

Dec. 3, 1957

W. R. POLYE

2,815,423

ELECTRIC CONTROL DEVICE

Filed Jan. 28, 1950

FIG. 1

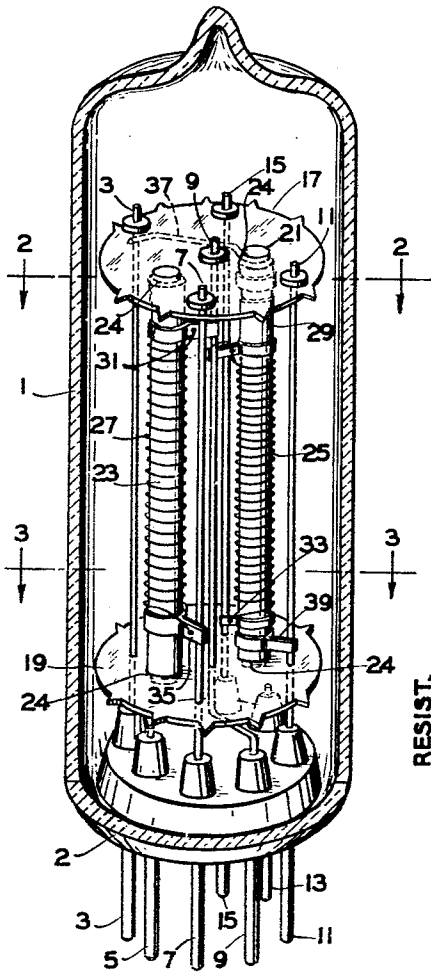


FIG. 2

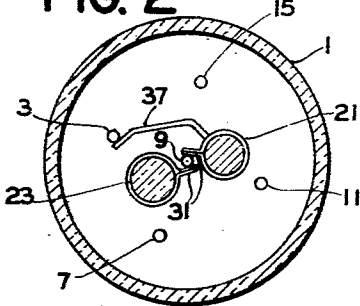


FIG. 3

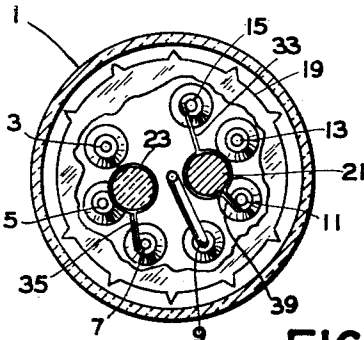


FIG. 4

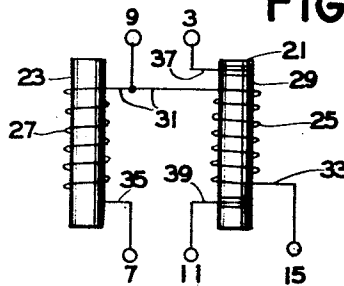


FIG. 5

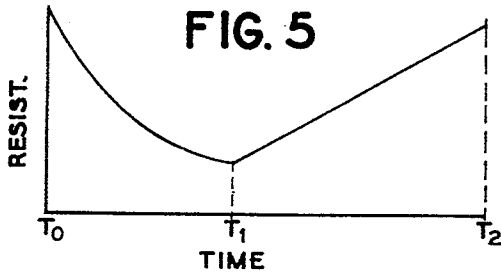
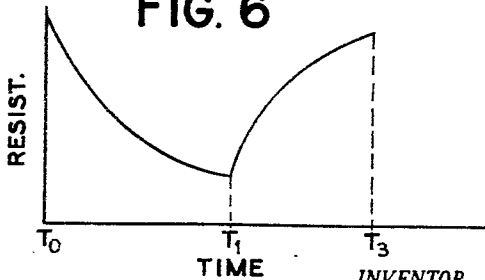


FIG. 6



INVENTOR.
WILLIAM R. POLYE
BY

[Signature]
- ATTORNEY -

1

2,815,423

ELECTRIC CONTROL DEVICE

William R. Polye, River Edge, N. J., assignor to Bendix Aviation Corporation, Teterboro, N. J., a corporation of Delaware

Application January 28, 1950, Serial No. 141,085

1 Claim. (Cl. 201-63)

The invention relates to control devices, and more particularly to time delay control devices of the kind shown and described in Patent No. 2,463,805, issued March 8, 1949, to William R. Polye and James R. Peek, and assigned to the same assignee as the present invention.

In the patented device, the time required for heating the conductor to its maximum temperature and the time required for cooling the conductor to its minimum temperature are determined by the mass and material of the conductor. The time required for heating the conductor to its maximum temperature and the time required for cooling the conductor to its minimum temperature are so inter-related that one cannot be varied without changing the other also.

The main object of the present invention is to provide a thermal time delay device in which the cooling rate may be varied independently of the heating rate.

Another object is to provide a time delay device in which the resistance during cooling is approximately a linear function of time.

The invention contemplates a thermal time delay device including an electrical conductor adapted to change resistance in response to variations in temperature and a heat retaining body in heat exchange relation thereto. Means are provided to heat the conductor and the body. The body radiates heat to the conductor and delays cooling of the conductor when the heating means are deenergized. The conductor and body may be mounted within a sealed envelope and the envelope may be evacuated or the envelope may contain one or more gases at any suitable pressure.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawing wherein one embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawing is for the purposes of illustration and description only, and is not to be construed as defining the limits of the invention.

In the drawing, Figure 1 is a perspective view of a novel thermal time delay device constructed according to the invention and with a portion of the envelope broken away.

Figures 2 and 3 are transverse horizontal sections taken approximately on the lines 2-2 and 3-3, respectively, of Figure 1.

Figure 4 is a wiring diagram showing the electrical connections in the device.

Figure 5 is a graph showing resistance of the conductor of the present invention during heating and cooling plotted against time.

Figure 6 is a corresponding graph for the conductor of the patent referred to above.

Referring now to the drawing for a more detailed description of the novel time delay device of the present invention, the device is shown in Figure 1 as comprising an envelope 1 with a base 2 having a plurality of pins 3, 5, 7, 9, 11, 13 and 15 sealed therein and extending therethrough. The portions of the pins exteriorly of the envelope are adapted to be received in an associated socket (not shown). Pins 3, 7, 9, 11 and 15 extend a substantial distance into the envelope and mount a pair of spaced parallel mica discs 17, 19.

A conductor 21 and a body 23 in heat exchanging relation with one another but spaced from one another

2

extend through apertures 24 in discs 17, 19, and are supported by the discs. Conductor 21 preferably has a relatively high temperature coefficient of resistance and may be of the thermistor type. Body 23 may be made of ceramic or other suitable material and preferably has a different heat capacity than conductor 21 so that the body cools more slowly than the conductor.

A sleeve 29 of insulating material surrounds conductor 21 and a pair of individual heating coils 25, 27 are wrapped about insulator 29 and ceramic body 23 respectively. Heating coils 25, 27 are connected in series with one another at the top of the envelope by strips 31 and in series with pins 15 and 7 by strips 33, 35 at the bottom of the envelope. Strips 31 are connected at the top of the envelope to pin 9 and provide for connecting heating coils 25, 27 in parallel or two separate sources. Conductor 21 is connected at its upper end by a connector 37 to pin 3 and at its lower end by a connector 39 to pin 11. Conductor 21 may be used as a cathode bias resistor and preferably is kept at a relatively low resistance value by heating coil 25.

If the characteristics of the tubes of the present invention and the earlier patent are such as to require the same time T_0T_1 to bring the conductors to their maximum steady temperature, as shown by the curves in Figures 5 and 6, then the time T_1T_2 for cooling the tube of the present invention will be longer than the time T_1T_3 for cooling the tube of the earlier patent. The heated body 23 radiates heat to conductor 21 when heater windings 25, 27 are deenergized, and delays cooling of conductor 21. The desired rate of cooling of conductor 21 may be obtained by selecting a body 23 having the required heat capacity. The envelope preferably is filled with one or more gases, such as hydrogen, helium, etc., at approximately one-half atmosphere to provide for heat exchange between the body and thermistor by conduction as well as by radiation. During cooling, the ratio of resistance to time of the tube of the present invention is substantially linear, whereas the ratio of resistance to time of the tube of the earlier patent is non-linear.

Although but one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

A thermal time delay device comprising a resistor having a relatively high temperature coefficient of resistance, circuit means for connecting said resistor to a source of energy, a heater element wrapped about said resistor, a heat storage body having greater thermal capacity than said resistor, a heater element wrapped about said body, circuit means for connecting said heaters to a source of energy, an envelope for enclosing said resistor and heat storage body, and means positioning said resistor and heat storage body in said envelope, whereby when said heaters are deenergized, heat is transferred from said heat storage body to said resistor to provide a cooling rate for said resistor at which the change in resistance is substantially a linear function of time.

References Cited in the file of this patent

UNITED STATES PATENTS

2,031,480	Hamada	Feb. 18, 1936
2,293,045	Crowell	Aug. 18, 1942
2,341,013	Black	Feb. 8, 1944
2,463,805	Polye et al.	Mar. 8, 1949

FOREIGN PATENTS

417,665	Great Britain	Oct. 8, 1934
---------	---------------	--------------