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2,885,604

TEMPERATURE COMPENSATED RELAY CONTROL CIRCUIT

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FIG. 1

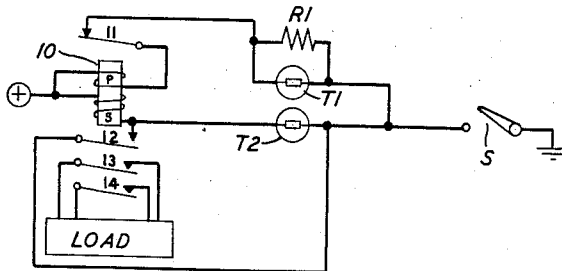
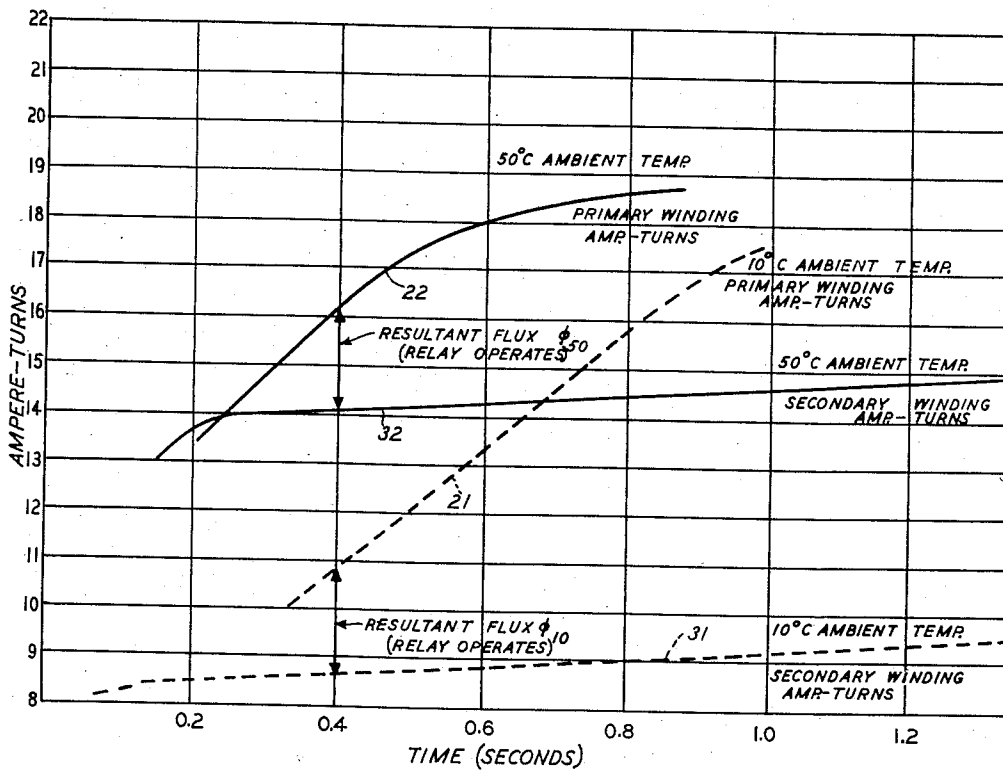


FIG. 2



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TEMPERATURE COMPENSATED RELAY CONTROL CIRCUIT

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1 Claim. (Cl. 317-131)

This invention relates to electromagnetic time-delay devices and more particularly to the improvement of such devices to provide greater constancy in time of operation.

The slow-to-operate feature in relay arrangements has been provided in many ways and among these are devices which employ resistors having a relatively high negative temperature coefficient of resistance. Such resistors, whether the temperature coefficient of resistance be positive or negative, are normally called and will hereinafter be referred to as thermistors. The temperature and consequently the resistance of a thermistor may be altered by the application of an external source of heat or cold or by electrically energizing the thermistor. One such time-delay arrangement has a thermistor in series with the winding of an ordinary fast-operate relay and the constants of the circuit, including the energizing voltage, are chosen to limit the initial current in the relay winding to a value which will not cause it to operate; and after a period of time, the resistance of the thermistor, under the influence of the electrical current, reduces to a critical value to effect operation of the relay. In such devices, the period of time between the energization of the circuit and operation of the relay is dependent upon ambient temperature. The time of operation is reduced when the ambient temperature is above a defined normal and increased when the temperature is below this normal. Such delay arrangements are therefore unsatisfactory when a relatively precise time delay is required. Prior arrangements to compensate such circuits for ambient temperature changes have been bulky and complex as they have utilized an external source of heat and an insulated box to hold the thermistor at a temperature which is relatively independent of changes in the ambient temperature surrounding the box or have utilized relays having auxiliary switch contacts along with series and shunt compensating windings.

It is an object of this invention to provide a simple, inexpensive temperature compensated time-delay relay arrangement which will provide a substantially uniform time delay over a relatively large range of ambient operating temperatures.

In accordance with one feature of this invention, standard types of fast-operate relays and standard thermistors are connected to provide a relay time-delay device whose operation is substantially independent of variations in ambient temperature.

The invention and features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is an exemplary embodiment of the invention; and

Fig. 2 is a graph of the fluxes produced by the relay windings for various ambient temperatures.

The time-delay device shown in Fig. 1 consists of an electromagnetic relay 10 having two windings P and S and a set of electrical contacts 11, 12, 13, and 14, two

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thermistors T1 and T2 which both have a negative coefficient of resistance and a standard resistor R1 which has a small positive temperature coefficient of resistance.

The relay is of standard design similar to any one of those disclosed in Patents 1,652,489, issued to Edward D. Mead on December 13, 1927, and 1,973,090, issued to Daniel D. Miller on September 11, 1934.

Thermistors T1 and T2 are similar to those disclosed in Patent 2,258,646, issued to Richard O. Grisdale on October 14, 1941.

It is to be particularly noted that the thermistor T2 is selected to have a high initial resistance and a relatively low negative temperature coefficient of resistance; and that the thermistor T1 has a lower initial resistance and a higher negative temperature coefficient of resistance relative to thermistor T2.

The circuit which comprises the primary winding P of relay 10, the upper back contact 11 and the parallel combination of resistor R1 and thermistor T1 is typical of an uncompensated relay time-delay circuit. The resistor R1 shunting T1 merely alters the temperature resistance characteristic of the above series circuit. Curves 21 and 22 in Fig. 2 are a graph of the fluxes produced by the primary winding at ambient temperatures of 10° C. and 50° C., respectively. The secondary winding, which has many more turns than the primary winding, is connected to produce flux of opposite polarity to that produced by the primary. The thermistor T2 has an initial high resistance which changes slowly as a function of temperature. This slow change is apparent from the curves 31 and 32 which show the fluxes produced by the secondary winding for operation at ambient temperatures of 10° C. and 50° C., respectively. The curves of Fig. 2 apply where a time delay of four-tenths of a second is required between the time the circuit is energized and the time the relay operates. Although curves 31 and 32 are drawn in the same sense as curves 21 and 22, it should be remembered that these are differential fluxes and that the net flux at any instance, is the difference between curves 21 and 31 or 22 and 32.

The circuit is energized by the closure of switch S. Assuming an ambient temperature of 10° C., the flux produced by the primary winding will follow the curve 21 and the differential flux produced by the secondary winding will follow the curve 31. Four-tenths of a second after switch S is closed, the critical flux Φ 10 will result and the relay will operate. Examination of the resultant flux Φ 50, which is the difference between the fluxes produced by the primary and secondary windings for operation at 50° C., shows that the critical flux is again reached four-tenths of a second after the circuit is energized and that the delay in operation is substantially independent of ambient temperature. The curves for ambient temperatures lying between 10° C. and 50° C., for both the primary and secondary fluxes, will lie between the curves shown in Fig. 2 and will have approximately the same character as those shown. Operation of the relay opens the operating path for the primary winding and shunts the high resistance thermistor T2. Therefore, if the relay remains operated long enough for thermistors T1 and T2 to return to the ambient temperature, the relay circuit may be released and immediately reenergized and a uniform time delay will be incurred.

What is claimed is:

In combination, electromagnetic relay means comprising primary and secondary windings and electrical contact means controlled by energization of the relay windings, said secondary winding having many more turns than said primary winding, means including switch means for closing separate and opposing energizing circuits through said windings, each of said circuits including a resistor having a negative temperature coefficient of re-

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sistance for delaying increase of the current through the associated winding after closure of the circuit there-
through, a resistor having a low positive temperature
coefficient of resistance shunting said resistor in series with
said primary winding, a normally closed contact of said
contact means in series with said primary winding, a
normally open contact of said contact means shunting the
resistor which is in series with said secondary winding,
the resistor in series with said secondary winding having
a much higher initial resistance and a lower negative tem-
perature coefficient of resistance than the similar resistor
in series with said primary winding, the resistors being
selected to have resistance temperature characteristics in

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combination to effect operation of said contacts at a pre-
determined interval of time after closing of said energiz-
ing circuits substantially independent of variations in am-
bient temperature.

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