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SNAP ACTION THERMAL LIMIT SWITCH

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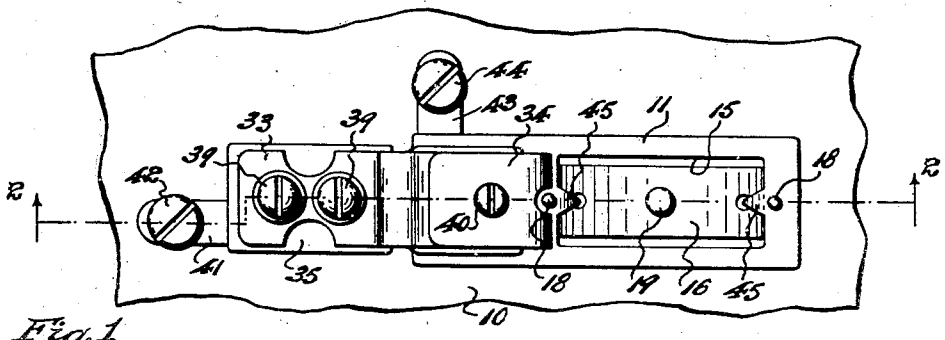

Fig. 1

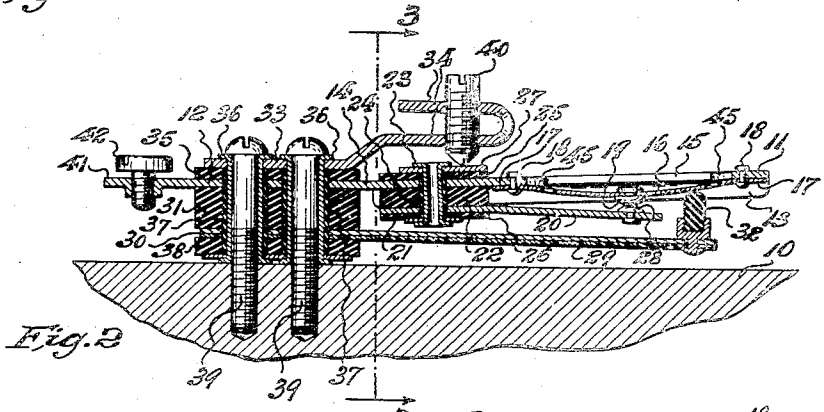

Fig. 2

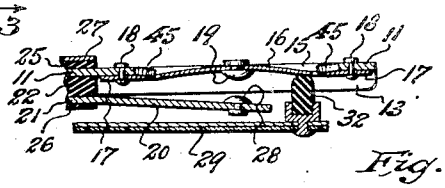

Fig. 4

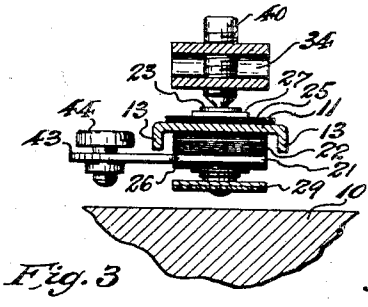

Fig. 3

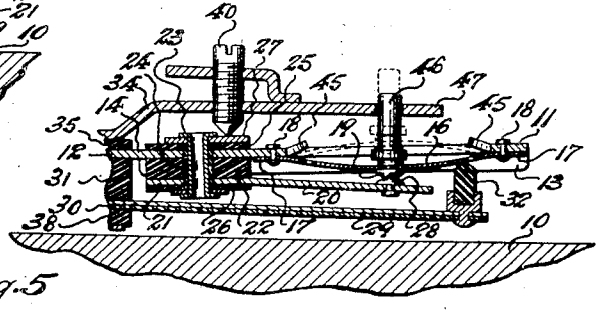

Fig. 5

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SNAP ACTION THERMAL LIMIT SWITCH

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6 Claims. (Cl. 200—139)

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This invention relates to improvements in electrical switches of the thermal limit type adapted to automatically open with a snap action when temperature of a device or at a location served thereby exceeds a desired predetermined limit.

This invention has for an object to provide a novel snap action thermal limit switch, which is easily convertible for optional operation as either a self-resetting switch or a manually resettable switch.

The invention has for a further object to provide a novel normally closed electrical switch adapted to be opened by a bi-metallic element which is responsive to temperature rise; the movable contact means of which comprises a flat carrier spring which is fixed by its opposite ends to a support so as to be subjected to compression stress adapted to dispose the same in arcuate or bowed condition relative to the plane of its support, but neverthless so as to be responsive to a proper directionally applied pressure, substantially perpendicular thereto, whereby it may be sprung or snapped across a center line from down-bowed to up-bowed position, or vice versa, to bring the movable contact means in closed or open relation, as the case may be, to a relatively stationary contact means cooperative therewith; said bi-metallic element being adapted, in operation, to deflect the carrier spring in direction to separate the movable and stationary contact means.

The invention has for another object to provide a novel relative arrangement of the circuit make and break elements of the switch together with means for adjusting the same in relation to the thermostatic bi-metallic element of the switch, whereby to be actuated by the latter in response to temperature of a selected predetermined degree; the arrangement of said circuit make and break elements being such that adjusting movement thereof relative to the thermostatic bi-metallic element cannot disturb the normal initial relation of said make and break elements one to the other.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

Illustrative embodiments of this invention are shown in the accompanying drawings, in which:

Fig. 1 is a top plan view of a self-resetting form of the switch of this invention, the same being shown in circuit closing condition; Fig. 2 is a longitudinal sectional view thereof, taken on line 2—2 in Fig. 1; Fig. 3 is a transverse sectional view thereof, taken on line 3—3 in Fig. 2; and Fig. 4 is

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a fragmentary longitudinal sectional view, similar to that of Fig. 2, but showing the switch in circuit interrupting condition.

Fig. 5 is a fragmentary longitudinal sectional view of a manually resettable form of the switch of this invention.

Similar characters of reference are employed in the herein above described views, to indicate corresponding parts.

In the drawings, the reference character 10 indicates a heated body, the temperature of which is desired to be electrically controlled through a circuit including the thermal limit switch of this invention.

The switch structure, according to this invention, comprises a metallic, and therefore electrically conductive, supporting frame plate 11 having a butt portion 12 integral therewith. Said frame plate 11 per se is of rigid or inflexible character, and, to assure such rigidity, is provided with means to stiffen the same against bending, such e. g. as stiffening flanges or ribs 13 disposed to project angularly from the plane thereof along its longitudinal margins. The transverse zone 14 intermediate the body of said frame plate 11 and its butt portion 12 provides a flexibly resilient section adapted to form a hinge-like connection about which the frame plate may be swung up or down, for purposes to be subsequently set forth. The tension of such hinge-like connection is such as to normally but yieldably up-swing the frame-plate relative to the horizontal plane of the fixed butt portion 12.

The body of the frame plate 11 is provided with an elongated opening 15 of suitable length and width extending between inner and outer end portions thereof. Aligned with and extending longitudinally over said opening 15 is a flat carrier spring 16 of a width somewhat less than the width of said opening 15. Said carrier spring 16 is fixedly anchored at its respective opposite end portions 17 to the body of said frame plate 11 by suitable fastening means, such e. g. as rivets 18. In such fixed relation, said carrier spring is subjected to a compression stress which is adapted to arcuately form or bow the body thereof relative to the flat plane of its fixed ends and that of the supporting frame plate 11 in one direction or the other. As thus bowed, the spring body is yieldably responsive to proper directionally applied pressure perpendicular thereto, whereby it may be sprung or snapped across a center line or plane from up-bowed to down-bowed position, or vice versa. Said carrier spring 16 is provided, centrally of its arcuate or bowed portion with a con-

tact element 19 projecting from its underside. Said carrier spring and its contact element constitutes the movable contact means of the circuit make and break elements of the switch. The relatively stationary contact means of the circuit make and break elements of the switch is also carried by the frame plate 11, and comprises a metallic, and therefore electrically conductive, arm 20 having a butt portion 21 disposed to underlie and to be affixed to the frame plate 11, but spaced and electrically insulated from the latter by an interposed block or body of insulation material 22. Said butt portion 21 and insulation material 22 is fixedly secured to the frame plate 11 by suitable fastening means, such e. g. as rivet means 23. Said rivet means 23 being electrically insulated from both the frame member 11 and the butt portion 21 and arm 20 by an insulating sleeve 24 and external insulation elements 25 and 26. Said rivet means 23 is also utilized to secure a wear plate 27 in place relative to the upper or outer side or face of the frame plate 11; said wear plate 27 being adapted to receive the operative thrust of means provided for adjusting the circuit make and break elements of the switch relative to the thermostatic bi-metallic element of the switch, as will presently appear. From its fixed butt portion 21 said conductive arm 20 extends forwardly in aligned but downwardly spaced relation to and beneath the frame plate 11 and carrier spring 16. Said arm 20 is provided at its free end portion, with a contact element 28 disposed to project from its upper side toward the contact element 19 of the movable contact means and in the path of movement of the latter.

The thermostatic member of the switch comprises a bimetallic plate 29 having a butt portion 30 which is disposed to underlie and to be affixed to the butt portion 12 of the frame plate 11, but spaced and electrically insulated from the latter by an interposed block or body of insulation material 31. From its fixed butt portion 30, said bi-metallic plate 29 extends forwardly in aligned but spaced relation to and beneath the aforesaid movable and stationary contact means. The free end portion of said bi-metallic plate 29 extends beyond the free end of the arm 20 of the stationary contact means, so as to underlie a portion of the bowed carrier spring 16 of the movable contact means. Suitably affixed to the free end portion of said bi-metallic plate 29 is an upstanding, electrically non-conductive push-finger 32, which is directed toward the carrier spring 16 of the movable contact means. As related to and disposed beneath the movable and stationary contact means, said bi-metallic plate 29 is positioned at the under or inner side of the switch, and so as to lie closely adjacent to the surface of the heated body 10, when the switch is mounted upon and fixed to said body. Said bi-metallic plate 29 is so characterized, that, when expanded by heat radiated from the body 10, it is upwardly deflected, thus causing its free end portion to move toward the carrier spring 16 of the movable contact means.

Mounted on the upper or outer side of the switch is the butt portion 33 of a bracket arm 34, the latter being upwardly offset so as to overhang the frame plate 11. Said butt portion 33 of the bracket arm 34 is affixed to the butt portion 12 of the frame plate 11, but is spaced and electrically insulated from the latter by an interposed block or body of insulation material 35.

To secure the butt portions of the described elements of the switch and the interposed insulation in assembled relation, suitable fastening means is passed through the assembly. A preferable form of fastening means comprises one or more hollow rivets 36, the same being insulated from electrical contact with the conductive elements of the switch by surrounding sleeves 37 of insulation material; a bottom block or body of insulation material 38 being preferably included contiguous to the butt portion 30 of the bi-metallic plate 29. Said hollow rivets 36 provide passages through which may be passed fastening screws 39, whereby to secure the butt or heel of the switch to the body 10 upon which it is desired to operatively mount said switch.

Threaded through the bracket arm 34 is an adjusting screw 40, which may be utilized for adjustably moving the frame plate 11, and the movable and stationary contact means carried thereby, toward and from the push-finger 32 of the bi-metallic plate 29, whereby to selectively predetermine the temperature at which movement of said bi-metallic plate, when expanded and flexed by heat radiated from the body 10, will be sufficient to carry the push-finger 32 into switch opening engagement with the carrier spring 16. By turning said adjusting screw 40 inwardly, the same thrusts downwardly on the wear plate 27, thus swinging the frame plate 11 downwardly about the flexible connection 14 by which it is joined to its butt portion 12, thereby moving the contact elements closer to the push-finger 32, so that the latter becomes operative at a relatively low degree of temperature. By turning said adjusting screw 40 outwardly, said frame plate and the contact elements carried thereby, is permitted to move farther away from the push-finger 32 of the bi-metallic plate, so that the latter becomes operative at a relatively higher degree of temperature. Owing to the fact that both the movable contact element, comprising the carrier spring 16, and the stationary contact element, comprising the contact arm 20, are both carried by the movable or swingable frame plate 11, it will be obvious that adjusting movement of the latter, will not interfere with or disturb the normal initial set relation of the make and break contact elements one to the other. This is of decided advantage, and permits of very precise adjustment of the switch for response to a selected degree of operating temperature.

Means is provided for connecting the frame plate 11 and carrier spring 16 supported thereby to one side of an electrical circuit to be controlled by the switch. Illustrative of one form of such means, as shown, the same may comprise an exteriorly projecting pole piece 41 having a binding screw 42 operative to mechanically and electrically connect thereto a circuit wire (not shown). Similarly, means is provided for connecting the stationary contact arm 20 to the other side of said electrical circuit, an illustrative form of which, as shown, may comprise an exteriorly projecting pole piece 43 extending from the butt portion 21 of said arm, and having a binding screw 44 operative to mechanically and electrically connect thereto a circuit wire (not shown).

Means is provided in connection with the frame plate 11 which is cooperative with the carrier spring 16 of the movable contact means of the switch, and which is subject to adjustment whereby said carrier spring may be optionally controlled or set relative to the frame plate so as to be either self resetting or returning to a normal switch closed position, or manually resettable

to such position. The means for this purpose comprises adjustable check lugs 45 which project longitudinally from the frame plate 11 at the ends of the opening 15 of the latter so as to respectively overlie end parts of the bowed section of the carrier spring 16. As shown in Figs. 2 and 4 more particularly, if it is desired that the carrier spring 16 be controlled or set whereby to be self resetting or returning from up-bowed switch open position to down-bowed switch closed position, said check lugs 45 are bent downwardly or depressed toward the carrier spring body, so that the extremities of said check lugs bear on the carrier spring at points spaced longitudinally inward from the fixed ends of the latter, thereby exerting upon the end portions of the carrier spring, which lie between the check lug extremities and the fixed ends of the carrier spring, especially when the carrier spring is moved to up-bowed or switch open position, a counter stress operative to automatically urge the up-bowed mid-position of the carrier spring back to down-bowed switch closed position, when up-bowing pressure of the bi-metallic plate 29 is relaxed. As shown in Fig. 5, if it is desired that the carrier spring 16 be controlled or set whereby to retain an up-bowed or switch open position to which it has been moved, said check lugs are turned or bent upwardly or away from and out of contact with the end portions of the bowed section of the carrier spring, whereby all restraint upon the up-bowing stresses upon the carrier spring, once it is moved to up-bowed position, are removed, so that said carrier spring will remain in up-bowed or switch open position until said up-bowing stresses are manually overcome. As also shown in Fig. 5, means may be provided for manually overcoming such up-bowing stresses, such e. g. as a manipulatable push-button 46 adapted to be supported in and by an extension 47 of the bracket arm 34, so as to engage the medial portion of the bowed section of said carrier spring 16. By reason of the provision of said check lugs 45, it will be obvious that the switch may be easily converted at will from a self-resetting type to a manually resettable type, or vice versa.

In the operation of the switch, the circuit controlled thereby is used to energize suitable electrical heating means (not shown) for heating the body 10. As the temperature of the heated body 10 rises, heat radiated or conducted therefrom is transferred to the bi-metallic plate 29. Under the influence of the applied heat, said bi-metallic plate is deflected or warped, whereby to cause its free end portion to move toward the down-bowed carrier spring 16, until, on attaining a desired temperature degree to which the switch is adjusted to respond, the push-finger 32 engages and pushes upwardly upon the carrier spring 16, whereby to up-bow the mid portion of the same with a rapid snap action, thus separating the contacts 19 and 28 and interrupting the controlled electrical circuit. If the carrier spring is controlled by the check lugs 45 so as to be self returning, said carrier spring will snap back to switch closing position, when, under temperature drop, the bi-metallic plate 29 contracts to normal initial condition. This is due to the fact that the up-bowing of the mid-portion of the carrier spring, which extends inwardly of the engaging check lugs 45, is accompanied by down-bowing of end portions of said carrier spring, which respectively extend outwardly of the engaging check lugs. Said down-bowed end portions exert a counter stressing effect upon said up-bowed mid-portion of the carrier spring when up-thrusting pressure of the push-finger 32 is withdrawn, so that said mid-portion of the carrier spring will be snapped back to normal down-bowed switch closing condition. Under these circumstances the extremities of the check lugs 45 serve as fulcrums between the stressed up-bowed mid-portion of the carrier spring and the counter stressed down-bowed end portions of the latter. If the carrier spring is relieved from the restraint of the check lugs 45, said carrier spring will remain in up-bowed switch opening position, until manually down-bowed to switch closing position. If desired an electrical resistance may be applied to and around the bi-metallic plate 29 for electrically heating the same, whereby the switch may be operated as an overload circuit breaker, relay or thermal timer.

I am aware that changes could be made in the above described thermal limit switch without departing from the scope of this invention as defined in the here following claims. It is therefore intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a snap action thermal limit switch having a stationary contact means and a movable contact spring, and a frame plate provided with an elongated opening bridged by said contact spring, said contact spring being fixed by its opposite ends to said frame plate under compression stress operative to bow its mid-portion, an adjustable means connected with said frame plate disposed to overhang an end portion of the frame plate opening, said adjustable means being adapted to be moved to optionally position the same out of engagement with the contact spring or so as to intersect the plane of a fixed end of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

2. In a snap action thermal limit switch having a stationary contact means and a movable contact spring, and a frame plate provided with an elongated opening bridged by said contact spring, said contact spring being fixed by its opposite ends to said frame plate under compression stress operative to bow its mid-portion, bendable check lugs integral with the frame plate disposed to respectively extend over the respective end portions of the frame plate opening, said lugs being adapted to be optionally bent angularly to the plane of said frame plate in one direction or the other, whereby to be selectively positioned out of engagement with the contact spring or so as to intersect the plane of the fixed ends of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

3. In a snap action thermal limit switch having a frame plate provided with an elongated opening, a movable contact spring bridging said frame plate opening and fixed by its opposite ends to said frame plate so as to be subject to compression stress adapted to bow its mid-portion, a stationary contact means subject to engagement by said movable contact spring, and a temperature sensitive element having a push finger directed toward said contact spring and operative upon deflection by heat to engage and bow said contact spring in direction to disengage said stationary contact means, an adjustable means connected with said frame plate disposed to

overhang an end portion of the frame plate opening, said means being adapted to be adjusted to optionally position the same out of engagement with the contact spring or so as to intersect the plane of a fixed end of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

4. In a snap action thermal limit switch having a frame plate provided with an elongated opening, a movable contact spring bridging said frame plate opening and fixed by its opposite ends to said frame plate so as to be subject to compression stress adapted to bow its mid-portion, a stationary contact means subject to engagement by said movable contact spring, and a temperature sensitive element having a push finger directed toward said contact spring and operative upon deflection by heat to engage and bow said contact spring in direction to disengage said stationary contact means, a plurality of adjustable means connected with said frame plate respectively disposed to overhang the respective end portions of the frame plate opening, said adjustable means being adapted to be moved to optionally position the same out of engagement with the contact spring or so as to intersect the plane of the fixed ends of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

5. In a snap action thermal limit switch having a frame plate provided with an elongated opening, a movable contact spring bridging said frame plate opening and fixed by its opposite ends to said frame plate so as to be subject to compression stress adapted to bow its mid-portion, a stationary contact means subject to engagement by said movable contact spring, and a temperature sensitive element having a push finger directed toward said contact spring and operative upon deflection by heat to engage and bow said contact spring in direction to disengage said stationary contact means, a bendable check lug integral with the frame plate disposed to extend over an end portion of the frame plate opening, said lug being adapted to be optionally bent angularly to the plane of said frame plate in one direction or the other, whereby to be selectively positioned out of engagement with the contact spring or so as to intersect the plane of the fixed ends of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

6. In a snap action thermal limit switch having a frame plate provided with an elongated opening, a movable contact spring bridging said frame plate opening and fixed by its opposite ends to said frame plate so as to be subject to compression stress adapted to bow its mid-portion, a stationary contact means subject to engagement by said movable contact spring, and a temperature sensitive element having a push finger directed toward said contact spring and operative upon deflection by heat to engage and bow said contact spring in direction to disengage said stationary contact means, bendable check lugs integral with the frame plate disposed to respectively extend over the respective end portions of the frame plate opening, said lugs being adapted to be optionally bent angularly to the plane of said frame plate in one direction or the other, whereby to be selectively positioned out of engagement with the contact spring or so as to intersect the plane of the fixed ends of said contact spring and thus to engage and pre-stress the contact spring toward the stationary contact means.

HERMAN ULANET.

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