United States Patent

Ball et al.

[15] **3,701,962**

[45] **Oct. 31, 1972**

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

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[22] Filed: **March 18, 1971**

[21] Appl. No.: **125,673**

[52] **U.S. Cl.**.....**337/101**, 200/5 C, 200/18, 337/340

[51] **Int. Cl.**.....**H01h 71/22**

[58] **Field of Search**.....200/5 C, 18, 67 D; 337/44, 337/86, 87, 99, 101, 311, 337, 340, 364, 378

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[57] **ABSTRACT**

A switching device for operating a plurality 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 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 wobble plate is made of plurality of bimetal sheet members to bend in a cup shaped manner upon changes in temperature to provide ambient temperature compensation for the switching device.

7 Claims, 3 Drawing Figures

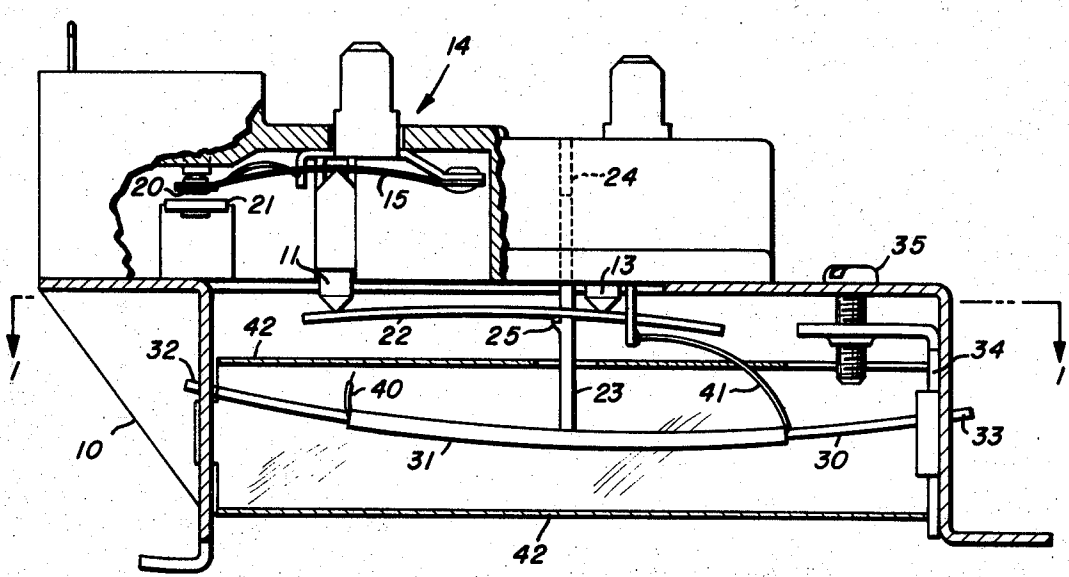


FIG. 1

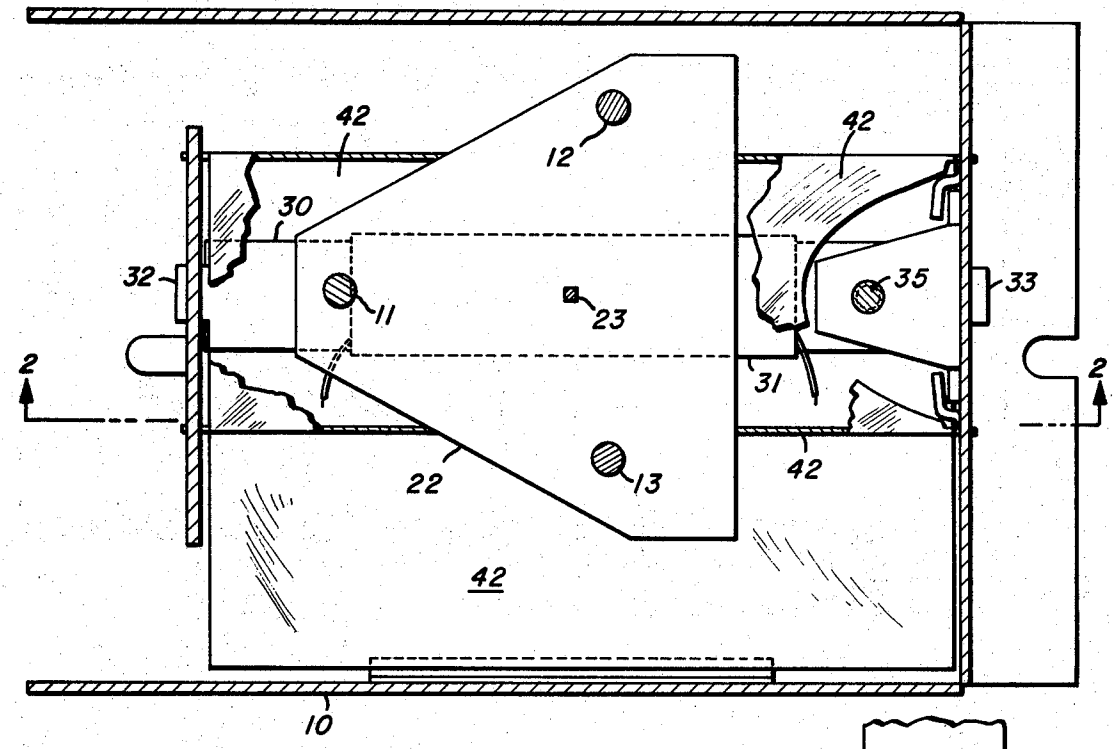


FIG. 3

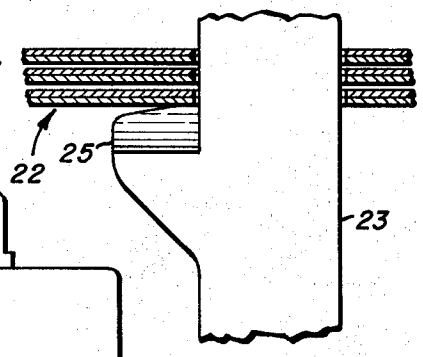


FIG. 2

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

BACKGROUND AND SUMMARY OF THE INVENTION

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.

The present invention provides for a switching device for operating a plurality of switches in a timed sequence and for ambient temperature compensation by operating the switches through a bimetal wobble plate which changes in shape as the ambient temperature changes. Specifically, the plate is made of a plurality of sheets of bimetal to contact a plurality of switch operators around its periphery; so that, when a force is applied by a member near the center of the 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 plate will change shape to change the necessary dimensions; so that, regardless of the ambient temperature, the timing between the sequential switch operations remains substantially the same.

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

FIG. 3 is an enlarged view of the plate which is made of a plurality of bimetal sheets to which a force is applied by the output member from the thermal operator.

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 around the periphery of an ambient temperature responsive compensating means or wobble plate member **22** which distributes a force applied to wobble plate **22** by an output member **23** protruding through plate **22** 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** has a high point at shoulder **25** for engaging the under side of wobble plate **22** to apply a force to plate **22** at a definite or fixed position throughout the operation of the switching device.

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 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 confined in the enclosure **42** made of an insulating paper, causes bimetal **30** and member **23** to bend downward to remove the force from plate **22**.

Specifically plate **22** is made up of a plurality of sheets of bimetal as shown in FIG. 3. The sheets are assembled with the "high side" or side of the bimetal which expands the greatest upon a temperature change downward in the direction of shoulder **25** of member **23**. When the bimetal sheets change in temperature due to the change in the ambient temperature surrounding housing **10**, plate **22** bends with the center area downward in a "dish" manner to change the relative position of the center portion of the plate near member **23** and the portion near the ends of the operating pins **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 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. 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 times sequence of operation of the switches associated with members **11**, **12** and **13** is obtained.

As ambient temperature changes, plate **22** changes shape. 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, plate **22** moves so that the center portion adjacent shoulder **25**, as shown in FIG. 2, moves upward because of **30** with respect to the ends of pins **11**, **12** and **13**. The dish shape of the plate is in-

creased. With the same decrease in ambient temperature bimetal **30** bends so the center portion moves upward, 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. A switching device comprising:

at least two switch means each having an operator to which a force is applied to operate said switch means,

thermal operator means having an output member for providing a force when said operator means is energized, and

ambient temperature responsive means connecting said output member of said thermal operator means to said operators of the switch means for applying a force to each of said operators for operating said switch means in sequence,

said ambient temperature responsive means comprises a bimetal to which said force of said output member of said operator means is applied at a point of contact between the points of contact on said bimetal of said operators of said switch means to operate said switch means.

2. A switching device comprising:

at least two switch means each having an operator to which a force is applied to operate said switch means,

thermal operator means having an output member for providing a force when said operator means is energized, and

ambient temperature responsive means connecting said output member of said thermal operator means to said operators of the switch means for applying a force to each of said operators for operating said switch means in sequence,

said two switch means are spaced apart to have said operators a first predetermined distance apart,

said thermal operator means being a heated bimetal supported at both ends and having said output member attached near the center of said bimetal,

said ambient temperature responsive means being a second bimetal member for engaging said operators near the extremities of said second bimetal member, and

said output member engaging said second bimetal member at a position within said predetermined distance whereby with a predetermined force needed on each of said operators to operate each of said switch means, a timed sequential operation of said switch means is obtained as a force at said output member increases.

3. A switching device comprising

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

and operating means for providing a force on an output member, and

temperature responsive wobble plate means connecting said operating means and said switch means and being responsive to ambient temperature wherein said wobble plate means engages said operators and said output member applies a force to said plate means to be distributed to said operators for operating said switch means in a selected sequence regardless of any changes in ambient temperature.

4. The invention of claim **4** wherein

said output member has a high point for engaging said wobble plate means whereby said force is applied to a predetermined point on said wobble plate throughout the operation of said switch means.

5. A switching device comprising

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

and operating means for providing a force on an output member, and

wobble plate means connecting said operating means and said switch means wherein said wobble plate means engages said operators and said output member applies a force to said plate means to be distributed to said operators for operating said switch means in a selected sequence,

said switch means are snap acting switches mounted in a base member with said three operators protruding from one side of said base member,

said operating means comprising a heated bimetal attached at its extremities to said base member,

said output member being a drive pin passing through a hole in a heat barrier separating said operating member from said switch means to engage said wobble plate means,

said wobble plate means comprising a temperature responsive bimetal member substantially uneffected by the heat applied to said operating means to only respond to changes in ambient temperature for changing the distance between an end of said drive pin and the ends of said operators whereby upon said temperature responsive member being engaged by said drive pin and said operators a predetermined sequence of operation of said switch means is obtained uneffected by changes in ambient temperature.

6. The invention of claim **5** wherein

said drive pin is piloted at one extremity in a hole in said base member and engages said heated bimetal between its extremities,

said drive pin has a shoulder between in extremities, and

said wobble plate having a hole therethrough for receiving said drive pin whereby said shoulder engages said wobble plate to apply said force to said wobble plate at a predetermined point on said wobble plate throughout the operation of said switch means.

7. The invention of claim **7** wherein

said temperature responsive member of said wobble plate means comprises at least two sheets of bimetal whereby upon each of said sheets of bimetal bending with changes in ambient temperature said sheets slip with respect to each other.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,701,962 Dated October 31, 1972

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:

In Column 4, line 8, after "claim" delete "4" and insert therefor--3--. In Column 4, line 58, after "claim" delete "7" and insert therefor--6--.

Signed and sealed this 23rd day of April 1974.

(SEAL)
Attest:

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Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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