

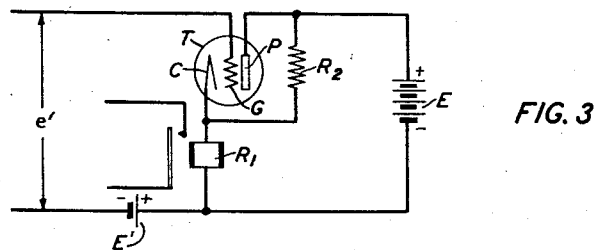
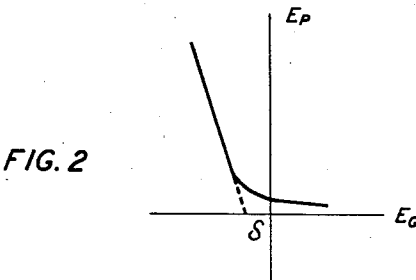
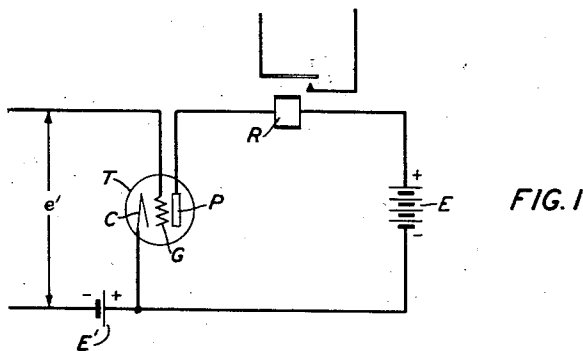
Sept. 21, 1943.

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2,329,764

RELAY CIRCUIT

Filed Aug. 26, 1941



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2,329,764

RELAY CIRCUIT

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Application August 26, 1941, Serial No. 408,302

3 Claims. (Cl. 175—320)

This invention relates to relay circuits and more particularly to a relay circuit involving the use of a gaseous conductor tube for activating the circuit upon the application of the appropriate firing potential to the tube.

As is well known, a gaseous conductor or thyatron tube is one that is filled with a low pressure gaseous content which, for purposes of illustration, might be neon, argon, helium, mercury vapor or combinations of gases of this group. The tube has a number of characteristics among which may be mentioned the fact that its gaseous content will become ionized and thus conducting on one potential determined by the electrode design, the nature of the gaseous content and its pressure and will remain conducting on a somewhat lower potential. Another characteristic is that the tube will cease to be conducting upon the removal of the supply voltage from its plate or anode electrode or upon rendering such voltage negative with respect to cathode potential. Yet another characteristic is a certain instability that results from the "age" of the tube; that is, the relation between "firing" voltage and supply voltage is apt to change with time.

Relay circuits involving the use of thyatron tubes are widely used where a relay operation is to be performed and high sensitivity and speed of operation are required. Such circuits, however, are limited in their stability for two reasons; first, that variations in the plate supply voltage will cause corresponding variations in the signal voltage required to fire the tube and, second, that the variations in tube characteristics with time will cause a similar result.

It is the principal object of the present invention to provide a relay circuit employing a thyatron tube for the control of the relays, in which variations in the plate voltage of the tube are compensated for by maintaining the grid or firing electrode of the tube at a predetermined working point on the grid current-plate voltage characteristic curve so that a variation in the plate voltage will produce a compensating variation in the potential required to operate the tube and complete the circuit of the relay.

For further details of the invention reference may be made to the drawing, in which:

Fig. 1 shows a typical thyatron relay circuit; Fig. 2 shows the plate-grid voltage characteristic curve of a thyatron tube; while

Fig. 3 shows a circuit illustrating the principle of my invention.

Referring now particularly to Fig. 1, the grid G of tube T is negatively biased by the battery E', and when a signal e' applied between the grid G and cathode C causes the grid of the tube to exceed the critical grid voltage, current passes from the positive terminal of plate supply battery E, winding of relay R, the anode P of the

tube, the ionized space between the anode and cathode to the negative terminal of battery E, and causes thereby the operation of relay R.

Fig. 2 shows the critical grid characteristic of a negative grid thyatron. For any plate voltage E_P there is a corresponding critical grid voltage E_G at which the tube will fire and be rendered conducting. If, now, the tube is non-conducting and the grid is maintained more negative than the critical grid voltage, no current will flow. However, if the grid is made more positive than the critical grid voltage, the tube will fire and current will continue to flow through the anode circuit until the anode supply is interrupted or the anode potential made negative with respect to the cathode. The straight line portion of such a characteristic curve may be represented, in general, by the equation:

$$E_G = -\frac{E_P}{\mu} + \delta \quad (1)$$

Where E_G is the critical grid voltage at which the tube will fire; E_P is the plate voltage; μ is the negative slope of the grid characteristic and δ is the intercept of μ on the grid voltage axis.

Fig. 3 shows the proposed stabilized relay circuit illustrative of my invention. The load consisting of the relay R₁ has been placed in the cathode lead, and a resistance R₂ is connected between the cathode and anode of the tube T. The presence of the resistance of the relay R₁ in the cathode lead provides a negative voltage for the grid circuit which is proportional to the supply voltage E. It will be shown that, by choosing the resistance R₂ appropriately, this negative component of the grid voltage may be made to compensate for the slope in the critical grid characteristic so that the signal voltage e' required to fire the tube will be independent of variations in the supply voltage E.

Substituting in equation (1) the values appropriate to this circuit we get:

$$e' - \frac{R_1 E}{R_1 + R_2} = -\frac{R_2 E}{\mu(R_1 + R_2)} + \delta \quad (2)$$

or

$$e' = \left(\frac{R_1}{R_1 + R_2} - \frac{R_2}{\mu(R_1 + R_2)} \right) E + \delta \quad (3)$$

Since we wish e' to be independent of E, set

$$\frac{de'}{dE} = \frac{R_1}{R_1 + R_2} - \frac{R_2}{\mu(R_1 + R_2)} = 0 \quad (4)$$

Thus,

$$R_1 = \frac{R_2}{\mu} \quad (5)$$

or

$$R_2 = \mu R_1 \quad (6)$$

The required value for R₂ in order to insure that

the firing potential e' is independent of the variation in E , is thus μ times the load resistance where μ is the negative slope of the critical grid characteristic.

In such a circuit, the load relay R_L will have a small current passing through it continually over an obvious circuit. In typical thyatron tubes, however, the value of μ may be made of the order of 100 so that this current will be small and may be made much below the operating current of the relay. This continuous current also represents a power loss, but this power loss, in general, will be small compared with the cathode power which must also be continuously supplied.

What is claimed is:

1. A circuit for a relay comprising a thyatron device provided with a source of space current and a firing potential, a relay controlled by said device having one of its terminals connected to the cathode of said device and the other of its terminals connected to said source of space current, and means including said relay for causing the value of said firing potential to be independent of any variation in said source of space current, said means being a resistance equal to the product of the resistance of said relay and

the grid critical characteristic constant of said thyatron device.

2. An electric circuit comprising a gas-filled tube provided with an anode, a cathode and a grid, a relay connected between said cathode and said grid, a source of space current, and a critical resistance connected between said relay at the cathode end and said anode whereby the voltage drop across said relay derived from the current flowing through said relay and said critical resistance is applied to said grid to cause the firing potential for said tube to be independent of any variation in said source of space current.

3. A thyatron relay circuit comprising a thyatron tube and a source of space current therefor, a relay connected to the cathode of said tube and to said source of space current, and means also connected to said relay and to said source of space current for deriving a biasing potential for said grid which shall be independent of any variation in said source, said means being a resistance equal to the product of the resistance of said relay and the critical grid characteristic constant of said thyatron tube.

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