Nov. 24, 1953

G. H. FRITZINGER

2,660,646

THERMOSTATIC SWITCH

Filed Aug. 24, 1951

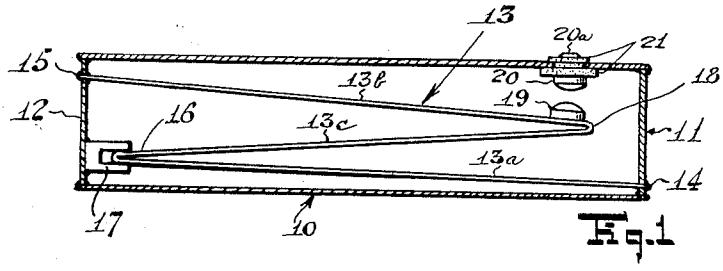

Fig. 1

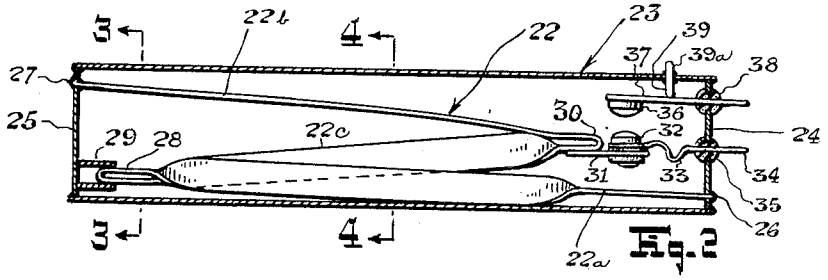

Fig. 2

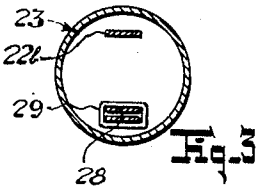

Fig. 3

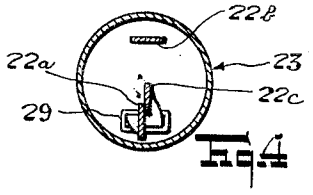

Fig. 4

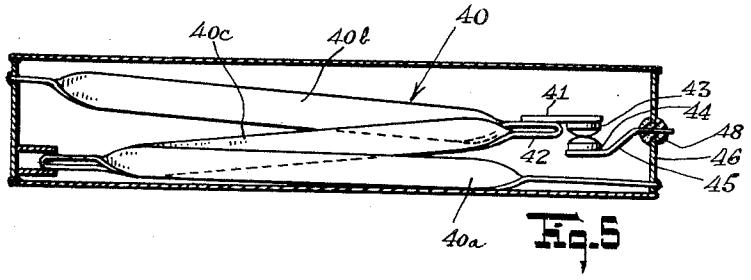

Fig. 5

INVENTOR

George H. Fritzinger

By Henry Lanahan

Attorney

Patented Nov. 24, 1953

2,660,646

UNITED STATES PATENT OFFICE

2,660,646

THERMOSTATIC SWITCH

George H. Fritzinger, West Orange, N. J., assignor to Thomas A. Edison, Incorporated, West Orange, N. J., a corporation of New Jersey

Application August 24, 1951, Serial No. 243,470

11 Claims. (Cl. 200—137)

1

This invention relates to thermostatic switches using thermally-responsive actuating elements which have small actuating movement, and to novel means for amplifying that movement to effect a switch operation. More particularly, the invention relates to such a thermostatic switch whose housing or frame constitutes the thermally-responsive actuating element of the switch.

Objects of my invention are to provide a compact, simple and economical form of thermostatic switch of the character mentioned which has high thermal sensitivity, is very rugged and is unresponsive to vibration forces.

A still further object is to provide a novel and improved motion-amplifying structure for an encased thermostatic switch whose case constitutes the thermal actuating element of the switch.

These and other objects and features of my invention will be apparent from the following description and the appended claims.

In the description of my invention, reference is had to the accompanying drawings, of which:

Figure 1 is a side view of an encased thermostatic switch showing the case in section on a plane through the longitudinal axis of the switch and showing a basic simplified form of motion-amplifying means according to my invention for actuating the switch contacts in response to a longitudinal expansion of the case;

Figure 2 is a side view of an encased thermostatic switch similar to Figure 1 and showing a preferred embodiment of my invention;

Figures 3 and 4 are sectional views taken on the lines 3—3 and 4—4 respectively of Figure 2; and

Figure 5 is a view similar to Figure 2 showing another embodiment of my invention.

In the simplified embodiment of my invention shown in Figure 1, which is chosen to illustrate the principal structure of my invention for producing amplified contact movement in response to a small case expansion, 10 is a frame in the form of a tubular case made of a material, preferably metal, having a high coefficient of thermal expansion, such as brass. This case is preferably closed by end walls 11 and 12 which may be silver soldered in place to hermetically seal the internal structure.

Within the case 10 there is a Z structure 13 according to my invention for obtaining a large contact movement in response to a small change in length of the case. This Z structure comprises a strip of metal having a relatively-low co-efficient of expansion, such as Invar, which is bent in the form of a Z, having outer legs 13a and 13b

2

and an integral diagonal leg 13c. This Z strip extends lengthwise of the case, and is compressed or flattened so that its length dimension is typically several times greater than the spacing between the outer legs. The ends of the outer legs 13a and 13b are secured firmly, as by silver soldering, to the end walls 11 and 12 at 14 and 15 respectively. Also, one apex of this Z strip, referred to as 16, is constrained against movement transversely of the case as by a slotted guide member 17 secured to the respective end wall 12 and embracing slidably under pressure the apex portion of the strip which is bent back on itself. Preferably, the apex 16 and the outer leg 13a leading therefrom are positioned adjacent the outer wall of the case, and the leg 13a is disposed substantially parallel with the case. The point 15 whereat the other leg 13b is secured to the end wall 12 is adjacent a portion of the outer wall of the case diametrically opposite the guide bar 17. As so arranged, the outer legs of the Z strip will diverge slightly when the Z strip is in its unactuated condition shown in Figure 1, which is the condition it has when the case is not expanded. Because of the small spacing transversely of the case between the points whereat the legs 13a and 13b are secured to the end walls, and because of the relatively great length of the Z strip, the other or free apex 18 of the Z strip will receive a large motion transversely of the case in response to a small change in length of the case. For instance, as the case is heated, the longitudinal expansion thereof will cause the apex 18 to swing away from the leg 13a. This amplified transverse movement of the apex 18 is utilized to effect a switch operation. Such switch may comprise, by way of illustration, a contact 19 mounted on the apex 18 and a stationary cooperating contact 20 having a stud 20a extending through the outer wall of the case and insulated therefrom by insulation 21. This stud will serve as the terminal of the thermostatic switch. If the contact 19 is mounted directly on the apex 18, the case will serve as the other terminal.

Since the apex 16 is constrained against transverse movement but is movable lengthwise of the case, the full Z strip is utilized to obtain a maximum amplification of motion. Moreover, it is apparent that this amplifying Z structure is very simple and economical to manufacture, and that it is a very compact structure which can be fitted into a small tubular case having only ¼" diameter or less.

In the preferred embodiment of my invention

shown in Figures 2, 3 and 4, certain portions of the Z structure, now generally referred to as 22, are twisted with respect to other portions thereof so as to rigidify this structure and render it less sensitive to vibration of the switch in the critical direction of the contact movement. This second embodiment comprises also a tubular case 23 of a metal having a high coefficient of thermal expansion and having end walls 24 and 25 preferably sealed in place by silver soldering. As before, the ends of the outer legs 22*a* and 22*b* of the Z strip 22 are secured rigidly to the end walls at 26 and 27 respectively, also as by silver soldering. The apex 28 between the outer leg 22*a* and the diagonal leg 22*c* is constrained against transverse movement in all directions by a short tubular element 29 of rectangular cross section which slidably embraces the portion of the Z strip at this apex and which is secured to the case as by silver soldering. By way of example, the other apex 30 may have a bracket arm 31 secured thereto which carries insulatedly a switch contact 32 that is connected electrically by a flexible metal strip 33 having the central portion folded as shown. This strip 33 extends through the end wall 24, to form an exterior terminal 34, and is sealed to and insulated from the end wall as by a glass bead 35. The contact 32 cooperates with a semistationary switch contact 36 mounted on a cantilever spring 37. The spring 37 extends also through the end wall 24 and is sealed thereto and insulated therefrom by a glass bead 38. The contact 36 is located by a stop member 39 interposed between the outer case wall and the inner half portion of the cantilever spring. The portion of the cantilever spring extending beyond the stop member 39 allows the movable contact 32 to overshoot should the switch be overheated, without effecting any permanent displacement of any parts to change the calibration. The stop member 39 is secured to the case as by soldering and is preferably extended through the wall of the case to have an exterior arm 39*a*. The portion of the case wall surrounding this stop member is preferably made suitably thin to permit easy adjustment of the stop member from the outside so that the thermostatic switch may be set to a predetermined calibration after the case is sealed.

In this second embodiment, the main intermediate portions of the outer leg 22*a* and of the diagonal leg 22*c* of the Z strip are bent at right angles to their end portions to be coplanar with the direction of movement of the free apex 30, which is the critical direction of movement of the switch structure. By so bending these legs of the Z structure the same are rigidified against moving in the critical direction in response to vibration forces. For instance, if the switch as a whole is vibrated in the critical transverse direction, the outer leg 22*a* will be wholly unresponsive thereto because it is held rigidly to the case at its ends and because its intermediate portion is so rigid in that direction that it will not bend in response to the vibration forces. The central portion of the diagonal leg will also be rigid in this critical direction and will not bend in response to the vibration forces. Furthermore, as an additional feature of my invention, the aforestated bending of the apex 28 relative to the remaining portions of the legs 22*a* and 22*c* is made in the direction causing these legs to be bound against one another. This has the benefit of effectively precluding vibratory

movements of the free apex 30 about the apex 28 as a hinge because it tightens up the Z structure by increasing the inherent resilient forces therein tending to press the free apex 30 against the adjacent portion of the leg 22, and it introduces friction in the effective hinge between the legs 22*a* and 22*c*. The outer leg 22*b* is preferably bowed outwardly by contact of the central portion thereof with the adjacent edge of the twisted central portion of the diagonal leg. Such outward bowing precludes relative vibration of intermediate portions of this leg in the critical direction of contact movement and also it causes the Z structure to respond more rapidly to the longitudinal expansion of the case. Thus, by performing several simple bending operations on the simple unitary Z structure of my invention, the same is rendered well-nigh unresponsive to vibration in the direction of contact movement.

In the embodiment shown in Figure 5, the Z structure, now referred to as 40, differs from the Z structure 22 of the foregoing embodiment only in that the central portion of the second outer leg 40*b* is also bent to be coplanar with the central portions of the other two legs 40*a* and 40*c*. Also, a different switch structure is here illustrated which opens instead of closes in response to heating of the thermostat. For example, the switch structure may comprise a bracket arm 41 secured directly to the free apex 42 of the Z structure. This bracket carries a contact 43 in cooperation with a semistationary contact 44 carried by a cantilever spring 45 which extends through the adjacent end wall 46 of the case and which is sealed to and insulated from this end wall by a glass bead 48. When the contact 43 is connected electrically to the Z structure, the case itself will serve as one terminal of the thermostatic switch. The other terminal of this switch will be the extending arm of the cantilever spring 45.

The embodiments of my invention herein particularly described are intended to be illustrative and not necessarily limitative of my invention, since the same are subject to changes and modifications without departure from the scope of my invention, which I endeavor to express according to the following claims.

I claim:

1. A thermostatic switch comprising a frame member of a material having a relatively high coefficient of expansion, a Z strip of a material having a relatively low coefficient of expansion disposed along the length of said frame member, means securing the ends of said strip to end portions of said frame member, means at one end of said frame member constraining one apex portion of said Z strip to movement lengthwise of the frame member, and a switch on said frame member operable by the other apex portion of said Z strip in response to transverse movement thereof caused by longitudinal expansion of said frame member.

2. A thermostatic switch comprising a case of a material having a relatively high coefficient of expansion, a Z strip of a material having a relatively low coefficient of expansion disposed in said case lengthwise thereof, means on said case constraining one apex portion of said Z strip to movement lengthwise of the case, means securing the ends of said Z strip to the ends of said case for causing an amplified transverse movement of the other apex portion of said Z strip in response to lengthwise expansion and contraction

of said case, and a switch in said case operable by said other apex portion of said Z strip.

3. A thermostatic switch comprising a case of a metal having a relatively high coefficient of expansion, a Z strip of a metal having a relatively low coefficient of expansion disposed in said case along substantially the full length thereof, means at one end of said case slidably engaging one apex of said Z strip to confine the same to movement lengthwise of the case, the other apex of said Z strip being inset from the other end of said case, end walls on said case, means securing the ends of said Z strip to said end walls respectively for causing an amplified transverse movement of said other apex transversely of said case in response to a change in length of the case, and a switch in said other end portion of said case operatively associated with said other apex and operable thereby in response to a change in length of said case.

4. The thermostatic switch set forth in claim 3 wherein said one apex and said one end of said Z strip are positioned adjacent diametrically opposite portions of the respective end wall of said case, and wherein the other end of said Z strip is substantially in line lengthwise of the case with said one apex.

5. In a thermostatic switch, a strip of metal having a relatively low coefficient of expansion bent into a Z-shaped structure having outer legs thereof approximately parallel and having a length dimension substantially greater than the spacing between said outer legs, means secured to the ends of said Z structure for varying their distance of separation, means slidably embracing one apex of said Z structure for preventing movement thereof transverse to the direction of said separating movement, and a switch operatively associated with the other apex of said Z structure and operable by transverse movement of said other apex caused by variation in the separation of said ends.

6. In a thermostatic switch, a rigid frame member of a metal having a relatively high coefficient of expansion, a Z structure of a metal having a relatively low coefficient of expansion disposed lengthwise of said frame member, means on said frame member for confining one apex of said Z structure to movement lengthwise of said

frame member, means securing the ends of said Z structure to said frame member for causing an amplified transverse movement of the other apex of said Z structure in response to a change in the length dimension of said frame member, and a switch operable by said other apex.

7. The thermostatic switch set forth in claim 6 wherein at least the central portions of the outer leg leading from said one apex and the diagonal leg of said Z structure are bent at right angles to the end portions thereof to be substantially coplanar with the direction of transverse movement of said other apex for rigidifying said Z structure to reduce response of said other apex to transverse vibration of the frame member in said direction.

8. The thermostatic switch set forth in claim 6 wherein the central portions of each of the legs of said Z structure are bent at right angles to the end portions thereof to be coplanar with the direction of transverse movement of said other apex.

9. The thermostatic switch set forth in claim 6 wherein the outer and diagonal legs of said Z structure extending from said one apex are bent at right angles to said one apex, and wherein the direction of said bend is one binding said outer and diagonal legs together tending to oppose outward transverse deflection of said other apex and producing friction between said outer and diagonal legs in the effective hinge therebetween at said one apex.

10. The thermostatic switch set forth in claim 6 wherein the central portions of the outer and diagonal legs of said Z structure extending from said one apex are bent at right angles to the end portions of said legs to be substantially coplanar with the direction of transverse movement of said other apex, and wherein the other outer leg of said Z structure is bowed outwardly.

11. The thermostatic switch set forth in claim 10, wherein said outward bowing of said other outer leg is effected by contact of the central portion thereof with an edge of the stated central portion of said diagonal leg.

GEORGE H. FRITZINGER.

No references cited.