May 31, 1949. J. D. BOLESKY 2,471,924

THERMAL RELAY

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FIG. 1.

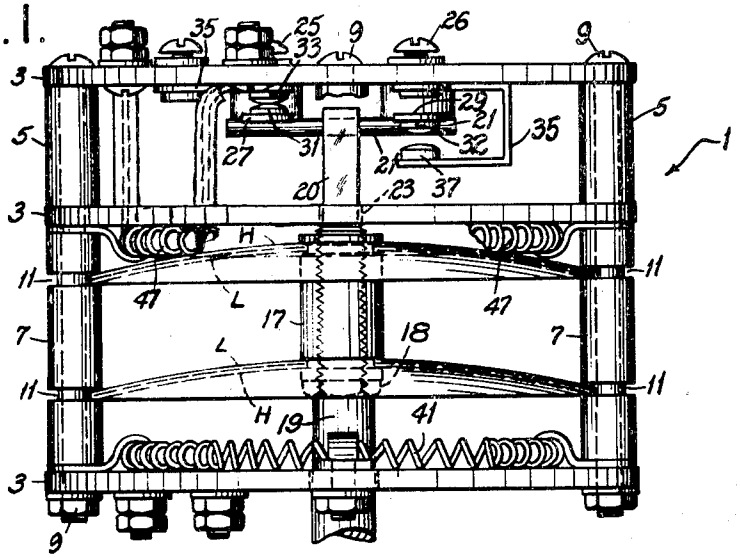
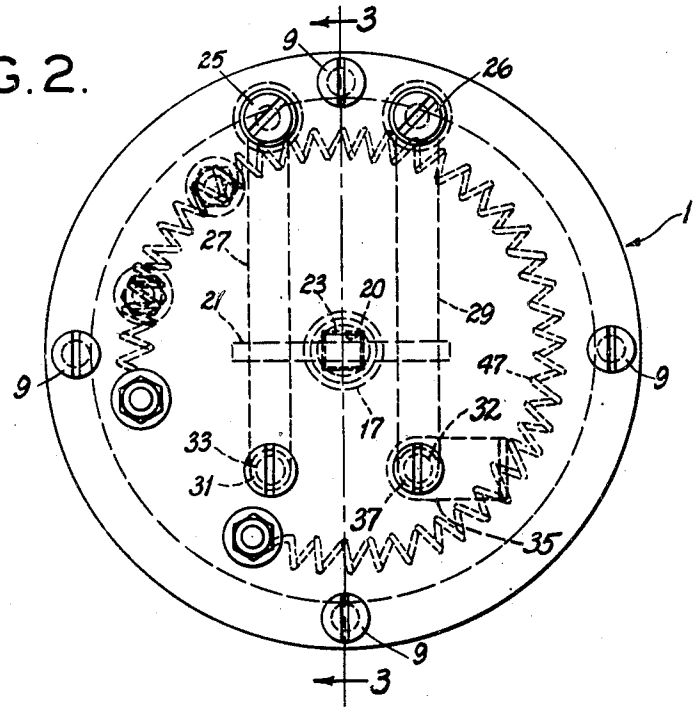


FIG. 2.



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FIG. 5.

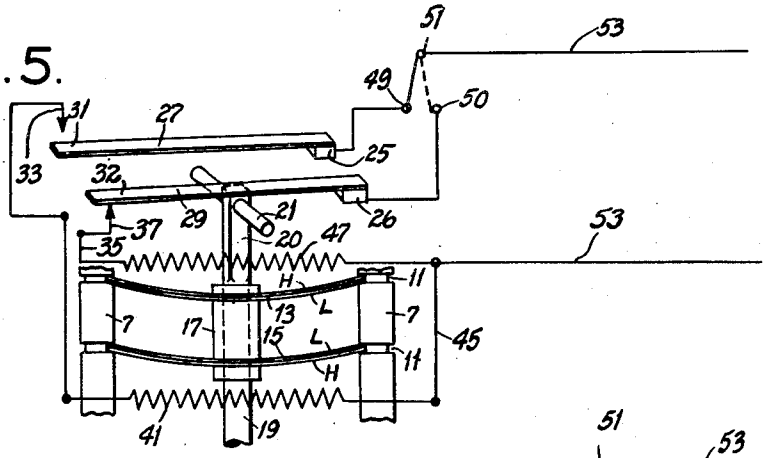


FIG. 4.

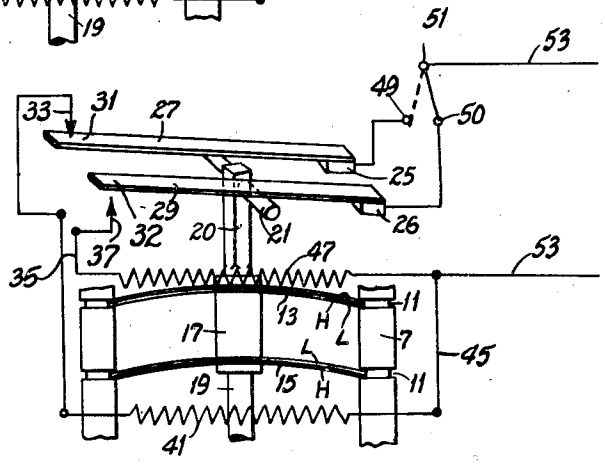
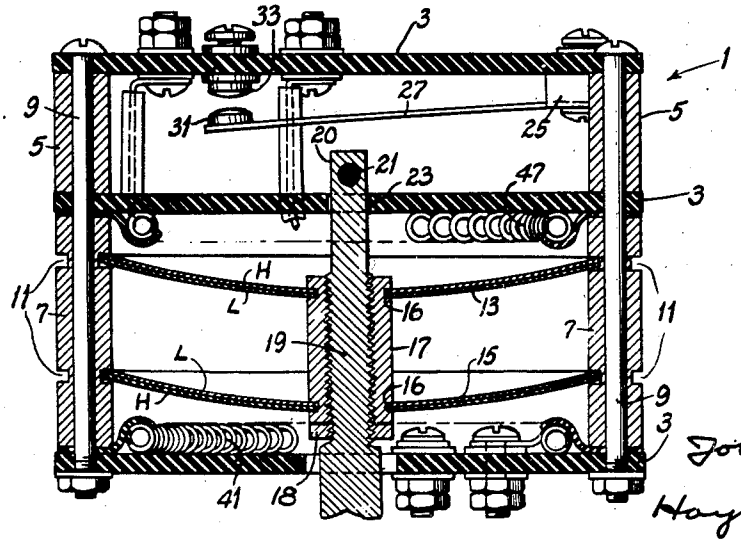


FIG. 3.



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FIG. 6.

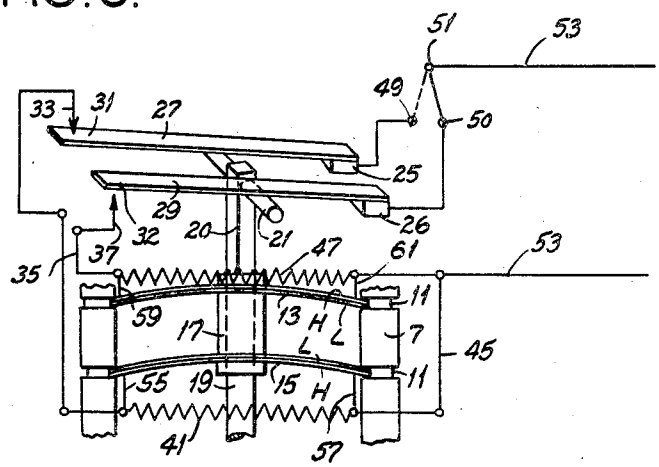
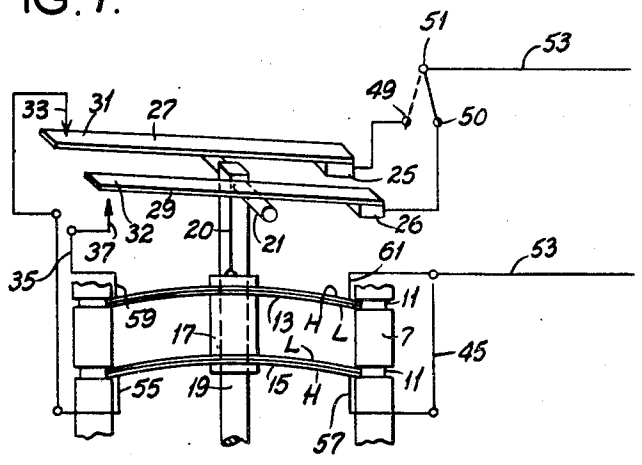


FIG. 7.



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Patented May 31, 1949 2,471,924

UNITED STATES PATENT OFFICE

2,471,924

THERMAL RELAY

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Application July 10, 1943, Serial No. 494,173

10 Claims. (Cl. 60—23)

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This invention relates to thermal relays, and more specifically to an ambiently compensated thermostatic relay mechanism.

Among the several objects of the invention may be noted the provision of a simple and reliable snap-acting thermal relay mechanism which has a quick response from a remote control; the provision of apparatus of the class described in which no current flows except during relatively short periods; and the provision of apparatus of this class which is compensated for changes in ambient temperature. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a view in elevation showing certain mechanical parts in one position, wiring being omitted;

Fig. 2 is a top plan view of Fig. 1;

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2, but showing the parts in an alternate position;

Fig. 4 is a wiring diagram with parts according to their position shown in Fig. 1;

Fig. 5 is a wiring diagram with parts according to their position shown in Fig. 3;

Fig. 6 is a wiring diagram showing an alternative form of the invention; and,

Fig. 7 is a wiring diagram showing still another form of the invention.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Fig. 1, there is shown in general at numeral 1 a thermostatic relay unit. At numerals 3 are shown electrical insulating and heat resistant plates held together spacedly by spacing pillars 5 and 7, these being clamped together by studs 9 (see also Figs. 2 and 3).

The lower pillars 7 are grooved as shown at 11 for loosely holding edges of thermostatic snap-acting plates in the form of discs 13 and 15. These discs are what are known to the art as Spencer discs, each preferably consisting of a bimetallic snap-acting curved sheet. The upper disc 13 has its metal of high coefficient of expansion H on the upper side and the metal of low

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coefficient of expansion L on its lower side. The lower disc 15 has its metal of high coefficient of expansion on the lower side and its metal of low coefficient of expansion on the upper side. Thus the metals L are adjacent to one another and inside of the pair of discs, and the metals H are outside.

Centrally, the discs are provided with openings for loose reception in grooves 16 of a spacing pillar 17. Through pillar 17 is threaded a stem 19 held in place by a lock nut 18. Stem 19 carries at its top 20 an insulating bar 21. At its top the stem is square so as to be guided without rotation in a square opening 23 in the middle plate 3.

The bar 21 is a switch actuating means. The switches operated thereby are carried on the upper insulating plate 3. These switches comprise terminals 25 and 26, from which extend cantilever springs 27 and 29 respectively. These springs carry at their ends movable contacts 31 and 32 respectively. The movable contact 32 of the spring 29 is normally biased downward to touch a fixed contact 37 carried on an underslung bracket 35 (Fig. 5). The movable contact 31 at the end of the spring 27 is engageable with a fixed contact 33, but normally stands in downwardly spaced relation to said contact 33 (Fig. 5). The contact 33 is wired to a lower heater coil 41 held on suitable insulating brackets on the lower plate 3, the other end of this coil 41 connecting with a line wire 53 at 45, as shown in Fig. 5. The contact 37 is wired into an upper heater 47 supported under the middle plate 3. The other end of the heater 47 is connected to said circuit 53, as shown in Fig. 5.

The terminals 25 and 26 are respectively connected to terminals 49 and 50 of a single-pole double-throw switch 51, the single pole of which is connected to the other side of the energizing circuit 53.

The upper heater 47 is adjacent to the high-expansion side (outside) of the upper disc 13 and the lower heater 41 is adjacent the high-expansion side (outside) of lower disc 15. Thus the discs are respectively exteriorly heated by the respectively adjacent heaters.

The two thermostatic discs 13 and 15 have the same strength and temperature-operating characteristics, but they are oppositely operative in response to a given temperature change, because of the opposite location of the metals of high and low coefficients of expansion. The discs being coupled in tandem and located parallel to one another, when heated to the same temperature (as would be the case were they both in the same

ambient heating medium), there will be no activity of the discs from a given position, such as shown in Fig. 4 or 5. That is to say, the pair of discs 13 and 15 may be placed either in the position shown in Fig. 4, or in the position shown in Fig. 5, and change in the ambient temperature will cause no activity of the discs.

If the upper heater 47 alone is heated sufficiently in the Fig. 5 position, then the discs 13 and 15 will snap from the positions shown in Figs. 3 and 5 to the upward positions shown in Figs. 1 and 4 and remain there even though the disc temperatures later equalize. If only the lower heater 41 is heated in the Fig. 4 position, then the discs will snap from their upward positions shown in Figs. 1 and 4 to the downward positions shown in Figs. 3 and 5 and remain there even though the disc temperatures later equalize. The discs will retain a given up or down position which is stable at any value of ambient temperature around them as long as it is substantially the same for both discs, for reasons given in United States Patent 2,203,558 (refer to Figs. 5 and 6 and accompanying description therein).

Operation is as follows, referring to Figs. 4 and 5:

The parts are stable in the Fig. 5 position. To operate, the selective control switch 51 is thrown over to the dotted-line position, that is, on point 50. This sends current through the then-closed switch contacts 32, 37, heater 47 and back to the line 53. The heater 47 heats the upper disc 13, and since the metal of high coefficient of expansion is on top, the disc snaps up from the position shown in Fig. 5 to that shown in Fig. 4 (carrying along disc 15). Both discs then permanently hold the Fig. 4 position, even after the upper disc 13 cools down to the temperature of lower disc 15. This cooling will of course occur, since when the device moves from the Fig. 5 to the Fig. 4 position, the contacts 32, 37 are opened and the heater 47 is deenergized.

The above closes switch contacts 31 and 33 (Fig. 4), but since the control switch 51 is at this time on point 50, as indicated by the solid line in Fig. 4, no current is available for either heater 41 or 47.

Now, if the control switch 51 be thrown from its solid-line to its dotted-line position (Fig. 4) to point 49, current will flow through contacts 31, 33, lower heater 41, and back to the line 53. This heats the lower disc 15, and since its metal of high coefficient of expansion is below, this disc will snap down, carrying along with it the upper disc 13. This opens contacts 31, 33 and recloses the contacts 32, 37 as shown in Fig. 5. Since switch 51 is on point 49 all circuits are again broken through the heaters, and the parts maintain the Fig. 5 position until the switch 51 is again thrown to point 50.

The member 19 has a downward extension which is attached to means which it is desired to operate, such as for example an electric switch, valve or the like.

It will be seen that the invention provides a thermal relay which has a quick-acting forceful response. The metals H of high coefficient of expansion of the tandem discs 13 and 15 being on the outside of the assembly of discs and the heaters being also placed outside of this assembly results in heat flowing quickly to the metal of high coefficient of expansion. The metal of low coefficient of expansion receives its rise in temperature with some delay caused by the time

that it takes for heat to be transmitted through the outside component. Thus, the design is particularly effective to bring about a quick and positive action.

Between operations no current is consumed, switch 51 being normally closed in connection with whichever of the pairs of contacts 31, 33 or 32, 37 is open.

As shown in Fig. 7 the heaters 47 and 41 may be dispensed with if it is desired to use the discs 13 and 15 per se as heating units. In such case the discs will be made of material presenting proper electrical resistance to generate the required amount of heat for self-operation; or self-operating current-conducting discs may be used with auxiliary heaters. Self-operated current-carrying discs are shown in the patent to Vaughan et al. 2,207,422; and discs with auxiliary heaters are shown in my Patents 2,199,387 and 2,199,388. The application of the circuit connections for causing the discs to generate heat for self-energization will be clear from said patents and from Figs. 6 and 7. Thus the parallel circuit branches through the automatic switches 27 and 29, may include the respective discs 15 and 13, with (Fig. 6) or without (Fig. 7) the heaters 41 and 47. In Fig. 6 the disc 13 is connected in shunt around heater 47 by lines 59 and 61. The disc 15 is connected in shunt around heater 41 by lines 55 and 57. In Fig. 7 discs 13 and 15 are connected in their respective circuits by lines 59 and 61, and 55 and 57, but heaters 41 and 47 are omitted. Discs 13 and 15 therefore in both embodiments carry the current in their respective circuits and themselves serve as a heating means.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A thermal relay comprising an ambient-temperature-compensated thermostatic means embodying two inherently snap-acting thermostatic plates arranged so that snap movement of one opposes snap movement of the other, said plates being coupled for conjoint snap movement, a first electrical heating circuit including a first switch for heating one of said plates to snap both plates from a first position to a second position, a second electrical heating circuit including a second switch for heating the other plate to snap both plates from their second position to their first position, and switch actuating means controlled by said thermostatic means adapted in the first position of said plates to close the first switch and open the second switch, and in the second position of said plates to close the second switch and open the first switch.

2. A thermal relay comprising an ambient-temperature-compensated thermostatic means embodying two inherently snap-acting thermostatic plates arranged so that snap movement of one opposes snap movement of the other, said plates being coupled for conjoint snap movement, a first circuit including a first switch and a first electrical heating element in heat-exchange relation to one of said plates for heating said one plate to snap both plates from a first position to a second position, a second circuit including a second switch and a second electrical heating

element in heat-exchange relation to the other plate for heating it to snap both plates from their second to their first position, and switch actuating means controlled by said thermostatic means adapted in the first position of said plates to close the first switch and open the second switch, and in the second position of said plates to close the second switch and open the first switch.

3. A thermal relay comprising an ambient-temperature-compensated thermostatic means embodying two inherently snap-acting thermostatic plates arranged so that snap movement of one opposes snap movement of the other, said plates being coupled for conjoint snap movement, a first electrical heating circuit including a first switch and also including one of said plates as an electrical resistance heating element for heating said one plate to snap both plates from a first position to a second position, a second electrical heating circuit including a second switch and also including the other of said plates as an electrical resistance heating element for heating said other plate to snap both plates from their second to their first position, and switch actuating means controlled by said thermostatic means adapted in the first position of said plates to close the first switch and open the second switch, and in the second position of said plates to close the second switch and open the first switch.

4. A thermal relay comprising an ambient-temperature-compensated thermostatic means embodying two coaxial and parallel inherently snap-acting thermostatic bimetal dished discs coupled for conjoint snap movement with their respective low coefficient of expansion sides adjacent one another, whereby snap movement of one disc opposes snap movement of the other, a first electrical resistance heating element adjacent the high expansion side of one disc for heating said one disc to snap both discs from a first to a second position, said element being connected in a first circuit including a first switch, a second electrical resistance heating element adjacent the high expansion side of the other disc for heating said other disc to snap both discs from their second to their first position, said second heating element being connected in a second circuit including a second switch, and switch actuating means controlled by said thermostatic means adapted in the first position of said discs to close the first switch and open the second switch, and in the second position of said discs to close the second switch and open the first switch.

5. A thermal relay comprising a support including a pair of spaced insulation plates held together by spacing members, a pair of snap-acting thermostat bimetal dished discs edge-mounted in grooves in the spacing members between the plates, said discs being mounted in coaxial spaced relation with their low coefficient of expansion sides facing one another, a stem centrally connecting the discs for conjoint snap movement, one end of the stem extending through an aperture in one of the plates and carrying a switch actuating member outward of the plate, a first electrical resistance heating element carried by one of the plates in heat-exchange relation to the high coefficient side of the disc adjacent that plate for heating said disc to snap both discs to a first position bowed toward said first heating element, a second electrical resistance heating element carried by the other plate in heat-exchange relation to the high coefficient of expansion side of the other disc for heating said other disc to snap both discs to a second position bowed toward said second heating element, first and second switches carried by the support in position for actuation by the switch-actuating member, the first switch being connected in a first circuit in series with the first heating element, the second switch being connected in a second circuit in series with the second heating element, said switch actuating member closing the first switch and opening the second switch in the first position of the discs, and closing the second switch and opening the first switch in the second position of the discs.

6. A thermal relay as set forth in claim 1, further including a power supply circuit having a double-throw control switch adapted selectively to energize one or the other of said first and second heating circuits.

7. A thermal relay as set forth in claim 2, further including a power supply circuit having a double-throw control switch adapted selectively to energize one or the other of said first and second circuits.

8. A thermal relay as set forth in claim 3, further including a power supply circuit having a double-throw control switch adapted selectively to energize one or the other of said first and second heating circuits.

9. A thermal relay as set forth in claim 4, further including a power supply circuit having a double-throw control switch adapted selectively to energize one or the other of said first and second circuits.

10. A thermal relay as set forth in claim 5, further including a power supply circuit having a double-throw control switch adapted selectively to energize one or the other of said first and second circuits.

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