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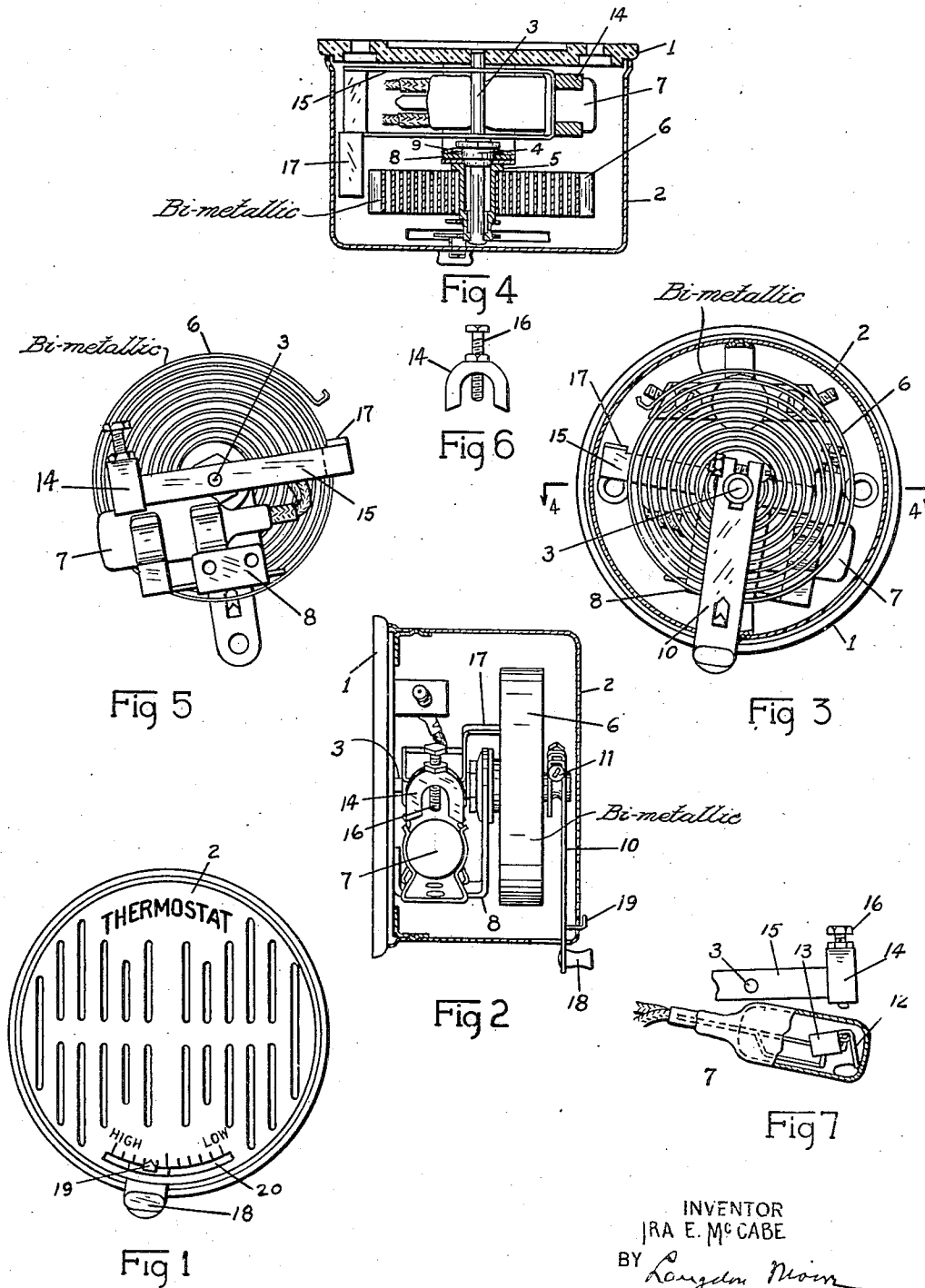
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1,975,856

THERMALLY ACTUATED SWITCH

Filed Oct. 9, 1931

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

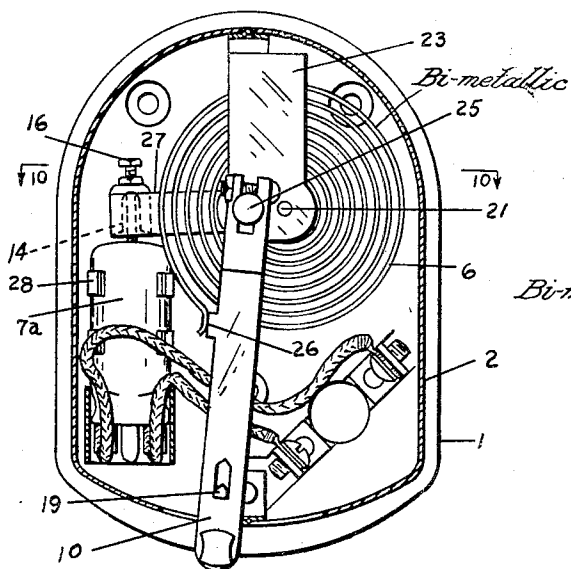


Fig 8

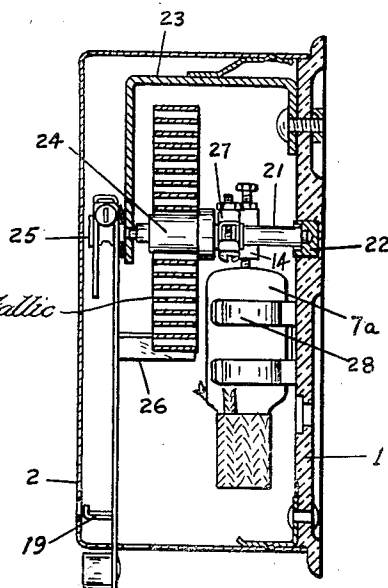


Fig 9

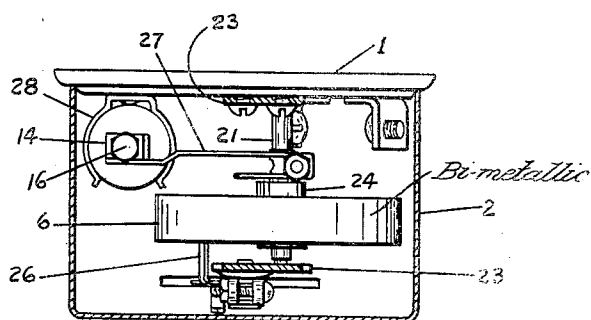


Fig 10

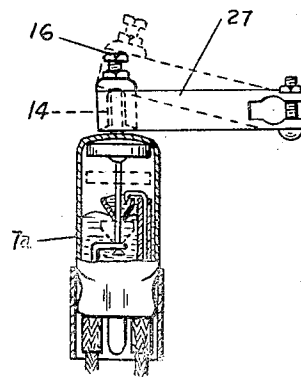


Fig 11

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UNITED STATES PATENT OFFICE

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THERMALLY ACTUATED SWITCH

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Application October 9, 1931, Serial No. 567,779

6 Claims. (Cl. 200—138)

This invention relates to improvements in electric switches and more particularly to a thermally actuated switch.

A type of electric switches the operation of which are responsive to temperature conditions are known to the trade as thermostats and are used in connection with the controls employed in connection with fluid fuel burners and refrigeration devices. It is to this general type of switches this invention relates and more particularly to the thermostat including a bi-metallic strip wound in a coil subject to the temperature of the surrounding atmosphere and switch operating mechanism which is actuated by the expansion and contraction of the metal comprising the thermal coil.

It is an object of this invention to provide a thermostat of the latter type employing a fixed or stationary mercury tube switch which is caused to operate to close or open the circuit by a magnet which in turn is actuated by the expansion and contraction of the thermal coil. It is a further object of this invention to provide a switch mechanism of this character which is readily set to operate at any desired temperature and having been operated a further expansion or contraction of the thermal coil allowed thereafter to avoid the possibility of the bi-metallic strip losing its sensitiveness or taking a set.

With these and other objects in view, reference is made to the accompanying sheets of drawings which illustrate preferred forms of this invention with the understanding that minor detail changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 is a view in front elevation of a preferred embodiment of this invention.

Figure 2 is a view in side elevation with the cover shown in section.

Figure 3 is a view similar to Figure 1 with the cover removed.

Figure 4 is a sectional view taken on the line 4—4, Figure 3 with parts shown in plan.

Figure 5 is a rear detail view in elevation of the switch actuating means.

Figure 6 is a detail view in elevation of the magnet.

Figure 7 is a detail view in elevation and partly in section illustrating the interior of the mercury switch and relation of the magnet.

Figure 8 is a view in front elevation, with the cover shown in section, of a modified form of this invention.

Figure 9 is a view in central vertical section of Figure 8, with parts shown in elevation.

Figure 10 is a view in section taken on the line 10—10, Figure 8.

Figure 11 is a detail view partly in section and partly in elevation of the type mercury switch employed in the modification and showing the relation of the magnet.

In the embodiment of this invention, illustrated in Figures 1 to 7, inclusive, the base 1 is provided with a perforated cover 2 enclosing the operating mechanism. A shaft 3, supported at one end by the base 1 and at about its center by the bracket 8 which is secured to the base, is used to carry the switch operating mechanism. The shaft is held in frictional engagement with the bracket by spring washer 9. The bracket 8 also positions and supports a mercury switch 7.

The mercury tube switch 7 is of the type shown in Figure 7, which is held in fixed position at the angle shown, and contains a small body of mercury normally out of contact with the switch electrodes and adapted to be bodily moved into contact therewith to close the circuit by a member 12 pivotally mounted within the switch tube and having a portion 13 thereof of magnetic material adapted to respond to the attraction of a magnet to close the circuit. Such a switch is illustrated and described in the application of Karl Hunciker, Serial No. 554,182 filed, July 31, 1931, and the structure of this switch per se forms no part of this invention. It being understood that the switch is connected in the circuit to be controlled by the thermostat.

To operate the switch 7 a magnet 14 is mounted on one end of an operating arm 15 pivotally mounted upon the shaft 3. The magnet 14 as shown is a fixed horseshoe magnet but any other type of fixed magnet or electro magnet may be employed without departing from the scope of this invention. The magnet 14 is so arranged on the pivoted arm 15 that it may be caused to move to and from the end of the switch tube 7 containing the magnetic member 13 as the arm 15 is oscillated whereby the switch is operated to close and open the circuit therethrough. The side of the arm 15 nearest the bi-metallic coil 6 and at the end opposite the magnet is provided with a stop 17 extending in the direction of the coil and adapted to be engaged by the free end of the coil 6 as it contracts, and rotates the arm 15.

The coil 6 is made of the material known to the trade as bi-metal which consists of two metals one of which has a greater coefficient of expansion than the other. The coil in this device and shown

in Figure 3 is so constructed that the metal most effected by temperature changes makes up the outer surface so that upon an increase in temperature it expands faster than that on the inner side with the result that the coil rotates in a counter-clockwise direction and hereafter such movement will be referred to as contraction of the coil. Upon a decrease in temperature the outer surface contracts faster which results in rotation of the coil in a clockwise direction and this action will hereinafter be referred to as expansion of the coil.

The coil 6 is fixed at its inner end to a sleeve 5 mounted and secured to the shaft 3. The end of the sleeve to the front of the instrument supports an adjustable control lever 10 the upper end of which is bifurcated and bent back upon itself so as to receive the end of the sleeve 5 and by use of a bolt and nut 11 securely clamped in its desired position on the sleeve.

The magnet 14 shown in Figure 6 is provided with an adjustable stop 16 adapted to contact the switch tube when the arm 15 is rotated in that direction to regulate the power of attraction for the switch contained magnetic member 13. It is through the screw that the operating differential is set. The operating differential is the number of degrees change in temperature required to open the circuit following the closing of it. It is evident that the closer the magnet is allowed to come toward the magnetic switch member 13 the more effort will be required by the coil 6 to overcome the magnetic attraction and consequently the change in temperature to actuate the coil to move the magnet will be greater. While the screw 16 is shown as a part of the magnet it may, without departing from the scope of this invention, be made a part of a stationary post and there adjusted to limit the movement of the arm 15.

In this form of this invention the control lever 10 extends below the casing 1 and is provided with an operating handle 18 and a struck up indicator pointer 19 adapted to travel through a slot 20 in the cover and travel over a temperature scale marked thereon, as shown in Figure 1. The stop 16 is adjusted so that the magnet when adjacent the switch tube will close the circuit therethrough and the position of the lever adjusted on the sleeve 5 so that when the pointer 20 is over a certain degree of temperature, that temperature will cause the coil 6 to contract to cause its free end to engage the stop 17 and rotate the magnet away from the switch tube 7 whereupon the circuit will be broken. These adjustments are made at the factory. The weight of the magnet 14 normally maintains the switch closed when the coil 6 is expanded and upon contraction the free end engages the stop 17 to rotate the arm 15 to open the switch, and as the rotation is unlimited a continued contraction beyond the degree required to open the switch is not restricted. It is therefore seen that this thermostat is actuated by a bi-metallic coil 6 which expands and contracts normally in an unrestricted manner during continued operation of the switch. It is evident that the lever 10 being fixed to the sleeve 5 which in turn is fixed to the shaft will maintain its position when manually positioned by the handle 18 since the shaft is held in frictional engagement with the stationary bracket. Therefore any change in the position of the lever 10 will also change that of the free end of the coil 6 as it is fixed to the sleeve. However, the arm 15 is undisturbed as it is free on the shaft 3. If

it is desired to raise the temperature at which point the switch will be operated to open the circuit, movement of the control lever 10 is made to increase the gap between the stop 17 and the free end of the coil. To break the circuit at a lower temperature the lever is moved to decrease the gap.

In the modification illustrated in Figures 8 to 11, inclusive, a rotatable shaft 21 is mounted in bearings 22 in the base 1 and bracket 23 mounted on the base 1. The inner end of the coil of bi-metallic metal 6 is secured to drum 24 forming a part of the shaft 21. The control lever 10 is mounted with frictional engagement on a stud 25 mounted on the bracket 23 at one side of the shaft bearing and is provided with a stop 26 adapted to be engaged by the free outer end of the coil 6. The magnet 14 is mounted on the free end of an arm 27 the other end of which is preferably adjustably secured to the shaft 21 in the same manner as the lever 10 described in connection with the first form. The switch 7^a in this form is another type which is held stationary by clip 28 upon the base 1 with its normally closed end in position to be engaged by the magnet 14. A switch of the type illustrated in Figure 11 is described and disclosed in this applicant's copending application Serial No. 554,185 filed July 31, 1931, and the structure of this switch per se forms no part of this invention.

In this form, as in the first, the coil 6 is so made as to contract, or wind up upon heating and to expand upon cooling. The movement of the magnet arm is actuated, however, in a different manner. In this modified form the coil as it contracts first moves its free end, in a counter-clockwise direction, until it engages the stop 26 and then upon further contraction rotates the shaft 21 in a clockwise direction. This lifts the magnet away from the mercury switch 7^a which results in the opening of the circuit therethrough.

Upon the expansion of the coil 6 the movement is first taken up by the shaft 21, due to the weight of the magnet 14, and after said magnet comes to a stop above the mercury switch, further expansion thereafter withdraws the free end from engagement with the stop 26.

It is evident that contraction of the coil beyond the operating point as set by the control arm 10 is unrestricted as sufficient movement is obtainable for the clockwise rotation of the magnet arm by the shaft following the abutment of the free coil end with stop 26 and likewise movement of the free end in a clockwise direction is unrestricted upon expansion, after the shaft ceases to rotate upon engagement of the magnet with the mercury switch.

What I claim is:

1. In a thermostat, a base, a stationary mercury tube switch having a movable armature therein for making and breaking the circuit therethrough mounted on the base, a movable magnet adapted to cooperate with the armature to actuate the switch, an operating arm mounted on a pivot extending from said base at one side of the switch, said pivoted arm mounting said magnet at one end thereof with the magnet normally in contact with the mercury tube switch, a stop mounted at the other end of said arm, and a coiled bi-metallic element responsive to temperature changes having one end mounted on the operating arm pivot with the other end free extending above and in line with the operating arm stop and responsive to certain temperature changes to engage said stop and rotate the

operating arm to move the magnet away from its armature to operate the mercury tube switch.

2. In a thermostat, a base, a stationary mercury tube switch having a movable armature therein for making and breaking the circuit there-
through mounted on the base, a movable magnet adapted to cooperate with the armature to actuate the switch, an operating arm mounted on a pivot extending from said base at one side of the switch, said pivoted arm mounting said magnet at one end thereof with the magnet normally in contact with the mercury tube switch, a stop mounted at the other end of said arm, a coiled bi-metallic element responsive to temperature changes having one end mounted on the operating arm pivot with the other end free extending above and in line with the operating arm stop and responsive to certain temperature changes to engage said stop and rotate the operating arm to move the magnet away from its armature to operate the mercury tube switch, and means for adjusting the normal position of the free end.

3. In a thermostat, a base, a stationary mercury tube switch having a movable armature therein for making and breaking the circuit therethrough mounted on the base, a movable magnet adapted to cooperate with the armature to actuate the switch, an operating arm mounted on a pivot extending from said base at one side of the switch, said pivoted arm mounting said magnet at one end thereof with the magnet normally in contact with the mercury tube switch, a stop mounted at the other end of said arm, a coiled bi-metallic element responsive to temperature changes having one end mounted on the operating arm pivot with the other end free extending above and in line with the operating arm stop and responsive to certain temperature changes to engage said stop and rotate the operating arm to move the magnet away from its armature to operate the mercury tube switch, and means for adjusting the normal position of the free end including means for rotating the mounting of the coil upon the pivot.

4. A switch operating mechanism including a base mounting thereon an electric switch having an operating armature for making and breaking the circuit therethrough, a coiled bi-metallic element responsive to temperature changes to expand and contract having one end fixed and the

other end free to move upon temperature changes, a stop adapted upon contraction of the coil to be engaged by the free end of the coil, a movable magnet adapted to cooperate with the armature to actuate the switch, and a movable support for the magnet, and means actuated by further continued expansion of the coil after engagement with the stop to coact with the coil and magnet support to bodily move the magnet to operate the switch.

5. In a thermostat, a base, a stationary mercury tube switch having a movable armature therein for making and breaking the circuit there-
through mounted on the base, a movable magnet adapted to cooperate with the armature to actuate the switch, an operating arm mounting said magnet at one end thereof normally in contact with the mercury tube switch and the other end secured to a rotatable pivot mounted on the base, a coiled bi-metallic element responsive to temperature changes to expand and contract having one end free and the other end mounted upon said pivot, and an adjustable lever having a stop in the path of the free end of the coil and normally in engagement therewith, whereby an increase in temperature causes the coil to rotate the pivot to move the magnet away from its armature to operate the switch.

6. In a thermostat, a base, a stationary mercury tube switch having a movable armature therein for making and breaking the circuit there-
through mounted on the base, a movable magnet adapted to cooperate with the armature to actuate the switch, an operating arm mounting said magnet at one end thereof normally in contact with the mercury tube switch and the other end secured to a rotatable pivot mounted on the base, a coiled bi-metallic element responsive to temperature changes to expand and contract having one end free and the other end mounted upon said pivot, and an adjustable lever having a stop in the path of the free end of the coil and normally in engagement therewith, whereby an increase in temperature causes the coil to rotate the pivot to move the magnet away from its armature to operate the switch and upon a decrease in temperature thereafter causes the coil to rotate the pivot in the opposite direction to move the magnet to contact the mercury tube switch to operate the switch in the opposite direction.

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