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2,159,090

THERMOSTATIC SWITCH

Filed Nov. 1, 1937

FIG. 1

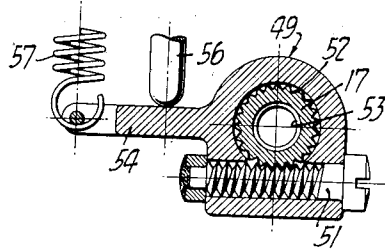
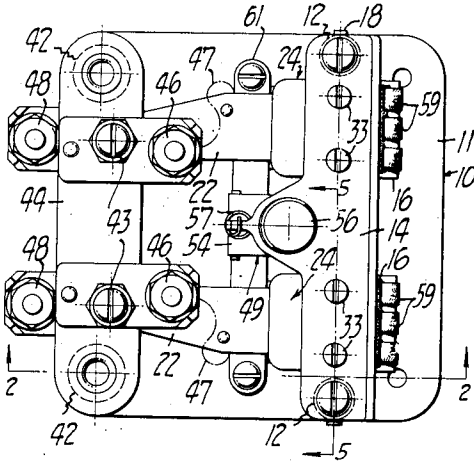


FIG. 4

FIG. 2

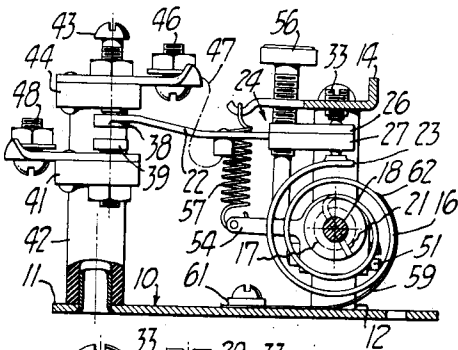


FIG. 3

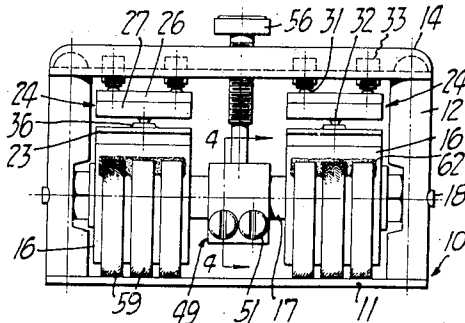
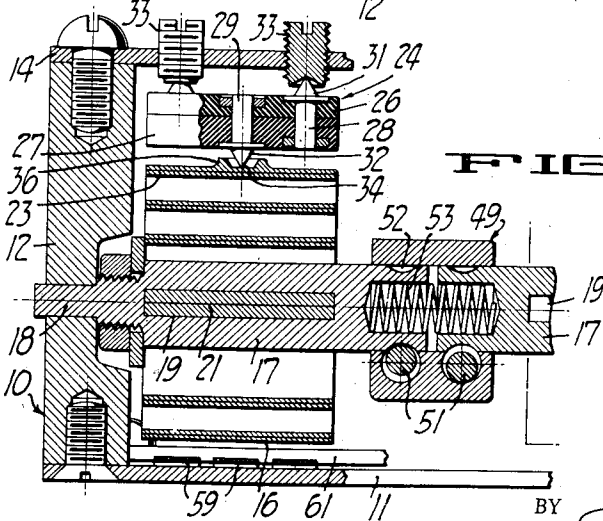


FIG. 5



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THERMOSTATIC SWITCH

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7 Claims. (Cl. 200—139)

This invention relates generally to thermostatic switches for controlling electrical circuits responsive to temperature changes. More particularly it relates to thermostatic switches of the double pole type having two sets of electrical contacts.

Several types of single pole thermostatic switches are available on the market, and are capable of satisfactory service to open and close electrical circuits according to predetermined temperature levels. For example, one type of satisfactory thermostatic switch, having a single set of contacts rapidly moved between open and closed positions, is shown in my Patent No. 1,905,233, granted April 25, 1933. When it is attempted to modify a thermostatic switch for operation of two sets of contacts, as it is necessary in the controlling of certain types of circuits, difficulty is encountered, particularly where the thermostatic element employed is of the simple bi-metallic type. If it is attempted to mount two separate electrical contacts upon a common switch arm, for operation of two sets of stationary contacts, it is difficult to equalize the pressure and to secure a clean make-and-break for each set of contacts. The present invention has for its object the development of a bi-metallic thermostatic switch of the double pole type, which will be characterized by positive and rapid opening and closing movements of both sets of contacts, whereby reliable control is afforded in accordance with temperature changes.

A further disadvantage characteristic of all switches using bi-metallic elements, is that considerable heat lag is necessarily involved when they are utilized in conjunction with devices such as electrical water heaters. This is because the metal parts interposed between the mounting and the bi-metallic elements, afford relatively poor heat transfer. It is accordingly a further object of the invention to provide a structure affording good heat transfer between the metal parts of the switch mounting and the bi-metallic elements, whereby the switch will rapidly respond to temperature changes.

Additional objects of the invention will appear from the following description in which the preferred embodiment of the invention has been set forth in detail, in conjunction with the accompanying drawing.

Referring to the drawing:

Fig. 1 is a plan view, illustrating a switch incorporating the present invention.

Fig. 2 is a side elevational view partly in cross-section of the thermostatic switch shown in Fig. 1.

Fig. 3 is an end view of the switch illustrated in Figs. 1 and 2.

Fig. 4 is a cross-sectional detail taken along the line 4—4 of Fig. 3.

Fig. 5 is a cross-sectional detail taken along the line 5—5 of Fig. 1 on an enlarged scale.

The switch as illustrated in the drawing consists generally of a mounting 10, which carries electrical contacts and operating parts, and which in practice is used to secure the device to an electrical appliance. In the structure illustrated the base consists of a metal plate 11, carrying a pair of spaced posts 12. The lower ends of these posts are shown attached to plate 11, while the upper ends of the posts are shown connected by the cross strip 14. Disposed between the two posts 12 are the bi-metallic strips 16 which are preferably formed spirally. In order to provide adjustable mountings for the inner ends of strips 16, a pair of aligned shafts 17 are provided, the outer ends of which have portions 18 of reduced diameters, to pivotally extend through the posts 12. To effect proper attachment between the bi-metallic strips 16 and the shafts 17, the shafts are shown provided with slots 19, to accommodate the end portions 21 of the bi-metallic strips.

Each of the bi-metallic strips 16 is adapted to operate a contact arm 22 and each arm is cooperatively associated with the outer end portion 23 of each bi-metallic strip, by a toggle arrangement 24. The detailed construction illustrated, to provide this toggle arrangement makes use of a pair of members 26 and 27, of suitable insulating material, which are secured to the adjacent end of contact arm 22. Rivet pins 28 and 29 are shown extending through these members to retain the same together, and the projecting ends of these pins form pivot points 31 and 32. Pivot points 31 engage within the concave ends of small set screws 33, carried by the cross strip 14. Pivot point 32 engages a small indentation 34 in the adjacent end of the bi-metallic strip 16, and is retained from serious displacement with respect to the bi-metallic strip, by an annular ridge 36. When assembled as illustrated in Fig. 2, each of the bi-metallic strips 16 are sprung within their elastic limits whereby their outer ends 23 are urged upwardly against pivot points 32, to urge pivot points 31 against the set screws 33.

The free end of each of the contact arms 22 carries a movable electrical contact 38, which cooperates with a stationary electrical contact 39. Contact 39 is shown carried by a suitable mounting strip 41, which in turn is carried by the sup-

porting posts 42, extending upwardly from the base plate 11. On its back movement each of the contact arms 22 engages an adjustable set screw 43, carried by a mounting 44, which is likewise secured to the upper ends of posts 42. Terminals 46 for making electrical connections to the movable contact 38, are shown carried by the mounting 44. Flexible bus conductors 47 can extend directly from terminals 46, to the contact arms 22. Terminals 48 are for making electrical connection with the stationary contacts 39.

In order to synchronize operation of the contact arms 22, for operation at the same temperature levels, a special form of coupler 49 directly connects the shafts 17. This coupler is in the form of a collar snugly surrounding the adjacent ends of the shafts 17, and provided with a pair of adjustable screws 51. The threads of screws 51 engage annular toothed portions 52 of the shafts 17, so that when one or the other of screws 51 is rotated, relative angular movement takes place between the shafts 17. Lost motion between the shafts 17 is avoided by means of a compression spring 53, fitted within the adjacent ends of shafts 17, and serving to urge these shafts apart.

In order to afford an adjustment for the switch as a whole, to secure operation at different temperature levels, the coupler 49 is shown provided with an arm 54. An adjusting screw 56 has threaded engagement with the cross strip 14, and the end of this screw has abutting engagement with the arm 54. A tension spring 57 serves to retain the arm 54 into engagement with the adjacent end of screw 56.

In many instances the metal base plate 11 will be mounted in direct heat conductive relationship with a member being subject to temperature variations, in order to secure operation of the switch contacts in response to such variations. For example in an electrical hot water heater plate 11 may be clamped directly into engagement with one wall of the water tank, in which hot water is stored. If one should rely upon heat transfer through the posts 12 and shafts 17, to the bi-metallic strips, a large amount of heat lag would be present, thus making rapid response or a high degree of sensitivity impossible, and making it difficult to properly synchronize operation of the switch contact arms. To avoid such difficulties and at the same time to afford a minimum amount of heat lag, I provide flexible metal ribbons 59, which serve to directly conduct heat from the base plate 11, to the bi-metallic strips. Thus three of these flexible metal ribbons are shown for each of the bi-metallic strips 16, and corresponding ends of each set of ribbons are clamped down upon the base plate 11, by means of straps 61. The other ends of the ribbons curve about the adjacent convolutions of the bi-metallic strips 16, and are soldered to the bi-metallic strips, as indicated at 62. These ribbons can be conveniently formed of woven copper or bronze, or can be made of any suitable metallic material capable of effectively conducting heat in the direction of its length, and having proper resiliency to permit the desired flexing operation of the bi-metallic strips 16.

Operation of the thermostatic switch described above can be outlined as follows: The terminals 46 and 48 are connected to the electrical circuit or circuits to be controlled at the same temperature levels. Now by carefully adjusting one or both of the screws 51, the angular relationship between the two shafts 17 is adjusted so that the contact arms 22 are operated at the same tem-

perature levels. In other words the adjustment is made in such a manner that as the temperature of the two bi-metallic strips 16 increases to a predetermined level, the torques imposed upon the toggle arrangements 24 are such that contact arms 22 snap towards open position, at substantially the same instant. Similarly upon a decreasing temperature gradient the two contact arms 22 snap towards closed position at substantially the same instant. To vary the temperature levels of operation, without affecting the synchronization of the two contact arms, one turns screws 56, whereby the contacts 38 and 39 can be caused to close at any temperature level over a substantial temperature range. Assuming that the base plate 11 is in good heat transfer relationship with a member, the temperature of which is to control operation of the thermostatic switch, temperature variations of the base plate 11 are rapidly conducted through the flexible ribbons 59, and thus imparted to the bi-metallic strip 16. Thus a minimum amount of lag is involved in effecting operation of the contacts, and operation is made more or less independent of the temperature of air surrounding the bi-metallic strips. It is to be understood that if the device is applied to respond to variations in the temperature of the surrounding air or other gas, the ribbons 59 can be omitted, since in that instance heat is transferred directly from the gas to the bi-metallic strips 16.

I claim:

1. In a thermostatic switch, a pair of bi-metal strips responsive to temperature changes, a pair of members to which corresponding ends of said bi-metal strips are secured, a pair of contact arms, means forming operative connections between the other ends of said bi-metal strips and said arms, whereby flexing of said bi-metal strips in response to temperature changes are caused to operate said contact arms, means for adjusting the position of one of said members with respect to the other, whereby operation of said contact arms can be synchronized for a given temperature level, and means for simultaneously adjusting the temperature level of operation of both said bi-metal strips.

2. In a thermostatic switch, a pair of thermally responsive bi-metal strips, said strips being flexed by temperature changes, a pair of members to which one end of each of said bi-metal strips is secured, a pair of contact arms cooperatively connected to the other ends of said bi-metal strips, whereby flexing of said strips responsive to temperature changes causes operation of said contact arms, a mounting to which said first-named members are movably secured, means acting between said members to adjust the relative positioning of the same, and means for simultaneously adjusting the positioning of both said members with respect to said mounting, whereby the temperature level of operation of the switch is varied.

3. In a thermostatic switch, a pair of bi-metal strips, a mounting, a pair of aligned members pivotally secured to said mounting, one end of each of said bi-metal strips being secured to a corresponding member, a pair of contact arms each movable in opposite directions, means forming operative connections between each of said contact arms and the other ends of said bi-metal strips, whereby flexing of said bi-metal strips responsive to temperature changes causes movements of said contact arms, adjustable

means coupling together said aligned members, whereby said members can be adjusted angularly with respect to each other, and means for simultaneously adjusting the angular setting of both said aligned members with respect to said mounting, to thereby adjust the temperature level of operation of both said contact arms.

4. In a thermostatic switch, a mounting, a pair of aligned members pivotally secured to said mounting, a pair of spirally formed bi-metallic strips, the inner ends of said strips being secured to said members, a pair of contact arms, toggle means forming operative connections between the outer ends of said bi-metallic strips and said contact arms, whereby said contact arms are oscillated responsive to temperature changes of said bi-metallic strips, means for coupling together said aligned members, said last means including a member movable to effect angular adjustment between said members, and means for simultaneously adjusting the angular setting of both said aligned members with respect to said mounting, to thereby adjust the temperature level of operation of the switch.

5. In a thermostatic switch, a mounting, a pair of aligned shafts pivotally secured to said mounting, a pair of spirally formed bi-metallic strips, the inner ends of said strips being secured to said shafts, a pair of contact arms, toggle means forming operative connections between the outer ends of said bi-metallic strips and said contact arms, a coupler serving to connect said aligned shafts together, said coupler including a member movable to adjust the angular setting between said shafts, and means for angularly adjusting the setting of said coupler with respect to said mounting, whereby the tem-

perature level of operation of said contact arms is simultaneously varied.

6. In a thermostatic switch, a mounting, a pair of aligned shafts pivotally carried by the mounting, a pair of spirally formed bi-metallic strips, the inner ends of said strips being secured to said shafts, a pair of contact arms, toggle means forming operative connections between the outer ends of said bi-metallic strips and said contact arms, a coupler serving to directly connect the adjacent ends of said aligned shafts, said coupler including a member movable to adjust the angular relationship between said shafts, spring means serving to urge said shafts to rotate in one direction, an arm carried by said coupler, and an adjustable member engaging said arm and serving to simultaneously adjust the angular setting of said shafts with respect to said mounting, thereby adjusting the temperature level of operation.

7. In a thermostatic switch, a pair of bi-metal strips, a mounting, a pair of aligned members pivotally secured to said mounting, one end of each of said bi-metal strips being secured to a corresponding member, a pair of contact arms each movable in opposite directions, means forming operative connections between each of said contact arms and the other ends of said bi-metal strips, whereby flexing of said bi-metal strips responsive to temperature changes causes movements of said contact arms, adjustable means coupling together said aligned members, whereby said members can be adjusted angularly with respect to each other, and means for simultaneously adjusting the temperature level of operation of both said contact arms.

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