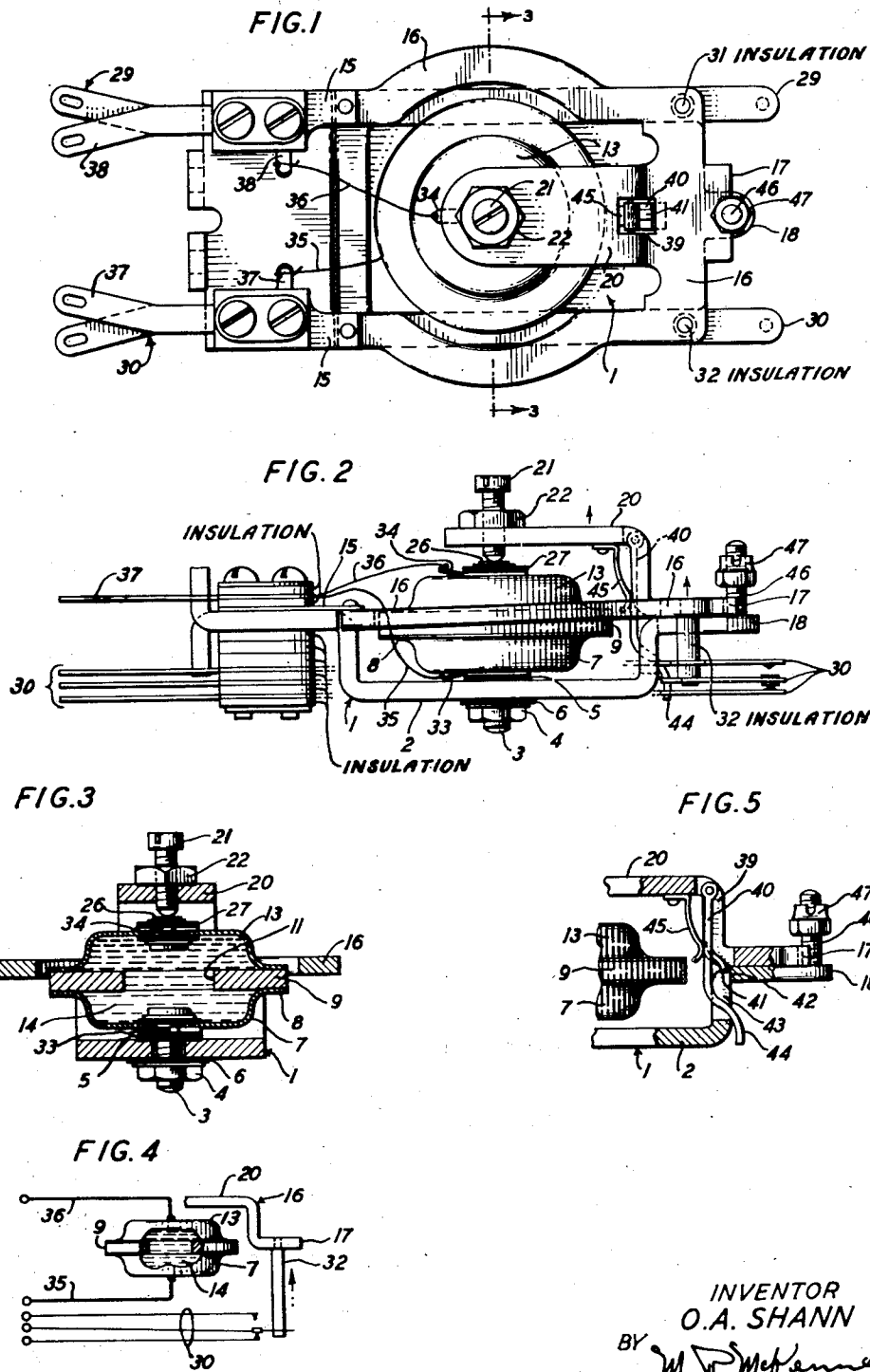


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CONTACT MAKERS AND BREAKERS

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CONTACT MAKER AND BREAKER

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1

This invention relates to electrothermal relays and particularly to electrothermal elements for controlling such relays.

An object is to simplify and reduce the cost of the component parts of such relays and otherwise to effect improvements therein.

Heretofore thermal devices comprising liquid containing closed vessels have been used for actuating contacts in response to expansion of said vessels due to external heat.

The present invention relates in general to devices of this kind and a feature thereof is a relay means consisting of a thermal element preferably having negative resistance characteristics in the form of a disc with an opening in its center and a cup-shaped metal disc soldered to said element on each side of the opening to form a hermetically closed chamber, this chamber being filled with a liquid such as alcohol. One of the discs is stationary and the other associated with contact springs. When current is passed through said discs, the thermal element is heated to expand the liquid in said chamber and thereby cause the cups to expand to control the contact springs.

An exemplary embodiment of the invention disclosed herein comprises the above-mentioned chamber as part of a relay structure such that the expansion and contraction of the chamber, when under the heating influence of a current passing therethrough, may control the relay contacts through a suitable actuating arm or lever. The chamber may be used to control electrical contacts other than those on relays or may be employed merely to effect mechanical movement symbolic of the heating effect of the current passing therethrough.

The invention has been illustrated in the accompanying drawings, in which:

Fig. 1 shows a top view of a relay constructed in accordance with the applicant's invention;

Fig. 2 is a side view of Fig. 1;

Fig. 3 is a cross-section taken on lines 3-3 of Fig. 1;

Fig. 4 is a circuit diagram; and

Fig. 5 is a detail view of the latching mechanism partially in cross-section.

Referring now to the drawings a frame 1 is provided having a U-shaped middle portion 2 through the center of which is passed a screw 3 having a nut 4, to hold a lower cup-shaped disc 7 preferably made of copper, the screw and nut being insulated from the portion 2 by suitable insulation washers 5 and 6. To the rim 8 of cup 7 is soldered a disc 9 of a material having negative resistance characteristics, such as for example selenium or other similar materials. This

2

disc 9 is provided with a central aperture 11 and to the opposite side of this disc 9 is soldered by its rim a cup-shaped copper disc 13 of the same shape as the cup 7. The hermetically closed chamber formed by these cups 7 and 13 and disc 9 is filled with a liquid 14 having a comparatively high coefficient of expansion such as, for example, alcohol. To the frame 1 is attached by means of a spring hinge 15 a lever 16, the free end 17 of which normally rests against the free end 18 of the frame 1. This lever is cut out in the center to leave space for the cup 13 and is provided with an angular extension 20 bent back and over the central portion of the cup 13. To the free end of this extension 20 is secured an adjusting screw 21 by means of a nut 22. This screw 21 is adjustable to engage, under normal conditions with a small disc 26 fastened to the outer surface of cup 13 but insulated therefrom by means of a washer 27. On opposite sides of cup 7 and bent past the cup are two piles of contact springs 29 and 30 insulatedly secured at one end to the frame 1. To the middle springs of these two piles and at opposite free ends thereof are secured insulation studs 31 and 32, respectively. These studs pass through openings in the upper springs and are respectively secured to the lever portion 16. To cups 7 and 13 are attached respectively terminals 33 and 34 which in turn may be connected by conductors 35 and 36 to terminals 37 and 38 insulatedly secured on said frame 1. Rotatably attached to lever 16 at a cut-out or aperture 39 is a latch member 40. This latch member is provided with a pawl 41 normally engaged in the side 42 of the aperture 43 in the frame 1 and the latch member extends further beyond the pawl through the aperture 43 to form an extension member 44 protruding at the front thereof. The latch member is held in this position by a spring 45 attached to the lever 16. A bolt 46 is attached to end 18 of frame 1 provided with a nut 47 to limit the back stroke of lever 16.

This relay may operate as follows: When current is supplied to terminals 37 and 38, it passes through the conductors 35 and 36, terminals 33 and 34, cups 7 and 13 and disc 9. As the disc 9 is made of a material having negative resistance characteristics, the current through this circuit will increase as this element is heated and the resistance decreases. The heating of the disc 9 is rapid and heat therefrom is quickly absorbed by the liquid 14. The liquid 14 is thereby expanded and causes cups 7 and 13 to bulge or flex outwardly as in any similar terminal device. Although the bottom surfaces of the discs 7 and 13

are shown flat, they may, if desired, be corrugated to readily respond to the expanse of the liquid. As the disc 7 is secured to the frame 1 and the disc 13 engages the screw 21 on the lever extension 20, the lever 16 will be lifted by this expansion of the cups and thereby cause studs 31 and 32 to act on the middle springs of the pile-ups 29 and 30 to close and open the desired connections between these springs. As the lever is lifted, it causes the pawl 41 of the latch member 40 to engage the upper surface of the extension 18 of frame 1 under tension of the spring 45 and thereby lock the lever in actuated position. Thus when the current through the cups and the resistance element 9 ceases, the lever will still remain in this locked operated position. To release the lever to normal at this time manual pressure may be exerted on the extension 44 of this latch member and thus releasing the lever to normal position. If this relay is to be operated and released merely by the expansion and contraction of the cups due to a current passing through them and the element 9, the latch member may be omitted and in that case the lever will release as soon as the current is removed and the liquid 14 is cooled sufficiently to contract the cups to their normal condition.

The disc 9, disclosed as preferably having a negative temperature coefficient of resistance, may very well have a positive coefficient of resistance or substantially no coefficient thereof at all. In either case the heating effect of the current passing therethrough will eventually effect the desired expansion of the cups 7 and 13. The use of a material, such as selenium, having a negative coefficient enables the use of a lower voltage to actuate the relay disclosed since the heat produced in the decreasing resistance actually increases from its initial value when the resistance is high. A positive coefficient of resistance, on the other hand, is effective to reduce the actual heat produced therein under constant voltage or constant current as opposite to the heat produced by these conditions in a negative coefficient material.

In order to employ a positive coefficient material or even a substantially zero coefficient material to effect actuation of a relay the amount of current or voltage used must be at least high enough to produce a minimum of heat. Furthermore, a longer time delay generally results due to transfer of a constant or decreasing amount of heat to the expansible chamber. A negative coefficient material, however, whether under the action of a constant current or a constant voltage, will permit lower initial values of current or heat with shorter time delays prior to the mechanical operation desired due to an increasing amount of heat available for transfer to the expansible chamber.

What is claimed is:

1. In a relay a disc of material having a negative temperature coefficient of resistance and an opening in the center thereof, a flexible cup-shaped member secured with its rim to the outer rim of said disc on each side thereof to form a hermetically sealed chamber between the cups with a major portion of said disc inside said chamber, a liquid having a high coefficient of expansion inside said chamber, a frame member attached below one of said cups to the center thereof, a lever yieldingly attached at one end to the rear end of said frame and extending above the center of said other cup, a small disc insulatedly attached to said other cup to the center thereof, a

pin on said lever normally resting against said small disc, said frame and said lever being bent to normally engage each other at their free front ends, sets of contact springs insulatedly attached to said frame at the rear end thereof and extending with their free ends towards the free front ends of said frame and lever, insulation pins attached to said front end of said lever and associated with the front ends of said spring for the control of the connection between them to change said connection when the lever is lifted away from said frame, circuit means for establishing electrical connections across said cups and said resistance disc to heat said resistance disc by current passing through said cups and resistance disc when said circuit is energized and to transfer heat to said liquid to expand it and thereby cause said cups to expand to lift the lever and to thereby control the connections between the springs through the medium of said insulation pins, a latch member attached to said lever operative when said lever is lifted to engage the frame to hold said lever in its lifted position and an extension of said latch member for the manual moving thereof to release the lever from said latched position and permit its return to normal position when the liquid in said chamber has cooled sufficiently to permit said cups to contract to their normal shape.

2. A flat plate of resistance material having an opening substantially in the center thereof, flexible convex plates of metal secured with their peripheries to the outer peripheries of flat surfaces of said resistance plate, one of said metal plates on each side of said resistance plate to form a sealed chamber between said metal plates with all except the outer peripheral surface of said resistance plate inside said chamber, an expansible fluid filling said chamber, said resistance plate adapted to have an electric current passed therethrough to heat said resistance plate, said heated resistance plate, by reason of being all except its outer peripheral surface inside said chamber, adapted to transfer substantially all of its heat to said fluid to expand said metal plates.

3. A flat disc of resistance material having an opening substantially in the center thereof, flexible convex circular plates of metal secured with their rims to the outer rims of the faces of said disc, one of said plates on each side of said disc to form a sealed chamber between said plates with all except the outer circumferential surface of said disc inside said chamber, an expansible fluid filling said chamber, said disc adapted to have an electric current passed therethrough to heat said disc, said heated disc, by reason of being all except its outer circumferential surface inside said chamber, adapted to transfer substantially all of its heat to said fluid to expand said metal plates.

4. A flat annular disc of resistance material, flexible convex circular members of metal secured with their rims to the outer rims of the faces of said annular disc, one of said metal members on each side of said annular disc to form a sealed chamber between said metal members with all except the outer circumferential surface of said annular disc inside said chamber, an expansible fluid filling said chamber, said annular disc adapted to have an electric current passed therethrough to heat said annular disc, said heated disc, by reason of being all except its outer circumferential surface inside said chamber, adapted to transfer substantially all of its heat to said fluid to expand said metal members.

5

5. A flat, thin, annular disc of resistance material having a negative temperature coefficient of resistance, flexible cup-shaped circular members of metal secured with their rims to the outer rims of the faces of said annular disc, one of said metal members on each side of said annular disc to form a hermetically sealed chamber between said metal members with all except the outer circumferential surface of said annular disc inside said chamber, an expansible liquid filling said chamber, said annular disc adapted to have an electrical current passed therethrough in series with said metal members to heat said annular disc, said heated disc, by reason of being all except its outer circumferential surface inside said chamber, adapted to transfer substantially all of its heat to said liquid to expand said metal members.

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