

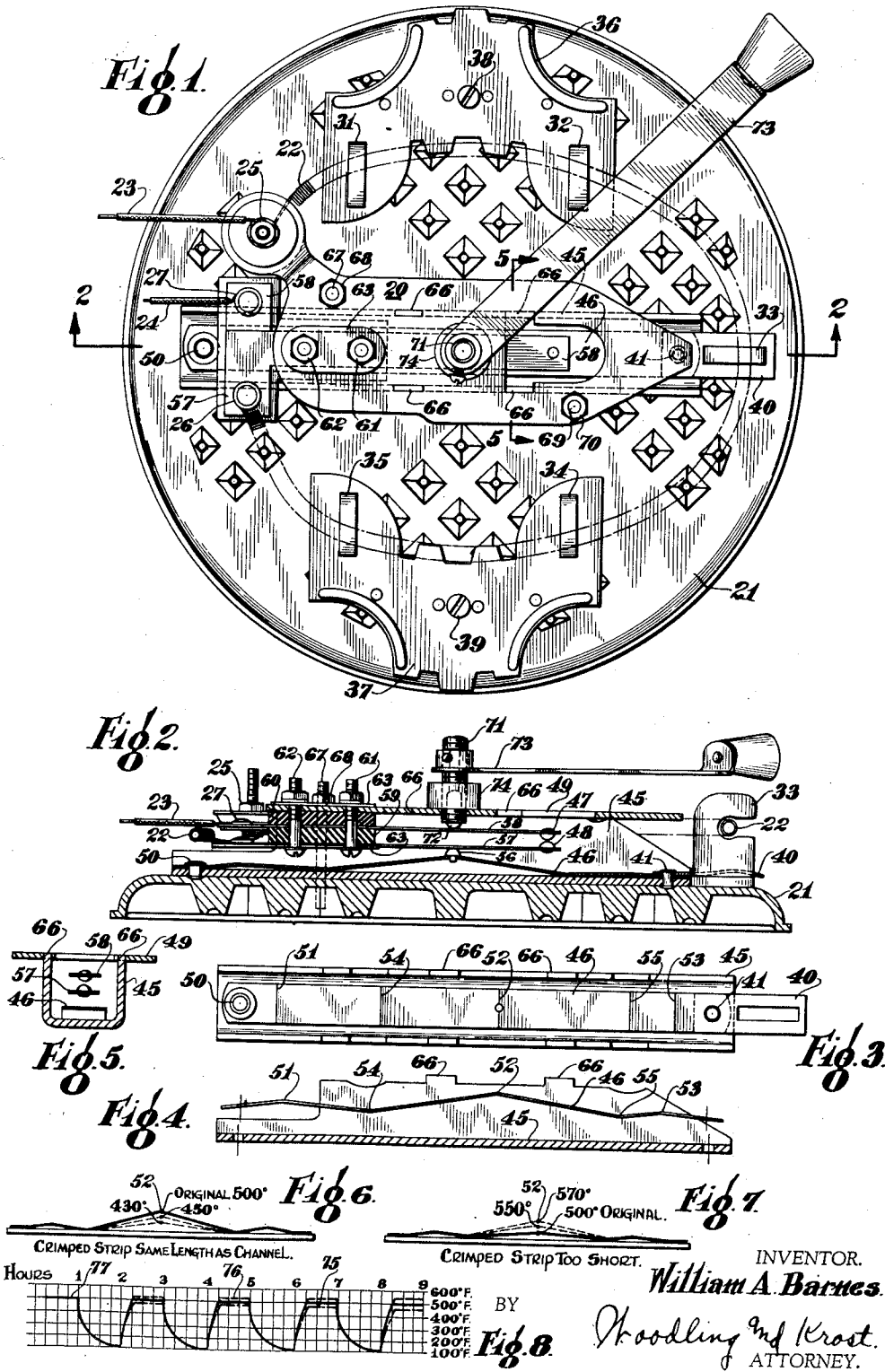
Oct. 8, 1940.

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2,217,328

TEMPERATURE RESPONSIVE DEVICE

Filed Jan. 31, 1938



UNITED STATES PATENT OFFICE

2,217,328

TEMPERATURE RESPONSIVE DEVICE

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Application January 31, 1938, Serial No. 187,883

20 Claims. (Cl. 200—137)

My invention relates in general to temperature responsive devices, and more particularly to temperature responsive devices arranged to control electrical appliances.

5 An object of my invention is the provision of a temperature responsive device having metallic elements in which one of the metallic elements comprises an aluminum strip.

10 Another object of my invention is to provide for opposing the permanent growth of an aluminum element utilized in the construction of a temperature responsive device.

15 Another object of my invention is to provide for utilizing in a temperature responsive device a relative thin longitudinal aluminum member shaped to have a relatively high section modulus to oppose any bending action therein incident to contraction and expansion.

20 Another object of my invention is to provide for utilizing in the construction of a temperature responsive device a longitudinal aluminum channel member having a relatively high section modulus to oppose any bending action therein incident to contraction and expansion.

25 Another object of my invention is to provide for compressing an aluminum element of a temperature responsive device lengthwise to oppose the permanent growth of the aluminum element.

30 Another object of my invention is the provision of a temperature responsive device comprising metallic longitudinal elements joined at their ends and arranged to have different section moduli, so that substantially all of the movement due to the contraction and expansion of the elements occurs in one of the elements only.

35 Another object of my invention is to provide for causing the moving element of a temperature responsive device to have the rigid effect of a short strip but the expansion effect of a long strip.

40 Another object of my invention is the provision of a crimped element in a temperature responsive device to give the effect of a rigid short strip but the expansion effect of a long strip.

45 Another object of my invention is to provide in a temperature responsive device for foreshortening a crimped longitudinal metallic strip so that when it is joined with the ends of an aluminum strip it causes the aluminum strip to be compressed lengthwise to oppose the permanent growth of the aluminum strip.

50 Another object of my invention is the provision of utilizing an aluminum strip in the construction of a temperature responsive device, so that the aluminum strip will maintain its origi-

nal characteristics throughout a period of relatively long use.

Another object of my invention is the provision of a temperature responsive device employing an aluminum element as one of the metallic elements, in which the adjustable setting of temperature responsive device remains substantially the same throughout a long period of use.

Another object of my invention is the provision of utilizing my temperature responsive device in electrical household appliances.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which like parts are designated by like reference characters, and in which:

Figure 1 illustrates my temperature responsive device mounted upon the heating plate of an electrical appliance, such for example, as a waffle iron plate;

Figure 2 designates a cross-sectional view of Figure 1, taken along the line 2—2 of Figure 1;

Figure 3 shows a plan view of the metallic longitudinal elements of my temperature responsive device;

Figure 4 shows a side view of the longitudinal metallic elements of my temperature responsive device, with the channel member shown in cross-section and with the upper longitudinal crimped strip shown as being foreshortened preparatory to joining the two metallic elements together;

Figure 5 is the cross-sectional view taken along the line 5—5 of Figure 1;

Figure 6 shows a diagrammatical illustration of the permanent growth of an aluminum strip when employed as an element of a temperature responsive device, with the crimped strip the same length as the aluminum channel;

Figure 7 shows a diagrammatical illustration of the permanent growth of an aluminum strip when employed as an element in a temperature responsive device, with the crimped strip too short;

Figure 8 shows a graph illustrating the effect of the permanent growth of an aluminum strip when used as a metallic element of a temperature responsive device.

With reference to the drawing, my temperature responsive device is indicated generally by the reference character 20, and in Figures 1 and 2, it is shown as being mounted upon a waffle iron plate 21, heated by a heating element 22 energized by the supply conductors 23 and 24 which are respectively connected to the terminals 25

and 26. The heating element 22 may comprise any suitable construction and material and may be mounted in spaced relation from the waffle iron plate 21 by any suitable means such, for example, as by the illustrated upright insulated supports 31, 32, 33, 34, and 35 which have laterally extending notches into which the heating element 22 may be positioned. The insulated supports 31 and 32, and 34 and 35 may be held in position by means of metal brackets 36 and 37, respectively, which may be fastened to the waffle iron plate 21 by means of the screw 38 and 39. The insulated support 33 may be held in position by means of a metal bracket 40 which is suitably fastened to the right hand end of my temperature responsive device 20 by the rivets 41.

The metallic elements of my temperature responsive device comprise a longitudinal channel member 45 and a longitudinal crimped strip 46 having their ends joined by means of the rivets 41 and 50. In the embodiment of my invention, I preferably construct the channel member 45 of aluminum which has a relatively high coefficient of expansion and the longitudinal crimped strip 46 is preferably constructed of a piece of stainless steel which has a relatively low coefficient of expansion. As illustrated, the central portion of the longitudinal crimped strip 46 is provided with an insulated actuating member 56 arranged to actuate the contact member 48 relative to the contact member 47 which are carried on the right hand end of the resilient contact fingers 57 and 58, respectively. The left hand end of the resilient contact fingers 57 and 58 are mounted to a supporting plate 49 by means of insulating washers 59 and 60 which are held in position by the nut and bolt assembly 61 and 62. The nuts of the bolts are likewise insulated from the supporting plate 49 by means of insulating members 63 which are positioned between the nuts and the heads of the screws and the supporting plate 49. Any suitable means may be employed to secure the supporting plate 49 to the top edges of the channel member 46, and as illustrated, I employ four tabs 66 along the upper edge of the insides of the channel member 46. The tabs 66 extend through registered openings of the supporting plate 49 and are upset to form a rivet like construction. The entire assembly of my temperature responsive device 20 may be held in fixed engagement with the waffle iron plate 21 by means of studs 67 and 69 having their lower ends threadably secured in the waffle iron plate 22 and having their upper ends provided with nuts 68 and 70 which screw down on top of the supporting plate 49.

The contact member 47 is arranged to be adjustably positioned with reference to the contact member 48 by means of an adjustable screw 71 threadably mounted in a collar 74 mounted on top of the supporting plate 49. The lower end of the adjustment screw 71 is recessed and provided with an insulating member 72 which directly engages the resilient contact finger 58. The adjustment screw 71 may be adjustably turned in any suitable manner and as illustrated I employ a lever 73 which may be actuated by the user to regulate the temperature of the electrical appliance.

The energization of the heating element 22 is controlled by the contacts 47 and 48 governed by the contraction and expansion of the channel member 45 and the stainless steel strip 46. When the temperature of the waffle iron plate 21 exceeds a predetermined value, as determined by

the setting of the adjustment screw 71, the aluminum channel member 45 expands and draws the central portion of the stainless steel strip 46 downwardly and thereby permits the contact 48 to separate from the contact 47 to de-energize the heating element 22. When the temperature of the waffle iron plate 21 recedes to a predetermined low value, the aluminum channel member 45 contracts and forces the central portion of the stainless steel strip upwardly and causes the contact 48 to engage the contact 47 which closes the circuit for energizing the heating element 22. When the circuit is closed, the flow of the current may be traced from the supply conductor 23 through the terminal 25, the heating element 22, the terminal 26, the resilient contact finger 57, the contacts 47 and 48, the resilient contact finger 58, the terminal 27 to the other supply conductor 24.

Aluminum is an excellent metal to be employed in a temperature responsive device because of its relatively high coefficient of expansion but because of its permanent growth characteristic, it has never been commercially feasible for use in electrical appliances in relatively thin strips. Also, heretofore, it has never been commercially possible to employ a relatively thin aluminum strip as an element of a temperature responsive device in which the appliance exceeded a temperature in the neighborhood of 300 degrees F. This is because the aluminum strip would lose its original characteristics and the setting of the temperature responsive device would be thereby proportionately disturbed. For example, the temperature responsive device may be adjustably set to give a temperature of 500 degrees F. for baking waffles and after continued use of alternate expansions and contractions of the aluminum strip, the temperature setting may drop as low as 425 degrees F. resulting from the permanent growth of the aluminum. A drop in temperature to or below 425 degrees F. is inadequate to bake waffles satisfactorily. In an iron, if the temperature drops much below the neighborhood of 450 degrees F., it becomes undesirable for general use. In a sandwich toaster, if the temperature drops much below 375 degrees F., it will not toast the sandwich. In order to overcome the permanent growth which disturbs the setting of the temperature of the appliance, I provide for compressing the aluminum strip lengthwise to oppose the permanent growth and thereby enable an aluminum strip, which heretofore was undesirable for high temperatures, to be used at high temperatures such as employed in waffle irons, sandwich toasters and electric irons. I arrange to compress the aluminum channel member 45 lengthwise by foreshortening the crimped strip 46, as illustrated in Figure 4, by the offset center lines passing through the rivet openings in the ends of the channel member 45 and the longitudinal strip 46. The aluminum channel member 45 and the stainless steel strip 46 shown in Figures 1, 2, 3, 4, and 8 are drawn to scale of an actual embodiment of my invention and the registered openings at the ends of the channel member 45 and the stainless steel strip 46 for the rivets 41 and 50 are such that the openings in the stainless steel strip 46 are foreshortened approximately fifteen thousandths of an inch preparatory to joining the two members together. In joining the two members together by means of the rivets 41 and 50, the stainless steel strip 46 is pressed downwardly at its central portion to elongate the same to make the open-

ings for the rivets 41 and 50 to register for assembly. After the rivets 41 and 50 are assembled, the tension in the stainless steel strip 46 compresses the aluminum channel member 45 lengthwise to oppose the permanent growth resulting from alternate heating and cooling of the aluminum channel 45, as will occur through ordinary and continued use. In the embodiment of my invention, the aluminum strip is in the form of a channel member to give a relatively high section modulus to oppose any bending action therein incident to contraction and expansion. The channel construction also makes it possible to reduce the mass of the aluminum member so that it is immediately responsive to changes in temperatures. The channel construction in addition, shields the stainless steel strip 46 from being directly influenced by the heating element 22 of the waffle iron or any other heating element which may be used in electrical appliances.

In order to give the rigid effect of a short strip but the expansion effect of a long strip, I provide for crimping the longitudinal strip 46, producing crimped peak portions 51, 52, and 53, and crimped depressed portions 54 and 55, the latter of which engage the bottom of a channel member 45 to give rigidity to the intermediate portion of the strip 46 which lifts the resilient contact finger 57. Therefore, the distance between the depressed crimp portions 54 and 55 is substantially one-half the overall length of the strip member 46. This reduction in length more than doubles the rigidity for lifting purposes, but retains the expansion effect of the entire length of the strip. In Figure 6, I show diagrammatically the effect of the permanent growth of the aluminum channel member 45 when the registered openings through which the rivets 41 and 50 pass, prior to assembly, are the same length for both the crimped strip 46 and the channel member 45. If the temperature responsive device is set originally at 500 degrees F., the elongation of the aluminum channel member 45 resulting from the permanent growth may cause the setting of the temperature responsive device to drop to a temperature as low as 450 degrees F. after a short period of use. Continued use may cause the setting to drop as low as 430 degrees F., as diagrammatically illustrated in Figure 6. This dropping characteristic is further illustrated in the graph in Figure 8, in which the dot-and-dash line 75 represents the drop in temperature after each hourly interval of alternate heating and cooling of the appliance. In Figure 8, beginning at the left-hand side of the graph, the temperature responsive device is adjustably set at 500 degrees F. At the end of one hour, the appliance is disconnected and allowed to cool for an hour. At the beginning of the second hour, the appliance is again connected and the temperature of the appliance rises but does not attain 500 degrees F., but falls slightly below as illustrated. At the end of the third hour, the appliance is again turned off and allowed to cool for an hour, at which time the appliance is again energized and the temperature to which it attains is slightly decreased a further amount. The alternate periods of heating and cooling continues and upon each alternate period, the temperatures fail to reach a value equal to its next preceding temperature.

In Figure 7, I show a diagrammatic arrangement where the stainless steel strip 46 is too short and the aluminum is compressed too much. In a construction of this kind, the setting of the

temperature rises upon each alternate heating and cooling. Thus, the original temperature may be adjustably set for 500 degrees F. which may gradually rise as high as 550 degrees F. after a short period of use. Continued use may cause the temperature to reach 570 degrees F. The increasing temperature characteristics in Figure 7, caused by too much compression, is shown in Figure 8 by the dotted line 76 which shows that upon each alternate cooling and heating the temperature gradually rises. The full line 77 shows the characteristics of my temperature responsive device where the aluminum channel is compressed the exact amount to oppose equally the permanent growth of the aluminum incident to expansions and contractions. Therefore by means of my construction, I have made it possible to employ an aluminum strip as one of the metallic elements of a temperature responsive device suitable for commercial employment in electrical devices having temperatures considerably higher than that in which an aluminum strip heretofore could be employed.

Although I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. Means for preventing creep in a temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the lower coefficient of expansion comprising a longitudinal strip having a portion intermediate its ends arranged to move respectively away from or toward the element having the higher coefficient of expansion upon the contraction or expansion of the said element having the higher coefficient of expansion, the element having the higher coefficient of expansion comprising a thin longitudinal aluminum member subject to creep and shaped to have a relatively high section modulus to oppose any bending action therein incident to the contraction and expansion of the elements, the element having the lower coefficient of expansion compressing the aluminum member lengthwise throughout the temperature range of the device and at all times to substantially prevent the permanent growth.

2. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the lower coefficient of expansion comprising a longitudinal strip having a portion intermediate its ends arranged to move respectively away from or toward the element having the higher coefficient of expansion upon the contraction or expansion of the said element having the higher coefficient of expansion, the element having the lower coefficient of expansion also having two spaced portions for engaging the other metallic element, the distance between the spaced portions being substantially one-half the length of the metallic elements.

3. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the lower coefficient of expansion com-

prising a longitudinal strip having a portion intermediate its ends arranged to move respectively away from or toward the element having the higher coefficient of expansion upon the contraction or expansion of the said element having the higher coefficient of expansion, the element having the lower coefficient of expansion also having two spaced portions located inwardly of the ends thereof for engaging the other metallic element to give the rigid effect of a short strip but the expansion effect of a long strip.

4. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the lower coefficient of expansion comprising a longitudinal strip crimped intermediate its joined ends and engaging the other metallic element at the crimped places to give the rigid effect of a short strip but the expansion effect of a long strip.

5. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an aluminum channel member, the element having the lower coefficient of expansion comprising a longitudinal strip crimped intermediate its joined ends and engaging the aluminum channel member at the crimped places to give the rigid effect of a short strip but the expansion effect of a long strip, said crimped longitudinal strip being foreshortened to compress the aluminum channel member lengthwise to oppose the permanent growth thereof.

6. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, one of said elements being bent intermediate its ends and engaging at said bent place said other element which has a permanent growth characteristic, said crimped element being foreshortened to compress said other element lengthwise to oppose the permanent growth thereof.

7. Means for preventing creep in a temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, one of said elements being aluminum and subject to permanent growth and the other element being foreshortened to compress the aluminum element throughout the temperature range of the device to prevent the permanent growth thereof.

8. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, one of said elements being bent intermediate its ends to engage the other to give the rigid effect of a short strip but the expansion effect of a long strip.

9. A temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, one of said elements having two longitudinal portions, one of said longitudinal portions being spaced from said other element to provide means for actuating said temperature responsive device and the other of said longitudinal portions being arranged to engage said other element along part

of its length to give the rigid effect of a short strip but the expansion effect of a long strip.

10. Means for preventing creep in a temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an aluminum channel member with a creep characteristic, said other element having a tensile stress which is opposed by a lengthwise compressive stress in said aluminum channel member throughout the temperature range of the device, said lengthwise compressive stress substantially eliminating said creep characteristic.

11. Means for preventing creep in a temperature responsive device comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an aluminum member with angularly disposed portions and with a creep characteristic, said other element having a tensile stress which is opposed by a lengthwise compressive stress in said aluminum member throughout the temperature range of the device, said lengthwise compressive stress substantially eliminating said creep characteristic.

12. Means for preventing creep in a temperature responsive device comprising longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the first of said elements being subject to creep and the second of said elements having a stress therein which stresses said first element throughout the temperature range of the device to substantially prevent the creep thereof.

13. Means for preventing creep in a temperature responsive device comprising, longitudinal metallic elements having their ends secured together and having substantially equal and opposite forces therein, one of said longitudinal elements being subject to creep, and opposing force in said other element acting upon said element subject to creep to prevent the creep substantially throughout the temperature range of the device.

14. In a temperature responsive device, a longitudinal metallic element subject to creep due to repeated temperature changes, and means comprising a second metallic element for putting a compressive stress into said longitudinal metallic element to substantially prevent said creep throughout the temperature range of the device.

15. In a temperature responsive device, an element subject to creep due to repeated changes in temperature and resilient means engaging said element for putting a balancing force on said element throughout the range of temperature change of said device, said balancing force being substantially equal to and opposite a force established by said creep tendency thereby substantially preventing said creep.

16. A temperature responsive device for electrical apparatus comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an elongated aluminum channel member having a bottom and sides with an open top, a top member attached to said sides, insulating means attached to said top member, a pair of contacts mounted on said insulating means and positioned within said channel member, said longitudinal metallic elements

upon a change in temperature actuating one of said contacts with respect to the other to automatically regulate the electrical circuit through the said apparatus.

17. A temperature responsive device for electrical apparatus comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an elongated aluminum channel member having a bottom and sides with an open top, the said sides of the channel member having tabs thereon, a top member with holes therein, said tabs fitting in the said holes in the said top member and attaching said top member to the said sides, insulating means attached to said top member, a pair of contacts mounted on said insulating means and positioned within said channel member, said longitudinal metallic elements upon a change in temperature actuating one of said contacts with respect to the other to automatically regulate the electrical circuit through the said apparatus.

18. A temperature responsive device for electrical apparatus comprising, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an elongated aluminum channel member having a bottom and sides with an open top, a top member attached to said sides for supporting said contacts within said channel member, said longitudinal metallic elements upon a change in temperature actuating one of said contacts to automatically regulate the electrical circuit through the said apparatus, and

manually operable means mounted on said top member for actuating the other of said contacts to regulate the electrical circuit through the said apparatus.

19. In a thermostatic switch having a pair of contacts to regulate the flow of electric current through an electrical apparatus, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an elongated aluminum channel member having a bottom and sides with an open top, a top member attached to said sides for supporting said contacts within said channel member, said longitudinal metallic elements upon a change in temperature actuating one of said contacts with respect to the other to automatically regulate the electrical circuit through the said apparatus.

20. In a thermostatic switch having a pair of contacts to regulate the flow of electric current through an electrical apparatus, in combination, longitudinal metallic elements having their ends secured together and having different coefficients of expansion, the element having the higher coefficient of expansion comprising an elongated aluminum channel member having a bottom and sides with an open top, a top member attached to said sides for supporting said contacts within said channel member, said longitudinal metallic elements upon a change in temperature actuating one of said contacts to automatically regulate the electrical circuit through the said apparatus, and manually operable means mounted on said top member for actuating the other of said contacts to regulate the electrical circuit through the said apparatus.

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