Nov. 30, 1965 A. MORO 3,221,126

THERMALLY CONTROLLED ELECTRICAL SWITCH
HAVING MOTION-AMPLIFYING LEVER MEANS
Filed May 9, 1963

FIG1

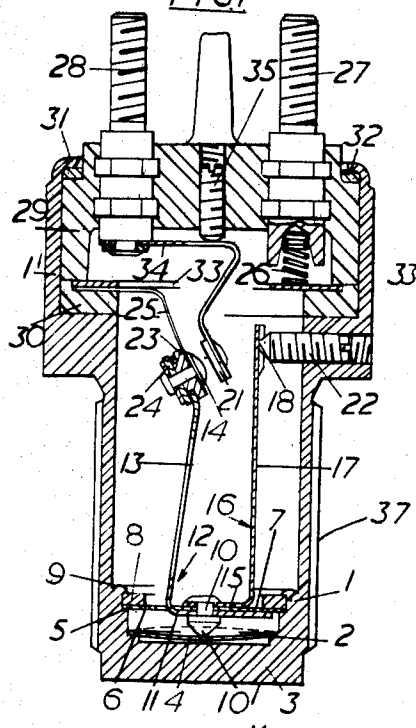


FIG2

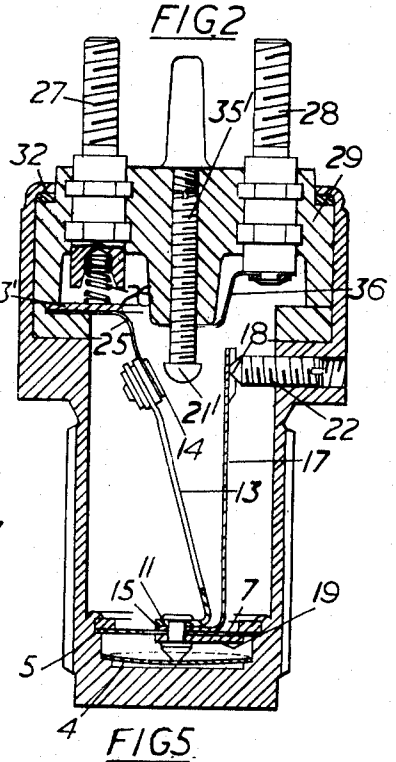


FIG3

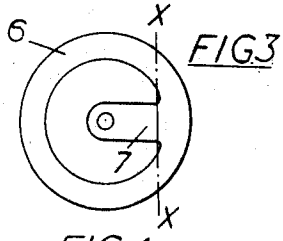


FIG4

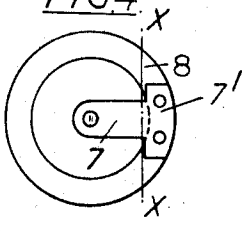


FIG5

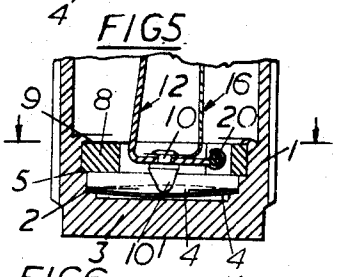
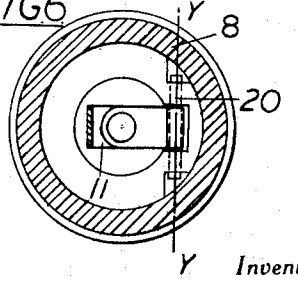


FIG6



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THERMALLY CONTROLLED ELECTRICAL SWITCH HAVING MOTION-AMPLIFYING LEVER MEANS

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The present invention relates to a thermally controlled electrical switch with a metallic housing of the type in which the movable contact is subjected to the opposing actions of resilient means and of a bi-metallic plate in the form of a disc which is curved in cross section and is located on the base of the housing, and which reverses its curvature in accordance with predetermined limits of the temperature of the medium in which the thermal element of the switch is immersed.

The invention is characterized by the feature that the movable contact is carried by an arm, disposed along the axis of the housing of a bent lever the other arm of which extends parallel to the plate and is secured at one end to a fixed point in the interior of the housing, about which it can turn under the action of the said plate and of the said resilient means, imparting to the movable contact a displacement greater than the movement of the plate so as to bring the movable contact into a position for closing or opening the circuit in which the switch is included.

According to a further feature of the invention the said resilient means are controllable from the exterior of the housing so as to permit adjustment of its action on the bent lever carrying the movable contact relative to the action of the bi-metallic plate or bi-metal disc.

These and other features of the invention will be more clearly understood from the following description of some embodiments of the invention with reference to the accompanying drawings, in which:

FIG. 1 is a section on the axis of the metal housing in the plane of the location of the movable contact, of a first embodiment of the invention;

FIG. 2 is a similar section of a modification of the said embodiment;

FIG. 3 is a plan view of a detail of FIGS. 1 and 2;

FIG. 4 is a similar view of a modification of the said detail; and

FIGS. 5 and 6 are respectively an axial section and a section normal to the axis of the part of the device containing the bi-metallic member.

In all the embodiments illustrated the switch according to the invention comprises a cylindrical metal housing **1** the base **3** of which is formed with an annular step **2** on which rests a bi-metallic plate in the form of a disc **4** which normally, viz. when the contact is open, is convex towards the base **3**.

On a second step **5** in the housing rests a metal ring **6** of flexible sheet metal having a radial arm **7** and held in position by a rigid ring **8** fixed to the housing by upsetting the edge **9**. An upset pin **10** disposed on the axis of the housing so that its conical end **10'** coincides with the centre of the bi-metallic disc **4** connects the arm **7** firmly on the one hand to an arm **11** of a bent lever **12** the other arm **13** of which carries the movable contact **14**, and on the other hand to the arm **15** of a leaf spring **16** the other arm **17** of which abuts against a fixed point **18** of the housing so as to oppose the action of the bi-metal **4**. The arms **13** and **17** respectively of the bent lever **12** and the leaf spring **16** are disposed substantially parallel to the axis of the housing **1**, which is appreciably elongated in that direction, and the said arms are much longer than the respective arms **11** and **15** which are connected to one another and to the resilient arm **7** by the pin **10** on which the bi-metal **4** acts, so that the deformations of the latter are appreciably amplified at the ends of the arms **13** and **17**.

The lever and the leaf spring **16** may be mounted in opposite senses (FIG. 1) with their arms **11** and **15** in contact with different surfaces of the arm **7**, or they may be mounted in the same sense (FIG. 2) with the arms **11** and **15** on the same side of the arm **7**; in the latter case, a reinforcing and strengthening strip **19** may be associated with the other surface of the arm **7**.

In a modification, the ring **6** is entirely omitted and the arm **7** is carried by a plate **7'** secured directly to the ring **8** (FIG. 4).

In another modification, the arm **7** is also omitted and the arm **11** of the lever **12** is directly pivoted at one end (FIGS. 5 and 6) on a pin **20** carried by the ring **8**.

In any case the lever **12** is capable of swinging, under the opposed actions of the bi-metal **4** and of the leaf spring **16**, about the imaginary axis *x*—*x* or the real axis *y*—*y* in such manner as to cause the movable contact **14** to approach or move away from the fixed contact **21** or **21'**, at the same time loading or partly relieving the leaf spring **16**, whilst the bi-metal **4** passes from the position illustrated in the drawings in full lines to the position illustrated in broken lines, reversing its normal curvature or vice versa.

In the embodiments of the invention shown in FIGS. 3 and 4 there is the advantage that the oscillations of the movable system about the imaginary axis of rotation *x*—*x* take place without play and without thereby detracting from the maximum sensibility.

In both cases the conical point **10'** of the pin **10** is held constantly in contact with the bi-metal **4**, on the centre thereof, by the force of the leaf spring **16** the action of which is controllable by variation of the position of the fixed point **18** which is constituted by the end of a screw **22** screwed into the body of the housing **1**. Advancing of the screw **22** towards the interior of the housing increases the force of the point **10'** on the bi-metal **4**; conversely, if the screw **22** is moved outwardly the force decreases. This permits of modification, between certain limits, of the temperature value above which the bi-metal **4** springs from the position shown in full lines to the position shown in broken lines and brings about the closing of the movable contact **14** with the fixed contact **21** or **21'**.

The movable contact **14** is insulated from the lever **12** by washers **23**, **24** of insulating material, but on the other hand is electrically connected by means of a flexible conductor **25** constituted by a metal strip or a thin wire and by a helical spring **26** to one of the contact pins **27** of the device. This pin **27** and the other contact pin **28** are carried by a closure member **29** of insulating material fixed within an enlarged part **1'** of the housing **1** against a ring **30**, also of insulating material, by the inturned edge **31** of the part **1'** of the housing, with an interposed packing ring **32**. The closure member **29** in turn clamps between itself and the ring **30** a conducting ring **33** or a conducting plate **33'** which provide the electrical connection for the flexible conductor **25** and the helical spring **26** which latter is located on the side of the housing opposite to the flexible conductor **25**.

In the embodiment shown in FIG. 1 the fixed contact **21** is mounted on the end of a bent member **34** of flexible material which connects it to the inner end of the terminal pin **28** and is in turn provided with a screw **35** screwed into the closure member **29**. Screwing the screw **35** more or less into the closure member **29** varies the position of the member **34**, thus regulating the distance of the fixed contact **21** from the movable contact **14**; in this

case it is possible to adjust the temperature below which the bi-metal 4 returns from the position shown in broken lines to the position shown in full lines.

The same possibility is afforded by the switch shown in FIG. 2, in which the fixed contact 21' is carried directly by the screw 35' which when screwed more or less into the closure member 29 causes the fixed contact 21' to approach or move away from the movable contact 14; the electrical connection between the fixed contact 21' and the associated terminal pin 29 is effected by means of the metal strip 36.

The switch described may be fixed in position by screwing it, by means of the external screwthread 37 provided on the housing 1, onto a wall of the enclosure that contains the fluid the temperature of which it is desired to control, for example the radiator of an automobile vehicle or the conductors that connect it to the engine, in such manner that the housing 1 becomes at least partly immersed in the fluid.

Assuming the contact to be open when the temperature of the water rises and reaches a predetermined value, the bi-metal 4 springs from the position shown in full lines into the position shown in broken lines. The point 10' springs upwardly at the centre of the bi-metal; the lever 12 turns slightly about the axis x—x or y—y and the contact 14 comes into engagement with the other contact 21 or 21', the position of which has previously been adjusted and fixed by means of the screw 35 or 35', during final inspection.

When the temperature of the water falls below a predetermined value the bi-metal springs in the opposite sense and again takes up the position shown in full lines; the lever 12 returns to its initial position under the action of the leaf spring 16, the force of which is adjusted and determined by means of the screw 22, the contact 14 moving away from the contact 21 or 21'.

As has already been pointed out, if it is desired to raise the value of the temperature at which the contact closes, the spring 16 is loaded by screwing in the screw 22; this operation increases the pressure of the point 10' on the centre of the bi-metal 4, thereby delaying its change of shape.

If, on the other hand, it is desired that the contact should be interrupted at a different high temperature, then the fixed contact 21 or 21' is moved towards or away from the movable contact 14 by actuating the screw 35 or 35'.

When the two contacts 14 and 21 or 21' are in contact the electrical circuit to which the two terminal pins 27 and 28 are connected closes, permitting current to be fed to the consumer device.

What I claim is:

1. A thermally controlled electrical switch comprising an elongated metal housing, a bi-metal element of curved configuration adapted to reverse its curvature in response to predetermined variations in the ambient temperature, means mounting said element at one end of said housing, a lever disposed within the housing and spaced from said element and comprising a first arm extending longitudinally of said housing away from the element and a second arm integral with the first arm and extending generally parallel to said element and subject to the curvature reversal movements thereof, means supporting said lever for pivotal movement relative to the housing in response to said curvature reversal movements comprising a first ring clamped between a step formed within said housing and spaced from said element and a further ring fixed in position by upsetting part of said housing on the internal side

of said step, said first ring having a resilient radially inwardly projecting arm to which said second arm is connected, a relatively fixed contact mounted within said housing, a relatively movable contact carried by said first arm, and resilient means carried by the housing to act on said second arm in opposition to the action of said element.

2. A thermally controlled electrical switch comprising an elongated metal housing, a bi-metal element of curved configuration adapted to reverse its curvature in response to predetermined variations in the ambient temperature, means mounting said element at one end of said housing, a lever disposed within the housing and spaced from said element and comprising a first arm extending longitudinally of said housing away from the element and a second arm integral with the first arm and extending generally parallel to said element and subject to the curvature reversal movements thereof, means supporting said lever for pivotal movement relative to the housing in response to said curvature reversal movements, a relatively fixed contact mounted within said housing, a relatively movable contact carried by said first arm, and resilient means carried by the housing to act on said second arm in opposition to the action of said element, said last-named means comprising a leaf spring with two arms, one of said arms extending substantially longitudinally of and within said housing, and the other arm extending parallel to the second arm of said lever, an adjusting screw manipulable from outside the housing and associated with said one arm, and means operatively connecting said other arm to said second arm.

3. A switch as claimed in claim 2, said connecting means comprising a rivet with a pointed head.

4. A thermally controlled electrical switch, comprising a bi-metal element of curved configuration adapted to reverse its curvature in response to predetermined variations in the ambient temperature, a lever having a relatively short arm and a relatively long arm, a relatively fixed switch contact, means mounting the lever and said element and the relatively fixed contact in assembly with each other with the lever supported for rocking movement relative to said element and relative to said relatively fixed contact, means for moving said relatively short arm upon curvature reversal of said element, a relatively movable switch contact carried by said relatively long arm and movable into and out of contact with said relatively fixed contact upon curvature reversal of said element, and a second relatively long arm in unitary assembly with said relatively short arm, and means adjustably bearing against said second arm to vary the value of said predetermined temperature.

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