Dec. 8, 1964 R. N. LEVINN ETAL 3,160,010

THERMOSTAT WITH COMPOUND BIMETALLIC STRIP

Filed Aug. 3, 1961

FIG. 1

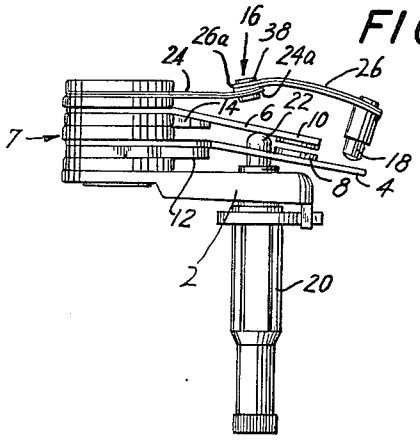


FIG. 4

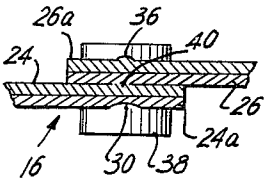


FIG. 2

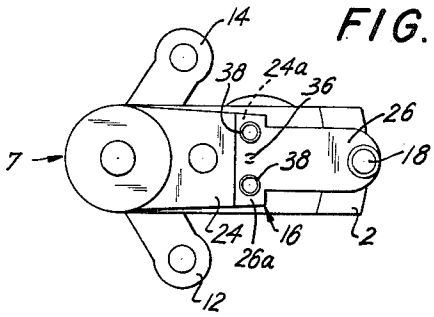


FIG. 5

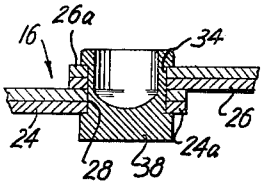
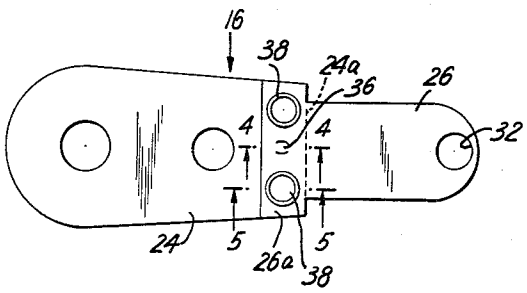


FIG. 3



INVENTOR.
ROBERT N. LEVINN
JOSEPH REINGRUBER

BY James and Franklin

ATTORNEYS

United States Patent Office 3,160,010 Patented Dec. 8, 1964

3,160,010

THERMOSTAT WITH COMPOUND BI-METALLIC STRIP

Robert N. Levinn, Catskill, and Joseph Reingruber, Cairo, N.Y., assignors to American Thermostat Corporation, South Cairo, N.Y., a corporation of New York

Filed Aug. 3, 1961, Ser. No. 129,129
13 Claims. (Cl. 73—363.5)

The present invention relates to a thermostat having a compound bimetallic strip incorporated therein, and more specifically to a construction of that strip which permits far greater uniformity and reliability in its manufacture than has heretofore been thought possible.

Compound bimetallic strips, that is to say, strips formed of two longitudinally arranged sections which bend respectively in opposite directions when subjected to changes in temperature, are quite commonly employed as operative elements of thermostatic switches and the like, in large part because they give rise to a type of operation not otherwise obtainable. However, one major drawback to their more widespread use has been the difficulty which has been experienced in manufacturing a plurality of such strips which will function in substantially the same manner. The calibration problems involved in the use of two different temperature-sensitive parts rather rather than one are compounded by the variations in overall operation, deriving from slight variations, as between one compound strip and another, in the way in which the two strip sections are secured to one another. Because of these problems in securing uniformity of these devices on a production basis, the cost of such items has been rather high and their reliability has left much to be desired.

There are two prime factors involved in securing the two oppositely bending strip sections to one another, one involving mechanical connection and the other involving thermal connection. The strip sections must be secured to one another in such a manner that the individual bending of each section can occur without adversely affecting the bending of the other section and without any lost motion or slippage between them. Moreover, since both sections should at any given moment be responding to the same temperature if the overall response of the compound strip is to be accurate, it is essential that the two strip sections be in intimate thermal connection with one another.

The simultaneous achievement of both of these connections—mechanical and thermal—has in the past eluded these working in this art. Ordinary mechanical connection as by rivets, eyelets, or the like, while satisfactory from a mechanical point of view, has not provided for adequate thermal connection no matter with what force the two strips have been pressed against one another by the rivets. Welding, both strip and spot, has been tried, and this has resulted in satisfactory thermal connection, but the mechanical action of weld-connected compound strips has been inferior, probably because it has proved to be impossible to control the size and location of the weld with that degree of precision needed to produce uniformity of action among a plurality of strips made in a given production run, much less in strips made in successive production runs.

We have developed a construction by means of which the mechanical and thermal requirements of this type of compound structure are simultaneously met, and in a manner exceptionally well adapted to quantity production methods and equipment. Through the use of this construction a large number of compound bimetallic strips may be manufactured quickly and without requiring highly skilled personnel, and the strips thus manufactured will all have closely the same operating

characteristics over a wide temperature range, thus greatly minimizing rejects and practically eliminating the need for selective matching of strips.

In accordance with our invention the two strip sections are, as is conventional, provided with overlapping portions. These portions are mechanically held together by rivets or the like which are spaced from one another, preferably at right angles to the longitudinal axis of the compound strip. The overlapping strip portions are welded to one another at one or more locations spaced from the rivets, and preferably located between the rivets. With this arrangement the rivets produce an optimum mechanical connection between the strips which is unaffected by the weld or any production variations in the size or location of the weld, while the weld produces proper thermal connection between the strip sections with no deleterious side effects. The presence of the rivets seems to eliminate the defects existing when welding alone is employed to secure the strip sections to one another, while the weld supplies the deficiency inherent in the use of rivets alone. The same results obtain if the rivets and weld are reversed.

In order to assist in the proper orientation of the strip sections and proper location of the welded area, each of the strips may be provided with upset areas which are adapted to interfit when the strip sections are properly assembled, those upset areas also marking the location for the welds.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the construction of a thermostat with a compound bimetallic strip, as defined in the appended claims and as described in this specification, in which:

FIG. 1 is a side elevational view of a thermostat embodying the present invention;

FIG. 2 is a top plan view thereof;

FIG. 3 is a top plan view, on an enlarged scale, of the compound bimetallic strip of the embodiment of FIG. 1; and

FIGS. 4 and 5 are cross-sectional views, on an enlarged scale, taken along the lines 4—4 and 5—5 respectively of FIG. 3. The typical thermostat shown in FIG. 1 comprises a base **2** on which, in conventional fashion, a moveable conductive strip **4** and a fixed conductive strip **6** are insulatedly mounted one above the other in a stack generally designated **7**, the strips **4** and **6** carrying engageable contacts **8** and **10** respectively. Terminal strips **12** and **14** are electrically connected to the strips **4** and **6** respectively. Also mounted on the base **2** is the compound bimetallic strip generally designated **16**. The strip **16** carries at its free end an insulating finger **18**, which, as the strip **16** bends, engages the moveable strip **4** and moves it away from the fixed contact strip **6**, thus causing the contacts **8** and **10** to separate, thereby opening the electrical circuit through the switch. An adjusting member such as the shaft **20** is rotatably threadedly mounted in the base **2** and carries an insulating tip **22** which passes freely through the strip **4** and engages the strip **6**, which strip is biased, generally by its own inherent resiliency, against the tip **22**. The strip **4** is biased, as by its own inherent resiliency, upwardly toward the strip **6**. Hence the rotative setting of the shaft **20** will control the position of the strip **6** and the contact **10** carried thereby, thus determining the degree to which the compound bimetallic strip **16** must bend before its finger **18** engages the strip **4** and moves it downwardly.

The compound bimetallic strip **16** is composed of two sections **24** and **26**, each bimetallic so that it will tend to bend when subjected to changes in temperature, but bimetallic in different senses so that each section will tend to bend in a different direction when subjected to the same change in temperature. Thus, as here disclosed, the

section **24**, one end of which is fixedly connected to the stack **7**, tends to bend upwardly with rise in temperature, while the section **26** tends to bend downwardly with rise in temperature. The free end portion **24***a* of the section **24** is provided with a pair of apertures **28** (one of which is shown in FIG. 5) spaced laterally of the section **24**, and with an upset area **30** between the apertures **28**. The body of the section **26** is narrower than that of the section **24**, and at its free end it is provided with an aperture **32** in which the insulating finger **18** is adapted to be mounted. One end portion **26***a* of the section **26** is, however, of substantially the same width and shape, and is adapted to overlie, as the free end **24***a* of the section **24**. The section end portion **26***a* is provided with a pair of apertures **34** spaced laterally thereof, and with an upset area **36** between the apertures **34**. When the sections **24** and **26** are assembled with their end portions **24***a* and **26***a* respectively overlying one another the upset areas **30** and **36** are adapted to interfit or mate with one another, and the apertures **28** and **34** are adapted to register with one another.

Rivets or eyelets **38** are passed through the registering pairs of apertures **28**, **34** (see FIG. 5), the flanges on those rivets or eyelets engaging the upper and lower (outwardly facing) surfaces of the strip section portions **24***a* and **26***a* and pressing those portions firmly against one another, thus mechanically joining them together. The strip section portions **24***a* and **26***a* are also welded together at a location spaced from the rivet members **38**, and perferably located substantially between them, for example, at locations defined by the interfitting upset areas **30** and **36**. (See FIG. 4, where the reference numeral **40** is applied to the location when the weld has integrated the two strips.) Insofar as manufacturing convenience is concerned it is preferable to apply the rivet members **38** before making the weld, but from a functional point of view the sequence in which these operations are performed is immaterial. The welded area need not be in the middle of the space between the rivets **38**, and its precise location and size is not critical. Indeed, a plurality of such welded areas could be provided. They should, however, be spaced from the rivet members **38** and be located in those areas the relative movement of which is substantially contained and restricted by the rivets **38**. In that way the good heat conductive properties between the strip sections **24** and **26** imparted by the weld do not detract from the uniform and desired mechanical connection imparted by the rivets **38**, despite production variations in the size or location of the weld.

The different shapes of the sections **24** and **26** permit design of the compound strip **16** to function in just the way desired for a particular application, while the similar sizes of the overlapping section portions **24***a* and **26***a* facilitate the mechanical and thermal connection of those sections on a production basis with much greater reliability and uniformity than has heretofore been deemed possible. As a result, compound bimetallic strips can now be made in large quantities with far fewer rejects and at far lower cost than in the past, thus making it possible to provide compound bimetallic strip operation at a cost not much higher than that involved in the manufacture of simple bimetallic strips. For example, under production conditions compound strips with a temperature variation of 5°–7° F. are produced, as compared with temperature variations of 30° F. in the past.

The rivets **38** and weld **40** could be reversed, i.e. welds **40** could be provided at the areas occupied by the rivets **38** in the drawings, while one or more rivets **38** could be located between such welded areas **40**.

While but a single embodiment of the present invention has been here specifically disclosed, it will be apparent that many variations may be made therein, all within the scope of the following claims.

We claim:

1. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping strip portions having their opposed surfaces pressed toward one another by means of members spaced from one another, passing through said overlapping portions and having flanges engaging the outer surfaces of said portions, said overlapping portions being welded to one another at a location spaced from said members and substantially on a line which passes through said members.

2. The thermostat of claim 1, in which said overlapping strip portions are provided with registering interfitting upset areas, the weld between said portions being located at least in part at said upset areas.

3. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another longitudinally of said composite strip in opposite directions, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping strip portions having their opposed surfaces pressed toward one another by means of members laterally spaced from one another, passing through said overlapping portions and having flanges engaging the outer surfaces of said portions, said overlapping portions being welded to one another at a location spaced from said members and substantially on a line which passes through said members.

4. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping strip portions having their opposed surfaces pressed toward one another by means of members spaced from one another, passing through said overlapping portions and having flanges engaging the outer surfaces of said portions, said overlapping portions being welded to one another at a location spaced from and positioned between said members.

5. The thermostat of claim 4, in which said overlapping strip portions are provided with registering interfitting upset areas, the weld between said portions being located at least in part at said upset areas.

6. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another longitudinally of said composite strip in opposite directions, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping strip portions having their opposed surfaces pressed toward one another by means of members laterally spaced from one another, passing through said overlapping portions and having flanges engaging the outer surfaces of said portions, said overlapping portions being welded to one another at a location spaced from and positioned between said members.

7. The thermostat of claim 6, in which said overlapping strip portions are provided with registering interfitting upset areas, the weld between said portions being located at least in part at said upset areas.

8. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another, and parts

operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping portions having two spaced pairs of registering apertures therethrough, rivet-like members passing snugly through said pairs of registering apertures, engaging the exposed surfaces of said overlapping portions, and pressing the opposed surfaces of said overlapping portions toward one another, registering areas of said overlapping portions spaced from said rivet-like members and substantially on a line which passes through said members being welded to one another.

9. The thermostat of claim 8, in which said overlapping strip portions are provided with registering interfitting upset areas, the weld between said portions being located at least in part at said upset areas.

10. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another longitudinally of said composite strip in opposite directions, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping portions having two laterally spaced pairs of registering apertures therethrough, rivet-like members passing snugly through said pairs of registering apertures, engaging the exposed surfaces of said overlapping portions, and pressing the opposed surfaces of said overlapping portions toward one another, registering areas of said overlapping portions spaced from said rivet-like members and substantially on a line which passes through said members being welded to one another.

11. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping portions having two spaced pairs of registering apertures therethrough, rivet-like members passing snugly through

said pairs of registering apertures, engaging the exposed surfaces of said overlapping portions, and pressing the opposed surfaces of said overlapping portions toward one another, registering areas of said overlapping portions spaced from and positioned between said rivet-like members being welded to one another.

12. The thermostat of claim 11, in which said overlapping strip portions are provided with registering interfitting upset areas, the weld between said portions being located at least in part at said upset areas.

13. In a thermostat including a compound bimetallic strip comprising first and second bimetallic sections bendable in opposite directions upon a change of temperature and having portions overlapping one another and other portions extending beyond one another in a given direction, and parts operatively connected to said strip for actuation thereby; the improvement which comprises said overlapping strip portions having their opposed surfaces mechanically pressed toward one another by at least one member which passes through said overlapping portions and has flanges engaging the outer surfaces of said portions, said overlapping portions being welded to one another at at least one area spaced from said members, said members and said welded areas being substantially in a line substantially perpendicular to said given direction, one of said members and said welded areas being present as a plurality and the other of said members and said welded areas being spaced therefrom.

References Cited by the Examiner

UNITED STATES PATENTS

1,322,250	11/19	Lewis	29—470.5
1,812,151	6/31	Jacocke	29—470.5
2,128,869	8/38	Winborne	73—363.5 X
2,196,671	4/40	Gille et al.	73—363.5

FOREIGN PATENTS

3,854	3/90	Great Britain.

ISAAC LISANN, *Primary Examiner.*