

Feb. 26, 1957

E. A. NEWMAN
ELECTRICAL GATE CIRCUITS

2,783,374

Filed March 9, 1954

2 Sheets-Sheet 1

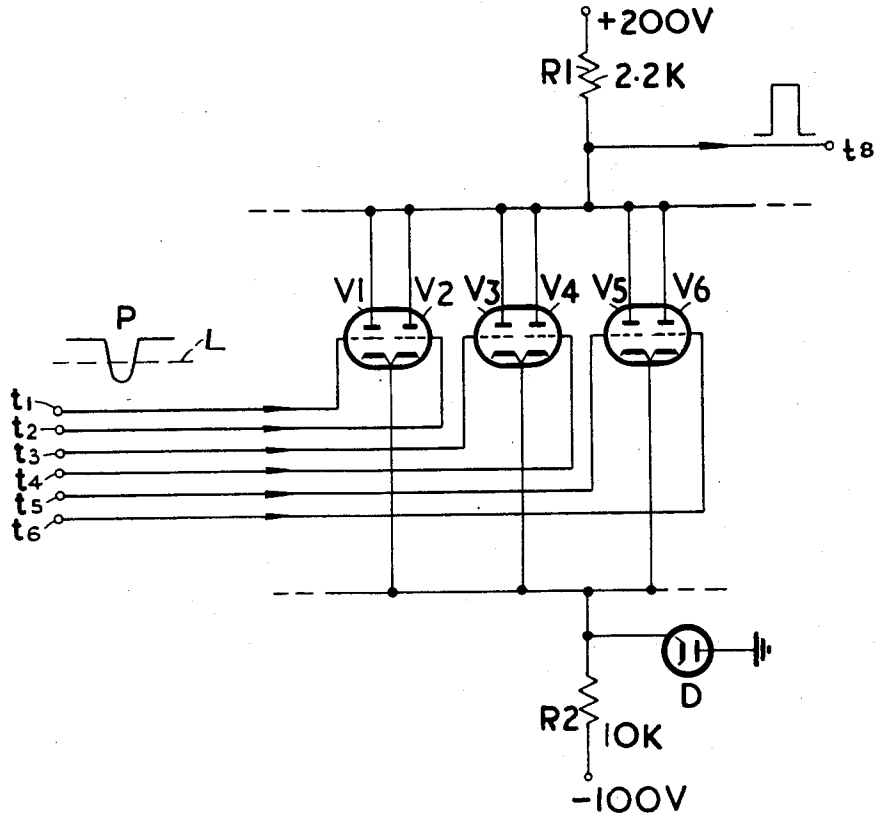


Fig. 1.

Inventor
EDWARD A. NEWMAN
By
Stevens, Davis, Miller & Moskowitz
Attorneys

Feb. 26, 1957

E. A. NEWMAN
ELECTRICAL GATE CIRCUITS

2,783,374

Filed March 9, 1954

2 Sheets-Sheet 2

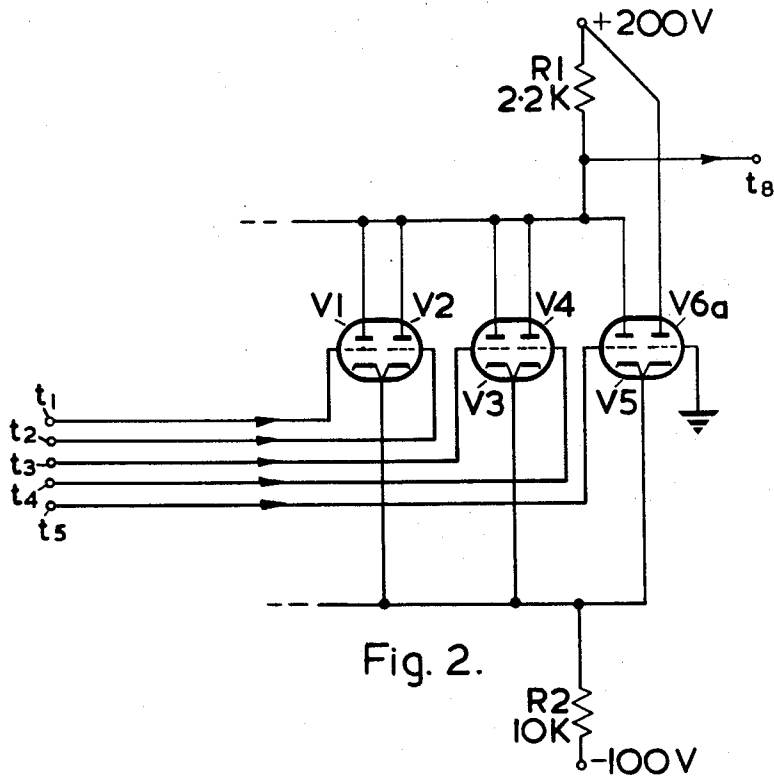


Fig. 2.

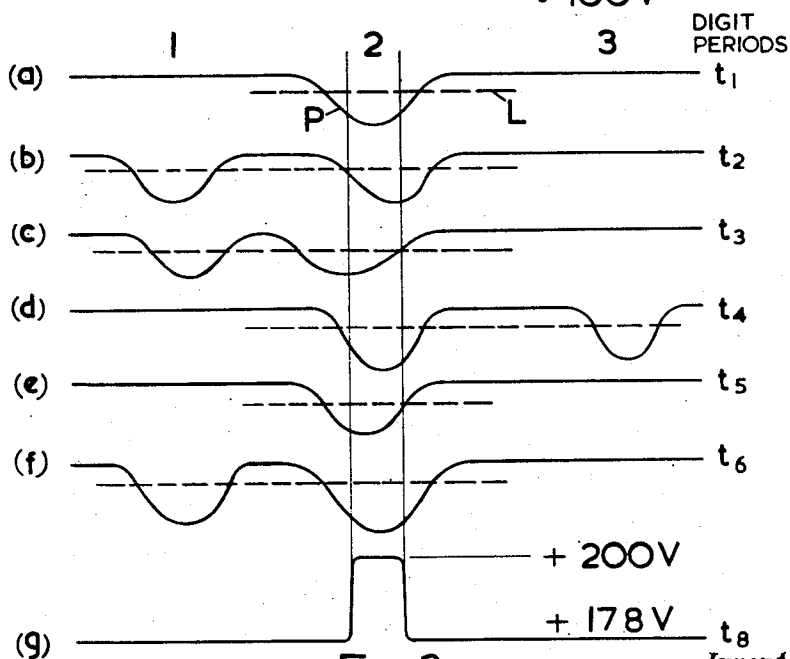


Fig. 3.

Inventor
EDWARD A. NEWMAN
By
Stevens, Davis, Miller & Mosher
Attorneys

1

2,783,374

ELECTRICAL GATE CIRCUITS

Edward Arthur Newman, Teddington, England, assignor to National Research Development Corporation, London, England, a British corporation

Application March 9, 1954, Serial No. 415,109

Claims priority, application Great Britain March 14, 1953

2 Claims. (Cl. 250—27)

The present invention relates to electrical gate circuits for binary digit signals which have inputs from two or more different signal sources and which produce an output which is in accordance with the combination of the types of the input signals. The invention is concerned with gate circuits which are fed on each input with binary digit signals which are presented in a serial form, each signal occurring during an allocated time interval called a digit period and being either a 1 type often in the form of a pulse and a 0 type often represented by the absence of a pulse during a digit period.

Trains of digit signals presented to a gate circuit from different sources are often not in step with each other so that digit signals which should occur at the same time in the various input signal trains occur earlier or later than one another by a portion of a digit period. As a result, especially when the signals are not of good quality, a gate circuit may produce an unsatisfactory or false output.

It is an object of the present invention to provide an electrical gate circuit which can produce correct output signals in response to input signals which are of poorer quality.

An electrical gate circuit according to the present invention comprises a plurality of thermionic valves each having a cathode, an anode and at least one intermediate grid, and being arranged in parallel with their anodes connected to a common anode resistor and their cathodes connected to a common cathode resistor, the remote ends of the anode and cathode resistors being adapted to be connected to the positive and negative outputs respectively of a high tension voltage supply, a plurality of signal input connections for supplying a train of binary digit signals to a grid of each valve in such a manner that when a digit signal of a first kind is present the anode to cathode current is cut off whereas it flows when a digit signal of the other kind is present, a connection from the valve cathodes through a unilateral conducting device to a source of an intermediate potential substantially equal to that of the valve cathodes when any of the valves are conducting, said device being arranged to conduct when the cathode potential moves negative with respect to the intermediate potential with the result that the common cathode potential is maintained at a substantially constant potential level, and a signal output connection connected to the valve anodes or an intermediate point on the anode resistor and on which an output voltage pulse signal at or substantially at the positive high tension voltage appears only when a digit signal of the first kind is present on all the signal input connections.

Gate circuits are extensively used in electronic digital computing machines and gate circuits according to the present invention may be readily used in these machines. Although it may be used in other types of gate circuits, the invention is particularly applicable to multiple coincidence gates (generally called and gates in the digital computer art) which produce a distinctive output signal when, and only when, all the input signals are of a given type.

2

In order that the invention and various features thereof may be more fully understood, two embodiments of the invention will now be described with reference to the drawings filed with this specification in which:

Figures 1 and 2 are circuit diagrams of two alternative arrangements; while

Figures 3(a) to 3(g) are voltage waveforms illustrating the action of the arrangement shown in Figure 1.

The gate circuit shown in Figure 1 consists of a number of type 12AT7 double-triode valves V1 and V2, V3 and V4, and V5 and V6 and so on, having their anodes connected through a common anode resistor R1 to a +200 v. H. T. supply, and having their cathodes connected through a common cathode resistor R2 to a -100 v. H. T. supply. The grids of each of the valves V1 to V6 are connected directly to signal input terminals t1 to t6 respectively, by which they are supplied with trains of pulse signals, each being either a 1 type binary digit signal in the form of a negative-going pulse during a digit period or a 0 type signal when a pulse is absent during a digit period.

The components of the circuit are chosen so that when a negative-going pulse is not present on the grid of a valve that valve conducts, but when a negative-going pulse is present the valve current is cut-off. Thus as depicted in Figure 1 a 1 type signal in the form of a pulse P which is supplied from a signal input terminal t1 to the grid of valve V1 cuts off the valve current during the period that the pulse voltage is more negative than the grid cut-off voltage of the valve represented by the broken line L.

In addition to being connected to the resistor R2, the cathodes of the valves V1 to V6 are connected to the cathode of a diode D, the anode of which is connected to earth or a source of potential a few volts more positive or negative than earth. This connection ensures that the potential on the cathodes of the valves V1 to V6 cannot fall below the potential on the anode of the diode D and so the grid cut-off voltage of the valves V1 to V6 cannot fall and so prevent a 1 type negative-going pulse signal applied to a valve acting to cut off the valve current.

When some but not all the valves V1 to V6 are supplied with 1 type pulse signals from terminals t1 to t6, so there is at least one valve passing current between the + H. T. and - H. T. supplies, there is a voltage drop across the anode resistor R1. This voltage drop is limited to about 22 volts in a circuit made up of components as shown in Figure 1, as the total valve current is limited by the action of the resistor R2 and the diode D to about 10 milliamperes and resistor R1 is 2.2 kilohms. This current is shared by all the valves V1 to V6 that are conducting so that the voltage level on a signal output terminal t8 is fairly constant at about +178 volts when any number of terminals t1 to t6 up to five are feeding type 1 signals.

Figures 3(a) to 3(f) show the voltage waveforms of digit signals applied from the terminals t1 to t6 during three typical digit periods 1, 2 and 3. In each of these figures the broken lines represent the grid cut-off voltage of the appropriate valves. Only when 1 type digit signals are fed from all six terminals t1 to t6 as occurs during digit period 2 is the flow of current from the + H. T. to the - H. T. supply stopped and the potential on the output terminal t8 as shown in Figure 3(g) is permitted to rise to nearly +200 volts. Thus a good quality positive-going output pulse signal is produced for the period of coincidence of 1 type negative-going pulse signals on all the signal input terminals. This output pulse will be initiated when the potential of the last input pulse moves negative with respect to the grid cut-off voltage, and will be terminated as soon as one of the input pulses is fin-

ished. It is therefore necessary for the input pulse signals to overlap in time for a small period sufficiently long to enable the potential on the output terminal *r8* to rise to a marked extent before it reverts to its base value.

A crystal rectifier, connected to a source of a suitable intermediate voltage near earth potential, may be used instead of the diode *D*, while each of the valves *V1* to *V6* may be a 6J6.

Alternatively, one of the triode valves *V1* to *V6* may be used as a unilateral conducting device instead of the diode *D*. An example of such an alternative arrangement is shown in Figure 2 in which a valve *V6a* is used in place of the diode *D* in the arrangement shown in Figure 1. The anode of the valve *V6a* is not connected to the anode resistor *R1* but is connected to the + H. T. supply direct as shown or through a low valued separate resistor. The valve *V6a* is of course not connected to a signal input terminal but its grid is connected to a source of a suitable intermediate potential near to earth potential or directly to earth potential as shown so that if the common cathode potential on the valves *V1* to *V5* tends to fall below earth potential, the valve *V6a* conducts and keeps the cathode potential up to earth potential.

It will be appreciated that any number of signal inputs from two upwards may be dealt with by providing a corresponding number of valves connected in parallel between the resistors *R1* and *R2*.

Although the circuit shown in Figure 1 has been described as a coincidence or and gate, it can function as another type of gate by changing the significance of the various signal inputs. For example, if the signal inputs are regarded as being of a 1 type when a positive-going pulse is present during a digit period and a 0 type if otherwise, then the voltage on the output terminal *r8* is at a higher level in the absence of any 1 type input signal and at a lower level if one or more 1 type input signals are present. Thus if a lower voltage level on terminal *r8* is taken as the distinctive output the circuit acts as an or gate. Also an inhibiting connection may be provided for a gate of either of these types by changing the significance of the input to one of the terminals *r1* to *r6*. Thus for the and gate as originally described, one of the inputs may be converted into an inhibiting input by making a negative-going pulse signal on this input signify a 0 type signal and the absence of a pulse a 1 type signal. It will

thus be seen that a 1 type signal on this inhibiting input will prevent a positive-going output pulse from appearing on the output terminal *r8*. These and other variations will be obvious to those skilled in the electronic digital computer art.

I claim:

1. An electrical gate circuit comprising a plurality of thermionic valves each having a cathode, an anode and at least one intermediate grid, and being arranged in parallel with their anodes connected to a common anode resistor and their cathodes connected to a common cathode resistor, the ends of the anode and cathode resistors remote from the valves being adapted to be connected to the positive and negative outputs respectively of a high tension voltage supply, a plurality of signal input connections which supply to a grid of each valve binary digit signals which are either of a first kind which cut off the valve current or of a second kind which permits the valve current to flow, a source of an intermediate potential substantially equal to that of the valve cathodes when any of the valves are conducting, a connection from the valve cathodes to said source through a unilateral conducting device which conducts when the cathode potential moves negative with respect to the intermediate potential with the result that the common cathode potential is maintained at a substantially constant potential level, and a signal output connection connected to the common valve anode circuit and on which an output voltage pulse signal substantially at the positive high tension voltage appears only when a digit signal of the first kind is present on all the signal input connections.

2. An electrical gate circuit according to claim 1 and in which the unilateral conducting device is a thermionic valve having an anode connected to the positive output of a high tension voltage supply, a cathode connected to the end of the common cathode resistor which is connected to the cathodes of the said plurality of thermionic valves, and a control grid connected direct to a source of said intermediate potential.

References Cited in the file of this patent

UNITED STATES PATENTS

2,485,665	Shepherd	Oct. 25, 1949
2,535,377	Titterton	Dec. 26, 1950