United States Patent

Tyler

[15] 3,691,499

[45] Sept. 12, 1972

[54] **ACTUATING DEVICE EMPLOYING A HEAT EXPANSIBLE WIRE**

[72] Inventor: **Hugh J. Tyler,** Santa Ana, Calif.

[73] Assignee: **Robertshaw Controls Company,** Richmond, Va.

[22] Filed: **Sept. 10, 1971**

[21] Appl. No.: **179,372**

[52] **U.S. Cl.** **337/123,** 60/23, 337/398

[51] **Int. Cl.**.....**H01h 71/18**

[58] **Field of Search**.....337/123, 126, 139, 140, 395, 337/398; 73/363, 378.3; 60/23

[56] **References Cited**

UNITED STATES PATENTS

3,169,180	2/1965	Chafer	337/140 X
3,254,178	5/1966	Voorman	337/140 X
3,254,180	5/1966	Flanagan	337/140 X

Primary Examiner—Bernard A. Gilheany
Assistant Examiner—F. E. Bell
Attorney—Anthony A. O'Brien et al.

[57] **ABSTRACT**

The present actuator employs a heat expansible element and is of the type actuator known as a "hot-wire" actuator. The present actuator has an extremely simplified structure formed by two substantially J-shaped frame members, the arms of which are interconnected by insulating members; a thermally expansible element extending between the base portions of the frame members, which base portions also have depending legs serving both as terminals and supports for the frame; and linkage means responsive to the tension of the element as it expands and contracts to produce movement useful for actuating switches, valves, etc.

3 Claims, 4 Drawing Figures

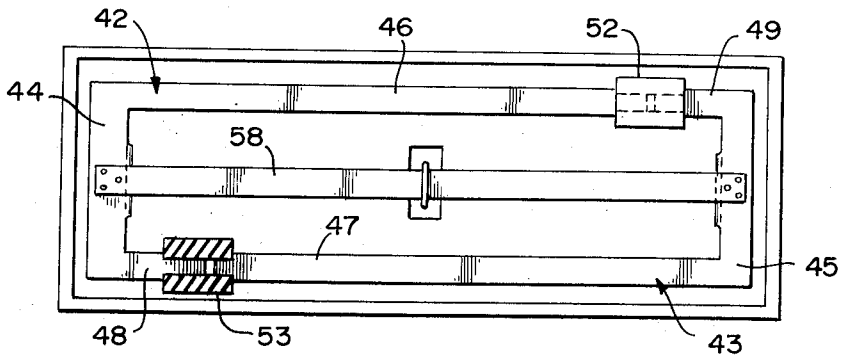


FIG. 1
PRIOR ART

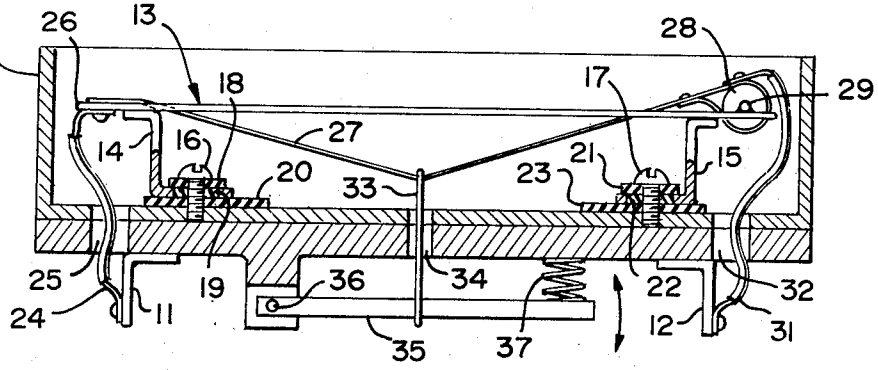


FIG. 2
PRIOR ART

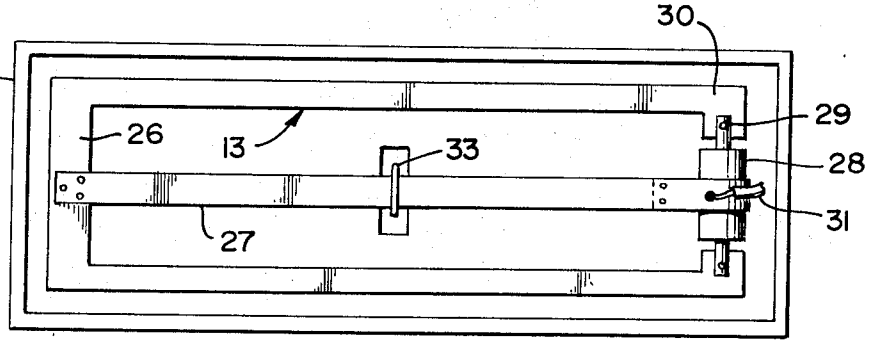


FIG. 3

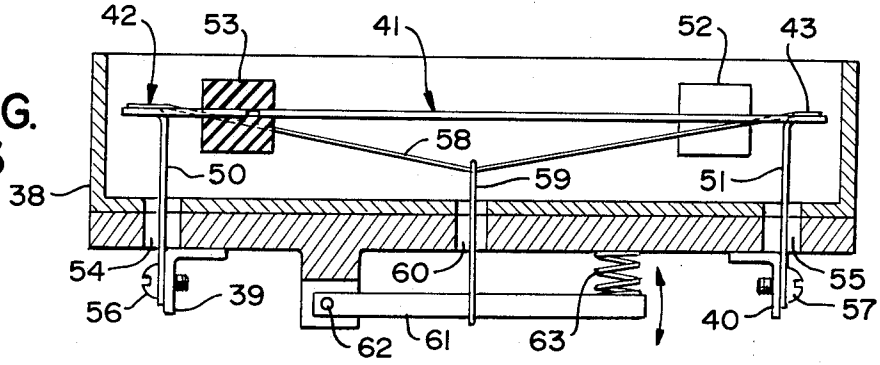
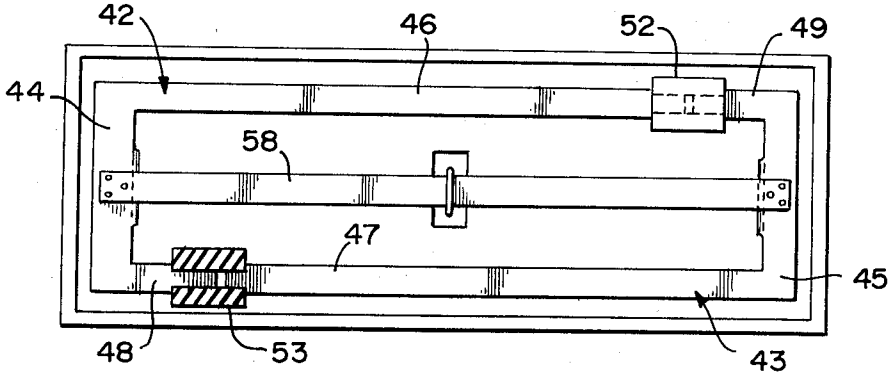


FIG. 4



ACTUATING DEVICE EMPLOYING A HEAT EXPANSIBLE WIRE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to actuators of the general type known as "hot-wire actuators" in which, when energized, a thermally expansible element heats and expands, the movement of expansion being transmitted to a device to be actuated.

2. Description of the Prior Art

An example of the known hot-wire actuators has been shown in FIGS. 1 and 2. These known actuators have provided the desired actuator operation through the movement of a thermally expansible element but generally suffer from the disadvantage of having a large number of parts and are both difficult and expensive to assemble and adjust for a desired accuracy.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an improved actuator consisting of a few simple parts which are both low in cost and easy to assemble.

It is a further object of this invention to provide a means for assembling the improved actuator by using loose fitting, easy-to-assemble insulators and frame members in such relationship with one another that their looseness or play will not affect the precision of the thermal operator output.

The inventive thermally responsive actuator is formed by a frame having two identical J-shaped frame elements with insulating members connecting the long leg of each element with the short leg of the other element. Base portions of the frame elements have terminals extending at right angles to the plane formed by the legs and serving both as electrical connectors and to mount the frame in a casing. A strip-shaped element of thermally expansive material is connected between base portions of the frame elements and linkage means are operatively connected between the thermally expansive element and the device to be actuated so that the movements of the former will be transmitted to the latter.

These and other objects and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment viewed in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal vertical section of a known hot-wire actuator;

FIG. 2 is a top plan view of the actuator of FIG. 1;

FIG. 3 is a longitudinal vertical section of the improved actuator of the present invention; and

FIG. 4 is a top plan view of the inventive actuator of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The known actuator shown in FIGS. 1 and 2 has a casing 10 with terminals 11 and 12 fixed on the exterior thereof. A generally C-shaped frame 13 is mounted within and spaced on all sides from the casing 10 by

brackets 14 and 15 and screws 16 and 17. The frame is insulated from the casing by insulators 18 to 23. Lead 24 passes through an aperture 25 in the casing to electrically connect terminal 11 to closed end 26 of the frame 13. A strip of thermally expansible material 27, known as a "hot-wire," is fastened between the closed end 26 and an insulating roller 28, which is rotatably mounted by axle 29 across the open end 30 of the frame 13. A second lead 31 electrically connects the terminal 12 to the strip 27 through orifice 32. A link 33 is fastened by one end to an intermediate portion of the strip 27 and extends through aperture 34 in casing 10 with its other end operatively connected to lever 35. Lever 35 has one end pivotally attached to the casing at 36 and has its other end biased for clockwise rotation by helical compression spring 37.

This known actuator is operated by energizing the electrical circuit including terminal 11, lead 24, frame 13, strip 27, lead 32 and terminal 12 to heat the thermally expansible strip 27. As the strip 27 heats and expands, it will be drawn downward by the action of the bias spring 37 through lever 35 and link 33, thereby producing a clockwise movement of the free end of the lever 35, which movement can be transmitted in a known manner (not shown) to the device being actuated. When the circuit is deenergized, the strip will cool and contract thus causing a counterclockwise movement of the lever 35 against the force of spring 37.

The present invention, shown in FIGS. 3 and 4, has a casing 38 with terminals 39 and 40 fixed on the exterior thereof. The frame 41 of the inventive actuator is formed by two identical frame elements 42 and 43. Each frame element has a generally J-shaped profile formed by base portions 44 and 45, long arms 46 and 47, and short arms 48 and 49 with terminal legs 50 and 51 depending from the base portions normal to the plane defined by the J-shaped profile. The frame is assembled by connecting arms 46 and 49 in fixed spaced relation by means of insulator element 52. Arms 47 and 48 are similarly connected by insulator element 53. The terminal legs 50 and 51 are, respectively, passed through apertures 54 and 55 and connected to terminals 39 and 40 by screws 56 and 57. Legs 50 and 51 thus serve to both fix the frame within and spaced on all sides from the casing and as electrical connections between the terminals and the strip of thermally expansible material 58, which is fixed between the base portions 44 and 45. Link 59 has one end attached to the strip and its other end passing through aperture 60 where it is attached to lever 61. Lever 61 has one end pivoted to casing 38 at pivot 62 and the other end biased for clockwise rotation by helical compression spring 63.

When the circuit including terminal 39, leg 50, base portion 44, strip 58, base portion 45, leg 51, and terminal 40 is energized, the strip 58 will heat, expand, and be drawn downward by link 59, lever 61 and spring 63. Insulator elements 52 and 53 insulate and mechanically restrain the frame arms as the thermally expansible strip expands and is drawn downwards so that the movement of the lever will reflect substantially only the expansion of strip 58.

A feature of the present invention is the loose fit of the insulator elements on the frame arms which acts to restrain any appreciable movement of the strip sup-

porting base portions towards one another. They also serve to prevent any twisting motion of the frame assembly during movement of the hot-wire in order to achieve the desired, and far superior, mechanical stability of the frame.

The low manufacturing cost of the parts and the assembly can be appreciated by visualizing the individual parts. Identical long and short frame arms are inserted into identical insulator elements. A hot-wire is spot-welded to the base areas of the frames to complete the self-supporting thermal actuator which can be assembled as a unit to the mechanism to be operated.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. Therefor the foregoing description is intended in all respects as illustrative and not in a limiting sense.

What is claimed is:

1. A thermal responsive actuator comprising

a casing,

a frame comprising two substantially identical frame elements mounted in said casing,

each said frame element having a generally J-shaped configuration formed by a long arm and a short arm extending from a base portion and a terminal portion extending from said base portion normal to the plane of said arms,

insulating means connecting said arm portions of one of said frame elements to said arm portions of the other of said elements,

thermally expansive wire means connected between said base portions of said frame elements, and

means connected to said wire means to be responsive to the movement thereof and to effect a useful movement.

2. A thermal responsive actuator according to claim 1 wherein said means connected to said wire means comprises,

lever means having one end pivotally mounted on the exterior of said casing,

spring means biasing the other end of said lever means away from said casing, and

link means passing through said casing with one end attached to said wire means and the other end attached to said lever means.

3. A thermal responsive actuator according to claim 1 wherein said frame is mounted with said terminal portions projecting out of said casing thereby forming electrical connection terminals for the actuator.

* * * * *