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TREATMENT FOR COMMERCIAL BIMETALS

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1 Claim. (Cl. 148—2)

The present invention relates to an improved bimetal and more particularly to a bimetallic element that may be subjected to a wide temperature range without permanent deformation and without losing its calibration.

Various efforts have been made in the past to secure a bimetallic element capable of holding its calibration over wide temperature ranges. The assumption has been that bimetal instability and failure to hold calibration results from high internal stresses. This stress condition presumably results from the standard methods of fabricating these bimetals, which comprises hot-welding the bimetal components together followed by various rolling operations. It would be desirable to eliminate these stresses and many stress-relieving treatments have been tried, including various heat treatments, cold treatments, thermal exercises, mechanical exercises, and various combinations of these treatments. However, these treatments have been largely ineffective in reducing the internal stresses.

It is an object of this invention to overcome the above and related disadvantages.

Another object of this invention is to provide an inexpensive quick conditioning method for producing a stable low-stressed bimetal.

A further object of this invention is to produce a low-stressed bimetal capable of retaining its calibration over a wide temperature range.

These and other objects of the invention will become apparent from the description and claims that follow.

This invention pertains in general to the prestressing of commercial types of bimetals to relieve internal stresses therein and thereby produce a bimetal that may be subjected to wide temperature ranges without losing its calibration.

There is provided, in accordance with this invention, a method of making a bimetal having reduced residual stress. This method is characterized by tension stressing the bimetal beyond its proportional limit.

According to a preferred form of this invention the bimetal should be stressed at about 95% of failure for about 15 minutes.

This invention is further concerned with bimetallic elements produced in accordance with the herein disclosed methods.

The following procedure has ben utilized for stress-relieving bimetals in accordance with this invention. Stock pieces of the bimetal were fashioned into conventional tensile stress specimens. The actual pieces used were approximately 24 inches long and from one to two inches wide in the primary section under tension. The strips were pulled in a standard Baldwin-Southwark testing machine, to varying degrees of unit stress and for varying degrees of time. The actual stress magnitudes used ranged from 83% of failure to actual failure. In the event of strip failure, specimens for internal stress measurement were cut from the pulled piece at a point somewhat remote from the point of failure. In various tests, the pieces were held under tension at the indicated stress for periods which varied from a few to approximately 30 minutes. Holding the bimetal specimen under

a tension stress of 95% of failure for 15 minutes was found to be a preferred treatment.

These tests were conducted on Wilson Highflex 45, with a thickness of about 0.030 inch. The nominal composition of the high-expansion component is 19.5% nickel, 2.5% chromium, 1.0% manganese, and the balance iron. The low-expansion component is a 36% nickel Invar steel. This is a typical commercial bimetal, and it may be assumed that effective stress-relieving treatments for this bimetal would be equally effective, or at least nearly so, on the products of other bimetal manufacturers.

The residual stresses in specimens prepared in accordance with the above procedure were found to be smaller than for any other Wilson Highflex 45 treated in accordance with prior known stress-relieving procedure. For example, a specimen pulled in tension in accordance with this invention is an "as-received" condition (a stock piece) under an applied stress of 130,000 p. s. i. was found to have a maximum measured residual stress of 7,500 p. s. i.

The following general theory has been evolved to explain the effectiveness of internal stress reduction by stressing in tension. Commercial bimetals in an "as received" condition have been shown to be stressed in rather consistent patterns with stresses of tension and compression sometimes near the yield point. Annealing such a bimetal is ineffective in reducing the stresses as the bimetal, upon cooling, is again stressed by the unequal contraction of its components. When the strip is pulled as herein described, a nearly uniform tensile stress is applied to all fibers of the metal. Such a stress adds to the tensile stresses already present and subtracts from the compressive stresses already in the bimetal. If the added stress is of such a magnitude that yielding takes place at points where the total stress is above the yield in tension, then other portions originally in compression may actually be stressed in tension. If the materials yield sufficiently before fracturing, it is possible to obtain plastic deformation, in tension, entirely across the piece. Subsequently, when the tensile stress is released, the bimetal is largely stress relieved. It is obvious that this stress-relieving treatment will be most effective when the Young's moduli values of the two bimetal components are nearly equal and when their proportional limits are also about equal.

As many apparently widely different embodiments of the invention may be made without departing from the spirit and scope hereof, it is to be understood that the invention is not to be limited to the spirit and scope hereof except as defined in the appended claim.

What is claimed is:

A method of reducing the internal stress of a bimetallic element, said element comprising a high-expansion component composed of about 19.5% nickel, 2.5% chromium, 1% manganese, and the remainder iron, and a low-expansion component composed of a 36% nickel steel, comprising the steps of stretching said element beyond its proportional limit to about 95% of failure, and maintaining said element in such stretched condition for about 15 minutes.

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