Dec. 18, 1951 C. S. MERTLER 2,579,389

THERMOSTATIC SWITCH

Filed Feb. 7, 1948

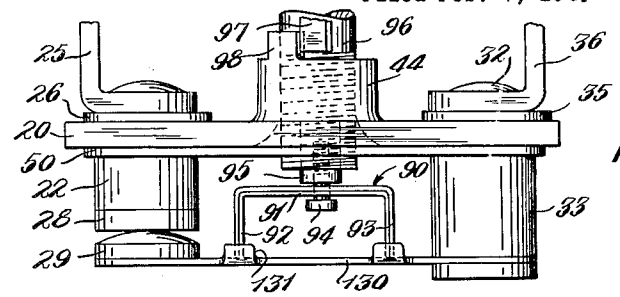


FIG. 11

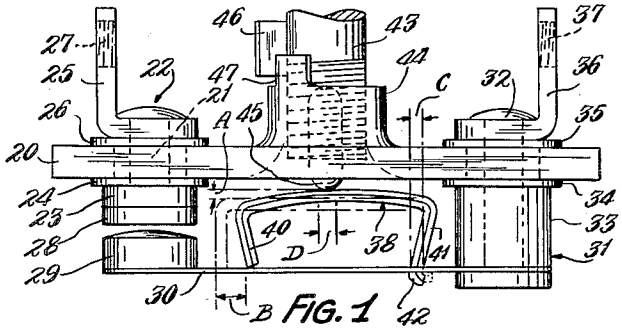


FIG. 1

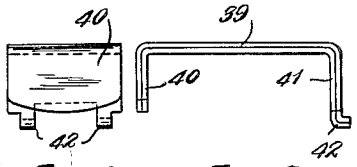


FIG. 4

FIG. 3

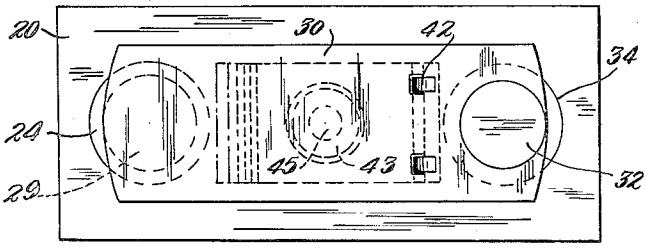


FIG. 2

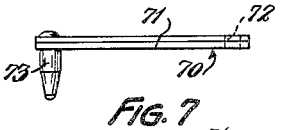


FIG. 7

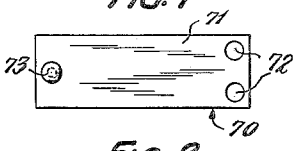


FIG. 8

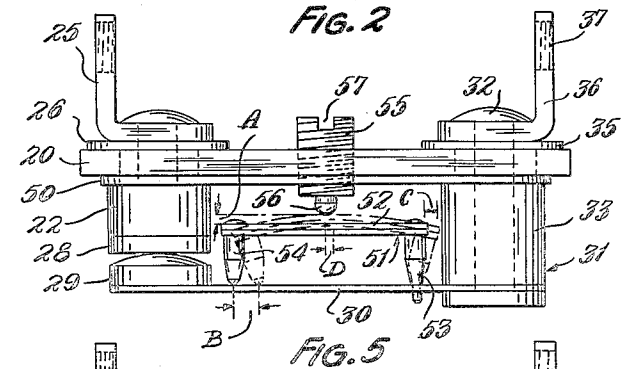


FIG. 5

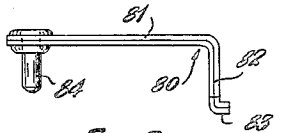


FIG. 9

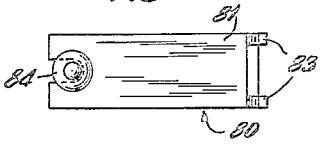


FIG. 10

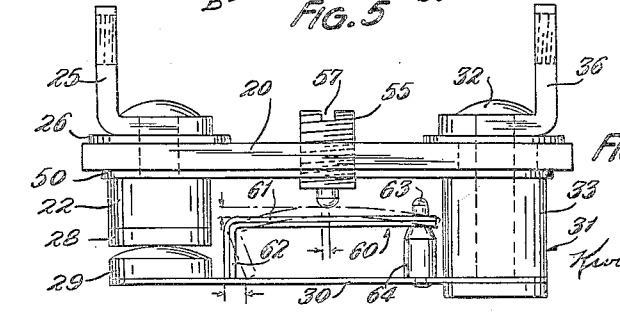


FIG. 6

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THERMOSTATIC SWITCH

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This invention relates to thermostatic electrical switches and more particularly to improvements in thermostatic switches which are of the type commonly known as semisnap acting.

Thermostatic electrical switches known to the art may be classified in accordance with their operational characteristics as being one of three main types. One of these main types includes those switches which are known as snap acting because they employ springs and/or levers to operate at least one of the electrical contacts with a positive snap action at the instant the thermal responsive member reaches a predetermined temperature. Switches of this type have the advantages of high current carrying capacity, long contact life and absence of circuit disurbances which cause interference with radio reception. However, such switches are relatively expensive to manufacture and possess an inherent wide temperature differential between the opening and closing operating temperatures.

A second category of thermostatic electrical switches comprise those which are known as the creep type because the electrical contacts are opened and closed relatively slowly under the sole influence of the bending of the thermal responsive member as the temperature thereof changes. Switches of this type possess the advantages of low cost and relatively small temperature differential but have relatively short contact life and cause considerable radio interference due to the fluttering, and consequent frying, of the contacts at the instant when they are either opening or closing. Moreover, the current carrying capacity of thermostatic switches of this type is of a relatively low order since high currents intensify the above mentioned disadvantages.

The third general type of thermostatic switches comprise those known as semisnap acting. Switches of this type are somewhat similar in construction to the creep type but differ in operating principle in that the contacts open with a small snap action. This snap action results from disposing the thermal responsive member so that it is effective to exert both a frictional and a motion producing force upon a member which movably supports one of the switch contacts. The frictional force enables the thermal responsive member to store up a certain amount of motion producing energy before any movement of the movable contact supporting member occurs. When the stored energy is sufficient to overcome the frictional force the movable contact is actuated with a small snap action and

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this mode of operation is effective in both contact opening and closing directions. Switches of this type combine the desirable operating features of both the creep and snap acting type thermostatic switches while retaining the relatively low cost of the creep type switches but without the undesirable functioning characteristics of the latter.

An object of this invention is to provide improved semisnap acting thermostatic switches which are simple and less expensive to manufacture and which have a greater snap action than prior switches of the same type.

Another object of the invention is to provide improved thermostatic switches of the semisnap acting type in each of which one of the switch contacts is mounted on a supporting member for movement in opposite directions relative to the other switch contact and biased to move in one of these directions and in which the thermal responsive member has an angular extension for effecting actuating of the contact supporting member with a semisnap action, the thermal responsive member being supported in a manner such that the snap action is greater than in prior switches of the same type.

A further object of the invention is to provide improved thermostatic switches of the semisnap acting type in each of which the thermal responsive member is adapted to be entirely supported by the movable contact arm intermediate the ends of the latter and to actuate the contact arm with a snap action when the ambient temperature reaches a predetermined value.

A still further object of the invention is to provide improved thermostatic switches of the semisnap acting type in which the thermal responsive member is supported by and hinged to the movable contact supporting member.

An additional object of the invention is to provide improved thermostatic switches of the semisnap acting type in which the thermal responsive member comprises a main portion, hinged to the movable contact supporting member and extending substantially parallel therewith in spaced relationship, and an extension disposed at an angle to the main portion with the free end of the extension in engagement with the movable contact supporting member, whereby flexing of the thermal responsive member, as the temperature varies, exerts both substantially perpendicular and longitudinal forces upon the movable contact supporting member so that the said flexing does not result in movement of the movable contact until sufficient

energy has been stored in the thermal responsive member to overcome the static friction between the said extension and the movable contact supporting member, whereupon the latter and its contact are moved with a snap action relative to the other contact.

Another object of the invention is to provide improved thermostatic switches of the type mentioned in the two preceding objects and further comprising adjustable means adapted to engage the main portion of the thermal responsive member intermediate its ends, whereby the snap action is enhanced and the switches may be adjusted for operation at different predetermined temperatures.

The invention also has as an object the provision of an improved thermostatic switch of the semisnap acting type in which the thermal responsive member comprises a main portion and an extension disposed at substantially right angles to each other and formed integrally from a bimetallic bar or strip, the said main portion being hinged to a resilient contact-carrying member so as to extend substantially parallel therewith in spaced relationship thereto, with the said extension resting upon the resilient member for actuation of the latter in response to temperature changes.

A still further object of the invention is to provide an improved thermostatic switch of the semisnap acting type in which the thermal responsive member is a substantially U-shaped bimetallic element, one leg of the bimetallic element being hinged to a resilient contact-carrying member and the other leg of the element resting upon the resilient member to actuate the latter, in response to a predetermined change in temperature, with a snap action as the result of friction produced between the said resilient member and the said other leg of the bimetallic element, the snap action being enhanced by the flexing of the legs of the bimetallic element.

The invention further resides in certain novel features of construction and combination and arrangements of parts, and further objects and advantages thereof will be apparent to those skilled in the art to which it pertains from the following description of the present preferred embodiment thereof, and certain modifications, described with reference to the accompanying drawing in which:

Fig. 1 is a side elevational view of the present preferred form of a thermostatic switch constructed in accordance with this invention, the switch being shown in its operated position;

Fig. 2 is a bottom elevational view of the switch illustrated in Fig. 1;

Fig. 3 is a detached, side elevational view of the thermal responsive member employed in the switch illustrated in Figs. 1 and 2;

Fig. 4 is an end elevational view of the thermal responsive member shown in Fig. 3, the view being taken from the left of Fig. 3;

Fig. 5 is a side elevational view of a modified form of thermostatic switch constructed in accordance with this invention;

Fig. 6 is a side elevational view of another modified form of thermostatic switch constructed in accordance with this invention;

Fig. 7 is a detached, side elevational view of another form of thermal responsive member which may be employed in thermostatic switches constructed in accordance with this invention;

Fig. 8 is a top plan view of the thermal responsive member illustrated in Fig. 7;

Fig. 9 is a detached, side elevational view of yet another form of thermal responsive member which may be employed in thermostatic switches constructed in accordance with this invention;

Fig. 10 is a bottom plan view of the thermal responsive member illustrated in Fig. 9; and

Fig. 11 is a side elevational view of yet another form of thermostatic switch constructed in accordance with this invention.

Referring first to Figs. 1 through 4 of the drawings, the improved thermostatic switch illustrated therein comprises a base member **20** preferably formed of metal although other relatively rigid materials such as hard rubber, plastic or the like may be employed. Adjacent one end, the base member **20** is provided with an opening through which the reduced diameter portion **21** of a mounting stud **22** passes with a substantial clearance. One end of the stud **22** is provided with an integral head **23** of larger diameter than the diameter of the opening in the base member and an insulating washer **24** is positioned on the stud between its head and the adjacent face of the base member **20**. The portion of the stud **22** projecting beyond the other face of the base member **20** is provided with a terminal member or bracket **25** and an insulating washer **26** is positioned on the stud between this terminal bracket and the base member. The end of the stud extending beyond the terminal bracket is peened over or otherwise deformed to rigidly connect the stud and terminal bracket to the base member with the stud electrically insulated from the base member but electrically connected with the terminal bracket. The terminal bracket **25** may be provided with any suitable means for connecting an electrical conductor thereto. For this purpose, the bracket **25** is shown as provided with a tapped hole **27** for receiving a screw by which a conductor may be connected. The outer face of the stud head **23** is provided with a layer of silver or other suitable electrical contact material thereby providing one contact **28** for the switch.

Cooperating with the contact **28**, and movable to and from engagement therewith, is a second contact **29** mounted upon one end of a resilient member or arm **30** which is biased to normally effect engagement of contact **29** with contact **28**. The other end of the resilient member or arm **30** is mounted upon the base **20** in spaced relationship therewith by a mounting means generally designated **31**. This mounting means comprises a headed stud **32** the shank of which passes through an opening in the resilient member or arm **30** and through a spacing collar **33**, the resilient member **30** being interposed between the head of the stud and the collar **33**. The shank of the stud also passes through an insulating washer **34**, an opening in the base member **20**, insulating washer **35** and terminal member or bracket **36**, the end of the shank of the stud **32** being peened or otherwise deformed into engagement with the outer surface of the terminal member **36** to hold the parts, just mentioned, rigidly upon the base member **20**. The terminal member or bracket **36** may be provided with any suitable means for connecting an electrical conductor therewith. As shown in the drawing, this means comprises a threaded opening **37** for receiving a connecting screw with which an electrical conductor may be attached to the terminal bracket. It will be observed that this bracket is electrically connected with the resilient switch arm and contact **29** through the shank of the stud **32**, the latter and the bracket

38 being insulated from the base member 20 by the washers 34 and 35.

The resilient member or arm 30 is provided, intermediate the contact 29 and the mounting means 31, with a thermal responsive member, generally designated 38, which is hingedly connected with the resilient member and adapted to move the latter, together with its contact 29, when the thermal responsive member flexes in response to temperature variations. As shown in Figs. 1, 2, 3 and 4, the thermal responsive member 38 comprises a substantially U-shaped element formed integrally from a bimetallic strip or bar which is bent to provide a main portion 39 and leg portions or extensions 40 and 41. The leg or extension 41 is preferably provided with a pair of spaced lugs or ears 42 which extend through correspondingly spaced openings in the resilient member 30 adjacent the mounting means 31, the lugs 42 being bent so that the thermal responsive member 38 is pivoted to the resilient member 30. Instead of providing ears or projections upon the leg or extension 41 of the thermal responsive member, it will be apparent that the hinging of the latter to the resilient member 30 may be accomplished in any other well-known manner. The thermal responsive member 38 is mounted, as just mentioned, on the resilient member or arm 30 in a manner such that the main portion 39 thereof extends between the base member 20 and the resilient member 30 in spaced relationship therewith and substantially parallel thereto, the undeflected or cold position of the thermal responsive member being indicated by the dot-dash lines in Fig. 1 from which it will be seen that the leg or extension 40 extends at substantially right angles to the resilient member 30, the end of the extension or leg 40 being adapted to engage the resilient arm or member and also being free to move with respect thereto.

At a point substantially intermediate the length of the main body portion 39 of the thermal responsive member, the base 20 is provided with an opening for receiving an adjusting member 43, here illustrated as a shaft the lower end of which is threaded into the threaded interior of a boss or sleeve member 44, attached to or integral with the base member 20, and extending outwardly therefrom. The inner end of the adjusting member or shaft 43 is provided with an insulating pin or projection 45 which is adapted to abut the main portion 39 of the thermal responsive member to limit the movement of the latter toward the base 20 and thereby regulate the operation of the switch as hereinafter described. Adjustment of the member 43 for effecting regulation of the switch operation may be effected by means of a conventional knob or the like, not shown, attached to the outer end of the shaft 43, the extent of adjustment being preferably limited by a radially extending projection 46 upon the shaft 43 which is adapted to abut an axially extending projection 47 provided upon the sleeve or boss 44 as is well known in the art.

The switch illustrated in Figs. 1 and 2 is such that the contacts 28 and 29 are normally in engagement for temperatures below a predetermined value, the contact 29 being moved relative to the contact 28 and separated therefrom when the ambient temperature exceeds the predetermined value for which the switch is set to operate. Let it be assumed that the ambient temperature is below that for which the switch is set to operate

so that the thermal responsive member 38 occupies the position indicated in the dot-dash lines of Fig. 1 and the contacts 28 and 29 are in engagement. As the ambient temperature rises the thermal responsive member, being bimetallic, will flex to a position substantially as shown in full lines in Fig. 1. It will be observed from this figure that the flexing of the thermal responsive member results in a number of different movements of various portions of the said member. Thus the main portion 39 bows so that its central portion engages the lower end of the projection 45, the said central portion having moved a distance A. This causes the legs or extensions 40 and 41 to be deflected relative to the resilient member 30 so that the leg or extension 40 tends to move longitudinally thereover, the extent of this tendency and the amount of the element movement in this direction being further increased by the inwardly bowing of the legs 40 and 41 themselves due to the flexing thereof in response to the temperature change.

The initial flexing of the thermal responsive member has resulted in a firm engagement of the free end of extension 40 with the resilient member 30, it being remembered that the resiliency of the latter acts in the direction for maintaining the contact 29 in engagement with the contact 28. Hence, this initial flexing does not result in a movement of the leg or extension 40 relative to the resilient member 30 since the friction produced by the engagement of this leg with the resilient member prevents any relative movement therebetween until the energy stored in the thermal responsive member by flexing thereof is sufficient to overcome the static friction between the leg 40 and the resilient member 30. Since the static friction is much greater than sliding friction, when the energy stored in the thermal responsive member in sufficient to overcome the static friction, the leg or extension 40 slides relatively rapidly in a longitudinal direction over the resilient member 30 to substantially the position shown in solid lines in Fig. 1, this rapid sliding being in the nature of a snap action and resulting in the corresponding relatively rapid movement of contact 29 out of engagement with contact 28.

With further reference to Fig. 1, it will be seen that the free end of the extension or leg 40 has moved a distance B in a longitudinal direction along the resilient member 30, as the result of deflection of the legs or extensions 40, 41, due to the flexing of the main portion 39, plus the deflection of the said legs or extensions themselves due to flexing in response to temperature changes. In addition to this movement of the free end of the leg or extension 40, the bowing of the main portion 39 and the bowing of the leg or extension 41 through a distance C has caused the main body portion 39 to move a distance D relative to the insulating pin or projection 45.

It will be seen, therefore, that the free end of the leg or extension 40 exerts both a substantially perpendicular and a substantially longitudinal force upon the resilient member 30, the perpendicular force being that which is effected to produce contact movement while the longitudinal force is that which produces the snap action. The novel construction results in greater longitudinal movement of the extension or leg 40 than is possible in prior art constructions so that the snap action effect is increased. This insures longer contact life and a more accurate

operation since equivalent snap action is effected at proportionately smaller temperature change or, conversely, wider contact separation is achieved for an equivalent temperature change. The operation is further enhanced by the movement of the main body portion 39 relative to the pin 45 which stabilizes the action of the extension or leg 40.

As the ambient temperature drops, after the switch has been operated as above described, the thermal responsive member 38 tends to return to its initial position and hence the leg or extension 40 again tends to move longitudinally with respect to the resilient arm 30. As in the case of the previously described movement in the opposite direction, the static friction between the leg or extension 40 and the resilient member 30 initially prevents this relative movement until sufficient energy has been stored in the thermal responsive member to overcome this static friction, whereupon the end of the extension 40 rapidly slides over the surface of the resilient member 30 so that the latter and its contact move with a snap action back to their initial position. The temperature at which the switch operates, as just described, may be selected within a predetermined range by adjustment of the shaft 43 thereby regulating the position of the abutment pin 45 relative to the portion 38 of the thermal responsive member. Other means of adjustment of the switch may be readily effected if desired. For example, instead of employing an adjustable abutment for cooperation with the main portion 39 of the thermal responsive member, a fixed abutment may be employed and the contact 28 mounted for adjustment relative to the base 30.

Fig. 5 illustrates a modified form of the invention employing a stationary contact 28 mounted by means of a stud 22 upon a base member 20 in the same manner as described for the correspondingly numbered parts illustrated in Fig. 1. As before, the contact 28 is mechanically and electrically connected with a terminal member or bracket 25 which is insulated from the base 20 by a washer 26, the contact 28 and stud 22 being insulated from the base 20 by a strip or plate of insulating material 50, although a washer similar to 24, as shown in Fig. 1, may be employed. Cooperating with the contact 28 is a movable contact 29 mounted upon one end of the resilient member or arm 30. The member or arm 30 is mounted upon the base 20 in substantially the same manner as shown in Fig. 1, and hence corresponding parts are designated by the same reference numerals. It will be observed, however, that the insulating washer 34 is now replaced by a portion of the resilient plate or strip 50, although, as mentioned above, this plate or strip 50 may be replaced by separate insulating washers 24 and 34 for cooperation with the studs 22 and 32, respectively. The stud 32 is provided with a terminal bracket or member 36 connected with the stud 32 as previously described.

In the present form of the switch, however, the thermal responsive member, generally designated 51, is constructed differently from the previously described thermal responsive member 38. As shown in Fig. 5, the thermal responsive member 51 comprises a substantially straight main portion 52 formed of a bimetallic strip or bar. Adjacent one end of the main portion 52 are connected a pair of spaced pins 53 which are rigidly connected with the main portion 52 and have tapered lower ends for reception in correspondingly spaced openings in the resilient member or arm 30. These openings in the resilient member 30 are of sufficient size to permit tilting of the pins 53 therein thus providing a hinged connection of the thermal responsive member to the resilient member or arm 30. The other end of the main portion 52 of the thermal responsive member is provided with a projection or pin 54 rigidly connected with the main portion 52 and extending at substantially right angles thereto for engagement with the resilient member 30. The pins 53 and 54 may be formed of any desired material but preferably are non-conductive so that the current flowing through the thermostatic switch does not pass through the bimetallic main portion 52 of the thermal responsive member.

The present form of the thermostatic switch is also provided with an adjustable abutment adapted to engage the main portion of the thermal responsive member intermediate its ends and thereby regulate the operation of the switch. This adjustment may be formed in the same manner as shown in Fig. 1. As illustrated in Fig. 5, however, the adjustment member is shown simply as a threaded stud 55 the lower end of which is provided with a projection or pin 56, preferably formed of insulating material, the stud 55 being screwed through a threaded opening in the base 20 and the outer end of the stud being provided with a slot or other suitable surface 57 for engagement with a screw driver or other tool.

A switch constructed as shown in Fig. 5 operates in substantially the same manner as that illustrated in Figs. 1 and 2 except that the extensions or legs 53, 54 of the thermal responsive member 51 do not themselves flex or bend in the construction illustrated in Fig. 5, the sole flexing occurring in the main body portion 52. Nevertheless, this flexing of the thermal responsive member produces movements A, B, C and D as before, although the values of these several movements are somewhat different than when the thermal responsive member is entirely constructed from bimetallic material. As before, the free end of the extension or leg 54 exerts both substantially perpendicular and longitudinal forces upon the resilient member 30, the longitudinal force creating friction between the said leg or extension and the resilient member 30 which friction results in the snap action of the resilient member and its contact for the reasons previously described. Thus, it will be observed that the thermal responsive member 51 in flexing from its cold position, as shown in full lines in Fig. 5, to its hot or operated position, as shown in dot-dash lines in the same figure, will have caused the free end of the extension or leg 54 to have moved a distance B longitudinally of the resilient member 30 and a distance A perpendicularly thereof. The movement through the distance B is that which produces the snap action while the movement through the distance A effects contact separation.

Fig. 6 illustrates a further modified form of thermostatic switch constructed in accordance with this invention, the switch being generally constructed in the same manner as illustrated in Fig. 5 and therefore the same reference numerals are employed for corresponding parts which need not be again described in detail. In the present switch construction, however, the thermal responsive member, generally designated 60, is differently constructed and is hingedly connected to the resilient member 30 in a somewhat different man-

ner from that illustrated and described for the forms of the switches illustrated in Figs. 1 and 5. In the present construction, the thermal responsive member 60 is a substantially L-shaped bimetallic strip or element with the main portion 61 thereof extending substantially parallel with and spaced from the resilient member 30 and with the free end of the integral extension or leg 62 engaging the said resilient member 30. The end of the main portion 61, opposite to that which is provided with the extension 62, is provided with a pair of spaced openings which are fitted over reduced diameter portions 63 of correspondingly spaced pins or projections 64, the other ends of which pins are rigidly connected with the resilient member 30. The openings in the portion 61 of the thermal responsive member are larger than the diameters of the extension 63 of the pins 64 so that the thermal responsive member can tilt or hinge relative to the pins 64, from its position as shown in full lines in Fig. 6 to that indicated in dot-dash lines in the same figure. Since a switch constructed as shown in Fig. 6 operates in the same manner as those described with reference to Figs. 1 and 5, it need not be further described in detail except to note that, in the present construction, the movement through the distance designated C in the previous figures is no longer present. Nevertheless, the extension or leg 62 itself flexes similar to the corresponding leg or extension in Fig. 1. The switch shown in Fig. 6 therefore operates with a snap action of its movable contact 29 in substantially the same manner as previously described and hence need not be repeated.

Figs. 7 and 8 illustrate another modified form of thermal responsive member which may be employed in switch constructions similar to those illustrated in Fig. 6 thereby producing switches having the same general operational characteristics. This form of thermal responsive element, generally designated 70, employs a substantially flat bimetallic strip or bar 71 forming the main portion of the thermal responsive element. One end of this portion 71 is provided with a pair of spaced openings 72 for positioning upon extensions such as 63 of the pins 64 in a switch construction similar to that shown in Fig. 6, the openings 72 being of larger diameter than the diameters of the extensions 63. The other end of the bimetallic strip or bar, constituting the main portion 71 of the thermal responsive member, is provided with a projection or pin 73 rigidly connected with the bimetallic portion and extending at substantially right angles therefrom for engagement with a resilient switch arm such as 30. This projection or pin 73 corresponds in function and operation with the pin 54 in the construction shown in Fig. 5, or the integral extensions 40 and 62 shown in Figs. 1 and 6, respectively. A switch employing a thermal responsive member 70 constructed as shown in Figs. 7 and 8 will also operate with a semisnap action, the principles thereof being the same as previously described. The snap action, however, will be less than that which results from the previously described constructions but nevertheless is still sufficient for satisfactory operation in certain installations.

Figs. 9 and 10 illustrate a still further modified form of thermal responsive member which may be readily employed in switch constructions similar to those illustrated in Figs. 1 and 5. The present form of thermal responsive member, which is generally designated 80, comprises a bimetallic strip or bar bent to a substantially L-shape thereby providing a main portion 81 and an extension or leg portion 82. The extension or leg 82 is preferably provided with a pair of spaced, integral ears or projections 83 which are adapted to be received in the spaced openings of the resilient arm or bar 30 shown in Figs. 1 and 5. The other end of the main portion 81 is provided with an extension or leg member 84, here illustrated as a pin rigidly connected with the main portion 81 and extending at substantially right angles therefrom. The lower end of this pin or extension 84 is adapted to engage and slide upon the resilient arm or member 30 in the same manner as the extensions or legs 40, 54, 62 and 73 previously described, thereby producing a semisnap action of the contact 29 when the thermal responsive member flexes in response to temperature variations. The operation of this form of thermal responsive member is substantially similar to those already described and hence need not be repeated, it being sufficient to note that, since the leg or portion 82 of the present form of thermal responsive member is bimetallic, the movement of the pin or projection 84 over the resilient member 30 is greater than in the case of the corresponding projection of the thermal responsive member illustrated in Figs. 7 and 8 but less than that of the member illustrated in Fig. 1.

Fig. 11 illustrates a still different form of thermostatic switch constructed in accordance with this invention. This switch also comprises a stationary contact 28 mounted by means of a stud 22 upon a base member 20 in the same manner as described for the correspondingly numbered parts illustrated in Fig. 5. As before, the contact 28 is mechanically and electrically connected with a terminal member or bracket 25 which is insulated from the base by an insulating washer 26, the contact 28 and stud 22 being insulated from the base 20 by a strip or plate of insulating material 50, although a washer similar to 24, as shown in Fig. 1, may be employed. Cooperating with the contact 28 is a movable contact 29 mounted upon one end of a movable contact supporting member or arm 130 biased to normally effect engagement of contact 29 with contact 28. As illustrated, this supporting member or arm is formed of relatively thin metal the previously mentioned biasing action being afforded by the resiliency of the member. The member or arm 130 is mounted upon the base 20 in substantially the same manner as shown in Figs. 1 and 5 and hence corresponding parts are designated by the same reference numerals. It will be observed, however, that the insulating washer 34, shown in Fig. 1, is now replaced by a portion of the resilient plate or strip 50, as in the construction shown in Fig. 5, although, as mentioned above, this plate or strip 50 may be replaced by separate insulating washers 24 and 34 for cooperation with the studs 22 and 32, respectively. The stud 32 is provided with a terminal bracket or member 36 connected with the stud 32 and insulated therefrom by a washer 35 as previously described.

In the present form of the switch the thermal responsive member, generally designated 90, comprises a substantially U-shaped member formed integrally from a bimetallic strip or bar so as to provide a main portion 91 and angularly extending legs or extensions 92 and 93. The main portion 91 of the thermal responsive member is provided with an opening

through which freely passes the shank of a headed stud 94, the inner end of the shank of the stud being received in and held by an insulating member 95 provided in the lower end of an adjusting screw or shaft 96. The adjusting screw or shaft 96 is otherwise similar to the corresponding element designated 43 and is similarly threadedly received in a threaded boss or sleeve 44 provided upon the base 20, rotation of the shaft or screw 96 being limited as before by a radially extending projection or lug 97 which is adapted to engage an axially extending projection 98 provided upon the sleeve or boss 44. Preferably, the stud 94 is threaded within the insulating member 95 and is initially adjusted so that the thermal responsive member 90, in the cold or non-operated condition of the switch, is disposed intermediate the insulating member 95 and the head of the stud 94 without engaging either, the thermal responsive member being entirely supported by the member or arm 130 upon which the ends of the extensions 92 and 93 rest. The thermal responsive member 90 is prevented from rotative displacement relative to the contact supporting member 130 in any suitable manner, one convenient mode being that illustrated in Fig. 11 as comprising integral lugs or ears 131 struck up from the edges of the member 130 and extending adjacent the sides of the extensions or legs 92 and 93.

A switch constructed as shown in Fig. 11 operates in similar manner to those previously illustrated and described except that in the present form both of the extensions or legs 92, 93 cooperate in effecting switch operation. This follows from the fact that the thermal responsive member 90 is bimetallic throughout its entire length, and hence every part thereof flexes in response to variations in temperature, the flexed or deflected condition of the thermal responsive member being somewhat similar to that of the member illustrated in Fig. 1 except that both the legs or extensions 92, 93 now move longitudinally of the member 130 in the same manner as does the extension or leg 40 shown in Fig. 1. In other words, the portion 91 deflects into engagement with the insulating button or member 95, thus limiting its movement in this direction, and the legs or extensions 92, 93 are deflected relative to the member or arm 130 and tend to move longitudinally thereover. The extent of this tendency, and the amount of ultimate movement of the extensions in this direction, being further increased by the inwardly bowing of the extensions or legs 92, 93 themselves due to flexing thereof in response to temperature change.

The initial flexing of the thermal responsive member results in a firm engagement of the free ends of the extensions or legs 92, 93 with the member 130, it being remembered that the resiliency of the latter acts in the direction for maintaining the contact 29 in engagement with the contact 28. This initial flexing does not result in a movement of the legs or extensions 92, 93 over the surface of the resilient member 130, however, since the static friction, produced by the engagement by these legs with the member, prevents any relative movement therebetween until the energy stored in the thermal responsive member is sufficient to overcome this static friction. Since the static friction is much greater than sliding friction, when the energy stored in the thermal responsive member is sufficient to overcome the static friction the legs or extensions 92, 93 slide relatively rapidly over the resilient member 130 and this rapid sliding, being in the nature of a snap action, results in correspondingly relatively rapid movement of contact 29 out of engagement with contact 28. In the present form of the switch it will be observed that, due to the presence of the stud 94, the main body portion 91 of the thermal responsive member does not shift longitudinally in the switch and hence there is no movement corresponding to that indicated D in Fig. 1.

The switch illustrated in Fig. 11 will also operate when the thermal responsive member is initially positioned in spaced relationship with respect to the contact carrying arm 130. That is to say, the switch may be adjusted by adjustment of the screw or shaft 96 and/or stud 94 so that the bimetallic member is normally supported by the head of the stud with the ends of the extensions or legs 92, 93 spaced slightly from the resilient arm or member 130. The operation of the switch, when initially adjusted in this manner, is substantially the same as previously described, initial flexing of the thermal responsive member resulting in engagement of the portion 91 with the insulating member or button 95 and a firm engagement of the legs or extensions 92, 93 with the resilient member or arm 130. Further flexing of the thermal responsive member then actuates the switch in a manner previously described.

Instead of employing a thermal responsive member entirely formed from a single bimetallic strip such as illustrated in Fig. 11, a switch of similar construction may be provided with a thermal responsive member formed of a plurality of different materials. For example, the member may have its main portion 91 formed from a substantially straight bimetallic strip or bar, the extensions or legs 92, 93 being separate members united therewith, as for example, insulating pins or buttons similar to 73 or 84, illustrated in Figs. 7 and 9, respectively.

It will be apparent that in all forms of the switch the thermal responsive member is supported, with respect to the resilient or flexible contact carrying arm with which it cooperates, in a manner such that both ends of the member are substantially free to flex, rigid connections thereof to stationary parts having been completely eliminated. Thus, in the forms of the switch in which pivotal connections to the resilient or flexible contact arm are employed, the holes with which the lugs or pins cooperate to provide the hinging action are of sufficient size to substantially prevent binding at such points. In the form of the switch shown in Fig. 11 the ends of the thermal responsive member 90 are free to move over the resilient contact arm and the central opening through the bight portion of the thermal responsive member is sufficiently larger than the portion of the stud 94 passing therethrough so as not to interfere with free flexing movement of the thermal responsive member. Hence, in all embodiments of the invention the thermal responsive member can be said to be floatingly supported with respect to the resilient contact arm. Consequently, where this terminology, namely, "floatingly supported," is employed in the subjoined claims, it is intended to be construed in the generic sense as here set forth.

While the present preferred form of construction of a thermostatic switch, constructed in ac-

cordance with this invention, has been illustrated and described in considerable detail, together with certain modifications, it will be readily apparent that the forms illustrated and described are intended as illustrative only since numerous variations and modifications may be made by those skilled in the art. For example, the principles here illustrated and described may be readily employed in switches whose contacts are normally open but are adapted to be closed upon a change in temperature. Moreover, while the movable contact supporting member has been illustrated as formed from a strip of metal, the natural resiliency of which effects the necessary biasing of the contact in one direction, it will be apparent that the same result may be achieved with other means for mounting and biasing the movable contact. Thus, the portion of the members **30** to which the thermal responsive members are hinged may be rigid and only the portion engaged by the extensions or legs **46, 54, 62, 73** or **84**, and carrying the contact **29**, need be movable. Likewise, the portion of member **130** which is engaged by the leg **93** need not be movable. Therefore, the invention is not to be considered as limited to the exact details of construction and arrangements of parts herein illustrated and described but only as required by the spirit and scope of the appended claims.

Having thus described my invention, I claim:

1. A thermostatic switch comprising a first contact, a second contact, a member supporting said second contact for movement in opposite directions to and from engagement with the first contact and biased for movement in one of said directions, and a substantially U-shaped thermal responsive member floatingly supported intermediate the ends of said supporting member and substantially aligned therewith, the said thermal responsive member including a bimetallic main portion extending substantially parallel with said supporting member and spaced legs extending angularly from said main portion and directed towards the said supporting member, at least one of said legs being adapted upon flexing of the thermal responsive member in response to variations in temperature to exert force upon said supporting member in directions both substantially parallel with and perpendicular to said supporting member so that friction is created between said supporting member and the said one leg, whereby flexing of said thermal responsive member does not effect movement of said supporting member until the thermal responsive member has stored sufficient force by flexing thereof to overcome the static friction between the supporting member and the said one leg whereupon the said thermal responsive member moves the said supporting member and the contact thereon relative to the first contact with a snap action, and means adapted to engage said main portion of the thermal responsive member intermediate the ends thereof to limit the extent of movement of said main portion away from said supporting member when said thermal responsive member flexes.

2. A thermostatic switch comprising a first contact, a second contact, a member supporting said second contact for movement in opposite directions to and from engagement with the first contact and biased for movement in one of said directions, a substantially U-shaped thermal responsive member floatingly supported intermediate the ends of said supporting member and substantially aligned therewith, the said thermal responsive member including a bimetallic main portion extending substantially parallel with said supporting member and spaced legs extending angularly from said main portion and directed towards the said supporting member, at least one of said legs being adapted upon flexing of the thermal responsive member in response to variations in temperature to exert force upon said supporting member in directions both substantially parallel with and perpendicular to said supporting member, means adapted to engage the said main portion of the thermal responsive member intermediate the ends of the latter to limit the extent of movement of said main portion away from said supporting member when said thermal responsive member flexes, and means to adjust the last mentioned means to thereby adjust the switch operation.

3. A thermostatic switch comprising a first contact, a second contact, a resilient member supporting said second contact for movement to and from engagement with the first contact, and a thermal responsive member supported by and hinged to said resilient member intermediate the ends thereof and having a portion directed towards said resilient member to exert force upon said resilient member in a direction to effect movement of said second contact relative to the first contact when said thermal responsive member flexes in response to variations in temperature.

4. A thermostatic switch as defined in claim 3 and further comprising means to adjust said switch for contact operation at different predetermined temperatures.

5. A thermostatic switch as defined in claim 3 and and in which the said thermal responsive member is substantially U-shaped with one of the legs thereof hinged to said resilient member and the other of said legs constituting the said portion directed towards said resilient member.

6. A thermostatic switch as defined in claim 3 and in which the said thermal responsive member is a substantially U-shaped unitary bimetallic element with one leg thereof forming the said portion directed towards the said resilient member and the other leg of the element hinged to said resilient member.

7. A thermostatic switch as defined in claim 3 and in which the said thermal responsive member comprises a bimetallic bar forming a main portion one end of which is provided with means for hinging it to said resilient member, and the said portion of the thermal responsive member which is directed towards the said resilient member is a non-bimetallic member connected to the other end of said main portion and extending at substantially right angles with respect thereto.

8. A thermostatic switch as defined in claim 3 and in which the thermal responsive member comprises a substantially L-shaped unitary bimetallic element.

9. A thermostatic switch comprising a base member, a first contact mounted on said base member, a resilient member mounted upon said base member, a second contact mounted upon said resilient member for movement to and from engagement with the first contact, a substantially U-shaped thermal responsive member having one of its legs hinged to said resilient member and the other of its legs directed towards and in engagement with said resilient member, whereby flexing of said thermal responsive member in response to temperature variations causes the end of said other leg to exert both substantially per-

pendicular and longitudinal forces on the said resilient member, the said longitudinal force creating static friction between the said other leg and the resilient member so that flexing of the thermal responsive member is prevented from effecting movement of said resilient member until the flexing has stored sufficient energy in the thermal responsive member to overcome the static friction, whereupon the resilient member and the contact carried thereby are moved with a snap action relative to said first contact, and adjustable means carried by said base member and adapted to cooperate with said thermal responsive member to adjust said switch for contact operation at different predetermined temperatures.

10. A thermostatic switch comprising a base member, a first contact mounted on said base member, a resilient member mounted upon said base member, a second contact mounted upon said resilient member for movement to and from engagement with the first contact, a substantially U-shaped bimetallic member, means for hinging one leg of said bimetallic member to said resilient member with the other leg thereof directed towards and in engagement with said resilient member, whereby flexing of said bimetallic member in response to a temperature variation causes the end of said other leg to exert both substantially perpendicular and longitudinal forces on the said resilient member, the said longitudinal force creating static friction between the said other leg and the resilient member so that flexing of the bimetallic member is prevented from effecting movement of said resilient member until the flexing has stored sufficient energy in the bimetallic member to overcome the static friction, whereupon the resilient member and the contact carried thereby are moved with a snap action relative to said first contact, and adjustable means carried by said base member and adapted to cooperate with said bimetallic member to adjust said switch for contact operation at different predetermined temperatures.

11. A thermostatic switch comprising a base member, a first contact mounted on said base member, a resilient member mounted on said base member, a second contact mounted upon said resilient member for movement to and from engagement with the first contact, a substantially L-shaped bimetallic member, means for hinging one leg of said bimetallic member to said resilient member in spaced relationship therewith and with the other leg extending substantially perpendicular to said resilient member and in engagement therewith, whereby flexing of said bimetallic member in response to temperature variations causes the end of said other leg to exert substantially perpendicular and longitudinal forces on the said resilient member, the said longitudinal force creating static friction between said other leg and the resilient member so that flexing of the bimetallic member is prevented from effecting movement of said resilient member until the flexing has stored sufficient energy in the bimetallic member to overcome the static friction, whereupon the resilient member and the contact carried thereby are moved with a snap action relative to said first contact, and adjustable means carried by said base member and adapted to cooperate with said thermal responsive member to adjust said switch for contact operation at different predetermined temperatures.

12. A thermostatic switch comprising a base member, a first contact mounted on said base member, a resilient member mounted on said base member, a second contact mounted upon said resilient member for movement to and from engagement with the first contact, a bimetallic bar, non-bimetallic extension members provided adjacent the ends of said bimetallic bar and extending substantially at right angles therefrom, one of said extension members being hinged to said resilient member and the other of said extension members being directed towards the resilient member and in engagement therewith, whereby flexing of said bimetallic bar in response to temperature variations causes the end of the other of said extension members to exert both substantially perpendicular and longitudinal forces on the said resilient member, the said longitudinal force creating static friction between the said other extension and the resilient member so that flexing of the bimetallic bar is prevented from effecting movement of said resilient member until the flexing has stored sufficient energy in the bimetallic bar to overcome the static friction, whereupon the resilient member and the contact carried thereby are moved with a snap action relative to said first contact, and adjustable means carried by said base member and adapted to cooperate with said bimetallic bar to adjust said switch for contact operation at different predetermined temperatures.

13. A thermostatic switch comprising a first contact, a second contact, a member supporting said second contact for movement in opposite directions to and from engagement with the first contact and biased for movement in one of said directions, a substantially U-shaped thermal responsive member floatingly supported adjacent said supporting member in a manner such that the ends of both legs of the thermal responsive member are adapted to engage and move along the said supporting member to effect movement of the latter, and means adapted to be engaged by the bight portion of said thermal responsive member to limit the flexing of the said bight portion thereof away from said supporting member and to prevent bodily displacement of the thermal responsive member longitudinal of the said supporting member.

14. A thermostatic switch comprising a first contact, an elongated member supported adjacent one end thereof for movement of the other end in opposite directions towards and away from said first contact and biased for movement in one of said directions, a second contact mounted on said elongated member adjacent the said other end thereof in substantial alignment with said first contact, the said elongated member having a planar surface thereon intermediate the ends of the member, a thermal responsive member floatingly supported intermediate the point of support of said elongated member and the said second contact, the said thermal responsive member including a bimetallic main portion extending substantially parallel with the said elongated member in spaced relation with respect thereto and at least one extension portion of substantial length extending angularly with respect to said main portion and directed towards said elongated member for engagement with the planar surface on the latter, the said extension portion exerting force upon the elongated member in directions both substantially parallel with and perpendicular to the latter upon flexing of the said thermal responsive member

in response to variations in temperature, and means adapted to engage the said main portion of the thermal responsive member intermediate the ends of the latter to limit the extent of movement of said main portion away from said elongated member when the said thermal responsive member flexes.

15. A thermostatic switch comprising a first contact, a second contact, means including a movable portion supporting said second contact for movement to and from engagement with the first contact, the said movable portion having a planar surface, a substantially U-shaped thermal responsive member having a bimetallic main portion and spaced leg portions disposed at an angle to said main portion, means hinging one of said leg portions to said supporting means in a manner to dispose said main portion in spaced relationship to said supporting means and with the end of the other of said leg portions adapted to engage the planar surface in the movable portion of said supporting means and slide thereover in the direction of the hinging means, whereby flexing of said thermal responsive member in response to a temperature variation causes the end of said other leg portion to exert both substantially perpendicular and longitudinal forces on the said movable portion, the said longitudinal force creating static friction between the said other leg and the said movable portion so that flexing of the thermal responsive member is prevented from effecting movement of said second contact until the flexing has stored sufficient energy in the thermal responsive member to overcome the static friction, whereupon the movable portion of the supporting means and the said second contact are moved with a snap action relative to said first contact.

16. A thermostatic switch as defined in claim 15 and in which the said main portion and at least one of the leg portions of the thermal responsive member are integral portions of a single bimetallic element.

17. A thermostatic switch as defined in claim 15 and in which the said main and both leg portions of said thermal responsive member are integral parts of a unitary bimetallic element.

18. A thermostatic switch comprising a first contact, a second contact, means including a movable portion supporting said second contact for movement to and from engagement with the first contact, the said movable portion having a planar surface, a substantially L-shaped unitary bimetallic element, and one or more members fixed to said supporting means and projecting substantially perpendicularly therefrom into hinging engagement with one portion of said bimetallic element in a manner permitting rocking movement of the latter with respect to said projecting members, the end of the other portion of said L-shaped bimetallic element being positioned to engage the planar surface on the movable portion of said supporting means and slide thereover in the direction of said projecting members, whereby a temperature variation causes both portions of the said bimetallic element to flex thereby causing the end of said other portion thereof to exert both substantially perpendicular and longitudinal forces on said movable portion, the said longitudinal force creating static friction between the said other portion of the bimetallic element and the movable portion of the contact supporting means so that flexing of the bimetallic element is prevented from effecting movement of said second contact until the flexing has stored sufficient energy in the bimetallic element to overcome the static friction, whereupon the movable portion of the supporting means and the said second contact are moved with a snap action relative to said first contact.

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