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THERMAL TIME DELAY SNAP-ACTION RELAY

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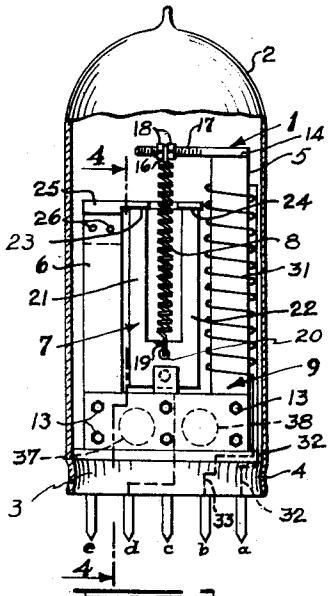

FIG. 1

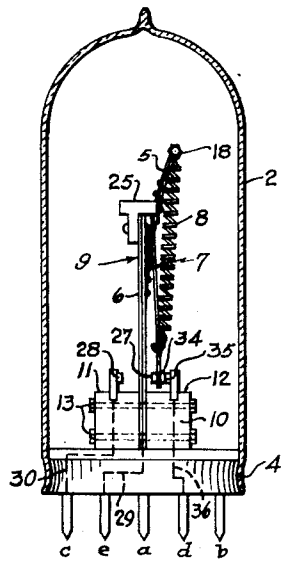

FIG. 2

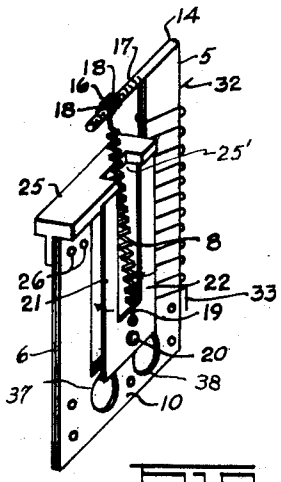

FIG. 3

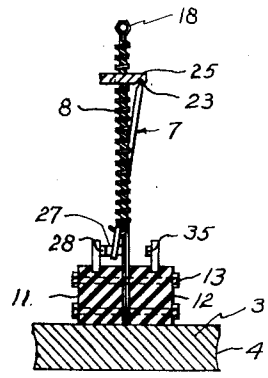

FIG. 4

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THERMAL TIME DELAY SNAP-ACTION RELAY

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6 Claims. (Cl. 200—122)

My invention relates to a thermal time delay relay of the snap-action type.

I propose to provide a thermal time delay relay having actuating and compensating bi-metal elements which control the operation of snap-action means to open and close the relay contacts. The snap-action means are located between the actuator and compensator, and are operated when the actuator is displaced sufficiently with respect to the compensator. Displacement of the actuator is controlled by a heater such that the snap-action means are caused to operate a pre-determined period of time after the heater is energized, the time period depending upon the relay design. The compensator serves to render operation of the relay independent of ambient temperature changes. The snap-action means are connected to the actuator and compensator, and in accordance with my invention all are mounted in substantially the same plane and adapted to move or warp transversely of such plane. By mounting the snap-action means, the actuator, and the compensator in substantially the same plane instead of in three distinct planes, undesirable bending of the actuator and compensator elements which would otherwise occur due to bending forces exerted by the snap-action means on these elements may be substantially eliminated. Elimination of such bending which is especially restrictive when thin bi-metals are used is a prime object of the invention.

Another object is to provide a relay such as described wherein the actuating and compensating elements may be formed as integral parts of a unitary piece.

The invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawings, Fig. 1 is a front elevational view of a relay embodying the features of my invention. Fig. 2 is a side elevational view showing the relay in the actuated condition. Fig. 3 is a perspective view showing the relation of the snap acting means to the actuating and compensating elements. Fig. 4 is a sectional view taken along the plane of the line 4—4 of Fig. 1.

In the drawings reference character 1 designates the relay which as shown is sealed in a glass envelope 2, but which may if desired be encased in a metal or other suitable envelope. The relay is mounted on a base 3 having a concave collar 4 and the base is retained within the envelope by forming the envelope about the collar. Extending through the base 3 are a number of connector pins *a*, *b*, *c*, *d* and *e* which are connected to the operative elements of the relay. The envelope 2 may be gas filled or evacuated.

Relay 1 includes a bi-metal actuator 5, a bi-metal compensator 6 and suitable snap-acting means disposed between these elements. Such snap-acting means includes the yoke 7 and tension spring 8. According to my invention the actuator, compensator, and snap-acting means are disposed in substantially the same plane and arranged

to move or warp transversely of such plane. As will become apparent, this arrangement reduces to a minimum undesirable bending of the actuator and the compensator due to forces exerted by the snap-acting means.

The actuator and compensator may be identical except for length, the actuator being somewhat longer than the compensator. In any event their characteristics should be alike in that they should warp corresponding amounts for like variations in temperature. As shown in the drawing, the actuator and compensator may be formed as an integral unit in the form of a yoke 9 with the actuator and compensator integrally connected by cross piece 10. With this construction the actuator and compensator including the connecting cross piece 10 may be formed in one operation as a single stamping.

Yoke 9 is clamped securely at cross piece 10 between insulating blocks 11 and 12 by the bolts 13. The free end of actuator 5 has a rod 14 integrally attached thereto which rod extends in the plane of the actuator. Spring 8 has one end 16 connected to a threaded end portion 17 on the rod 14. The end 16 of the spring may be precisely located on the rod by the nuts 18. As shown the other end 19 of the spring connects with the yoke through an opening 20 therein. The parallel arms 21 and 22 of yoke 7 have corresponding ends pivotally mounted in knife-edge mountings 23 and 24 respectively on the underside of member 25 which is attached to the compensator 6 as by rivets 26. As shown member 25 has a cut out portion 25′ through which the spring 8 may pass.

The location of knife-edge mountings 23 and 24 in member 25 is such that with the plane of the yoke 7 parallel to the plane of the actuator and compensator, the plane of yoke 7 is slightly out of the plane of the actuator and the compensator, and there is a tendency for the spring 15 to pull the yoke in the direction of the arrows shown in Fig. 3. In the normal condition of the relay, the actuator and compensator are vertical, and the yoke 7 therefore assumes a position as shown in Fig. 4 to the left of the line of the actuator and compensator. In this position of yoke 7, the contact point 27 on one side of the yoke at the free end thereof is in contact with the contact point 28 which is mounted in insulated block 11. Contact point 27 is connected through yokes 7 and 9 and wire 29 to connector pin *e*, whereas contact point 28 is connected to connector pin *c* through wire 30 so that an electrical path is provided from without the envelope of the relay over these contacts in the envelope.

Actuator 5 is provided with a heater element 31 of a suitable resistive material such as Nichrome wire which is electrically insulated from the actuator as for example by sheets of mica (not shown). Opposite ends of the heater 31 connect over wires 32 and 33 with the pins *a* and *b* respectively providing an electrical path from without the envelope to the heater element. Upon energization of the heater the bi-metal actuator 5 is caused to bend to the right as shown in Fig. 2. A predetermined period of time after energization of the heater, actuator 5 is bent sufficiently to position the spring 8 such that yoke 7 is snapped to the right (Fig. 2) opening contact points 27 and 28 and closing contact points 34 and 35 on the yoke and in block 12 respectively. This completes an electrical path extending from pin *d* over wire 36, the contact points 35 and 34, yokes 7 and 9, and wire 29 to pin *e*. It will be noted that yoke 9 is provided with rather large openings 37 and 38 in the cross piece 10. This prevents any substantial transfer of heat from the actuator to the compensator upon energization of the heater 31.

Operation of the relay is unaffected by ambient temperature changes since the operation of the relay is determined only by the relative positions of the actuator and

compensator, and such relative positions remain unchanged despite ambient temperature variations. An ambient temperature change causes identical warping of the actuator and compensator with reference to, and about the stationary cross-piece 10, which thus provides a common axis for such warping, so that a change in the actuator position is exactly compensated for by a changed position of the compensator in the same direction.

It will be appreciated that with the actuator, compensator and snap-action means arranged to move transversely of substantially the same plane rather than of respectively three distinct planes, bending of the actuator due to a bending moment exerted by the spring or any bending of the compensator due to a bending moment exerted by the yoke in the pivotal mountings is slight. Such bending is slight because the bending moments are exerted substantially in the plane of the actuator and compensator, and across their greatest widths. Of necessity the yoke 7 is somewhat out of the plane of the actuator 5 and compensator 6 but only slightly, and no appreciable bending forces are exerted on these elements because of this. As shown in Fig. 2 the actuator departs from the plane of the compensator when heated, however, this again has no appreciable effect. Indeed the parts have been proportioned in the drawing to exaggerate the bending of the actuator for purposes of clarification, and bending due to energization of the heater is slight.

It should be understood that this invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A time delay relay comprising elongated bimetallic actuator and compensator elements; a member that is permanently stationary relative to both said elements and has secured thereto an end of each element, said elements extending from the respective secured ends generally in the same direction relative to said stationary member and substantially in a single common plane and adapted to warp transversely of said plane and in the same direction with reference to, and about the common axis provided by said stationary member responsive to respective temperature changes of like sense; switching means, means connecting said actuator element to said switching means, and separate means connecting said compensator element to said switching means to render said switching means actuatable responsive to temperature difference between said elements; and a heater disposed in proximity to said actuator for heating the latter and actuating said switching means after a time delay.

2. A relay as specified in claim 1, wherein the bimetallic elements, the two connecting means, and the switching means are all disposed substantially in the common plane, said switching means being movable transversely of said plane.

3. A time delay relay comprising a bimetal actuator, a bimetal compensator and snap-action means all disposed in substantially the same plane and movable transversely of said plane, means connecting the snap-action means to the actuator, other means connecting the snap-action means to the compensator, a heater adapted to warp the actuator transversely of said plane, the snap-action means being actuated by displacement of the actuator relative to the compensator to move transversely of said plane, and contact means operated by the snap-action means.

4. A time delay relay comprising a bimetal yoke shaped member including an actuator arm and a compensator arm disposed in substantially the same plane and warpable transversely of said plane, snap-action means disposed between the actuator and compensator arms and in substantially the same plane and movable transversely of said plane, means connecting the snap-action means to the actuator arm, other means connecting the snap-action means to the compensator arm, a heater adapted to warp the actuator arm transversely of said plane, the snap-action means being actuated by displacement of the actuator arm relative to the compensator arm to move transversely of said plane, and contact means operated by the snap-action means.

5. A time delay relay comprising a bimetal actuator, a bimetal compensator and snap-action means all disposed in substantially the same plane and movable transversely of said plane, the snap-action means including a yoke-shaped member between the actuator and compensator and a spring connected to said yoke-shaped member, means connecting the spring to one of said bimetal elements, other means connected to the other of said bimetal elements and providing a pivotal mounting for the yoke-shaped member, a heater adapted to warp the actuator transversely of said plane, the yoke-shaped member being actuated by displacement of the actuator relative to the compensator to move transversely of said plane, and contact means controlled according to the position of the yoke-shaped member.

6. A time delay relay comprising a bimetal yoke-shaped member including an actuator arm and a compensator arm disposed in substantially the same plane, snap-action means disposed in substantially the same plane as the actuator and compensator arms, the snap-action means including a second yoke-shaped member located between the actuator and compensator arms and a spring connected to said second yoke-shaped member, means connecting the spring to said actuator arm, other means connected to the compensator arm and providing a pivotal mounting for said second yoke-shaped member, a heater adapted to warp the actuator, the second yoke-shaped member being actuated by displacement of the actuator relative to the compensator, and contact means controlled according to the position of the said second yoke-shaped member.

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