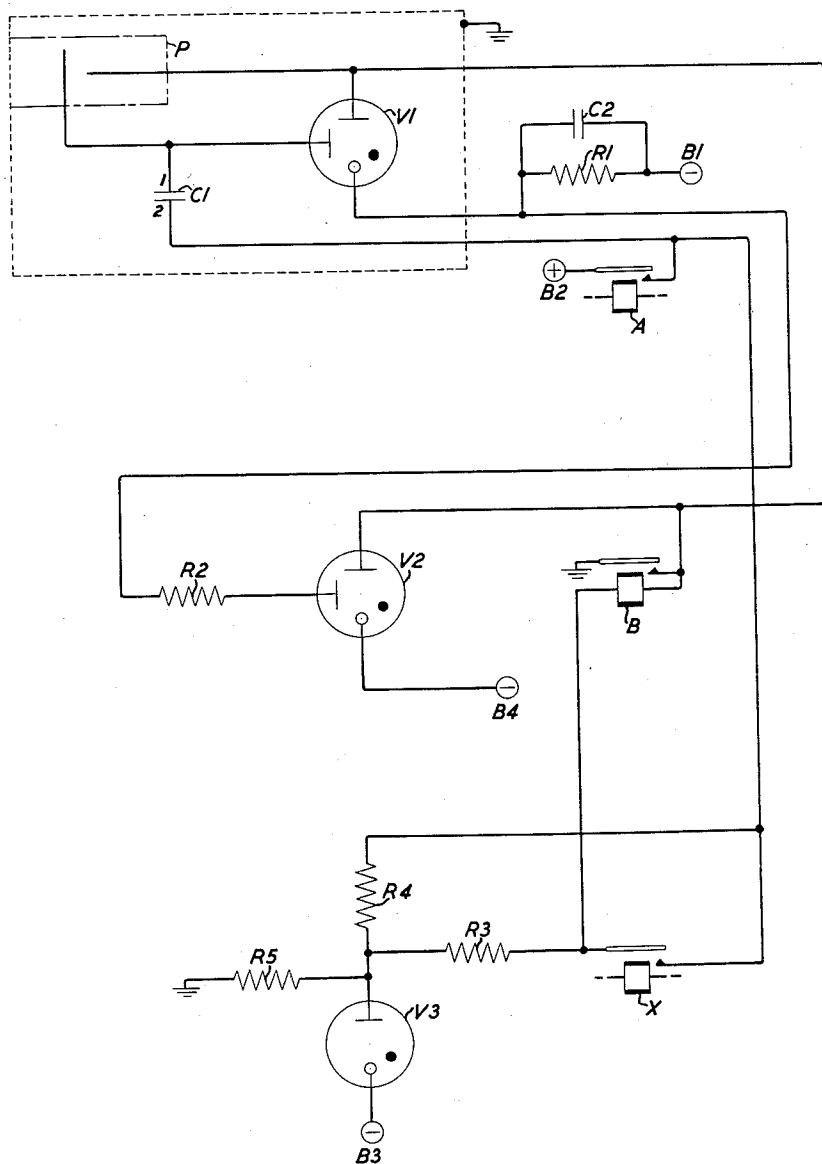


Dec. 5, 1950

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GAS-FILLED TUBE CIRCUIT
Filed Aug. 13, 1949

2,532,728



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2,532,728

GAS-FILLED TUBE CIRCUIT

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Application August 13, 1949, Serial No. 110,138

7 Claims. (Cl. 315—355)

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This invention relates to gas-filled tube devices and particularly to an arrangement for insuring the rapid operation of such a device in a circuit involving a photoelectric cell, the response of which to light impinging thereupon is to be determined.

In light-actuated devices such as, for example, the translator disclosed in copending application Serial No. 707,020, filed October 31, 1946, it is essential that when a beam of light strikes a photoelectric cell at the end of a light tunnel completed by the selective displacement of a perforated card or the like from a stack of cards, the activation of the cell be immediately ascertained by the operation of a gas-filled device in circuit with the electrodes of the cell. It has been found, however, that when certain gas-filled tubes especially adapted for use with photoelectric cells are infrequently used, the speed of tube operation lags somewhat, and this can be overcome if, prior to the intended normal operation of the tube in response to the activation of the cell, the tube is "primed" by the passage of an ionizing current through its control gap.

It is one of the purposes of the present invention to utilize a condenser for priming a gas-filled tube in advance of its use as a detector, by a transient discharge through its control gap as a condition precedent to detection operation.

A further object of the invention is to utilize the same or some other condenser to increase the speed of detection subsequent to the priming of the tube, by biasing said condenser with a voltage which is near to the voltage required on the control anode for breakdown of the control gap and thereby to reduce the time required to build up the voltage to the breakdown value.

These and other features of the invention will be more readily understood from the following description taken in connection with the appended claims and attached drawing which shows a circuit arrangement for detecting the presence of light impinging upon a photoelectric cell P by means of a gas-filled tube V1, and in which the condenser C1 is utilized to prime the tube V1 in advance of its operation and then to speed up the detection operation by a biasing charge.

Normally when no detection action is desired, relays A, B and X are released. Ground is then applied to terminal No. 1 of condenser C1 and to the control anode of the gas-filled tube V1 (the cathode of this tube being normally supplied with negative battery -B1 through resistor R1) through resistors R5 and R3, the winding of relay B and the anode and cathode of

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the photocell P. Ground on the control anode of tube V1 does not provide sufficient potential across the control gap of this tube to cause it to break down. Some minute ohmic current may flow through the tube, but it is not sufficient to prevent the tube becoming sluggish during relatively long periods of idleness. Ground is also applied to terminal 2 of condenser C1 by way of resistors R5 and R4. Thus under normal conditions condenser C1 is discharged.

When it is desired to determine whether light is impinging on photocell P, relay A is operated in any suitable manner. Positive battery +B2 is then applied through the contacts of said relay to terminal No. 2 of condenser C1, causing the control gap of tube V1 to break down and said condenser to be charged through a circuit completed from positive battery +B2, terminals No. 2 and No. 1 of said condenser, the control anode and cathode of tube V1, the network R1 and C1 to negative battery -B1. Condenser C2 is bridged across resistor R1 to provide a low impedance in the above-traced charging circuit in order to insure a maximum ionizing current through the control gap of the tube. The potential difference established at the control gap by the positive battery +B2 and negative battery -B1 through the circuit above traced will produce a relatively heavy current, thereby priming tube V1 during the period it takes condenser C1 to charge to the point where the voltage on its terminal No. 1 is insufficient to sustain ionization, subsequent to which the current in the tube will decrease to its minute ohmic value.

It will be observed that tube V3, which is also a gas-filled tube, has negative battery -B3 permanently connected to its cathode. At the time relay A is operated and positive battery +B2 is applied to condenser C1, said battery is also applied to the upper terminal of resistor R4, and the potential difference between negative battery +B3 and positive battery +B2 at the contacts of relay A is sufficient to cause ionization of tube V3, whereupon a current flow is established through tube V3 which results in a positive potential at the common terminal of resistors R5, R4 and R3 the value of which is determined by battery -B3 and the sustaining voltage of tube V3. As presently to be described, this positive voltage, of a value only a small amount below that necessary to break down tube V1, is applied to condenser C1 to decrease the time required to discharge said condenser to the point where the voltage on its terminal No. 1 is sufficient to cause breakdown of the control gap of tube V1, and

the value of this positive voltage is determined by battery -B3 and the sustaining value of tube V3. Obviously tube V3 can be replaced, if desired, by a switched-in battery or suitable network which supplies the same constant voltage. The above "biasing" voltage is applied to the No. 1 terminal of condenser C1 over a path traced through resistor R3, winding of relay B and the electrodes of the photocell P.

After the operation of relay A, relay X is then operated in any suitable manner. If, subsequent to the operation of relay X, light is impinging upon the photocell P, the equivalent resistance of said photocell will be reduced and a circuit will be then completed from positive battery +B2, contacts of relay A, contacts of relay X, winding of relay B, the anode and cathode of the photocell P, the control anode and cathode of tube V1, resistor R1 to negative battery -B1. The above circuit will cause tube V1 to break down through its control gap, and inasmuch as the positive potential of the above circuit is also applied to the main anode of tube V1, said tube will transfer from its control gap to its main gap over a circuit traced from negative battery -B1, resistor R1, cathode and main gap, main anode of said tube, to ground previously traced through the winding of relay B.

It will be observed that the voltage applied to the control anode of tube V1 is also applied to terminal No. 1 of condenser C1. This condenser, previously partially discharged from the voltage derived from the conductivity of tube V3, is now discharged further until the voltage on its terminal No. 1 and the control anode of tube V1 is sufficient to cause breakdown of the control gap. The condenser C1 now serves another function. When the control gap of tube V1 breaks down, a transient current passes through condenser C1 and this gap, this transient insuring the transfer of the ionization to the main gap.

In the present embodiment of the invention it is assumed that the capacity of tube V1 will not permit of sufficient current to operate relay B, for which purpose gas-filled tube V2 is provided. This tube normally has negative battery B4 connected to its cathode while negative battery -B1 is also normally applied through resistor R1 and resistor R2 to its control anode. When tube V1 is rendered conducting as above described, the positive voltage available at its main anode is also applied to the main anode of tube V2 since both anodes are connected together. However, the cathode voltage of tube V1, at the time that the tube is rendered conducting, becomes more positive and is sufficient in respect to the negative voltage B4 at the cathode of tube V2 to render said latter tube conducting through its control gap. The tube then transfers across its main gap due to the presence of the positive voltage at the terminal thereof.

Tube V2 functions as an amplifier and, as before stated, is used to provide the necessary current to operate relay B. In some light-detecting devices, the tube V1 is enclosed (as shown) in the same electrically shielded container as the photoelectric element P, and because the enclosure of the container is small, tube V1 is of small dimensions and limited current carrying capacity. Therefore, to provide sufficient current to operate the indicating device, such as relay B, for example, an auxiliary amplifying tube such as V2 is provided. Where, however,

tube V1 has the required current carrying capacity, tube V2 may be eliminated and the relay operated directly over the main circuit of tube V1. In this case the cathode of tube V1 is connected directly to battery -B1.

The operation of relay B applies ground to the anodes of both tubes V2 and V1, whereby causing them both to be extinguished. Relay B, however, remains locked over a circuit traced through ground on its contacts, the winding of the relay, contacts of relay X, contacts of relay A to positive battery +B2. Relay B remains in the operated condition as long as relay X remains operated (resistance R3 is relatively high), and its operated condition indicates that light was impinging upon the photocell P at the time it operated. When relay X releases relay B will release and when relay A releases, tube V3 is extinguished.

It should be noted that if no light strikes the photocell P at the time that relay X is operated to apply positive battery +B2 through the winding of relay B to the control anode of tube V1, relay B will not operate, due to the fact that the current flow through the photocell P in a darkened condition is extremely small, and in the presence of the minute ohmic flow through the control gap of tube V1 and other circuit leaks insufficient to discharge condenser C1 to the point where the voltage on its No. 1 terminal is high enough to cause breakdown of the control anode of tube V1.

While I have illustrated my invention in its application to a particular type of circuit, it is not limited to such application nor to the specific arrangements disclosed herein. It will be evident to one skilled in the art that many applications, arrangements and modifications other than those herein disclosed are within the scope of the invention.

Further, the terms and expressions which I have used in reference to the invention and its elements are used as terms of description and not of limitations, and I have no intention by the use of said terms and expressions of excluding thereby equivalents of the features shown and described or portions thereof but, on the contrary, intend to include therein any and all equivalents and modifications which may be employed without departing from the spirit of the invention.

What is claimed is:

1. An electric circuit comprising in combination a gas-filled tube having a plurality of control electrodes, means for applying detection breakdown potential to said control electrodes, and means including a condenser for applying to said electrodes a priming breakdown potential in advance of said detection breakdown potential.

2. An electric circuit comprising in combination a gas-filled tube device having a cathode with a source of potential connected thereto, an anode and a control electrode, a condenser connected to said control electrode, means for applying a potential to said condenser thereby to establish a charging circuit for said condenser between said control anode and said cathode whereby the charging current through said charging circuit produces a momentary ionization of the device, and means for applying detection breakdown potential between said control anode and said cathode after the charging current has decayed.

3. An electric circuit comprising in combina-

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tion a gas-filled device having a cathode with a source of potential connected thereto, an anode and a control electrode, a condenser connected to said control electrode, means for applying a potential to said condenser thereby to establish a charging circuit for said condenser through said control anode and said cathode whereby the charging current through said charging circuit produces a momentary ionization of the device, means for applying detection breakdown potential between said control anode and said cathode after said charging current has decayed, a relay, and means for applying anode potential to said relay, thereby to operate said relay in the circuit completed through the main gap of said device subsequent to the detection breakdown thereof through its control gap.

4. An electric circuit comprising in combination a gas-filled device having a cathode with a source of potential connected thereto, an anode and a control electrode, a condenser connected to said control electrode, means for applying a potential to said condenser thereby to establish a charging circuit therefor between said control electrode and said cathode, whereby the charging current through said charging circuit produces a momentary ionization of said device, means for applying detection breakdown potential between said control electrode and cathode after said charging current has decayed, a relay, and means for applying anode potential to said relay thereby to operate said relay in the circuit completed through the main gap of said device subsequent to the detection breakdown thereof through its control gap, said relay including a circuit for locking said relay and restoring said device to its non-conductive state.

5. An electric circuit comprising in combination a gas-filled tube having a plurality of control electrodes, means for applying a detection breakdown potential to said electrodes, means including a condenser for applying to said electrodes a priming potential in advance of said detection breakdown potential, and means effective after the application of said priming potential to said electrodes and prior to the application of said detection breakdown potential to said electrodes, for biasing said condenser with a potential, thereby to reduce the time of discharging said condenser in the detection operation.

6. A light-detecting circuit comprising in

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combination a photoelectric cell, a gas-filled tube in circuit with the elements of said photoelectric cell, said gas-filled tube including a cathode having a source of potential connected thereto and a control anode connected to one of the elements of said photoelectric cell, a condenser connected to said control anode, means for establishing a charging circuit for said condenser between said control anode and said cathode, whereby the charging current through said charging circuit produces a momentary ionization of the control gap of said tube, and means responsive to light impinging upon said photoelectric cell and effective after the decay of said charging current for completing a breakdown circuit for the control gap of said tube through the elements of said photoelectric cell.

7. A light-detecting circuit comprising in combination a photoelectric cell, a gas-filled tube in circuit with the elements thereof, said gas-filled tube including a cathode having a source of potential connected thereto and a control anode connected to one of the elements of said photoelectric cell, a condenser connected to said control anode, means for establishing a charging circuit for said condenser between said control anode and said cathode, whereby the charging current through said charging circuit produces a momentary ionization of the control gap of said tube, means responsive to light impinging upon said photoelectric cell and effective after the decay of said charging current for completing a breakdown circuit through the control gap of said tube and the elements of said photoelectric cell, an indicating device, and means for operating said indicating device through the main gap of said tube to indicate the impingement of light upon said photoelectric cell.

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