Jan. 13, 1948. P. G. CHACE 2,434,392

THERMOSTATIC ELEMENT

Filed Oct. 9, 1943

FIG. 1.

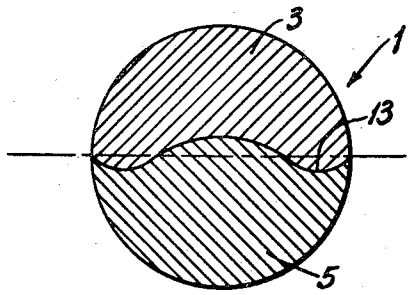


FIG. 2.

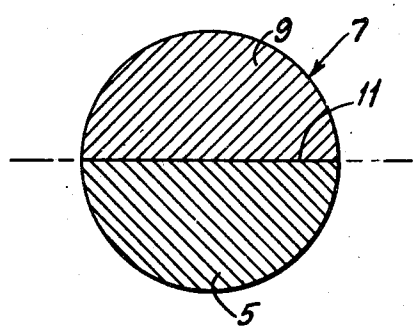
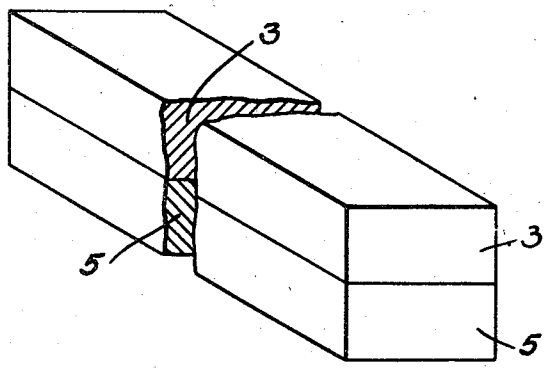


FIG. 3.



Paul G. Chace,
Inventor.
Haynes and Koenig,
Attorneys.

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2,434,392

THERMOSTATIC ELEMENT

Paul G. Chace, Attleboro Falls, Mass., assignor to Metals & Controls Corporation, Attleboro, Mass., a corporation of Massachusetts

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1 Claim. (Cl. 29—191.6)

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This invention relates to thermostatic elements, and with regard to certain more specific features to bimetallic thermostatic wire.

Among the several objects of the invention may be noted the provision of a bonded combination of metals to produce a bimetallic, hot-worked or cold-worked wire element having desired mechanical rigidity with more thermal flexibility than has been obtained heretofore in such wires; and the provision of an element of the class described which is simple and economical to manufacture. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claim.

In the accompanying drawings, in which is illustrated one of various possible embodiments of the invention,

Fig. 1 is an enlarged cross section of an old form of finished wire, shown for purposes of illustrating remarks made hereinafter;

Fig. 2 is an enlarged cross section of my new form of wire; and,

Fig. 3 is a fragmentary view, on a reduced scale, of a typical ingot from which wire is cold-worked.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Heretofore bimetallic elements for thermostatic and similar uses have been made in various cross sections and have been composed of various materials bonded together throughout their adjacent surfaces, as by fusing, hard soldering, etc. Included in these prior-art constructions were cold-drawn bimetallic wire made for example of brass and Invar components. The method of making such a wire was to form a bonded bimetallic ingot such as shown in Fig. 3, and then to cold work this down into wire form of the desired diameter and shape of cross section. Cold working was done by drawing, rolling etc.

The difficulty with this prior process of working a cold-worked bimetallic wire was that the cold working would cause a wavy or crinkled form of the bonding area between metal components. Such a wavy juncture would appear as a wavy line in any cross section of wire, as illustrated in Fig. 1, for example. It is not to be understood that the wave form shown in Fig. 1 is always that which would be assumed, and that depending upon circumstances it would have a variety of shapes. In Fig. 1, numeral 1 indicates in general the old form of cold-worked bimetallic wire. Numeral 3 indicates a brass component and numeral 5 a bonded Invar component.

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The reason for this prior-art characteristic wavy line or surface 13 between the cold-worked bimetallic components was that the metals employed (brass and Invar for example) did not have the same work-hardening rates throughout the whole work-hardening range. Thus one would become harder than the other during the work-hardening operations and distort the other at or near the bonded junction between the metals.

Another resulting disadvantage of the prior structure is that the wavy juncture between elements tends to stiffen the wire around the neutral axis indicated by dash lines, particularly in its bending responses to temperature changes.

The present invention avoids the wavy juncture and produces one that is practically a straight line, 11, as shown in Fig. 2. This is done by choosing a combination of metal elements, each of which has substantially the same work-hardening rate. For example, a satisfactory combination of elements is silicon-bronze and Invar, the bronze being constituted by approximately 98% copper, 1.5% silicon and 0.5% manganese (all by weight). The Invar contains (by weight) approximately 36% nickel, together with about 0.05% of carbon and 0.5% of manganese. The combination of these materials bonded in an ingot similar to the one shown in Fig. 3 and hot or cold worked by rolling or drawing down to the desired wire section will result in a wire such as shown at 7 in Fig. 2. In this case 9 represents the silicon-bronze component, and 5 the Invar component, both bonded at junction 11. Compared to the junction 13 shown in Fig. 1, junction 11 is quite straight and flat.

The thermal activity, for a given weight of wire, in the case of the construction shown in Fig. 1 averages of the order of 20 to 25% less than that shown in the construction of Fig. 2. This is because of the difference in the geometric character of the bonding surface in the final wire. In the improvements shown in Fig. 2, the two metal components exert more or less equal stresses on each other throughout the cold-working operation which results in the straight-line bond.

Another advantage of the invention is that the tendency to split the two metal components apart at or near the bond is much reduced by the

straight-line juncture. In the prior-art wire, shown in Fig. 1, even with proper bonding between the components 3 and 5 the uneven drawing stresses exerted upon the uneven juncture tend to cause splitting. This trouble is practically eliminated in the improved form of the invention (Fig. 2).

It is of course understood that a characteristic such as straightness is relative and that, due to processing errors and other unavoidable exigencies, a bond line in an article made according to the invention might deviate minutely from a straight line, but from a practical viewpoint it will be insubstantial.

The drawings are diagrammatic. In practice the wavy form of the juncture shown in Fig. 1 may take up any of various curvatures, depending upon local conditions.

Although the drawings show the bond lines about central, they may be offset to one side, if this should be found desirable. Thus a chord would be formed by line 11, instead of a diameter as shown in Fig. 2. Regardless of where the bond line is to the section of the thermostatic element, it is substantially straight and incorporates the advantages set forth herein. It will be understood that although the principles of the invention have been described in connection with a bimetallic wire they would likewise apply to wires having more than two different metallic components.

It is realized that heretofore bimetallic elements have been made up from sheet-like components which produced composite thermostatic elements having more or less straight line junctions between the components. But these were not drawn elements, such as contemplated by the present invention, and in which the problem solved arises. It is the cold-working operation that causes the difficulties solved. The invention is not limited, except where limited in the claims, to any particular cross section of wire because many different sections can be stretched into shape. It is noteworthy however that the circular shape of wire, during prior-art cold-working, produces quite a wavy bond.

Another advantage of a combination of materials as described is that their similar working properties allows the combination to be reduced by processes of hot working.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

A bimetallic wire having a substantially flat bond, the bimetallic components of which consist respectively of silicon-bronze containing approximately 98% copper, 1.5% silicon and 0.5% manganese by weight, and Invar containing approximately 36% nickel, 0.05% carbon, 0.5% manganese by weight and the remainder iron.

PAUL G. CHACE.

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