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3,139,500

THERMALLY ACTUATED DOUBLE THROW SWITCH MECHANISM

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Fig. 1.

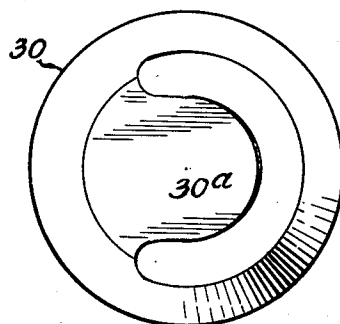
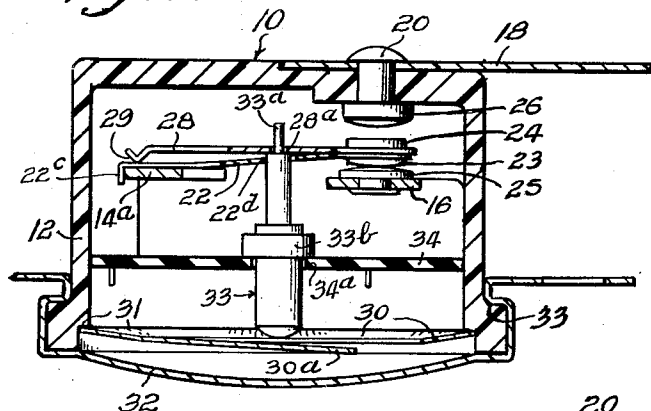


Fig. 5.

Fig. 2.

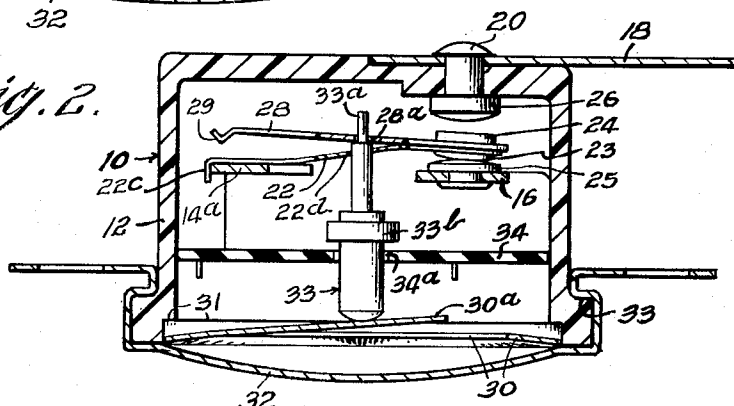


Fig. 3.

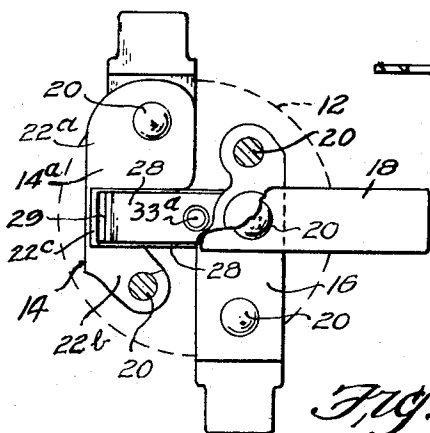
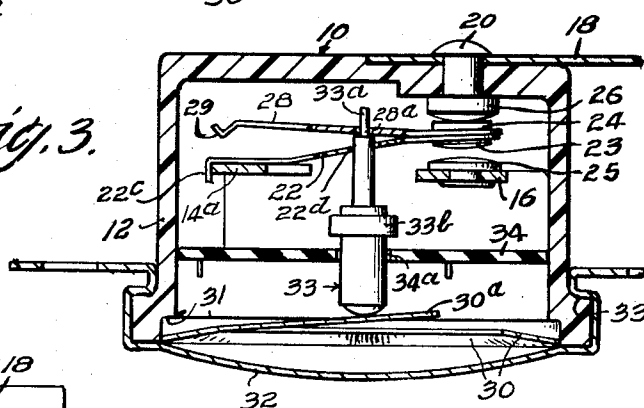


Fig. 4.

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1

3,139,500

THERMALLY ACTUATED DOUBLE THROW SWITCH MECHANISM

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The present invention relates to an improved electric switch mechanism particularly suitable for operation by a thermally responsive element.

One object of the present invention is the provision of an electric switch which may be of the double-throw type operated by a snap acting thermally responsive element which suddenly reverses its form in response to temperature changes and which provides movement in excess of that required for actuating the movable switch contact, the connection between the thermally responsive element and movable switch contact being yieldable to permit a relatively free normal amplitude of movement of the element so that its responsiveness to temperature changes is unaffected by confining stresses.

Another object of the invention is the provision of an improved switch comprising a flexible contact arm which is flexed to engage and disengage a fixed contact, the contact arm being moved from engagement with the fixed contact by a relatively rigid actuator member rigidly attached thereto at an area adjacent to the point at which the arm engages the contact so that when the actuator is moved in a direction in which the contact arm flexes and the contacts tend to stick due to welding, for example, the actuator pivots about the contact and rocks or twists the arm at the point of its engagement with the fixed contact, thereby breaking the weld by use of a relatively low force. The contact arm may move between two fixed contacts to provide a double-throw switch and the twisting action described occurs at each contact position.

A further object of the invention is to provide a switch structure of the character mentioned having a double-throw contact arrangement and in which the actuator lies along side the contact arm and has a heel portion which engages a stop so that an operating element acting on the actuator and exerting a force in excess of that required to flex the contact arm from one fixed contact to the other can overtravel relative to the arm by moving the actuator to separate the heel portion from the arm. The actuator then maintains the arm closed on the last mentioned fixed contact although the operating element may initially gradually shift toward the other switch position, and then upon snap movement of the operating element toward the other position, the heel portion of the actuator strikes the arm thereby imparting a hammer-like action to the arm to cause it to positively and quickly shift from the last engaged contact to the other.

The improved switch structure assures positive switch operation by a minimum of force on the actuator, and provides for yielding overtravel of the actuator so that the actuator may be operated by a condition responsive device having a response travel appreciably in excess of the travel required to actuate the switch and which may be of the type which has an initial relatively slow or "creeping" movement followed by a snap movement, such as a snap acting bimetal.

These and other aspects of the invention will become more readily apparent upon examination of the following detailed description together with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of a double-throw switch embodying the invention;

FIG. 2 is a cross-sectional view similar to FIG. 1 but showing a partial welding of the contacts and an initial

2

movement of the contact arm in shifting from the position shown in FIG. 1 to its alternate position;

FIG. 3 is a view similar to FIG. 2 showing the contact arm of the switch shifted to its alternate position;

FIG. 4 is a top, fragmentary view of the switch showing the relationship of the switch terminals and the contact portions thereof; and

FIG. 5 is a plan view of a bimetal element of this switch mechanism.

Referring to the drawings, reference numeral 10 indicates a thermally responsive switch constructed according to the present invention and which includes a generally cylindrical housing or frame 12 of suitable molded insulating material and which supports terminals 14, 16 and 18 attached thereto by rivets 20. Terminal 14 provides a bridge portion 14a to which one end of a flexible contact arm 22 is attached, the arm having laterally projecting lugs 22a and 22b which rest on and are attached to the terminal by the rivets 20, as shown in FIG. 4. A downwardly turned flange 22c cooperates with the left hand edge of terminal 14 to position the arm. The opposite end of arm 22 carries oppositely facing contacts 23 and 24 which alternately engage fixed spaced contacts 25 and 26 attached to terminals 16 and 18, respectively, as shown. Contact arm 22 may be formed of any suitable spring material having good electrical properties such as beryllium copper or Phosphor bronze, and is normally biased to close contact 23 on fixed contact 25 but may be flexed upwardly to engage contact 24 with contact 26.

Contact arm 22 is flexed upwardly, as viewed in the drawings, to separate contacts 23 and 25 and to close contacts 24 and 26 by an actuator 28 which is moved by an operating element 30 in the form of a snap acting bimetal. Actuator 28 comprises an elongated bar-like member which is rigid as compared to the contact arm and which extends generally parallel to the arm and is firmly attached thereto at the point between contacts 23 and 24. This arrangement is such that actuator 28 is urged toward contact arm 22 by the resiliency of the latter and the left hand end thereof is normally spaced from the arm by a heel portion or ridge 29 formed therein which engages the end of the contact arm attached to terminal 14, as seen in FIG. 1. In the form of the invention shown a thermally responsive element 30 operates actuator 28 in response to predetermined changes in temperature and comprises a snap acting type bimetal member which is dish-shaped and is normally bowed or dish downwardly when below a given temperature and which reverses its curvature to bow upwardly with a quick, substantial movement upon attaining the given degree of temperature. Such snap acting devices and variations thereof are well known in the art and any suitable type may be employed. Element 30 is disposed in the lower part of housing 12 so as to freely reverse its form, and the periphery thereof is loosely disposed between an annular shoulder 31 and a circular metal cover plate 32 crimped over a shoulder 33 formed about the lower end of the housing 12.

Actuator 28 is connected with element 30 by a plunger 33 which is guided vertically by the edges of an opening 34a in a partition 34 secured inside housing 12, and the upper end of the plunger has a neck portion 33a which projects through an opening 22d in contact arm 22 and through a smaller opening 28a in actuator 28, the shoulders about the neck portion abutting the underside of the actuator. Plunger 33 has a collar formation 33b which engages wall 34 about opening 34a to limit downward movement of the plunger and the lower end of the plunger is engaged by a central tongue 30a formed on element 30 when the element flexes upwardly, as is described more fully hereinafter.

With specific reference to FIGS. 1-3, the operation of the switch is shown in sequence as would occur should contacts 23 and 25 tend to stick, as will occur by arc welding. As plunger 33 is pushed upwardly by tongue 30a upon snap movement of bimetallic element 30, it acts upon the intermediate portion of the rigid actuator member 28 to cause the free end thereof to swing upwardly in a direction generally parallel to a line between contacts 25 and 26. This initial upward movement of the free end of actuator 28 causes the actuator to pivot about contact 25, which pivoting provides a rocking or twisting action of contact 23 on contact 25, thereby readily breaking the weld. At the same time, upward movement of the free end of actuator 28 causes some flexing of the resilient arm 22 to the left which shortens its effective length thereby tending to draw contact 23 slightly to the left, as it is twisted from contact 25. Further upward movement of plunger 33 causes actuator 28 to flex contact arm 22 upwardly and engage contact 23 with contact 26. It will be appreciated that as a practical matter the movement of contact arm 22 from contact 25 to contact 26 takes place with a snap action due to the snap movement of element 30.

It is to be noted that after contact arm 22 engages contact 26, actuator 28 may be further yieldingly pivoted about the engaging portions of contacts 23 and 26 so that but slight resistance is offered to tongue 30a of bimetal element 30 in its upward flexure, which permits the bimetal to assume a more or less unrestrained reversed curvature. We have found that if the bimetal is confined and limited in its movement to less than its normal amplitude, stresses are imposed thereon which tend to change its operative temperatures.

It will be understood that the movement of the contact arm from upper contact 26 to lower contact 25 is substantially the reverse of the movement just described. As the bimetallic disc 30 reverses its curvature under the influence of changes in temperature, the tongue thereof lowers plunger 33 and the free end of actuator 28 moves downwardly. This movement again has the effect of twisting or rocking contact 24 free from upper contact 26 should these contacts tend to stick, thereby breaking any welded connection which might have been formed. Simultaneously, resilient contact arm 22 is flexed somewhat from its straight-line position so that a wiping action between the contacts 23 and 26 takes place. As disc 30 snaps to its position of curvature shown in FIG. 1, the spring force stored in contact arm 22 by its initial upward deflection, causes the contact arm to follow the snap action of the disc and to bring about a snap action connection between contacts 23 and 25.

It will be noted that by the construction disclosed, initial slight movement of tongue 30a of element 30 does not appreciably lessen the contact pressure between contacts 24 and 26, and the separation of these contacts occurs only after the bimetal has commenced its snap action. This is likewise true with respect to movement of the bimetal and switch parts in the opposite direction inasmuch as tongue 30a is below plunger 33 during the initial pre-snap movement of the tongue.

One of the features of the invention is that the switch may be actuated by using a relatively low actuation force. This is due to the twisting or rocking movement imparted to the closed contacts by actuating member 28, thereby obviating the need for high forces in breaking partially welded contacts. At the same time, the construction of the switch is such that it can readily accommodate appreciably more movement of the prime actuator thereof than is necessary to shift the contact so as to permit over-travel of the actuator without imposition of undue stress on any of the elements.

It will be understood that the above description and the drawings are representative only and that changes may be made thereto without departing from the spirit and

scope of the invention as defined in the appended claims. We claim:

1. A switch mechanism comprising:

- (a) support means,
- (b) a fixed contact mounted on said support means,
- (c) a flexible spring arm having one end secured to said support means,
- (d) a movable contact carried on the other end of said spring arm and normally urged by said spring arm in a first direction toward said fixed contact,
- (e) an elongated actuator member formed of a relatively rigid material with respect to said spring arm and having one end fixed to the end of said spring arm on which said movable contact is carried, and extending along one side of said spring arm remote from said fixed contact and having the other end terminating adjacent said one end of said spring arm and being movable laterally therefrom,
- (f) said spring arm normally biasing said actuator member toward said spring arm, and
- (g) means for applying a moving force to said actuator member between the ends thereof in a direction opposite to said one direction so as to tend to separate said other end of said actuator member from said spring arm and flex said contact carrying end of said spring arm to impart a rolling action of said movable contact on said fixed contact before said movable contact is moved away from said fixed contact.

2. A switch mechanism comprising:

- (a) support means,
- (b) fixed contact mounted on said support means,
- (c) a flexible spring arm having one end secured to said support means,
- (d) a movable contact carried on the other end of said spring arm and normally urged by said spring arm in a first direction toward said fixed contact,
- (e) an elongated actuator member formed of a relatively rigid material with respect to said spring arm and having one end fixed to the end of said spring arm on which said movable contact is carried,
- (f) said actuator being disposed along the side of said spring arm remote from said fixed contact and terminating with its other end adjacent said one end of said spring arm,
- (g) said spring arm normally biasing said actuator member toward alignment against said spring arm,
- (h) means for applying a moving force to said actuator member between the ends thereof in a direction opposite to said one direction so as to tend to separate said actuator member from said spring arm and to flex said spring arm before said movable contact is moved away from said fixed contact,
- (i) said support means comprising stop means adjacent said one end of said spring arm, and
- (j) said other end of said actuator member terminating in a heel portion,
- (k) said heel portion being disposed adjacent said stop means for engagement therewith during movement of said movable contact toward said fixed contact upon withdrawal of said force whereby said actuator arm is caused to pivot about said heel portion and accelerate the movement of said movable contact into engagement with said fixed contact.

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