Oct. 8, 1946. C. M. OSTERHELD 2,408,873

SNAP ACTING THERMOSTATIC SWITCH

Filed March 20, 1944

Fig-1

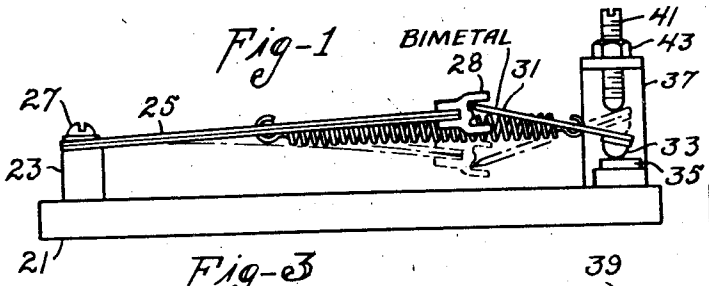


Fig-2

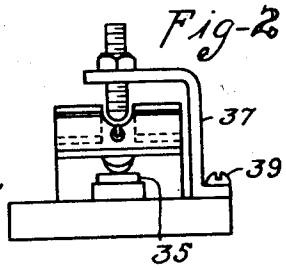


Fig-3

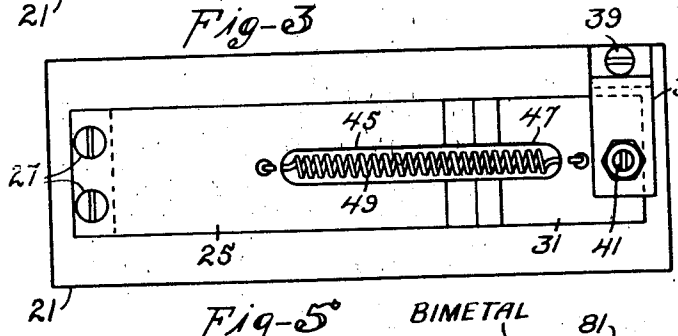


Fig-4

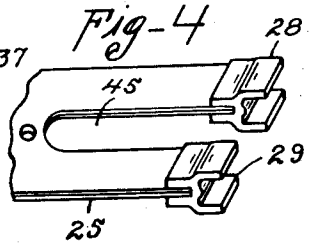


Fig-5

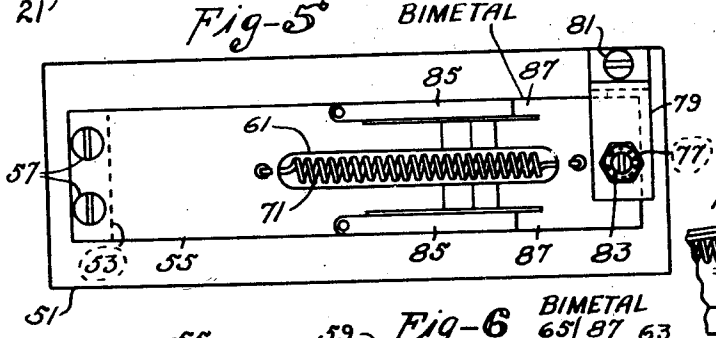


Fig-9

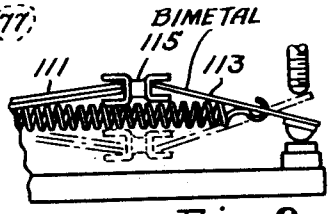


Fig-6

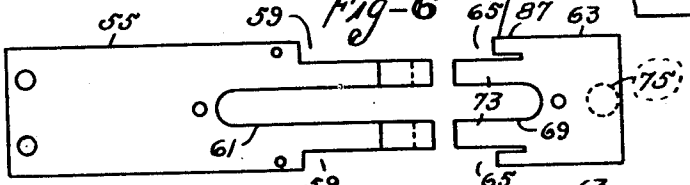


Fig-7

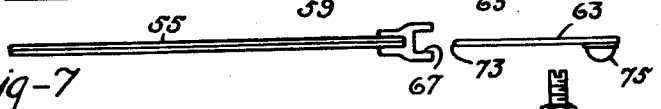


Fig-8

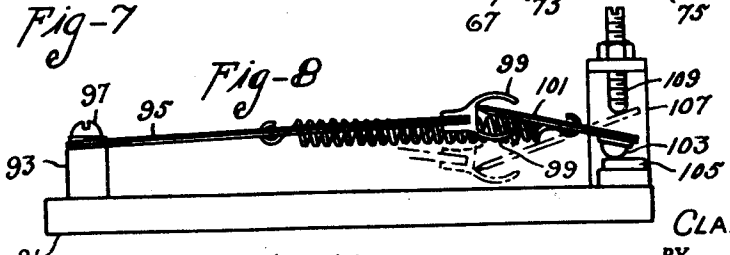
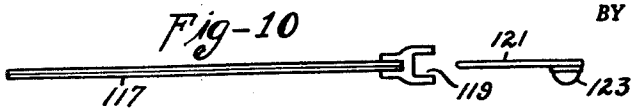


Fig-10



INVENTOR.
CLARK M. OSTERHELD
BY
A M Bielel
ATTORNEY

Patented Oct. 8, 1946 2,408,873

UNITED STATES PATENT OFFICE

2,408,873

SNAP ACTING THERMOSTATIC SWITCH

Clark M. Osterheld, Stoughton, Wis., assignor to McGraw Electric Company, Elgin, Ill., a corporation of Delaware

Application March 20, 1944, Serial No. 528,549

9 Claims. (Cl. 200—138)

1

My invention relates to switches and particularly to snap acting thermostatic switches.

An object of my invention is to provide a relatively simple, compact and inexpensive snap acting thermostatic switch assembly.

Another object of my invention is to provide a relatively simple snap acting thermostatic switch in which there shall be pressure between the contacts until the instant of separation.

Another object of my invention is to provide means in a snap acting thermostatic switch that shall increase the contact pressure until the instant of separation.

Other objects of my invention will either be apparent from a description of several different forms of devices embodying my invention or will be pointed out during such description and set forth in the appended claims.

In the drawing,

Figure 1 is a view, in side elevation, of a snap acting thermostatic switch embodying my invention,

Fig. 2 is a view in front elevation thereof,

Fig. 3 is a top plan view thereof,

Fig. 4 is an enlarged view, in end elevation, of the free end of one member of the switch,

Fig. 5 is a top plan view of another form embodying my invention,

Fig. 6 is an exploded top plan view of the two toggle members embodied in the form shown in Fig. 5,

Fig. 7 is a view, in side elevation, of the parts shown in Fig. 6,

Fig. 8 is a view, in side elevation, of another form of device embodying my invention,

Fig. 9 is a fragmentary view, in side elevation, of a modification embodying my invention, and,

Fig. 10 is a view, in side elevation, of another modification embodying my invention.

Referring first of all to Figs. 1 to 4 inclusive, I have there shown a base 21, of electric-insulating material on which the parts of the switch particularly constituting my invention are mounted. I provide a small block 23, of electric-insulating material, secured to base 21 adjacent one of the ends thereof. I provide a first or main bimetal bar 25 having one of its ends secured to base 23 as by one or more machine screws 27. For illustrative purposes only I may here state that the thickness of the bimetal bar 25 may be on the order of .025" or .030", although I do not desire to be limited thereto. The free end of bar 25 has either formed therein a socket member, which is of channel shape in lateral section, as by bending integral portions out on opposite sides of the bar to form a socket of channel shape, or secured thereto at its free end socket members 28 and 29, which are of channel shape and are secured as by welding or brazing to opposite sides of the bar 25. The shape of the bottom wall of the socket members may be flat or have a special form, as will be referred to hereinafter.

2

I provide a second or auxiliary bimetal bar 31, which is preferably, although not necessarily, relatively thinner than the bimetal bar 25. I may use a bimetal bar 31, the thickness of which is on the order of .015", although this particular dimension is noted for illustrative purposes only. The inner end of the second bimetal bar 31 is provided with a knife edge, and the outer end thereof has secured thereto a contact member 33. The knife edge end of bimetal bar 31 is adapted to be located in the members of channel shape formed or provided at the free end of the first bimetal bar 25. I wish to point out that the high expansion element is on the same side of the assembly in this form of device as well as in all of the other forms using two bimetal members.

The supporting block or base 21 has mounted thereon a contact member 35 adapted to engage with and be disengaged from the contact member 33 on the second bimetal bar 31. A stop means for the free end of the second bimetal bar 31 comprises a bar 37, of substantially Z-shape, having one end portion thereof secured against the upper surface of base 21 as by a machine screw 39. The other end portion of the bracket 37 has secured therein an adjustable stop screw 41 which may be held in any desired adjusted position by a lock nut 43.

The bimetal bar 25 has a medial longitudinally-extending slot 45 therein starting at the free end and extending thereinto over about one-half of its length. The second bimetal bar 31 has a similar elongated central slot 47 therein starting at the knife edge end thereof and an over-center spring 49 is located in the two slots and has the ends thereof secured to the respective intermediate portions of the two bimetal bars 25 and 31. The combination of the two bimetal bars 25 and 31 and the over-center spring constitute a toggle and, upon change of temperature, the second bimetal bar 31 will move from one limiting position to an opposite limiting position with a snap action.

A brief description of the operation of the device shown in Figs. 1 to 4 is as follows: Fig. 1 shows the general positions of the parts when

the temperature of the air is at a relatively low value so that the two contact members 33 and 35 are in circuit-closing position, that is if the switch controls an electric heater, the said heater will be energized. The position of the knife edge end of the second bar 31 will be substantially that shown in Fig. 1 of the drawing, that is the knife edge end will be in engagement with the upper corners of the socket members of channel shape. The spring 49 is under tension and causes the knife edge end to be held tightly in engagement with the inner wall of the socket member and also causes a contact pressure to exist between the contact members 33 and 35.

Upon increase of the temperature of the ambient air, the first bimetal bar 25 will flex in a clockwise direction around its fixed end, while the second bimetal bar 31 will tend to flex in a counter-clockwise direction around the fixed contact member 35. It may be here pointed out that the lateral width of the socket member of channel shape is such that the bimetal bar 31 will not engage the outside ends of the lower side portions of the socket members when the parts are in the positions shown in Fig. 1 of the drawing or in the opposite positions as shown by the broken lines in Fig. 1. The tension of spring 49 will cause a certain pressure between the knife edge end of bar 31 and the socket member, the result being that the parts comprising particularly the adjacent engaged end portions of the two bimetal bars will have a certain amount of frictional resistance to any lateral movement of the knife edge end of bar 31 in the socket members. This has the result that there will be a predetermined amount of pressure between the two contact members 33 and 35, thereby reducing the voltage drop of the current flowing through and controlled by the switch. Just prior to the disengagement of contact member 33 from the fixed contact member 35, the knife edge end of bar 31 will have moved laterally in the socket member to a position intermediate the side walls thereof in case the bottom wall is flat, and immediately after, if not substantially coincident with the snap acting movement of bimetal bar 31 to the opposite position, the knife edge end of bar 31 will move into the lower corner of the socket member.

The longitudinal distance between the contact member 33 and the holding screw 27 is less, in the positions of the parts shown in Fig. 1, than it will be when the two bars 25 and 31 are in substantially longitudinally alined positions, which latter positions they will occupy an instant before the above described snap acting movement of the second bar 31, with the attendant result that during the change of positions from those shown in Fig. 1 to when they are in substantial alinement with each other, the contact member 33 will have a sliding movement on contact member 35 with the result that a self-cleaning pair of contacts is obtained.

I may increase the frictional resistance to movement of the inner end of bar 31 by making the bottom wall of other than flat shape. I have shown a preferred shape in Figs. 1 and 4, this shape including a raised central portion and two lowered side portions. The longitudinal distance between the contact member 33 and the holding screw 27 will be momentarily increased during the time of snap-over action by the movement of the knife edge end of bar 31 from one side portion to the other side portion with the result of greater tension in the over-center spring 49. This results in greater pressure between the contacts 33 and 35 just before disengagement thereof.

Referring now to Figs. 5 to 7 inclusive of the drawing, I have there shown a modification embodying my invention. A base 51, of electric-insulating material has mounted thereon adjacent to one end thereof a small block 53 also of electric-insulating material against which is secured one end of a bimetal bar 55 as by machine screws 57. The bimetal bar 55 is of substantially the shape shown in Fig. 6, having cut out side portions 59 adjacent the free end thereof and having an extended slot 61 extending inwardly from the free end, centrally of the bar 55.

A second bimetal bar 63, which is relatively shorter than bimetal bar 55, has side portions 65 removed therefrom at that end adapted to engage socket members 67 formed in or secured to the free end of bar 55. Bar 63 has slot 69 therein extending substantially longitudinally centrally thereof from its inner end. An over-center spring 71 is adapted to be positioned in the alined slots 61 and 69 and to have its ends connected with the intermediate portions of the two bars 55 and 63. The inner ends 73 of the second bimetal bars 63 are of rounded shape adapted to fit into the socket members 67 provided at the free end of bimetal bar 55. In this form of the device the second bimetal bar 63 may be thinner than the first bimetal bar 55.

The second bimetal bar 63 has a contact member 75 provided at the outer, free, movable end thereof which is adapted to engage with and be disengaged from a fixed contact member 77 mounted on the base 51. I provide a stop member for the free end of the second bimetal bar 63 comprising a bracket 79 of L-shape, having one end thereof secured to block 51 as by a machine screw 81, an adjustable stop screw 83 being provided in the other end thereof adapted to be engaged by the movable end of bimetal bar 63.

A pair of leaf springs 85 have one end thereof fixedly secured against an intermediate portion of bimetal bar 55 at the sides thereof and extend over the cut out portions 59, the length of these springs being such as to extend to and slightly overlap the side portions 87 on bimetal bar 63, the overlap of the leaf springs 85 over the portions 87 being on the order of a few thousandths of an inch only. It is evident that the two springs 85, having one end secured to the first or main bimetal bar 55 and having the second end thereof overlapping and engaging with an intermediate portion of the second or auxiliary bar 63, will cause a lateral pressure against bar 63, the result being that the contact member 75 will be subject to an increased pressure against the fixed contact member 77. This contact pressure is additive to that produced by the inner end of the second bimetal bar moving in the socket members 67 provided at the free ends of the first bimetal bar 55. It is evident that the springs 85, the ends of which engage one side of bimetal bar 63, will have those ends move past the ends of the portions 87 of the second bimetal bar when snap acting movement of the second bar occurs, so that then the leaf springs 85 will exert a lateral pressure on the second bimetal bar 63, this pressure now being in the opposite direction to that exerted by the leaf springs 85 in the first place.

Referring now to Fig. 8 of the drawing, I have there shown a modification of the device shown in Figs. 5 to 7 inclusive, comprising a base 91, of electric-insulating material having a small

block 93 also of electric-insulating material secured thereagainst. A first bimetal bar 95 has one end thereof secured against block 93 as by one or more machine screws 97. The free end of the bar 95 has mounted thereon a socket member comprising a pair of leaf springs 99 which provide a socket member of substantially channel shape in lateral section, the main portions of the members 99 being resilient and of arcuate shape, the length of these portions being such as to extend over the knife edge end of a second bimetal bar 101, it being understood that the bottom face of the socket member provided by the spring members 99 is flat and even to receive the knife edge end of the second bimetal bar 101. Here again I may make the thickness of the second bimetal bar 101 less than that of the first or main bimetal bar 95.

I provide a contact member 103 on the outer end of bimetal bar 101, which contact member is adapted to be engaged with and disengaged from a fixed contact member 105 secured to the other end of base 91. I provide further a stop for the free end of bimetal bar 101, this stop comprising a bracket 107, of Z-shape, having one end thereof secured against base 91 and having an adjustable stop screw 109 engaged with the other end thereof. It is evident that the same comments with regard to the wiping action of contact 103 on contact 105 made hereinbefore in connection with the form shown in Figs. 1 to 4 inclusive, will apply here also. Further, the effect of the leaf springs 99 will be substantially the same, as regards the increase of pressure between the engaged contact members, as hereinbefore set forth in connection with the form shown in Figs. 5 to 7 inclusive, it being understood that the lateral distance between the outer ends of the arcuate portions of leaf springs 99 is such that one such leaf will engage the second bimetal bar 101 before substantial straight alinement of the two bars occurs, preparatory to snap-over movement of the second bar.

I have shown another modification in Fig. 9 in which there is interposed, between the two main arms 111 and 113 of bimetal, a third short arm 115 having ends of channel shape in lateral sections. The ends of the bimetal bars 111 and 113 will be positioned in the upper corners of the respective sockets when the bars are in the positions shown in Fig. 9 and will occupy the lower corners of the sockets when the contact members are out of engagement with each other.

Referring now to Fig. 10 of the drawing, I have there shown a further modification comprising a first bimetal bar 117 having socket members 119 at its free end. I provide a second arm 121 made of a single metal and having a rounded end adapted to be positioned in the socket member 119, while a contact member 123 is secured to the other free end of the single metal bar 121. It is to be understood that the device shown in Fig. 10 of the drawing is adapted to be mounted on a suitable base, and to be provided with an over-center spring substantially as shown in Fig. 1 of the drawing, but since the only difference between the device shown in Figs. 1 to 4 inclusive and that shown in Fig. 10 is that the second bimetal bar of Fig. 1 is replaced by a single metal bar, it is thought unnecessary to show the additional parts in Fig. 10 of the drawing.

The device particularly embodying my invention and shown in various forms provides a structure which inherently causes an appreciable contact pressure of the movable contact member on the fixed contact member. This will be evident from a consideration of the effect of the over-center tension spring provided in each of the various modifications, a component part of the tension of the over-center spring being active to cause the engaging contact pressure between the engaged contact members. Further, it is evident that the flexing of the main bimetal bar, as in a clockwise direction toward the fixed contact member (as seen in Fig. 1) causes inherently a pressure of one contact member against the other, which contact pressure is absent in many other forms of snap acting switches.

The provision of a knife edge end of the second bar held in relatively tight frictional engagement in a socket member further causes increased contact pressure between the contact members. The further provision of spring means, of leaf shape, having one end thereof secured to the first bimetal bar and extending over the junction of the two bars to engage the second bar, laterally thereof, intermediate its ends further provides additional contact pressure between the engaged contacts.

The provision of two bimetal toggle arms also ensures that the temperature differential of operation of my improved thermostatic switch, that is, the change of temperature necessary to cause movement of the second arm from one to the other of its positions, will be relatively small. Making the thickness of the second bimetal bar less than that of the first bimetal bar also tends to reduce the temperature differential of operation and when combined with the leaf springs results in a snap acting thermal switch, in which the engaged contacts are held with an appreciably large or heavy contact pressure up to the instant of disengagement.

Various modifications may be made without departing from the spirit and scope of my invention, and all such modifications clearly covered by the appended claims shall be considered as part of my invention.

I claim as my invention:

1. A snap acting thermostatic switch assembly comprising a first bimetal bar, a second bimetal bar having one end pivotally engaging one end of the first bar, the high expansion component of the two bars being on the same side of the assembly and an over-center spring having its ends connected to the intermediate portions of said bars.

2. A snap acting thermostatic switch assembly comprising a first and a second bimetal bar having ends pivotally connected with each other to form a toggle, an elongated slot at the adjacent end portions of each of said bars, an over-center spring positioned in said slot and having its ends connected to intermediate portions of said bars to cause snap acting movement of the other end of said second bar between two opposite limiting positions, a fixed support for the other end of said first bar, a contact member on the other end of said second bar, a fixed contact member and a stop member defining said limiting positions, the high expansion component of said two bars being on the same side of the assembly to cause flexing of both bars in the same direction around the fixed support and the fixed contact member and stop upon change of ambient temperature.

3. A snap acting thermostatic switch assembly comprising a first bimetal bar having one end thereof fixed and having a laterally enlarged recessed end portion at its other end, a second bimetal bar having one end positioned in said enlarged recessed end portion of said first bar and

movable laterally therein, an overcenter spring having its ends connected to said first and second bar and bridging the engaged ends thereof, a fixed contact member and a contact member on the other end of the second bar adapted to engage with and be disengaged from said fixed contact member with a snap action by the coincident flexure in the same direction of both bimetal bars around the fixed and contact members respectively.

4. A thermostatic switch assembly comprising a first bimetal bar having one end thereof fixed, a second bimetal bar having one end pivotally engaging the other end of the first bar, an over-center spring having its ends connected to intermediate portions of the respective bars, a fixed contact member, a contact member on the other end of the second bar adapted to be moved into engagement with and be disengaged from said fixed contact member with a snap action and spring means on said first bar at its other end and extending therebeyond over the second bar to engage the latter at one side thereof as the two bars move into alinement with each other to cause a substantial pressure of the contact member on the second bar against the fixed contact member just prior to disengagement of said two contact members.

5. A thermostatic switch assembly comprising a first bimetal bar having one end thereof fixed, a second bimetal bar having one end pivotally engaging the other end of the first bar, an over-center spring having its ends connected to intermediate portions of the respective bars and bridging the engaged ends thereof, a fixed contact member, a contact member on the other end of the second bar adapted to be moved into engagement with and be disengaged from said fixed contact member with a snap action and leaf spring means on said first bar at its other end and extending therebeyond over the second bar to engage the sides of the second bar intermediate its ends to cause a substantial pressure of the contact member on said second bar on said fixed contact member just prior to disengagement of the two contact members.

6. A thermostatic switch assembly comprising a main and an auxiliary bimetal bar pivotally connected with each other in end-to-end relation, the high expansion component of both bars being on the same side of the assembly, an over-center spring connected with the two bars intermediate their ends, a fixed contact, a contact on the free end of said auxiliary bar adapted to engage with and be disengaged from the fixed contact with a snap action and leaf spring means on that end of the main bar pivotally engaged by the auxiliary bar extending over the auxiliary bar to engage

the side of the latter bar intermediate its ends as the two bars move into longitudinal alinement with each other to cause a substantial pressure of the contact on said auxiliary bar against the fixed contact.

7. A thermostatic switch assembly comprising a first bimetal bar having one end thereof fixed and having laterally enlarged recessed portions at its other end, a second bimetal bar having a knife edge end portion at one of its ends engaging said end portion of channel shape of the first bar and movable laterally therein, an over-center spring bridging the engaging end portions of the two bars and having its ends connected to the respective bars intermediate their ends, the high expansion component of both bars being on the same side of the assembly and cooperating with said over-center spring to cause the other end of the second bar to move from one limiting position to another with a snap action under relatively small changes of temperature.

8. A snap acting thermostatic switch mechanism comprising a pair of toggle arms, at least one of which is a bimetal bar, one of said toggle arms having one end fixed and having socket members of channel shape in lateral section at its other end, the bottom wall of said socket members having a raised central portion and two lower side portions, said second arm having one end in said socket members and movable laterally therein, an over-center spring having its ends connected to the intermediate portions of said toggle arms to cause snap acting movement of the second arm upon change of ambient temperature, the tension of said spring being increased by said raised central portion to cause increased contact pressure upon said lateral movement of said second arm, a fixed contact and a contact on the other end of said second arm adapted to be engaged with and disengaged from said fixed contact with a snap action.

9. A snap acting thermostatic switch assembly comprising a first bimetal bar having one end fixed and having a socket member of channel shape in lateral section at its other end, a second bimetal bar of lesser thickness than said first bar having an end positioned in said socket member, the high expansion component of both bars being on the same side of the assembly, said bars having elongated slots in their adjacent end portions, an over-center spring in said slots having its ends connected with the respective bars adjacent to the ends of the slots, a fixed contact and a contact on the other end of said second bar adapted to engage with and be disengaged from said fixed contact with a snap action under relatively small changes of temperature.

CLARK M. OSTERHELD.