Jan. 29, 1929. 1,700,173

L. K. MARSHALL

METALLIC THERMOSTAT

Original Filed Feb. 26, 1925

Fig. 1.

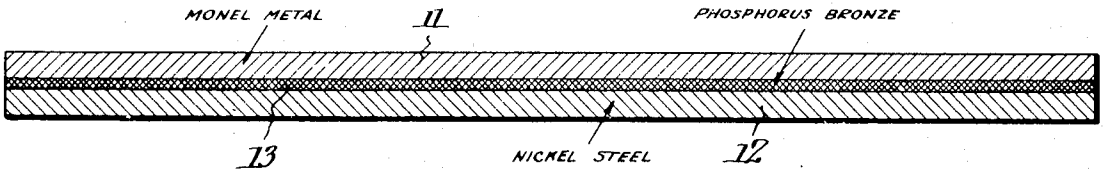
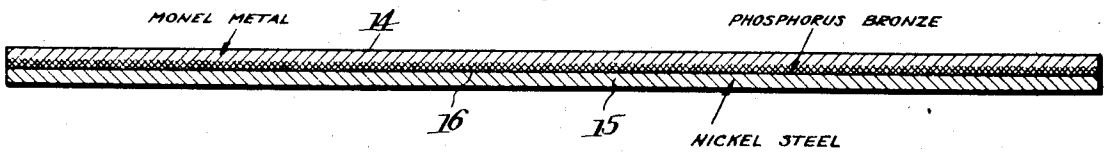


Fig. 2.



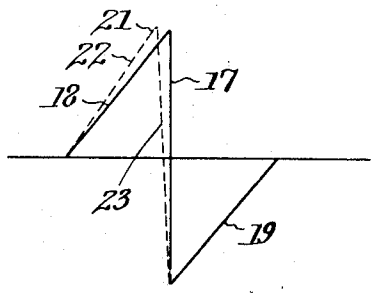


Fig. 3.

Inventor

Laurence K. Marshall,

By Cushman Bryant & Darby

Attorneys

Patented Jan. 29, 1929. 1,700,173

UNITED STATES PATENT OFFICE.

LAURENCE K. MARSHALL, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO SPENCER THERMOSTAT COMPANY, OF CAMBRIDGE, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

METALLIC THERMOSTAT.

Continuation of application Serial No. 11,896, filed February 26, 1925. This application filed January 10, 1927. Serial No. 160,157. Renewed June 28, 1927.

My invention relates to temperature controlled devices and particularly to metallic thermostats.

One object of my invention is to provide a metallic thermostat that shall embody means for effecting a good bond between the adjacent metallic elements, that shall be of appreciable thickness and preclude an abrupt change of stress between the adjacent metals.

In practicing my invention, I provide a metallic thermostat comprising a plurality of metallic elements that have different temperature expansivities and that are united by a bond of appreciable thickness.

This application is a continuation of application Serial No. 11,896, filed Feb. 26, 1925, and abandoned January 10, 1927.

In the drawings,

Figure 1 illustrates, in vertical section, a plurality of metallic elements, of different materials, together with a bond therebetween, before rolling.

Fig. 2 illustrates the elements after rolling shown on an enlarged scale embodying my invention, and

Fig. 3 is a schematic representation of stresses therein under temperature changes.

In my copending application, Serial No. 11,897, filed February 26, 1925, and assigned to the Spencer Thermostat Company, I have disclosed and claimed a method that may be employed in making a thermostat of the kind hereinafter to be described.

I prefer to employ Monel metal that is an alloy of nickel and copper as one of the metallic elements, and an alloy of nickel and steel as the other of the metallic elements of my improved thermostat and I employ a strip of phosphor bronze located therebetween as the bond.

While I do not wish to be restricted to particular dimensions or thicknesses of the original ingots employed, I may use a bar 11 of Monel metal that is approximately .25″ thick and a bar or strip of nickel steel 12 that is also approximately .25″ thick. I locate therebetween a strip 13 of phosphor bronze that is not less than .006″ thick and may approach .010″.

As more particularly described in the hereinbefore mentioned application, the three members illustrated in Fig. 1 of the drawing, constituting a part of the present invention, are heated to a suitable temperature to braze them together, and are then subjected to repeated rollings and annealings.

At the end of the repeated rollings and annealings, during which the thickness of the bimetallic element has been reduced to substantially .020″, the condition of the parts thereof is substantially that illustrated in Fig. 2 of the drawings. Numeral 14 indicates the Monel metal element, numeral 15 indicates the nickel steel element and numeral 16 indicates the phosphor bronze bond. I have found by careful investigation and microscopic tests that there is a relatively sharp line of demarkation between the phosphor bronze and the nickel steel element but that this line of demarkation is very much less sharp between the phosphor bronze and the Monel metal. I have indicated this latter condition in Fig. 2 by omitting the line indicating the separation of the metals.

While I am not prepared to state definitely what causes the different bonding action between the bond 13 and the two alloys, I am of the opinion that the copper of the phosphor bronze bond combines with the nickel in the Monel metal element that is located immediately adjacent to the bond.

I have found that such a metallic thermostatic member, comprising two elements that may be subjected to relatively high temperatures of the order of 300° C. or even higher, will retain its proper operating characteristics almost indefinitely. One of the great drawbacks, particularly where no bond of appreciable thickness is employed between the cooperating metallic elements having different temperature expansivities, appears to be that the change of stress between the two elements is a relatively abrupt one and that there is a marked tendency for the two metals to rupture longitudinally of their abutting surfaces.

This is illustrated schematically in Fig. 3 in which the curve 17, in full lines, indicates the change of stress from the respective outer surfaces of the metallic elements and laterally therethrough. The straight line 18 represents the stress in the Monel element and is zero at the outer surface thereof and becomes maximum at the abutting surface thereof. This stress changes abruptly from the positive value to a probably corre-

sponding negative value and then decreases again to zero as is indicated by the straight line portion 19.

If we employ a bond of appreciable thickness, the change of stress will not be so abrupt and may be represented by the broken line curve 21. The stress in the Monel metal will again start at zero on the outer face thereof and approach a maximum as indicated by the broken line 22, but this maximum will not lie in the same lateral plane as heretofore. The portion 23 of the curve 21 illustrates the change that occurs in the bond itself and it is assumed that the stress in the nickel steel element is substantially the same as heretofore and indicated by the portion 19 of the curve.

While I have employed the word "combined" in describing the fusion of the bond with the Monel metal, I do not wish to be limited thereto as it is possible that there is a diffusion of the bronze with the Monel, and a fusion of the phosphor bronze bond with the nickel steel element, and all such structures covered by the present description are intended to be covered in the appended claims.

I claim as my invention:

1. A thermostat comprising two metallic elements, one of said elements being an alloy comprising copper, and a metallic bond, of appreciable thickness and containing copper for uniting the two elements.

2. A thermostat consisting of two metallic elements each element being an alloy of nickel, and a bond between said elements comprising a layer of appreciable thickness of a copper alloy.

3. A thermostat comprising two metallic elements, and a metallic bond therebetween diffused into at least one of said elements.

4. A thermostat comprising two metallic elements, and a metallic bond of appreciable thickness located therebetween to unite said elements and being fused to one element and diffused into the other element.

5. A thermostat comprising two metallic elements having different temperature expansivities, and a metallic bond therebetween for precluding an abrupt change of stress between the two elements upon change of temperature thereof.

6. A thermostat comprising two metallic elements having different temperature expansivities, and a metallic bond of appreciable thickness therebetween fused to one element and diffused into the other element for uniting the same and for precluding an abrupt change of stress between the two elements upon change of temperature.

7. A thermostat comprising united metallic elements ordinarily having an abrupt change of stress therebetween and means comprising a metallic alloy for rendering the change of stress more gradual.

8. A thermostat comprising two metallic elements having different coefficients of expansion and means comprising a metallic alloy for joining the elements together so that the change of stress therebetween is sufficiently gradual to avoid substantial tendency to rupture.

9. A thermostatic composite metal comprising two different alloys with a third alloy between the first named two alloys, one alloy of the first named two alloys and the third alloy having an element in common.

10. A thermostatic composite metal comprising two different alloys with a third alloy between the first named two alloys, one alloy of the first named two alloys and the third alloy having an element in common, and both of the first named two alloys having an element in common.

11. A thermostatic composite metal comprising two different alloys with a third alloy between the first named two alloys, one alloy of the first named two alloys and the third alloy having an element in common, and both of the first named two alloys having an element in common, the two elements in common being different.

12. A thermostatic composite metal comprising two different alloys with a third alloy between the first named two alloys, one alloy of the first named two alloys and the third alloy having an element in common, and both of the first named two alloys having an element in common, said first named two alloys having different coefficients of expansion.

In witness hereof, I have hereunto signed my name at Cambridge, Middlesex County, Massachusetts, this eighth day of January, 1927.

LAURENCE K. MARSHALL.