Feb. 23, 1943. R. C. WINANS 2,311,801

THERMAL TIME DELAY RELAY

Filed July 11, 1941

FIG. 1

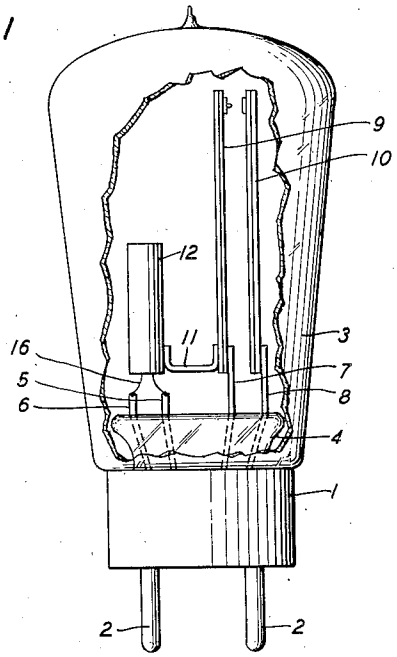


FIG. 4

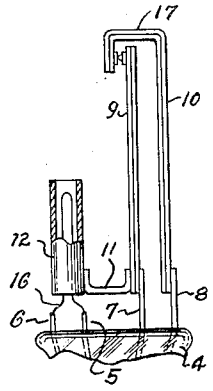


FIG. 2

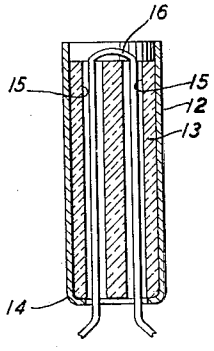
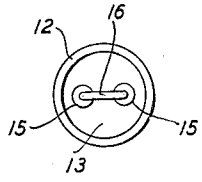


FIG. 3



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THERMAL TIME DELAY RELAY

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5 Claims. (Cl. 200—122)

This invention relates to switching devices and, more particularly, to relays of the thermal vacuum type.

In the control of electrical circuits it is often desirable to delay the opening or closing of such circuits for certain required intervals. It is a well-known expedient to render a relay slow to operate or slow to release by providing a short-circuited winding on its core whereby the relay armature is delayed in its movement, thereby delaying the closure or opening of the work circuit over the contact springs operated by the armature. For the measurement of short delay intervals this type of relay structure has been found to be very satisfactory. When, however, longer delay intervals are to be measured, such as intervals of several minutes, this type of relay is not adequate. Other types of delay relays, some of which have been of the thermal type, have heretofore been devised which permit longer delay intervals to be attained with a measure of accuracy but they have been complex in structure and, therefore, expensive to manufacture and to maintain.

It is, therefore, the object of the present invention to simplify delay relays of the thermal type and to render such relays more stable in operation and less affected by ambient temperatures.

To attain these objects the relay in accordance with the present invention comprises an evacuated glass envelope through the press of which extend four lead-in wires, the outer ends of which are connected to the base terminal plugs. Two of these lead-in wires form the terminals of the heater filament of the relay, which filament is looped through two longitudinally extending holes in a cylindrical ceramic insulator, which in turn is enclosed in a tubular metal shield. The other two lead-in wires support two bimetallic elements to the upper ends of which cooperating contacts are secured. The lower end of one of these elements is connected by a short wire to the tubular shield and serves both to support the shield and the enclosed ceramic insulator and to conduct heat from the shield to such bimetallic element. The bimetallic elements may be so positioned as to be normally out of contact and to be brought into contact by heat transferred from the filament through the ceramic insulator and shield to the adjacent bimetallic element. The other bimetallic element serves as a substantially fixed front contact support and moves toward or away from the first element only in response to ambient temperatures. If desired, the two contact supporting elements could be so arranged as to have their contacts normally in engagement and movable out of engagement by the transfer of heat from the filament.

For a clearer understanding of the invention reference may be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a side elevational view of the relay in accordance with the present invention with a portion of the envelope broken away to better disclose the structural details;

Fig. 2 is a cross-sectional view through the heater assembly of the relay;

Fig. 3 is a top plan view of the heater assembly; and

Fig. 4 shows a modified form of the invention.

The relay comprises a base portion 1 having four terminal plugs 2 of the usual type insulatedly supported therein. Secured to the base 1 is a glass envelope 3 provided with an inwardly projecting stem 4 in the press of which are sealed four supporting and lead-in wires 5, 6, 7 and 8. The outer ends of the lead-in wires are soldered or otherwise secured to the four terminal plugs 2, respectively. Secured to the inner or upper end of the lead-in wires 7 and 8 are two bimetallic thermostatic elements 9 and 10, respectively. These elements are positioned parallel to each other and carry contacts upon their upper or free ends which cooperate with each other but which are normally out of engagement.

Secured to the element 9 near its point of support on the lead-in wire 7 is a short wire 11 the other end of which is secured to the lower end of a cylindrical metal shield 12. The shield 12 surrounds a cylindrical insulator 13, preferably of ceramic material, which is held within the shield by the lower inturned edge 14 of the shield. The insulator 13 is provided with two holes 15 extending longitudinally therein through which a filament wire 16 is looped. The ends of the filament wire are suitably attached to the upper ends of the lead-in wires 5 and 6.

The wire 11 extending between the bimetallic element 9 and the shield 12 serves a dual purpose, first as a support for the heater assembly comprising shield 12, insulator 13 and filament 16, and secondly, as means for conducting heat from the shield to the element 9.

After the elements of the relay have been assembled the relay is placed on an evacuating pump station, a baking oven is lowered over the relay and the relay baked for one minute at a temperature of approximately 450° C. to degas

the envelope. This short application of heat is sufficient to degas the envelope without overheating the metal elements of the relay. The envelope is then rapidly exhausted. During the pumping the envelope may be baked for two other one-minute periods to further free it of gas, so that upon the completion of the pumping the envelope will be entirely free of gas. During this treatment the filament is also glowed. It is essential that the baking shall not be done continuously at a high temperature as the bimetallic elements might otherwise take a permanent set and thus render the relay inoperative.

When the filament 16, in series with a resistance in the order of 1400 ohms, is connected to a 48-volt circuit the filament will start to heat and due to the ceramic insulator 13 through which the filament is looped such heat will be delayed in reaching the shield 12. The shield 12 as it becomes heated will transfer some of its heat by radiation and some of its heat by conduction over the wire 11 to the bimetallic element 9. Most of the heat, however, is transferred by conduction. In response to the transfer of heat the element 9 bends toward the element 10 and after a predetermined interval following the closure of the filament circuit will engage the element 10 to complete a work circuit. This interval may be made to range between four minutes and two minutes for voltages between 45 and 50 volts.

By the provision of a bimetallic element 10 as a support for the front contact of the relay, a fairly uniform contact gap is maintained irrespective of changes in room temperature.

It will, of course, be obvious, as disclosed in Fig. 4, that the element 10 could be provided with a U-shaped extension 17 at the upper end thereof to embrace the upper end of the element 9, and provided with a contact on the downwardly extending free arm of such extension for normal engagement with a contact carried by the element 9, thereby providing normally closed contacts separable a predetermined interval following the closure of the circuit through the filament 16. Furthermore, the ceramic insulator 13 could be omitted and the filament 16 insulated from the shield 12 by a coating of insulating material such as aluminum oxide applied to the filament. In this case, the maximum operating time would be considerably less than if the ceramic insulator were used.

What is claimed is:

1. In a thermal time delay relay, a contact support of bimetallic construction, a second contact support, cooperating contacts on said supports, a heater coil, a shield surrounding said coil and insulated therefrom, and a heat-conducting support for said shield connected between said shield and the adjacent one of said supports.

2. In a thermal time delay relay, two parallelly disposed contact supports of bimetallic construction, cooperating contacts on said supports, a heater coil, a shield surrounding said coil and insulated therefrom, and a heat-conducting support for said shield connected between said shield and the adjacent one of said supports.

3. In a thermal time delay relay, two parallelly disposed contact supports of bimetallic construction, cooperating contacts on said supports, a heater filament, a shield surrounding said filament and insulated therefrom, a heat-conducting support for said shield connected between said shield and the adjacent one of said supports, and an evacuated envelope surrounding the aforementioned elements.

4. In a thermal time delay relay, an evacuated glass envelope having a tubular stem extending therein through the press of which four lead-in wires are sealed, two parallelly disposed contact supports of bimetallic construction secured to the inner ends of two of said lead-in wires, cooperating contacts on the free ends of said supports, a heater filament the ends of which are connected to the other two of said lead-in wires, a cylindrical metal shield surrounding said filament and insulated therefrom, and a heat-conducting support for said shield connected between said shield and the adjacent one of said supports.

5. In a thermal time delay relay, an evacuated glass envelope having a tubular stem extending therein through the press of which four lead-in wires are sealed, two parallelly disposed contact supports of bimetallic construction secured to the inner ends of two of said lead-in wires, cooperating contacts on the free ends of said supports, a cylindrical metal shield, a heat-conducting support for said shield connected between said shield and the adjacent one of said supports, a cylindrical ceramic insulator supported in said shield and having longitudinally extending holes therethrough, and a filament the ends of which are connected to the other two of said lead-in wires looped through the holes of said insulator.

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