

June 8, 1943.

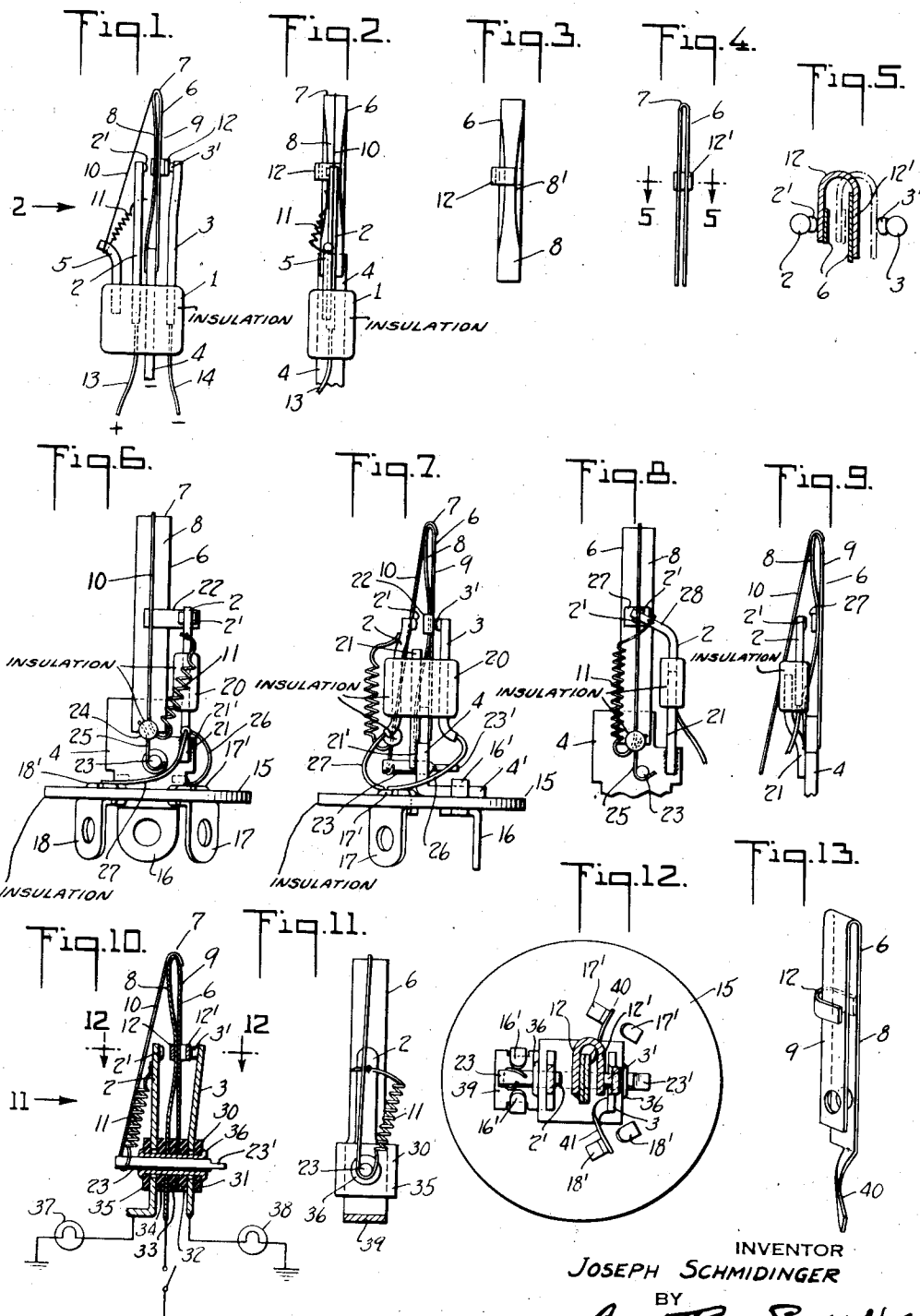
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2,321,049

THERMAL SWITCH DEVICE

Filed April 10, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

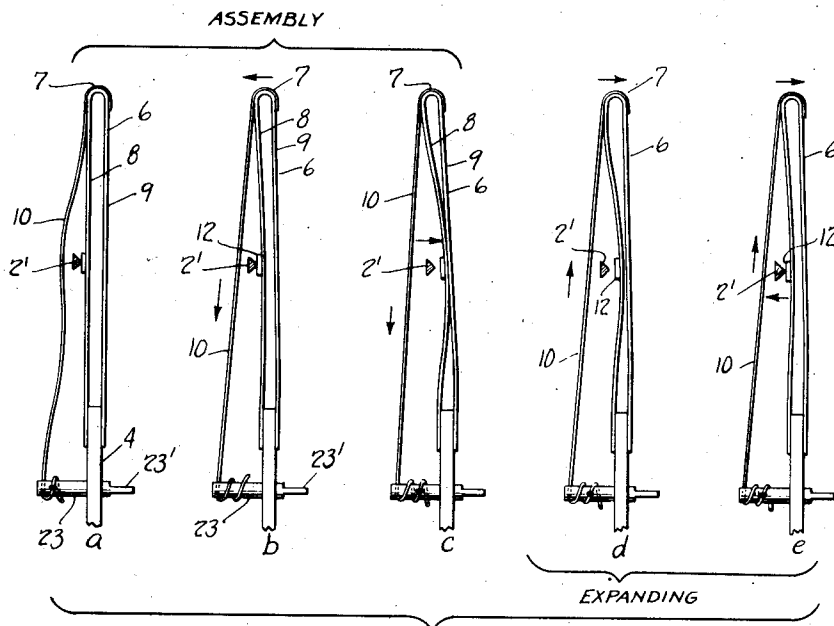


Fig. 14

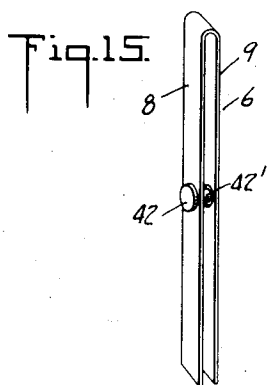


Fig. 15

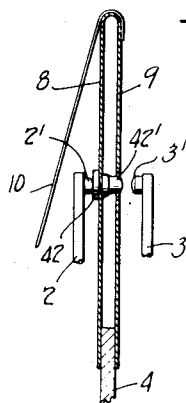


Fig. 16

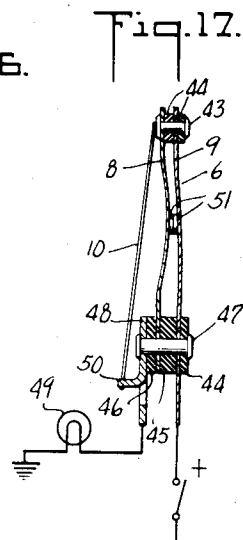


Fig. 17

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THERMAL SWITCH DEVICE

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Application April 10, 1940, Serial No. 328,802

17 Claims. (Cl. 200-113)

This invention relates to thermal switches and the like.

An object of the invention is a novel thermostatic switch and mechanism which is characterized by its sensitiveness to thermal conditions, by the accuracy with which it may be adjusted to operate under predetermined conditions, by its simplicity in construction and operation, by its reliability and dependability in service under severe service conditions and by the economy with which it may be manufactured.

A further object of the invention is a novel and improved switch and mechanism which is controlled by an expansible wire in response to thermal conditions.

Further objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawings forming a part of this application wherein:

Figs. 1 to 5 show one embodiment of the invention;

Figs. 6 and 7 show a further modification;

Figs. 8 and 9 show a further modification;

Figs. 10, 11, 12 and 13 show further modifications;

Fig. 14 includes enlarged views illustrating the assembly and the operation of the switch;

Figs. 15 and 16 show a further modification of the invention;

Fig. 17 shows a further modification of the invention.

Referring to the modification of Figs. 1 to 5 the novel switch mechanism comprises an insulating mass 1, and in this mass 1 are mounted a contact carrying arm 2, a contact carrying arm 3, a mount 4 and a post 5. An important feature of the invention is a buckling metallic strip 6 bent about and back upon itself at 7 and having two substantially parallel legs 8 and 9 whose free ends are fastened as by welding to the opposite sides of the mount plate 4. An expansible wire 10 is fastened at one end to the bend 7 of the buckling strip 6 as, for example, by welding and is fastened and wrapped around the curved end of the anchor support post 5. The expansible wire may be fastened to the post 5 in any suitable manner, as, for example, by welding and the post 5 may be bent in any suitable manner, as, for example, by the utilization of a tool to put the required tension on the wire 10. In the particular embodiment shown the wire 10 is continued as a resistor 11 and electrically connected with the contact arm 2. In this embodiment the leg 8 is of reduced width as shown at 8' and

this reduced part gradually increases in width in both directions until the width is equal to that of the strip. The strip 8 has welded thereto the end of a U-shaped contact 12, this U extending around to the opposite side of the leg 9 to form a contact 12' for co-operation with the contact 3' carried by the contact carrying arm 3. The contact 2' carried by the contact arm 2 contacts with the U 12 at its point of weld to the leg 8.

In the assembly of the switch the expansible wire 10 is tightened to cause the leg 8 of the strip to buckle away from the contact 2' and to carry the U-shaped contact 12 into engagement with the contact 3'. Upon suitably connecting the wires 13 and 14 and the mount 4 in electric circuits to be controlled the switch is caused to snap from one contact 2' to the other contact 3'. For example, upon connecting the wire 10 in circuit, the latter is heated thereby through expansion permitting the buckling member 6 to buckle to a position where the leg 8 with its contact member 12 is in engagement with contact 2'. This operation short circuits the wire 10 which thereupon cools and snaps the contacts 2' and 12 out of engagement with each other as indicated in Fig. 1. This action is repeated indefinitely. The circuit controlled by the contacts 3' and 12' is at the same time alternately opened and closed with the other circuit.

In the modification of Figs. 6 and 7 the mount 4 for the buckling member 6 is L-shaped and is mounted on an insulating disc 15 with one of the legs 4' of the L member lying flat against the disc. An eyelet contact 16 is fastened flat against the bottom of the disc 15 and is provided with fingers 16' extending up through the disc and engaging the upper side of the L member 4' for holding the mount, the disc and the contact 16 firmly fastened together. The two other eyelet contacts 17 and 18 are similarly fastened to the bottom of the disc 15 by fingers 17' and 18' passing up through the disc and being turned over to engage the top of the disc. The contact carrying arms 2 and 3 are in these instances mounted in an insulating button or mass 20 which in turn is mounted by a post 21 upon the mount 4 as by welding at 21'. The legs 8 of the buckling member 6 in this instance carries the contact member 22 projecting out laterally therefrom and the contacts 2' and 3' are alternately engaged by this contact 22. Thus while in the modification of Figs. 1 to 5 the contacts 2', 3' are carried on the opposite sides of the buckling member, in the modification of Figs. 6 and 7 these contacts

are displaced laterally of the buckling member 6. The leg 8 of the buckling strip of this modification is also shown of substantially the same width throughout with no reduction in width at any point. The expansible wire 10 is put under tension by means of an adjustable pin 23, the latter being adjustably mounted in the mount 4. In order to insulate the wire 10 from the pin 3 an insulating bead 24 as, for example, of glass is fastened as, for example, by fusing to the wire 10 and the latter continues by the connector or resistor 11 and is electrically connected with the contact arm 2. The bead 24 is fastened as by fusing to a wire length 25 the wire length being fastened in any suitable manner as by welding to the pin 23. By engaging the end 23' of the pin 23, for example, by any suitable tool, the wire 10 may be put under the desired tension for operating under the conditions desired. The contact arms 2 and 3 are electrically connected respectively with the eyelet contacts 17 and 18 by the wire connections 26 and 27 shown. The operation of this modification is similar to the modification of Figs. 1 to 5.

In the modification of Figs. 8 and 9 the leg 8 of the buckling strip 6 is provided with a contact 27 and the contact carrying arm is bent over at its upper end, as indicated at 28, to bring the contact 2' to a point opposite the contact 27 and disposed between planes of the edges of the buckling strip. The operation of the modifications of Figs. 8 and 9 is similar to that of the above modifications.

In the modification of Figs. 10 and 11 the buckling strip 6 is insulatedly mounted on an insulating bushing 30. This bushing comprises a series of insulating discs 31, 32, 33, 34 and 35, these insulating discs being mounted upon a sleeve 36; and the ends of the legs 8 and 9 of the buckling member 6 are clamped on the opposite sides of the disc 33 while the contact arm 2 is clamped between the discs 34 and 35 and the contact arm 3 between the discs 31 and 32. In the sleeve 36 is journaled the pin 23 for putting the wire 10 under tension. The contact arms 2 and 3 and the leg 8 of the buckling strip are provided with openings larger than the sleeve 36 so as to clear the same and to be insulated therefrom and are extended downwardly to form the electrical connection shown, the contact arm 2 going to an electric load 37 thence to the ground, the contact arm 3 leading by a connection to a similar electric load 38 and thence to the ground and the leg 8 leading to the opposite side of the electric circuit. The operation is similar to the operation with respect to the modification of Figs. 1 to 5. The switch mechanism of this modification of Figs. 10 and 11 may be mounted in any suitable manner, as, for example, upon an insulating disc like the disc 15 of Figs. 6 and 7.

Figs. 12 and 13 show a means for mounting the mechanism shown in Figs. 10 and 11. This comprises an insulating disc with the lower end of the contact arm 2 being formed with an angle piece 39 which is clamped in position by the turned over fingers 16' passing upwardly through the disc from a contact 16. The lower end of the leg 8 is provided preferably integrally therewith with a tongue 40 for connecting with the fingers 17' of the eyelet contact 17 and the lower end of contact arm 3 is provided with a similar tongue 41 which is electrically connected with the fingers 18' of the eyelet contact 18.

In the embodiment of Figs. 15 and 16 the leg 8 is provided with a contact member 42 which is riveted in an opening formed therein, this contact 42 being extended into a contact 42' for engagement with the contact 3'. This simplifies the construction and mount of the contacts, the contact 2' co-operating and contacting with the contact face 42 and the contact 3' co-operating and contacting with the contact 42'.

In the embodiment of Fig. 17 the buckling strip which is formed of two separate legs 8 and 9 are rigidly fastened and clamped together at their upper ends by means of the rivet 43 and insulating washers 44 shown. The wire 10 is fastened at its upper end to this rivet 43. The lower ends of the legs 8 and 9 are clamped between three insulating discs or members 44, 45 and 46 which are in turn clamped together by the rivet member 47. The legs 8 and 9 of the buckling strip are provided with openings larger than the rivet 47 so as to clear the same and to be insulated therefrom. The upper end of the leg 9 is also provided with an opening larger than the rivet 43 so as to clear the same and be insulated therefrom. The upper end of the leg 8 however is in electrical contact with the rivet 43. There is also clamped against the insulating disc or member 46 a metallic plate member 48 which forms an electrical connection with an electrical load 49 which is connected on the other side of the ground. The plate member 48 is a fastening and tightening lug 50 formed thereon with which the wire 10 is fastened, as, for example, by electrical welding. The wire 10 may be put under tension by bending the lug 50. The leg 9 of the buckling strip is extended downwardly to connect with the other side of the circuit. The two legs 8 and 9 carry contacts 51 which when the wire 10 is cooled are in engagement. Upon connecting the mechanism in circuit the wire 10, being in series through the contacts 51, is heated up and, accordingly, upon the extension thereof the circuit is broken at the contacts 51. Upon breaking of the circuit the wire again cools to permit the closing of the contacts at 51 and this operation is repeated.

Fig. 14 is an enlarged view of the buckling strip and mount showing the assembly and the operation thereof. 14a illustrates the approximate relation of the parts before the wire 10 is put under tension. 14b shows the wire 10 being tensioned by adjusting the pin 23 and it is observed that the first tension operation results in the upper end of the buckling strip 6 being bent over counter-clockwise about the contact 2' as a fulcrum point. Upon the further tensioning of the wire 10 the intermediate part of the leg 8 is caused to snap over to the right out of engagement with the contact 2'. In this adjusting and tensioning operation the contact 2' is also adjusted relatively to the strip so as to obtain the required operating actions desired. Figs. 14d and 14e illustrate the operation upon the heating of the wire 10, the arrows showing the expansion thereof. Starting with the position indicated in 14c and with the closure of the circuit, the first expansion of the wire 10 due to heating results in the upper end of the buckling strip 6 moving slightly to the right or resulting in a force tending to move it to the right, as indicated by the small arrow at the top of 14d. The further heating of the wire 10 results in the snapping over of the contact 12 into contact with contact 2' as shown in 14a.

Although certain of the advantages of the invention may be obtained by different relative arrangements of the double strip 6 and the wire 10, the preferred arrangement is that shown wherein the wire 10 is disposed at a relatively small and acute angle to the strip 6. With the arrangement shown the member 8 when it is biased by the tensioning of the wire 10 is put under compression by the act of the wire pulling the free end of the member 6 towards the side on which the wire 10 is disposed. This compression of the leg 8 results in a tendency of it to buckle in the direction of the pull of the wire. If there is a stop or contact present, as for example like the contact 2', to check the buckling action, this initial movement and compression of the leg 8 simply results in greater pressure upon the contact being exerted both by the pull of the free end of the double strip in that direction and by the outward buckling action of the leg. If there is no stop, as for example illustrated in Fig. 17, then the action is as follows: Assuming the wire 10 of Fig. 17 to be extended and with the two legs 8 and 9 under no restraint by the wire, and with the contacts 51 separated, the first initial movement of the upper end of the double strip upon the cooling of the wire 10 is to cause the leg 8 to buckle slightly outwardly from the leg 9. This condition is only momentary, however, because immediately upon further movement of the free end in that direction due to the further cooling of the wire 10 the leg 8 is caused to buckle in the opposite direction to close the contacts 51 as shown in Fig. 17. Accordingly, whether it is a contact closing action upon cooling of the wire 10, as shown in Fig. 17, or a contact opening action, as shown in Fig. 14, the action is a snap action in either event. This snap action is not only present where the leg on the side of the pull (leg 8) when not under restraint by the wire is straight but also where it may have some convexity toward the pull wires. Convexity of this leg away from the pull wire when not under restraint by the latter tends to minimize or prevent snap action.

The double buckling strip or member 6 containing the closely disposed legs 8 and 9 together with the expansible wire 10 possesses a number of advantages in thermal switch mechanisms. It is capable of the strong snap switch action desired in practice, it may be adjusted for either high or low speed contact action, it can be made in very small dimensions, so as to be accommodated in restricted spaces or chambers, it is particularly suitable for glass press mountings and it may be used as a flasher, a time switch, a relay and a circuit breaker.

I claim:

1. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expansible wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot.

2. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other

for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, wire fastened to the free end of said double strip and biasing the same to occupy one position when the wire is relatively cool and another position when the wire is relatively hot with one of the members serving as a stop for the other in one position, at least one of the members of the double strip carrying a contact.

3. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, wire fastened to the free end of said double strip and biasing the same to put one of the members of the double strip under buckling compression and a contact carried by said last named member.

4. A thermal switch mechanism comprising a double buckling strip whose members are disposed closely together and face to face and are rigidly fastened at one end against movement with the other ends of the double strip rigidly fastened against relative movement thereof and an expansible wire rigidly fastened to the free end of said buckling strip and disposed at an acute angle thereto, said expansible wire biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot and a contact carried by said double strip.

5. A thermal switch mechanism comprising a support, a buckling strip bent into sharp U-form to form a double buckling strip with the legs thereof disposed closely together and face to face and their ends rigidly fastened to said support and having said sharp U-bend free to move in a direction at right angles to the plane of the strip for putting one of the legs under buckling constraint and an expansible wire rigidly fastened to the U member at a point adjacent the free end thereof, said wire biasing the U member to occupy one position when the wire is relatively cool and another position when the wire is relatively hot.

6. A thermal switch mechanism comprising a frame member, a double buckling strip formed of two separate strips which are closely disposed to each other and face to face and are rigidly fastened to the frame member at one end and having their other ends rigidly fastened together at their free ends for putting one of the strips under buckling constraint when the free end is moved relatively to the frame, and an expansible wire fastened to the free end of said buckling strip and biasing the same to one position when the wire is relatively cool and to another position when the wire is relatively hot, and a contact carried by one of the members of said double strip.

7. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expansible wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool, and an-

other position when the wire is relatively hot, one of the members of the double strip being reduced in width intermediate its ends.

8. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expandable wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot, one of the members of the double strip being reduced in width intermediate its ends and being provided with a U-shaped contact member.

9. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expandable wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot, said contact members being mounted in an insulating press.

10. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expandable wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot, comprising an insulating press and contact supports, with the contact supports and the double strip mounted in said insulating press.

11. A thermal switch mechanism comprising a support, a double spring strip having the members thereof disposed face to face and firmly anchored at one end to said support and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, said strip carrying a contact, and an expandable wire fastened at the free end of said spring strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot, the double strip being mounted on a support carried by an insulating disc.

12. A thermal switch mechanism comprising a double buckling strip with the members thereof disposed face to face and carrying a contact and mounted rigidly at one end against movement with the other ends of the double strip rigidly fastened against relative movement thereof, and an expandable wire fastened at the free end of said buckling strip and biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot, a stationary contact member, an insulating sleeve structure and a tensioning pin journaled in said structure, said stationary contact member

and said buckling strip being insulatedly mounted about said sleeve structure and said tensioning pin.

13. A thermal switch mechanism of the character set forth comprising a support, a double buckling strip anchored at one end to said support and having the members thereof disposed face to face and rigidly fastened at the other and free end to each other for putting one of the members under buckling constraint when the free end is moved relatively to the support, an expandable wire fastened to the buckling strip at the free end and means for tensioning said wire, and a contact carried by one of the members of said buckling strip at a point intermediate its ends.

14. A thermal switch mechanism comprising a double buckling strip whose members are disposed closely together and face to face and are rigidly fastened at one end against movement with the other ends of the double strip rigidly fastened against relative movement thereof and an expandable wire rigidly fastened to the free end of said buckling strip and disposed at an acute angle thereto, said expandable wire biasing said strip to occupy one position when the wire is relatively cool and another position when the wire is relatively hot and a contact carried by said double strip, one of the members of the double buckling strip having greater buckling action than the other and said wire being disposed at the side of said member.

15. A thermal switch mechanism comprising a support, a double spring strip carrying a contact and anchored at one end to said support, with the other end of the double strip free to move relatively to the support and in a direction at right angles to the plane of the strip, the members of the double strip being disposed closely together and face to face and being rigidly fastened to each other at the free end for setting up buckling stresses in one of the members by movement of the free end toward the side of that member, and thermally responsive means engaging said strip and controlling the same.

16. A thermal switch mechanism comprising a support, a double buckling strip of duplicate structure rigidly mounted at one end on said support with the other end free to move relatively to the support and with the members thereof disposed closely together and face to face, the adjacent ends of said members being rigidly fastened together against relative movements and one of said members being thereby put under buckling longitudinal stress when the free end of the double strip is moved, and thermally actuated means engaging said strip at the free end and moving the same to apply a buckling and snap action to one of said members.

17. A thermal switch mechanism comprising a support, a double buckling strip of duplicate structure rigidly mounted at one end on said support with the other end free to move relatively to the support and with the members thereof disposed closely together and face to face, the adjacent ends of said members being rigidly fastened against relative movements and one of said members being thereby put under buckling longitudinal stress when the free end of the double strip is moved, and means engaging said double strip at a point adjacent one end thereof and moving the same to cause a buckling and snap action of one of said members.

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