Nov. 27, 1934. C. H. STAVE 1,982,548

THERMAL SWITCH

Filed March 30, 1933

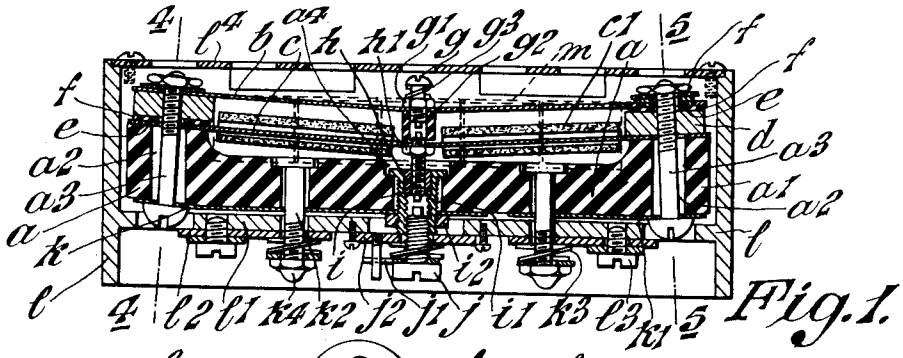

Fig. 1.

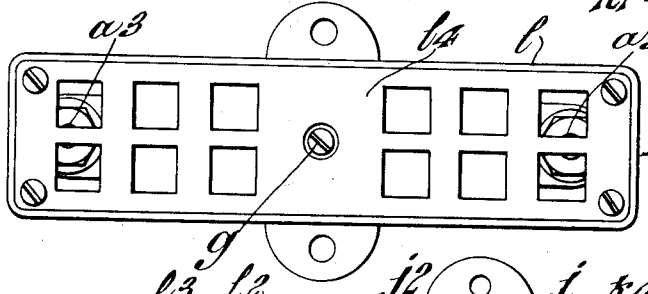

Fig. 2.

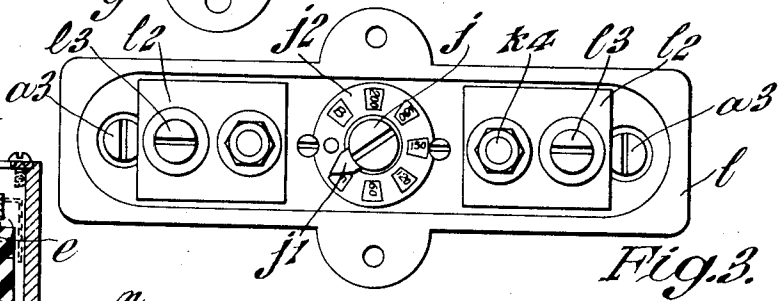

Fig. 3.

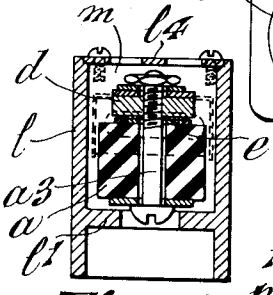

Fig. 4.

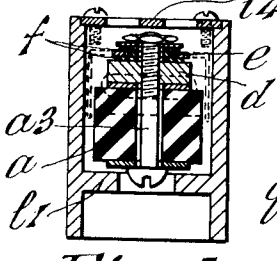

Fig. 5.

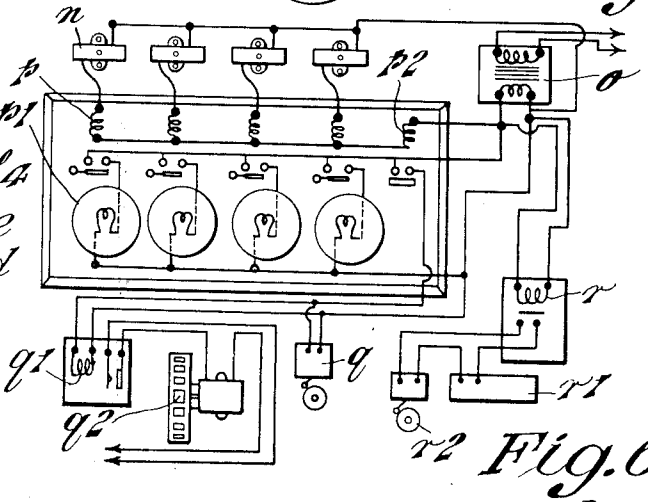

Fig. 6.

Inventor

Cecil H. Stave,

By William C. Linton

Attorney.

Patented Nov. 27, 1934

1,982,548

# UNITED STATES PATENT OFFICE

1,982,548

## THERMAL SWITCH

Cecil Herbert Stave, Kensington, London, England, assignor to Donlarm Limited, London, England

Application March 30, 1933, Serial No. 663,579
In Great Britain March 30, 1932

12 Claims. (Cl. 200—137)

This invention relates to thermal switches, more especially adapted for application as automatic fire detectors. The invention has for its objects to provide an improved device that is as before mentioned effectively responsive both to sudden rises of temperature and to slow long-continued rises of temperature which exceed a definite and predetermined limit which will be reliable in its action and will not be materially affected by seasonal changes of temperature, so that in the case of a fire detector, for example, the device is substantially equally sensitive in summer and winter.

The invention consists of an improved construction and is characterized in that two thermal elements are arranged one above or to the side of the other bridging an insulating base and are so constructed and arranged that upon a rapid temperature change a differential distortion of the two elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature change a substantially uniform distortion of both elements operates to establish an alarm circuit through a second pair of contacts. It will be apparent that on the same principles a switch according to the invention may be utilized to open a closed circuit instead of closing an open one by suitably arranging the thermal or heat sensitive element.

According to the invention, moreover, the heat-sensitive elements are preferably of identical construction, but one may be covered or screened under such conditions that while it is not quickly responsive to rapid changes of temperature, its capacity to vary under slow changes of temperature does not differ sensibly from the capacity of the element that is not so covered or screened.

The form of the heat-sensitive elements and the manner in which they are mounted may be varied, however, without departing from the invention.

The invention further comprises the features hereinafter described and claimed.

The invention is illustrated, by way of example, in the accompanying drawing representing an automatic fire detector provided according to the invention, and an installation in which such detector may be used.

Figure 1 is a sectional elevation of the fire detector.

Figure 2 is a plan view of the fire detector.

Figure 3 is an underside plan view of the fire detector.

Figure 4 is a cross-sectional elevation on the line 4—4 of Figure 1.

Figure 5 is a cross-sectional elevation on the line 5—5 of Figure 1.

Figure 6 is a diagram of one system of connections for an installation in which four of the fire detectors are provided.

In carrying the invention into effect according to one arrangement the construction of an automatic fire detector as illustrated in Figures 1 to 5 of the accompanying drawing, there is provided a base *a* of porcelain or other non-conducting material having a low co-efficient of expansion and whose length and width substantially correspond with those of the thermal or heat-sensitive elements *b*, *c*. At the ends, which are advantageously rounded, the base is provided with raised projections or bosses *a*1 to form seatings for the ends of the element *c*, the surfaces of the bosses being inclined downwardly towards the middle of the base in order that the element *c* may set in position with a downward inclination. The lower face of the base at the ends is formed parallel with the inclined surfaces of the projections *a*1 and through the base there are formed bores or holes *a*2 disposed in directions which are normal to the main lower surface of the base and which in this construction are of elongated cross-section in the direction of the longitudinal axis of the base.

The elements *b* and *c* are provided as flexible strips of a metal or alloy having a high co-efficient of expansion, such as phosphor-bronze, the strips being in this case identical in form and mass and being mounted upon the base *a* by means of fixing screws or bolts *a*3 which pass through the holes *a*2 in the base and engage holes in the ends of the elements *b*, *c*. Distance members *d* in the form of collars of brass or other suitable material are mounted upon the screws or bolts *a*3 between the elements *b*, *c* for the purpose of determining the separation of the elements. It will be observed that by reason of the inclination of the surfaces of the projections *a*1 and the corresponding portions of the lower surface of the base *a*, the bolts or screws *a*3 set at an inclination to the planes of the elements *b*, *c* when the latter are firmly secured in position.

In order that the screws or bolts *a*3 may form part of the circuits through the respective elements *b*, *c* each element is at one end formed with a hole for the screw or bolt of a diameter sufficient to admit an insulating washer *e* of mica or other suitable material. These enlarged holes are provided at opposite ends of the elements *b*, *c* that is to say, for the element *c* the enlarged hole for the reception of the washer is disposed to

the left, while in the case of the element *b* it is disposed to the right. In the latter instance the element is further insulated from the bolt or screw *a*3 and its nut by mica or like washers *f* disposed above and below the element, while in the case of the element *c* a similar insulating washer is disposed below the collar *d*. The element *b* is provided at the middle of its length with a screwed socket *g*1 in which is received the contact screw *g*, the extremity of which extends midway between the two elements *b* and *c* and is shrouded by a sleeve of material such as steatite *g*2. A spring washer *g*3 is advantageously disposed between the head of the screw *g* and the socket *g*1. The element *c* is similarly provided with a screw-threaded socket *h*1 in which is received a contact screw *h*, the upper extremity of which extends into the steatite bush *g*2 so that it is normally positioned from the extremity of the contact screw *g* a distance of, for example, .0005 of an inch. The air gap may readily be adjusted by rotation of the screw *g*. The screw *h* also extends downwardly with clearance in a steatite or other insulating bush *i* mounted within a screw-threaded metal bush *i*1 which is seated in a recess or boring *a*4 in the base *a* and is maintained in position by a nut *i*2. The bush *i*1 is screw-threaded internally for the lower part of its bore to receive the contact screw *j* which may be adjusted in position by rotation. The insulating bush *i* may be made of some flexible insulating material, such, for example, as oiled silk.

The screws or bolts *a*3 serve also to maintain on the lower face of the base *a* conducting strips *k*, *k*1, the strip *k* being extended and formed with a hole to receive the bush *i*1 so that it may be engaged by a nut *i*2.

The elements *b*, *c* are identical in form and material, and have therefore precisely the same capacity for expansion, but in order that the device may be responsive to rapid rises of temperature, the element *c* is lagged or jacketed by coverings *c*1 of asbestos or similar heat-insulating material. Thus the element *c* is protected against rapid rises of temperature and does not materially change its disposition, but the element *b*, being without such protection, is caused to expand rapidly so that by its distortion or flexure the extremity of the contact screw *g* is brought into engagement with the extremity of the contact screw *h* to close a circuit including the screws or bolts *a*3 and the strips *k*, *k*1. In the case of a slow rise in temperature the lagging of the element *c* is ineffective to protect the element and thus the elements *b*, *c* expand equally and together. As the result the air gap between the contact screws *g* and *h* is maintained substantially constant, but the contact screw *h* is brought into engagement with the contact screw *j*, upon a temperature rise according to a predetermined setting of screw j, so that a circuit is now completed by way of one of the screws or bolts *a*3, the contact screws *h* and *j* and the strips *k*, *k*1.

The heat-sensitive unit constructed in the manner described is mounted in a case *l* of substantially rectangular form made in a thermal setting or thermo-plastic substance such as a synthetic resin. For this purpose the casing is provided with a partition *l*1 disposed towards the lower end and provided with clearance holes for the heads of the screws *a*3, the nut *i*2 and the contact screw *j* and with clearance holes for screws *k*2 by which the porcelain base *a* is retained in position. A resilient mounting is provided by fitting the screws *k*2 with spring washers *k*3 which are disposed either below the nuts *k*4 or between the base *a* and the partition *l*1 or in both positions. The screws *k*2 also pass through conducting plates *l*2 which extend along the lower face of the partition *l*1 and serve to receive terminal screws *l*3.

In order to permit of the setting of the contact screw *j* so that the detector may become operative when a slow rise in temperature exceeds a determined limit, the screw is provided with a pointer *j*1 to operate over a graduated disc *j*2 adapted to fit around the screw *j* over the partition *l*1 and be secured in any desired position of adjustment as, for example, may be determined during manufacture for the purpose of compensating variations of setting or otherwise. By the setting of the pointer to a particular temperature indicated upon the dial and thus effecting the rotation of the contact screw *j*, the normal air gap between the contact screws *j* and *h* is varied accordingly.

The inner contacts and the inner element *c* are advantageously protected against dust by a channel section screen *m* fitting loosely over the element *c* and provided with an opening through which the contact screw *g* may extend. The casing is advantageously closed by means of a grid-like cover *l*4 permitting free access of the atmosphere to the elements *b*, *c*.

In the operation of the detector a sudden rise of temperature causes the element *b* to expand more rapidly than the element *c* in view of the lagging of the latter, and a circuit is therefore closed between the contact screws *g* and *h*. During a long and gradual rise in temperature, such as is due to seasonal change, the elements *b*, *c* expand together and approximately no change takes place in the air gap between the contact screws *g* and *h* so that the device remains still sensitive to a sudden rise of temperature which is effective to cause further expansion of the element *b*. Should, however, the temperature exceed the limit as determined by the setting of the contact screw *j* the device becomes operative by the engagement of the screws *h* and *j*.

In an installation involving the use of four of the detectors as shown in Figure 6, the detectors *n* are connected in parallel to the secondary of a mains transformer *o* and their circuits are completed through relay coils *p* respectively controlling indicating lamps *p*1, the circuit being completed through a relay coil *p*2 which is effective to operate an audible signal such as a bell *q* and a relay *q*1 serving to close the main circuit for the motor of a siren *q*2. The relay circuits are also supplied from the secondary side of the mains transformer *o* which is effective also to supply current to a relay *r* adapted in the event of failure of the mains supply to close a local circuit through a battery *r*1 and signal or alarm bell *r*2.

It will be understood that the invention is not limited to the details of construction hereinbefore described, nor to the application of the device for use as a fire detector. It may be applied merely for the purpose of controlling temperature conditions, for example, in refrigerators, stores and other situations where the maintenance of determined temperature conditions are desirable or essential.

I claim:

1. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising

an insulating base, projecting seats at the ends of said base, two thermal elements of the same mass and material, supported at their ends on said projecting seats and bridging said base, insulation lagging on one of said thermal elements, electrical contacts carried by and moving with said thermal elements, and a contact of fixed location, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

2. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, projecting seats at the end of said base, two differential thermal elements supported at their ends on said projecting seats and bridging said base, contacts carried by and moving with said thermal elements, and a contact of fixed location, all of said contacts being in alinement, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

3. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, projecting seats at the ends of said base, two thermal elements of the same mass and material, supported at their ends on said projecting seats and bridging said base, insulation lagging on one of said thermal elements, electrical contacts carried by and moving with said thermal elements, and a contact of fixed location, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts, all of said contacts being in alinement.

4. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, projecting seats at the end of said base, two differential thermal elements supported at their ends on said projecting seats and bridging said base, contacts carried by and moving with said thermal elements, a contact of fixed location and means for adjusting the gap between cooperating contacts, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

5. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, a rigid frame containing said base, a resilient mounting between said frame and said base, projecting seats at the end of said base, two differential thermal elements supported at the ends on said projecting seats and bridging said base, contacts carried by and moving with said thermal elements, and a contact of fixed location, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

6. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, projecting seats at the end of said base, two differential thermal elements supported one above the other at their ends on said projecting seats and bridging said base, contacts carried by and moving with said thermal elements, a contact of fixed location, and spacing elements separating said thermal elements and made of material having substantially the same coefficient of expansion as said moving contacts.

7. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, inwardly inclined projecting seats at the ends of said base, two differential thermal elements supported at the ends on said projecting seats and bridging said base, contacts carried by and moving with said thermal elements and a contact of fixed location.

8. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, inwardly inclined projecting seats at the ends of said base, two differential thermal elements supported one above the other at their ends on said projecting seats and bridging said base, contacts located between, carried by and moving with said thermal elements and a contact of fixed location.

9. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, inwardly inclined projecting seats at the ends of said base, two differential thermal elements supported one above the other at their ends on said projecting seats and bridging said base, contacts located between, carried

by and moving with said thermal elements, a contact of fixed location, and projecting sleeves enclosing said contacts.

10. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, projecting seats at the ends of said base, two differential thermal elements supported at their ends on said projecting seats and bridging said base, and secured to said base by means forming part of the circuit to be closed through contacts carried by them, contacts carried by and moving with said thermal elements and a contact of fixed location.

11. A thermal switch particularly for use in automatic temperature change alarm devices wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising a frame, an insulating base carried by said frame, projecting seats at the ends of said base, two thermal elements of the same mass and material, supported at their ends on said projecting seats arranged one above the other and bridging said base, insulation lagging on one of said thermal elements, electrical contacts carried by and moving with said thermal elements, a contact of fixed location, and sleeves enclosing all said contacts, whereby differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

12. A thermal switch, particularly for use in automatic temperature change alarm devices, wherein provision is made for establishing an electric alarm circuit upon either a sudden temperature change of a predetermined amount or a slow continued temperature change, comprising an insulating base, two differential thermal elements arranged one above the other bridging said base, contacts located between and carried by said thermal elements, a third contact extending from one of said thermal elements, and a fixed contact with which said third contact cooperates, whereby upon a rapid temperature rise differential distortion of the two thermal elements operates to establish an alarm circuit through one pair of contacts and upon a slow temperature rise substantially uniform distortion of the two thermal elements operates to establish an alarm circuit through a second pair of contacts.

CECIL HERBERT STAVE.