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METHOD OF HEAT TREATING BIMETAL

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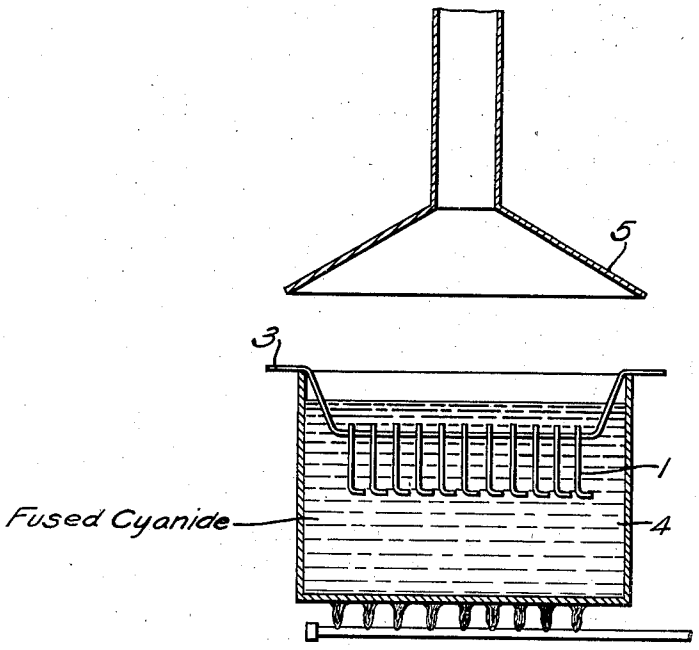


Fig. 1.

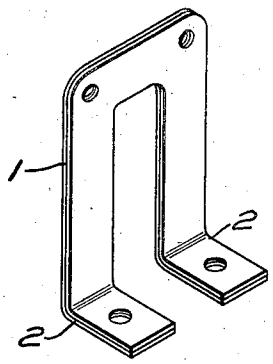


Fig. 2.

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METHOD OF HEAT TREATING BIMETAL

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This invention relates to the production of bimetallic elements such as are frequently used in circuit breakers and motor starters. Such elements are subjected to short periods of overheating when traversed by heavy short circuit currents, and it has been found that their calibration changes upon such overheating.

It is an object of this invention to produce a bimetallic element which will keep its calibration better than those heretofore known.

It is a further object of this invention to provide a heat treatment for bimetallic elements by which their calibration is rendered more permanent. By this treatment the calibration is rendered unlikely to change when the bimetallic element is heated to the highest temperatures which are likely to occur in its intended use.

The practice of the invention will be understood from the following detailed description and the accompanying drawing in which:

Figure 1 is a view, partly in section, illustrating the heating of the devices; and

Fig. 2 is a perspective view of one of the devices.

The devices comprise a U-shaped member 1 of two strip portions fastened together face-to-face, preferably by rolling the two strips together while hot, although other means of fastening are permissible. The two members are of different composition to provide different coefficients of thermal expansion.

The low expansion side is an alloy of nickel and steel. Various proportions have been found desirable, but, in several cases, 36% nickel and the remainder steel have been found a desirable composition for the low expansion side. In at least one instance 42% nickel has been used there.

The other side is an alloy of nickel and various other elements, usually including steel. An alloy of 25% nickel, 4% manganese and the rest steel has been used in some cases, for the high expansion side. Chromium, manganese, copper and zinc in various proportions have been combined with iron or steel and nickel to produce the alloy used on the high expansion side in various other cases. In one instance, pure nickel has been used on this side with good results.

The bimetallic element of this invention is used in circuit breakers of the type shown in Dorfman Patent No. 1,802,758, issued April 28, 1931. The bimetal must move sufficiently at its upper end (the closed end of the U) to cause the circuit breaker mechanism to trip on small overloads. The bimetal must also be capable of carrying short circuit currents of several thousand amperes. After being heated to a high temperature by such short circuit current, the bimetal must return to its original position and not take a permanent set, in order to again accurately trip the breaker if a small overload should occur.

The bimetallic member has heretofore been mounted in position in the circuit breaker by means of a pair of right-angled brackets to which the ends of the U-shaped bimetallic member have been secured. It has been found advantageous, however, to make the member with right-angled bends, as shown at 2 in Fig. 2, affording feet which may take the place of the brackets and be fixedly mounted on the base of the circuit breaker. This has the advantage that the part of the member subjected to the heating current is longer, whereby more bending is effected for the same expenditure of electrical energy. More movement of the closed end of the U for the same degree of bending is obtained because the portion which is bending is longer. Also in this arrangement there are no riveted joints which have been found disadvantageous both because of local heating and because of the added resistance.

Bending the bimetallic member to produce these feet introduces certain strains. One object of the heat treatment described herein is to relieve the material from these strains.

In said heat treatment, the members are supported in any convenient manner, for example, upon a bent rod 3, in a bath 4 of fused cyanide, which is illustrated in Fig. 1, a hood 5 being provided to remove the vapors. The bath 4 is preferably of an alkali cyanide such as potassium cyanide. The articles are immersed in the fused cyanide for a short time. From 10 to 15 seconds is usually long enough. The articles have only to come to the desired temperature. This temperature is preferably slightly above the highest temperature which the articles are expected to reach during their use. From 1450° F. to 1500° F. is right for many ordinary uses. The temperature may be varied from 1200° F. to 1800° F. and the time may also be varied from five seconds to thirty seconds to include the unusual cases. The higher temperature requires the shorter time.

The action of the cyanide upon the material of the bimetal articles is not well understood. The heat relieves any strains or stresses present in the bimetallic member. It is believed that the action of the cyanide tends to retard annealing or softening of the bimetal by the high temperature mentioned in the preceding paragraph so

that the change in their hardness can be kept within certain definite limits. The hot cyanide bath also provides a desirable means for controlling the heating of the members whereby they can be brought up quickly to the desired temperature and kept at the temperature for the desired length of time. There is no very great effect upon the hardness of the articles. The "Rockwell B" hardness in the case of a bimetal article having on its low expansion side 36% of nickel changed upon 15 seconds' treatment at 1450° F. from 97½ to 93 or approximately 5%. The high expansion side of this article was made of 22% nickel, 8% chromium and the rest steel. Its hardness changed during the same treatment from 102 to 96 or approximately 6%. Other samples of the same material were treated for a longer time, the maximum being 15 minutes which is longer than the treatment proposed here. Even with this long treatment, the hardness had changed only to 83 on the low expansion side or approximately 15% and 87½ on the high expansion side or approximately 14%. The cyanide apparently tends to prevent decarbonization of the bimetal and retards annealing or softening of the same thus allowing the bimetal to be heated to the high temperatures mentioned without producing more than a certain limited amount of softening of the material as indicated by the above tests.

While the heat treating process in the cyanide bath is the preferred process, it is to be understood that other methods of heat treating may be used providing they do not change the hardness of the bimetallic members more than a certain limited amount.

No annealing is necessary after this treatment. The articles may be quenched in water or cooled in air.

Although I have described the method as applied to the thermostat element illustrated, obviously it is applicable to other shapes. For example, a straight element with a bend at the one foot may be substituted for a U-shaped one. Also the bend at the foot need not be a right angle. The method has the advantage that the angle at the bend is not changed by the heat treatment. A 45° angle may be used to advantage in certain situations, and because the treatment does not alter the angle is one reason why it does not change the calibration.

The bimetallic members to which the treatment is particularly applicable are those which are traversed by the current although the treatment may also be used for bimetallic members which are used in different relationships in which they are subjected to extremely high temperatures.

In bimetallic elements of the type in which the current traverses the element, a heavy overload or short circuit condition in the circuit often produces temperatures as high as 1400° F. or more in the bimetallic element; at these temperatures bimetallic elements not subjected to the heat treatment herein disclosed would take a permanent set, or lose their calibration either partially or wholly.

It is found that the articles so treated retain their calibration during use provided that the heating which they receive in use does not exceed the temperature to which they are subjected in the cyanide bath. This is of great convenience in bimetal elements which are to be used in situations where they are occasionally subjected to short circuits or other conditions in which they pass a current which heats them to abnormally high temperatures.

Many variations of the details of this invention will occur to those skilled in the art, and I do not wish to be limited except as indicated in the following claims.

I claim as my invention:

1. The process of heat treating a bimetallic member to remove strain therein, which comprises immersing it in a bath of alkali cyanide at a temperature between 1450° F. and 1500° F. for from ten to fifteen seconds.

2. The process of heat treating a bimetallic member having two strips fastened together face-to-face containing different percentages of nickel and having different thermal coefficients of expansion, said bimetallic member also having a bend, which comprises immersing said member in a cyanide bath at a temperature between 1450° and 1500° F. for from ten to fifteen seconds.

3. The process of treating a bimetallic member of the class described to render its calibration more permanent which comprises heating the member in a cyanide bath at a temperature between 1200° F. and 1800° F. to relieve strains and to decrease its permanent hardness only from 5 to 15 percent.

HILLER D. DORFMAN.