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L. P. CROSMAN

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DISCHARGE TUBE ISOLATION CIRCUIT

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FIG. 1

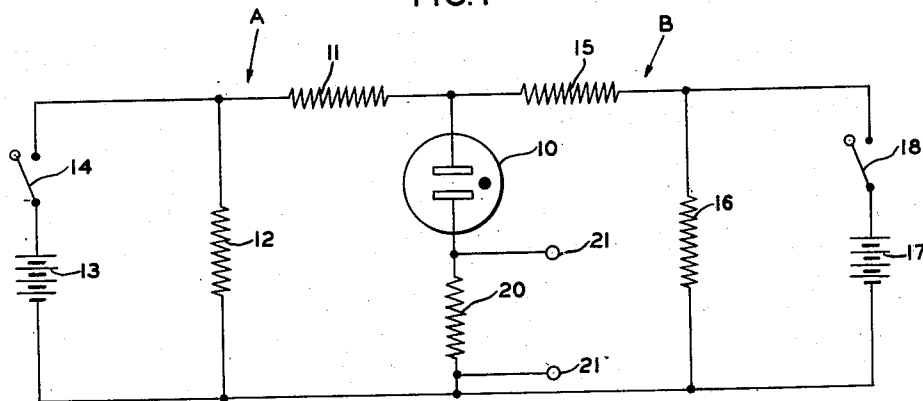
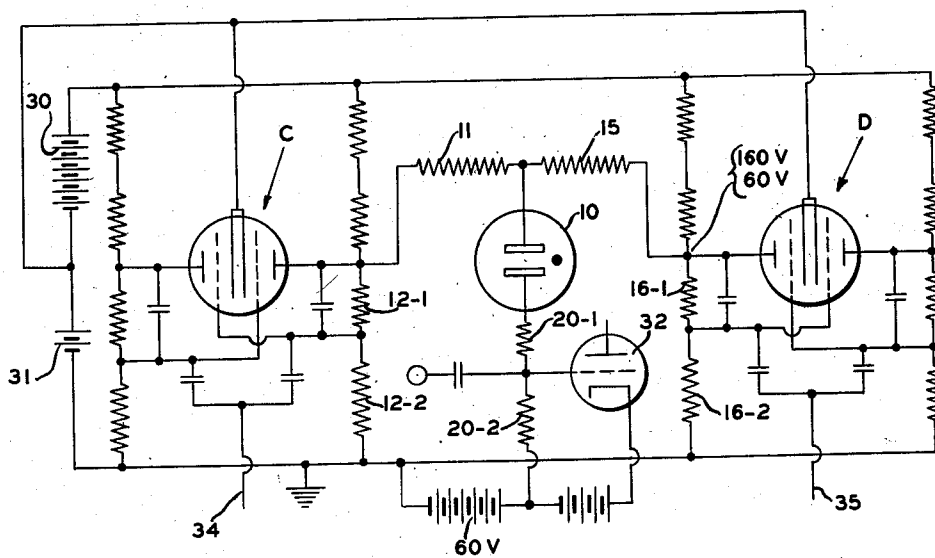


FIG. 2



INVENTOR.
LORING P. CROSMAN

BY *Ralph H. Bitner*

ATTORNEY

UNITED STATES PATENT OFFICE

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DISCHARGE TUBE ISOLATION CIRCUIT

Loring P. Crosman, Darien, Conn., assignor to
Remington Rand Inc., New York, N. Y., a cor-
poration of Delaware

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26, 1949, Serial No. 112,621

4 Claims. (Cl. 250-27)

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This invention relates to circuits which may be isolated and controlled by gaseous discharge tubes, and is a division of application S. N. 23,811, filed April 28, 1948, now abandoned. It more particularly relates to circuits which may be used for control of communication devices or for calculating machinery. While the circuits to be described can be used in a wide variety of applications, they are especially suited for use with two-element discharge lamps having symmetrical electrodes. One type of lamp which has been used in these circuits is filled with low pressure neon gas, and has an ionization potential of about 75 volts. At potentials below this value, the lamp cannot be lighted and will pass a very small current which is generally considerably less than one microampere. When the lamp is subjected to a voltage higher than the ionization potential, the gas is ionized, and in this lighted condition these lamps present a voltage drop of about 60 volts and pass current within the range of .5 milliamperes to 50 microamperes. Neon and other gas filled tubes have been used as voltage indicators and as constant current regulators, but so far as it is known, the two-electrode type has not been used as a variable impedance element to isolate certain parts of a circuit while other parts are working.

The present invention employs only gaseous discharge tubes which have two symmetrical electrodes. It is well known that prior art tubes having three, four, and five electrodes have been used in communication circuits for switching purposes and for generating oscillations. It is also well known that two electrode tubes with unsymmetrical electrodes have been used extensively for regulation of constant current and constant voltage circuits.

One feature of the invention includes a gas-discharge tube connected to two or more input circuits. A voltage dividing network comprising a plurality of impedances is associated with each of the input circuits, certain of the impedances being common to each of the dividing networks. The output circuit consists of an output resistor and a gaseous discharge tube arranged in series and connected across the terminals of the voltage dividers. The application of a predetermined voltage to one of the input circuits is not sufficient to ionize the discharge tube in the output circuit and, therefore, no electrical energy can be passed to the output resistor. However, if two or more input circuits receive input voltages of predetermined values, the discharge tube receives a voltage higher than its ionization potential.

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It is then rendered conductive and energy flows through the output resistor and is available at the output terminals.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawing.

Fig. 1 is a schematic diagram of the circuit in its simplest form.

Fig. 2 is a schematic diagram of a similar circuit showing a neon discharge tube connected to the output leads of two vacuum tube trigger circuits.

The circuit shown in Figure 1 comprises a gaseous discharge tube 10, an output impedance 20, two potential sources 13 and 17, and the impedance networks comprising impedances 11, 12, 15 and 16. Switches 14 and 18 control the application of potentials from batteries 13 and 17 respectively. Resistors 11, 15 and 16 in parallel with resistor 12 comprise a voltage dividing network associated with battery 13. When switch 14 alone is closed the potential at the junction of resistors 11 and 15 will be equal to the potential of battery 13 less the drop through resistor 11. The voltage dividing network associated with battery 17 comprises resistors 15, 11 and 12 which are in parallel with resistor 16. When switch 18 alone is closed the potential at the junction of resistors 11 and 15 will be equal to the potential of battery 17 less the drop through resistor 15. Note that resistors 11 and 15 are common to the voltage dividing networks associated with both batteries 13 and 17. If the batteries 13 and 17 provide equal potentials then the impedance networks can be made symmetrical; otherwise impedance values may be chosen to compensate for the inequality of supply potentials.

If the gaseous discharge tube 10 comprises a neon tube having an ionization potential of 75 volts, then for best operational results the resistors should be arranged so that the voltage across the tube is about 50 volts when either one of the input circuit switches is closed. The output circuit resistor 20 is bridged by conductors and output terminals 21 so that an output voltage may be derived from the terminals and transmitted to a voltage operated device such as a vacuum tube.

In order to disclose the operation of this simplified circuit, let it be assumed that resistors 11 and 15 have a value of 15,000 ohms and that resistors 12 and 16 have values of 5,000 ohms. The batteries 13 and 17 have a terminal potential

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supply of 88 volts. If, now, switch 14 is closed, the battery 13 will send currents through two branch circuits. One branch comprises resistor 12. The other branch includes resistors 11, 15, and 16 in series, the result being an applied voltage of 50 volts across the output circuit which includes the lamp 19 and the resistor 20. This applied voltage is insufficient to light the lamp and no current will pass through the output resistor. Because of the equivalents of the two input circuits, the same conditions will apply if switch 14 is open and switch 18 is closed. Now, if both switches 14 and 18 are closed, the same currents will flow through resistors 12 and 16. The output circuit, however, will receive the full battery voltage the instant before the lamp is lighted. This value of 88 volts is far above the average ionization value of about 75 volts. In this condition the lamp will be lighted and current will flow through the lamp 19 and the output resistor 20, thereby providing a potential difference between the two output terminals 21, which may be applied to a vacuum tube to operate other circuits.

It is clear from the foregoing that the values of the impedances comprising the network associated with each potential source must be so chosen that when only one potential source is operated the potential across the gas tube circuit is less than its ionization potential. If the impedance values are chosen such that with only one potential source active the potential across the gas tube circuit is less than its ionization potential but greater than its extinguishing potential, then once the tube is fired it will remain conducting until the potentials from both sources are removed. However, if the impedance values are chosen such that the aforementioned potential is less than the extinguishing potential as well as less than the ionization potential, then once the tube is fired it will be extinguished by removal of either of the potential sources. Which of these two alternatives will be employed will depend upon the function intended to be performed by the circuit.

Fig. 2 illustrates a practical adaptation of the simplified circuit shown in Fig. 1, and represents one of the applications of the basic idea to a high speed computing circuit. In this case, the output circuit is composed of two resistors 23-1 and 23-2. Resistors corresponding to 11 and 15 in Fig. 1 are reproduced without change in Fig. 2. The input circuit corresponding to resistor 12 in Fig. 1 is shown in Fig. 2 as two resistors 12-1 and 12-2. In a similar manner, the input circuit B comprises resistors 16-1 and 16-2. Instead of a battery and switch as is used in the simplified version, trigger circuits C and D are employed. Each trigger circuit comprises two triode electron discharge devices with the well known trigger circuit arrangements so that either one or the other triode components are in a conducting condition. The trigger circuits are supplied with an anode voltage supply 30 of 166 volts, and a grid potential supply 31 of 34 volts. The operation of this device is essentially the same as the operation of the simplified circuit shown in Fig. 1 except that the voltage values have a different range of operation. If, for example, the double triodes are similar to the 6SN7, then the trigger circuits may be easily adjusted so that the anode of the conducting triode has a potential of 60 volts, while the anode of the non-conducting triode has a potential of 160 volts. Under these conditions, the lower resistor

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20-2 is connected to a biasing source of potential of 60 volts. Now, if trigger circuit C is conducting on the right hand side, thereby applying a potential of 60 volts to resistor 11, and if the other trigger circuit D is also conducting on the right, thereby applying a potential of about 160 volts to resistor 15, the potential of the midpoint between resistors 11 and 15 is approximately 110 volts. This voltage minus the 60 volt biasing potential is considerably less than the ionization potential of the lamp and, therefore, the lamp will not light. If, however, trigger circuit C is actuated so that it conducts on the left, then its right hand anode potential will be 160 volts, the same as the left hand anode potential of trigger circuit D. Under these conditions, the lamp 19 will have an applied potential at its upper terminal of 160 volts which, minus the 60 volt biasing potential, equals 100 volts or considerably in excess of the ionization potential. The lamp will be lighted, current will pass through the output resistors 20-1 and 20-2, and an operating voltage will be made available to an output triode 32.

From the above disclosure it will be obvious that when trigger circuit C is conducting on the right hand side, and trigger circuit D is conducting on the left hand side, the lamp will not be lighted. When either one of the trigger circuits is actuated, the lamp will still not be lighted, but if both trigger circuits are actuated so that trigger circuit C is conducting on the left, and trigger circuit D is conducting on the right, the lamp 19 will be lighted and the potential across all or any part of the output resistor 20 can be made available for other circuits to control other operations. Trigger stages C and D may be actuated by the application of suitable negative pulses applied to conductors 34 and 35. While, in the embodiment of Figure 2, control potentials for the gas tube circuit are taken from the anodes of the trigger circuits, it is clear that control signals could be taken from other points in the trigger circuits such as, for example, the cathode circuits of the triggers. It should be further noted that the same considerations that affect the choice of impedance values in the embodiment of Figure 1 also apply in the embodiment of Figure 2. Thus, extinguishing of the gas tube after it is once fired may be made alternatively to depend upon the resetting of one or both of the trigger circuits.

While there have been described and illustrated specific embodiments of the invention, it will be obvious that various changes and modifications may be made therein without departing from the field of the invention which should be limited only by the scope of the appended claims.

What is claimed is:

1. An electronic isolating and gating device comprising in combination, a gaseous discharge diode, a first galvanic impedance connected in series with said diode to form a first series circuit, second and third galvanic impedances connected in series to form a second series circuit, fourth and fifth galvanic impedances connected in series to form a third series circuit, said first, second and third series circuits being connected in parallel with one another, a first and second source of potential, means for selectively applying said first source of potential across said second galvanic impedance, and means for selectively applying potential from said second source across said fourth galvanic impedance.

2. An electronic isolating and gating device as set forth in claim 1 wherein the relative values

of the second, third, fourth and fifth galvanic impedances are such that the application of potentials from either of the two sources alone results in the application across the gaseous discharge diode of a potential less than its ionization potential, and wherein the simultaneous application of potentials from both sources results in the application across the gaseous discharge diode of a potential exceeding its ionization potential.

3. An electronic isolating and gating device as set forth in claim 1 wherein the first and second sources of potential and the means for selectively applying potentials from these sources comprise a first and second trigger circuit, the steady state outputs of said trigger circuits being galvanically coupled with said second and fourth galvanic impedances.

4. An electronic isolating and gating device as set forth in claim 3 wherein the steady state trigger circuit outputs are taken from galvanic

connections to impedances in the anode circuits of said triggers.

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