

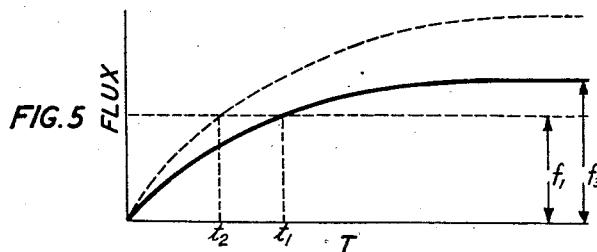
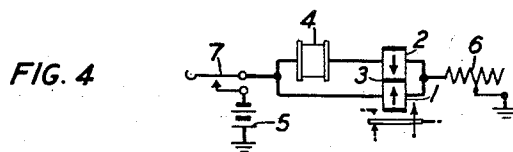
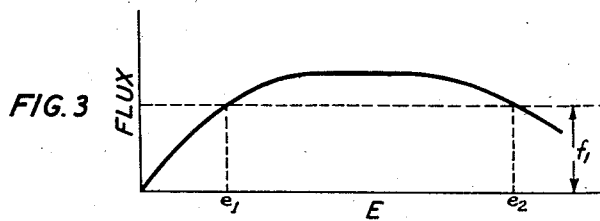
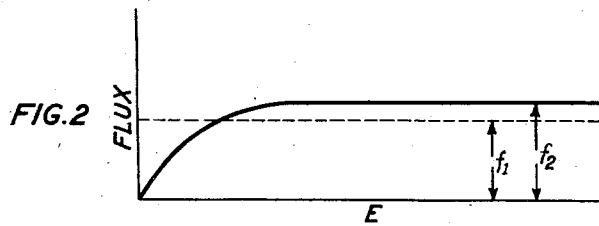
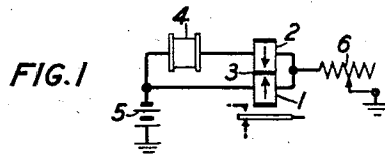
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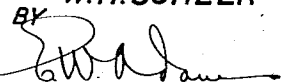
2,034,881

ELECTROMAGNETIC RELAY CIRCUITS

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ELECTROMAGNETIC RELAY CIRCUITS

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2 Claims. (Cl. 175—320)

This invention relates to relay circuits and more particularly to means for operating relays where a variety of circuit conditions are encountered.

5 An object of the invention is to operate a relay in a uniform manner under various conditions of applied potential and circuit resistance.

Another object is to keep the magnetic flux in a relay substantially constant over a predetermined range of applied potentials.

10 An additional object is to operate a relay on a predetermined range of applied potentials and to render it inoperative on potentials outside said range.

15 Still another object is to make the operating time of a relay uniform over a range of energizing potentials.

A feature of the present invention whereby the above stated objects are attained, resides in connecting a secondary winding on the relay in opposition to the energizing winding and in connecting a resistance element in series with said secondary winding, said resistance element having the characteristic of decreasing in resistance 20 substantially instantaneously with an increase in applied potential.

The invention will be understood from the following description, together with the accompanying figures of the drawing in which the invention is illustrated:

30 Fig. 1 shows my invention applied to an electromagnetic relay circuit;

Fig. 2 is a curve illustrating certain relay characteristics obtainable in a circuit arranged according to my invention;

35 Fig. 3 is a curve illustrating other characteristics obtainable in a circuit arranged according to my invention;

Fig. 4 shows my invention applied to a slow acting relay circuit; and

40 Fig. 5 is a curve illustrating certain time characteristics of this relay.

In Fig. 1, 3 is an electromagnetic relay having two windings 1 and 2 so wound thereon that when 45 they are connected in parallel circuits as shown, the currents through winding 2 tend to set up a magnetic field in the relay core of opposite polarity to that set up by the currents in winding 1. This is indicated in the drawing by the two oppositely directed arrows. Hence, the total magnetic flux in the relay core will be the difference between that which would be caused by winding 1 and that which would be caused by winding 2 if energized independently.

55 Windings 1 and 2 are in parallel circuits both

of which are connected in series with a source of electric current 5 and, for purposes of illustration, a resistance 6. In the parallel branch of the circuit which includes winding 2 is also connected a resistance element 4 which has the characteristic of substantially instantaneously decreasing 5 its resistance to current flow with an increase in the potential difference applied across its terminals. Such an element may be the synthetic resistance material described and claimed in U. S. Patent 1,822,742 or it may be any other element known to the art which is of like characteristics. 10

By making windings 1 and 2 of relay 3 of certain desired resistance values and designing non-ohmic resistance element 4 to have the desired 15 resistance-voltage characteristics a circuit may be obtained wherein relay 3 will have substantially the same flux (and hence will attract its armature with the same force) for a wide variety of applied voltages and circuit resistances. This is illustrated in the curve of Fig. 2 which shows the relation between the flux and the voltage (E) 20 applied to the relay circuit. This voltage will depend, for example, on the potential of source 5 and the value of resistance 6. The current in winding 1 will be directly proportional to the 25 voltage while that in winding 2 will increase with voltage in greater than direct proportion. Thus, with increase of applied voltage, the effects of the current in winding 2 will cancel progressively 30 greater proportions of the effects of the current in winding 1.

On the curve f_1 is a horizontal line representing the minimum flux necessary to operate the relay. The solid line curve shows the flux in the relay 35 for various voltages. It will be noticed that the flux increases with voltage to a certain point after which it remains substantially constant at a value indicated as f_2 .

A relay circuit having the above characteristics 40 is of value, for example, where a wide variety of circuit conditions are encountered and uniform relay operation is required. Such is the case, for example, in telephone systems having pulsing relay circuits where a relay at a central office 45 is required to operate and release in response to dial pulses from a subscriber's station. Such subscribers are located at various distances from the central office a wide variety of line resistances are encountered and hence different potentials 50 are applied to the pulsing relays.

Fig. 3 shows a curve for a relay circuit in which, by the selection of a resistance element which has the proper voltage-resistance characteristic and by properly proportioning the turns 55

and resistance of the relay windings with respect to each other and the resistance element, the relay will operate when the voltage exceeds a value e_1 and will release when the voltage rises above a higher value e_2 .

In other words, assuming a given potential range below and above which it is desired that the relay shall have insufficient flux to operate or to hold operated, it is only necessary to so proportion the windings 1 and 2 of Fig. 1 and to choose an element 4 having such a voltage-resistance characteristic that applied potentials higher than the predetermined maximum will cause such a lowering of the resistance of element 4 and a consequent increase in the flux caused by winding 2 that the flux difference between windings 1 and 2 will be carried below the value necessary to hold the relay operated, hence it will release.

Fig. 4 shows a circuit in which relay 3 has slow-to-operate characteristics. Such a relay might be produced, for example, by attaching a copper sleeve or collar around one end of the relay core.

When key 7 is depressed, thus closing its contacts, current starts to build up in windings 1 and 2 of relay 3 thus building up the flux in the core until it reaches the operating point of the relay. This is illustrated in Fig. 5 by the solid curve which shows the relation between flux and time measured from the closure of the contacts of key 7. The operating time of the relay will then be t_1 . With a circuit including a non-ohmic resistance element such as 4, the operating time can be made to be a constant for a wide range of energizing potentials. The value of the operating time of a relay may be expressed in a formula as follows:

$$t = K \log_{e} \frac{f_3}{f_3 - f_1}$$

where K is a constant, f_3 is the flux in the relay when the current has reached a steady value

and f_1 is the flux required to operate the relay. Since f_1 is a constant for the relay and f_3 has the same value for a variety of energizing voltages it follows that t will be a constant (equal to t_1) regardless of voltage, within a certain range.

In a relay circuit not arranged according to my invention, a higher energizing potential will cause quicker operation of the relay as indicated by the dash line curve (Fig. 5). In this case, the operating time of the relay with a certain high energizing potential will be t_2 and with a certain lower energizing potential it will be t_1 .

An actual relay connected in a circuit arranged according to my invention operated in from .054 to .064 seconds when various potentials ranging from 20 to 45 volts were applied. The same relay with winding 2 disconnected showed an operating time of .070 seconds with the flux adjusted to f_3 at 20 volts and only .020 seconds at 45 volts.

While the invention has been shown and described as embodied in certain specific arrangements, applicant does not wish to be limited thereby but desires to cover broadly all variations of the invention which come within the spirit or scope of the appended claims.

What is claimed is:

1. Means to operate a relay on a predetermined exclusive range of applied potentials comprising an electromagnetic relay, two opposing windings therefor connected in parallel circuits, and a resistance element in one of said circuits, said element having the characteristic of decreasing in resistance substantially instantaneously with an increase of applied potential.

2. Means to keep the magnetic flux in a relay constant at any applied voltage above a predetermined value comprising a relay, two opposing windings therefor connected in parallel and a resistance element in series with one of said windings, said element having the characteristic of decreasing in resistance substantially instantaneously with an increase of applied potential.

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