofarads.
Battery **22**	270 v.

While the invention has been described in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. In a gating circuit having a diode connected to ground at the cathode thereof and at the anode thereof to the cathode of a normally conducting grid controlled vacuum tube the improvement which comprises impedance means for applying signals to the juncture between said diode and the cathode of said vacuum tube, an impedance for connecting said juncture to an output terminal, a load impedance connected at a first terminal thereof to the anode of said vacuum tube, a voltage supply source connected to the second terminal of said load impedance, and means for applying fractional portions of voltage changes appearing at the anode of said vacuum tube to said output terminal to oppose the change which appears across said diode when conductivity of said vacuum tube is varied.

2. A controlled path for signals from a signal source comprising a series circuit connected to said source including an impedance and a diode connected at its anode to said impedance, an output terminal, an output circuit including an impedance interconnecting said anode and said output terminal, a source of direct current having the negative terminal thereof connected to ground, a current path connected to the positive terminal of said source and including in series an anode impedance and a normally conducting vacuum tube connected at its anode to said anode impedance and at its cathode to the anode of said diode, means for selectively rendering said vacuum tube non-conductive for passage of signals from said source to said output terminal, and means for applying fractional portions of voltage at the anode of said vacuum tube to said output terminal to maintain said output terminal at a uniform average voltage as conductivity of said vacuum tube is varied.

3. A controlled path for signals from a signal source comprising a series circuit connected to said source including an impedance and a diode connected at its anode to said impedance, an output terminal, an output circuit including an impedance interconnecting said anode and said output terminal, a source of direct current having the negative terminal thereof connected to ground, a current path connected to the positive terminal of said source

and including in series an anode impedance and a normally conducting vacuum tube connected at its anode to said anode impedance and at its cathode to the anode of said diode, means for selectively rendering said vacuum tube non-conductive for passage of signals from said source to said output terminal, and means for maintaining said output terminal at a uniform average voltage comprising a path connected in parallel to said vacuum tube comprising impedance means interconnecting the anode thereof and said output terminal, which impedance means bears the same ratio with respect to the sum of the impedances connected to the anode of said diode as the voltage across said anode impedance bears to the voltage across said diode.

4. The combination set forth in claim 3 in which said last named impedance means comprises a resistance and a condenser connected in parallel wherein said condenser has a capacity which bears the same relationship to the stray capacity appearing between the anode of said diode and ground as said resistance means bears to the sum of the impedances connected to the anode of said diode.

5. In a circuit for controlling transmission of signals from a signal source to an output terminal which circuit has a diode connected to ground at the cathode thereof and at the anode thereof to the cathode of a normally conducting grid controlled vacuum tube, the improvement which comprises an impedance interconnecting said source and said output terminal and connected at a midpoint thereof to the juncture between said diode and the cathode of said vacuum tube, a resistor connected at a first terminal thereof to the anode of said vacuum tube, a voltage supply source connected to the second terminal of said resistor, and a series circuit interconnecting the anode of said vacuum tube and said output terminal comprising a blocking condenser and a resistor which is large compared to said impedance for applying fractional portions of voltage changes appearing at the anode of said vacuum tube to said output terminal to oppose the change which appears across said diode when conductivity of said vacuum tube is varied.

6. In a circuit controlling transmission of signals from a signal source to an output terminal which has a diode connected to ground at the cathode thereof and at the anode thereof to the cathode of a normally conducting grid controlled vacuum tube the improvement which comprises a series resistor interconnecting said source and said output terminal and connected at a midpoint to the juncture between said diode and the cathode of said vacuum tube, a load impedance connected at a first terminal thereof to the anode of said vacuum tube, a voltage supply source connected to the second terminal of said load impedance, and means including a resistor interconnecting the anode of said vacuum tube and said output terminal wherein said resistance has a value which with respect to said series resistor is the same as the sum of said load impedance and the anode-cathode impedance of said vacuum tube, when conducting, is to the anode-cathode impedance of said diode, when conducting, for applying fractional portions of voltage changes appearing at the anode of said vacuum tube to said output terminal to oppose the change which appears across said diode when conductivity of said vacuum tube is varied.

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