

[54] **SWITCHING DEVICE FOR OPERATING A PLURALITY OF SWITCHES IN SEQUENCES WITH AMBIENT TEMPERATURE COMPENSATION**

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[51] Int. Cl.² **H01H 37/52**

[58] Field of Search **337/41, 44, 46, 67, 87, 337/101, 311, 340, 349**

[56] **References Cited**

UNITED STATES PATENTS

2,460,762	2/1949	Minnich.....	337/311
3,701,962	10/1972	Ball et al.....	337/101
3,786,218	1/1974	Fischer.....	337/311

FOREIGN PATENTS OR APPLICATIONS

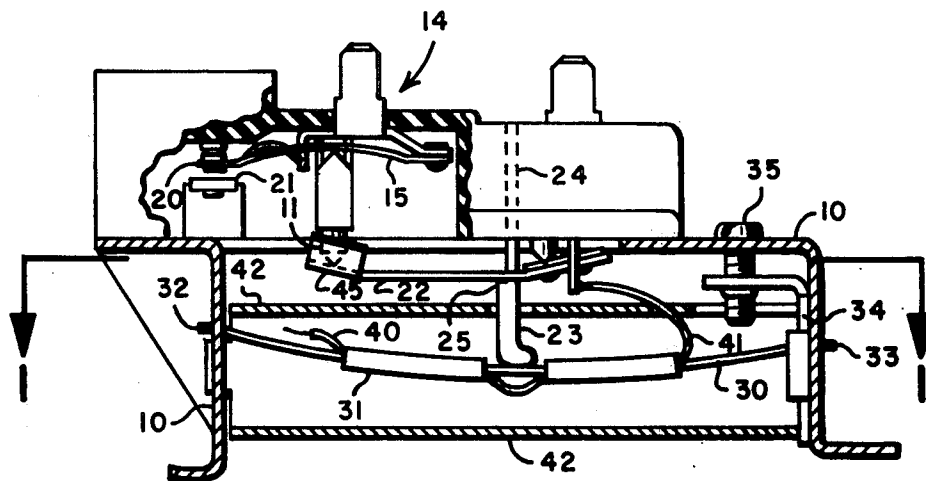
822,130	10/1959	Canada.....	337/101
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[57] **ABSTRACT**

An improved component for a switching device for operating a plurality of switch means sequentially such as taught in U.S. Pat. No. 3,701,962. The operators of each of the switch means are engaged by a "T" shaped wobble plate at spaced positions around the arms of the plate. A thermal operator comprising a heated bimetal has an output member for engaging at or near the center of the "T" wobble plate to apply a force on the plate and thus a force on each of the switch operators depending upon distance between the output member and the switch operator. The "T" wobble plate is made of two elongated bimetal sheet members fastened together to form a "T" configuration and has the effect of warping upon changes in temperature to provide ambient temperature compensation for the switching device.

4 Claims, 6 Drawing Figures



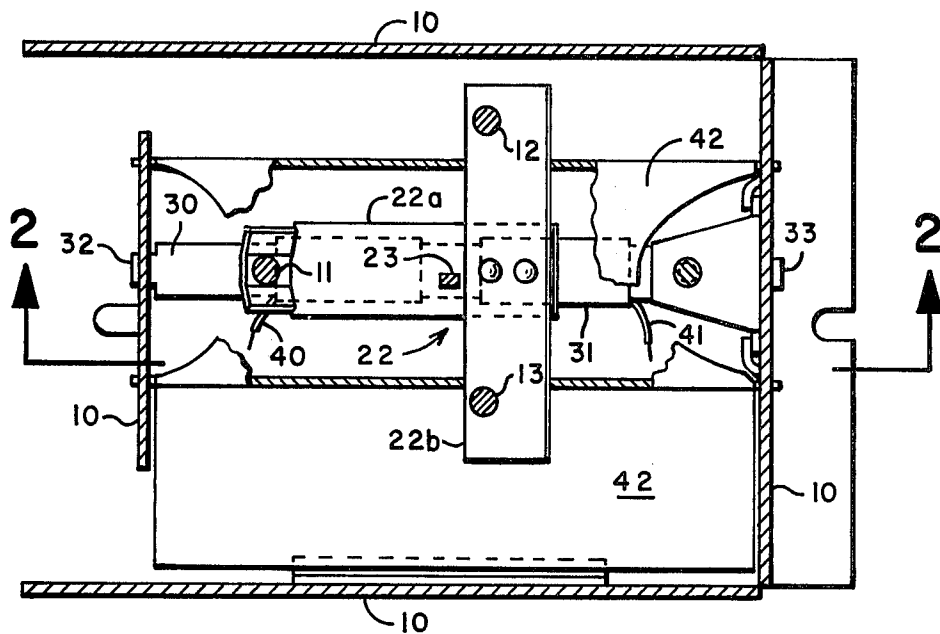


FIG. 1

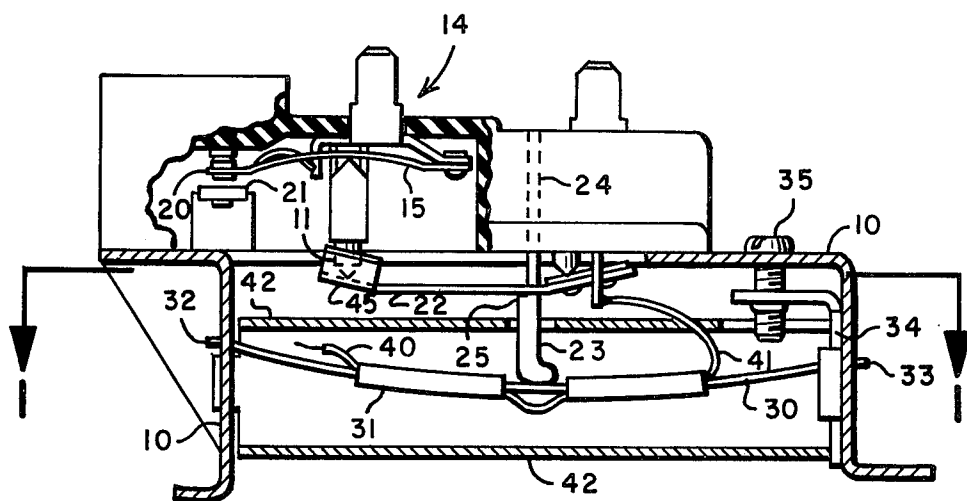
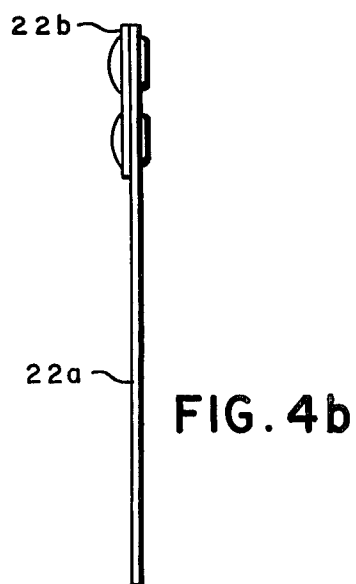
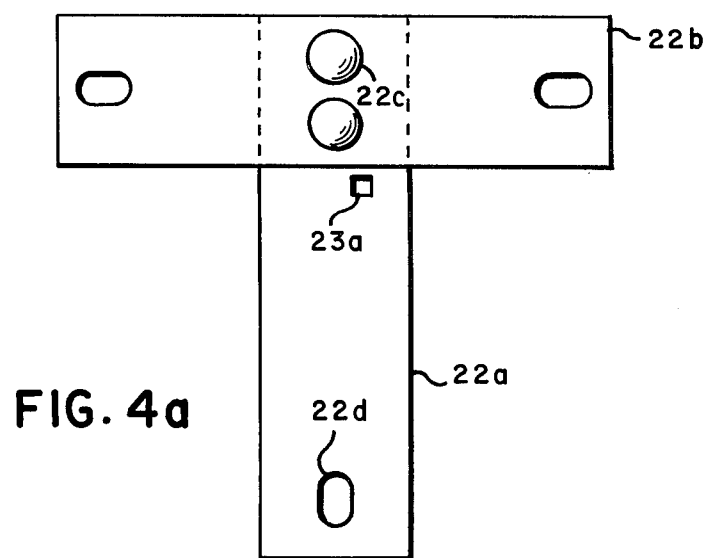
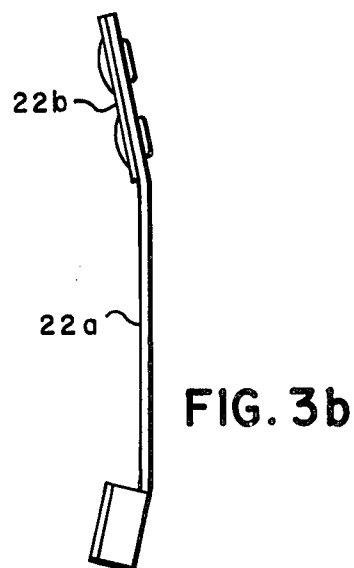
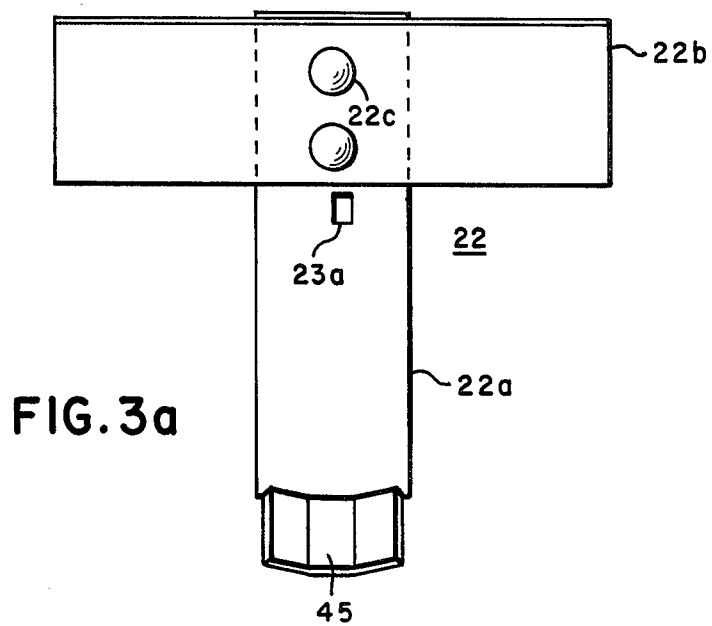


FIG. 2



SWITCHING DEVICE FOR OPERATING A PLURALITY OF SWITCHES IN SEQUENCES WITH AMBIENT TEMPERATURE COMPENSATION

BACKGROUND AND SUMMARY OF THE INVENTION

This invention is an improvement on the sequencing switch of the Ball et al. U.S. Pat. No. 3,701,962.

As electric heating for homes becomes more popular, the need for an inexpensive switching device to sequentially operate a plurality of stages of electric heating to prevent a sudden demand on the power source has been recognized. While step controllers, or motor driven switching devices and semiconductor switching devices with time delay mechanisms are commonly used, competition continually requires that apparatus for such a use be not only improved but made less expensive.

In the U.S. Pat. No. 3,701,962, issued Oct. 31, 1972 to Thomas E. Ball and Vincent R. Anderson and assigned to the same assignee as the present invention there is disclosed a switching device for operating a plurality of switch means sequentially wherein the operators of each of the switch means are engaged by a wobble plate at spaced positions around the periphery of the plate. A thermal operator comprising a heated bimetal has an output member for engaging at or near the center of the wobble plate to apply a force on the plate and thus a force on each of the switch operators depending upon distance between the output member and the switch operator. The compensator wobble plate is made of a sandwich of identical bimetal sheet members stacked together to bend in a cup shaped manner upon changes in temperature to provide ambient temperature compensation for the switching device. This device is sold by Honeywell Inc. as the R8330 Electric Furnace Sequencer. The record of operation of that device has been satisfactory, however, a limitation of that compensator wobble plate is that it is relatively massive in size.

The present invention provides for an improved compensating component to the sequential switching device which is a T-shaped bimetal wobble plate which changes in warp as the ambient temperature changes. Specifically, the T-wobble plate is made of two elongated rectangular sheets of bimetal riveted or otherwise rigidly fastened together in the form of a T and positioned to contact the plurality of switch operators at its extremities; so that, when a force is applied by a member near the center of the T-plate from a thermal operator, the force applied to the switch operators is such that the switches operate in sequence. As the ambient temperature and thus the temperature surrounding the switching device varies, the T-plate will change in warp to change the necessary dimensions; so that, regardless of the ambient temperature, the timing between the sequential switch operations remains substantially the same.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in the specification by referring to the drawings of which

FIG. 1 is a top view of the switching device with the cover and main portion of each of the switches removed to only show the switch operators engaging the plate;

FIG. 2 is a side view of a switching device with a portion cut away to show the switch operators and one switch with the wobble plate and thermal operator; and

FIGS. 3a and b shows in greater detail one embodiment of an improved T-bimetal wobble plate and FIGS. 4a and b details a modification thereof.

DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a base, housing or enclosure 10 contains a plurality of switch means or devices (not shown) operated when triangularly spaced switch operators or pins 11, 12, and 13 are moved in a direction perpendicular to the drawing. The switch means are of a conventional type, as shown at 14 in FIG. 2 associated with operator 11, wherein upon operator 11 moving downward to release the force which is applied to blade 15, a switch made of movable contact 20 and fixed contact 21 closes to close a circuit adapted to supply power to an electric heater of a furnace.

Operators 11, 12, and 13 as shown in FIG. 1 are engaged at or near the extremities of an ambient temperature responsive compensating means or T-shaped wobble plate member 22 which distributes a force applied to wobble plate 22 by an output member 23 protruding through plate 22 at a location 23a near its center. Member 23 is piloted in a hole in the upper part of the housing, shown at 24 in FIG. 2.

Member 23 moves up and down to apply a force to plate 22 upon the movement of a thermal operator means or bimetal 30 which is heated by an electric heater 31. Bimetal 30 is supported at its end or extremities 32 and 33 in housing 10. Specifically end 33 is held by a movable calibration bracket 34 which is positioned when a factory calibration screw 35 is adjusted to position the bracket. Heater 31 is energized by applying power to wires 40 and 41. The heat, which is generally confined in the enclosure 42, causes the center of bimetal 30 and member 23 to move downwardly to reduce the force applied to plate 22.

In the prior patent the bimetal wobble plate 22 was shown as being generally triangular in shape and as being made up of a sandwich of three layers of the bimetal. While being satisfactory in function and operation that configuration resulted in the use of a relatively large quantity of expensive bimetal per device and in some wastage of bimetal stock during stamping out of parts, due to the irregular shape of the plate.

Specifically the improved T-shaped wobble plate 22 of this invention is made up of two elongated rectangular sheets or strips 22a and 22b of bimetal as shown in FIGS. 3 or 4. The sheets 22a and 22b are rigidly fastened together with rivets 22c or the like. The improved T-shaped design for plate 22 of the present invention provides a cost advantage arising in a number of ways. Firstly the T-shaped design utilizes a lesser quantity of the relatively costly bimetal per device. Secondly, since the piece parts are now rectangular the scrap is minimized. Thirdly, the manufacturing and assembly problems are reduced and less tooling is required. Fourthly, the reduction in the mass of the compensator plate 22 has allowed a reduction in material by about 50% of the thermal operator bimetal 30.

Although not intended to be limiting in any way, but illustrative only, one successful embodiment of the T-plate 22 having the configuration of FIG. 3 utilized standard bimetal stock 0.025 inch thick for portion 22a and 0.015 inch thick for portion 22b.

The sequencer described herein is required to operate over a relatively large ambient temperature range such as from -20°F to 150°F . It is desired to have a given position of switch operating pins 11, 12, and 13 maintained throughout this ambient range. With a change in the ambient temperature surrounding housing 10, bimetal plate 22 responds and bends or warps in a manner to change the relative position of the center portion of the plate near member 23 with respect to the portion near the ends of the operating pins 11, 12, and 13 and thereby compensates for a similar ambient caused change occurring in the warp of bimetal 30.

It will be observed from FIGS. 2 and 3b that the wobble plate 22 has a "cupped" or angled shape because of two bends placed in the piece part 22a, one bend near section 45 and the other at the opposite end near part 22b. This angled contact has the effect of applying a force to the operators 11, 12, and 13 which has a horizontal component as well as a vertical component, the horizontal component on operation 11 tending to urge operator 11 towards member 23, i.e., towards the right in FIG. 1, and the horizontal component on operators 12 and 13 tending to urge them towards the left. The operators are rather loosely fitted in the channels in which they are to move axially (See FIG. 2). As a result, some degree of lateral movement or wandering of operators 11, 12, and 13 on the surface of plate 22 is possible but not desired. The horizontal components of force tend to cause a uniform lateral positioning of these operators by urging them in a predetermined direction, i.e., in FIG. 2 generally towards one another.

In FIG. 4 the T-compensating bimetal wobble plate is a slight modification of that shown in FIG. 3. An elongated hole 22d may be provided in one or more of the extremities of the parts 22a and 22b and acts as a locator to aid in keeping the plate in proper position with respect to operators 11, 12, and 13.

OPERATION OF THE INVENTION

Referring to FIG. 2, normally with bimetal 30 cold, that is heater 31 not energized, an upward force is applied to member 23 to cause an upward force to be applied to the switch operating pins 11, 12 and 13 shown in FIG. 1 to operate the associated switches to an open position. As heater 31 is energized, member 23 moves downward depending upon the position of the end 33 of the bimetal 23 previously determined by the calibration screw 35. Upon the downward movement of member 23, force is removed from the ends of pins 11, 12, and 13 to operate the switches. The relative operating forces of each of the switches can be preselected, as well as the length of the lever arm between member 23 and the pivot of the plate 22. The switches can be preselected to operate in a sequence to first close the switch associated with pin 11, then 12 and finally 13. Specifically, the force applied to pin 11 by wobble plate 22 is accomplished by the plate pivoting along a line between pins 12 and 13. When switch 14 associated with pin 11 operates the force then shifts. T-plate 22 then pivots about a line between pins 11 and 13 to operate the switch associated with pin 12. By the design of the length of the lever arm and the force required for operating the switches and the movement of bimetal 30, a predetermined timed sequence of operation of the switches associated with members 11, 12, and 13 is obtained.

As ambient temperature changes, both operator 30 and compensator plate 22 tend to change shape or warp. Assuming that the ambient temperature decreases which might be the case if the switching device was placed in an unheated compartment below the floor in the house, bimetal 30 bends so the center portion moves upward. With the same decrease in ambient temperature plate 22 moves so that the center portion adjacent shoulder 25, as shown in FIG. 2, moves upward with respect to the extremities i.e. the location of pins 11, 12, and 13 resulting in no net change in the position of operators 11, 12, and 13. With temperature compensating plate 22, the timed sequence of operation of the switches associated with operators 11, 12, and 13 remains the same upon changes in the ambient temperature.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. In an improved switching device of the type having one or more switch means each having an operator to which a force is applied to operate said switch means, having thermal operator means having an output member for providing a force when said operator means is energized,

and having bimetal ambient temperature responsive means connecting the output member of said thermal operator means to said switch means operators for applying a force to each of said operators for operating said switch means in sequence; the improvement residing in the ambient temperature responsive means and comprising:

T-shaped bimetal ambient temperature responsive means comprising two elongated rectangular strips of bimetal rigidly fastened together in the form of a T whereby said force of said output member of said operator means is applied at a point of contact between the points of contact on said T of said operators of said switch means.

2. The invention according to claim 1 in which said T-means is cupped to impart to said switch means operators a force having a horizontal component as well as a vertical component, the horizontal component of force urging the switch means operators in a predetermined direction.

3. The invention according to claim 1 in which the contact surface of said T-means with said switch means operators is angled with respect to said switch means operators to impart to said switch means operators a force having a horizontal component as well as a vertical component.

4. An improved T shaped temperature responsive wobble plate means for a sequential switching device comprising:

three switch means each having an operator to which force is applied to operate said switch means, said operators being spaced triangularly;

operating means for providing a force on an output member;

T-shaped temperature responsive wobble plate means connecting said operating means and said switch means, said T shaped means comprising two elongated rectangular strips of bimetal rigidly fastened together in the form of a T and being responsive to ambient temperature wherein extremities of said T wobble plate means engages said operators and said output member applies a force to a central portion of said plate means to be distributed to said operators for operating said switch means in a selected sequence.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,902,151 Dated August 26, 1975

Inventor(s) Thomas E. Ball et al.

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

Inventor name should read -- Thomas E. Ball --.

Signed and Sealed this

sixteenth Day of December 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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