Nov. 15, 1927. 1,649,094

P. H. BRACE

ALLOY

Filed Nov. 16, 1921

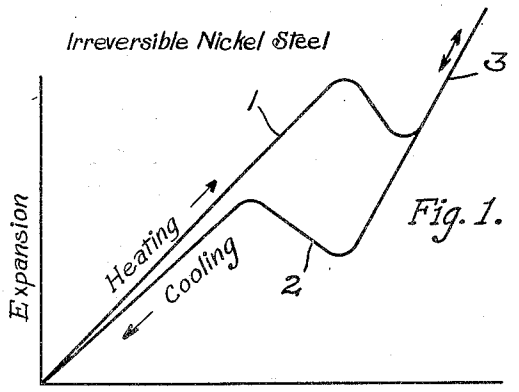


Fig. 1.

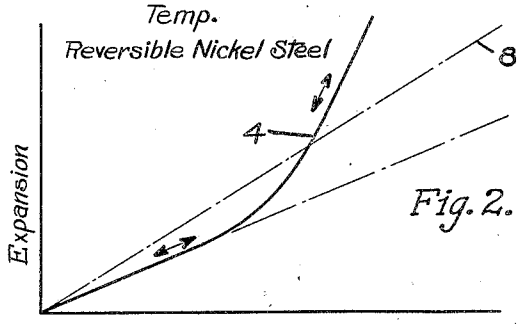


Fig. 2.

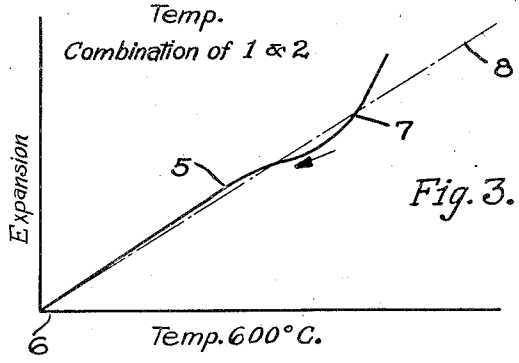


Fig. 3.

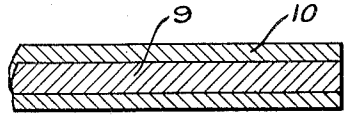


Fig. 4.

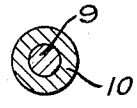


Fig. 5.



Fig. 6

Fig. 7.

WITNESSES:

P. H. Brock.

W. B. Jaspert.

INVENTOR

Porter H. Brace.

BY

Wesley G. Carr

ATTORNEY

Patented Nov. 15, 1927. 1,649,094

UNITED STATES PATENT OFFICE.

PORTER H. BRACE, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

ALLOY.

Application filed November 16, 1921. Serial No. 515,604.

This invention relates to alloys, more particularly to a composite wire of a plurality of alloys for use as lead wires for glass vacuum apparatus, such as lamps, vacuum tubes, and the like.

In glass vacuum apparatus, such as lamps or vacuum tubes, it is necessary that lead wires pass through the glass connecting the filaments or electrodes within the same to an external source of electrical energy. In order to provide a gas-tight seal between the lead wire and the glass of the apparatus, it is essential that the coefficients of expansion of the wire and the glass be approximately the same.

The characteristics of the glass used in such apparatus varies with the functions of the apparatus and generally there are used two types of glass, the so-called soft glass which has a low softening temperature, and a relatively high coefficient of expansion and is annealed at a temperature of 300° to 400° C., and the so-called hard glass which has a low coefficient of expansion and a high softening temperature and which is usually annealed at a temperature of about 600° C.

For the low softening temperature glass, the lead wires used generally consist of a 32% nickel steel which is covered with a copper sheath. Wire of this type functions well with soft glass but its coefficient of expansion is so high that it is entirely unsuited for use with the hard glass.

Hitherto, the only material which has been found suitable for lead wires for glass vacuum apparatus embodying hard glass has been tungsten, which has a low coefficient of expansion of the same order as that of the glass. However, tungsten is generally relatively fragile, is expensive and difficult to produce and work. It is, therefore, desirable to provide a lead wire for hard glass having the necessary low coefficient of expansion and which is inexpensive and easy to produce.

It is, therefore, an object of this invention to provide a material suitable for use with hard glass and which has a low coefficient of expansion.

It is a further object of this invention to provide a composite wire comprising alloys having inversions to their temperature-expansivity relations, the combination of which provides the low coefficient of expansion desirable for use with hard glass.

In practising my invention, I provide a wire including reversible and irreversible alloys, such as nickel steels, the wire being in the form of a core of one of the alloys having a concentric shell or shells of one or more other alloys. The ratio of the diameters of core and shell is determined by the characteristics of the alloys chosen, and the magnitude of the resultant expansion desired.

A reversible alloy is one which, on heating, follows a certain curve of expansion and, upon cooling, retraces the original heating curve. An irreversible alloy is one which, on heating, follows one curve and, on cooling, follows a different curve. In my invention, I utilize the properties of both the reversible and irreversible alloys, such as nickel steels, combining the same in such proportions that the resultant contraction curve is approximately that of the glass with which said alloys are to be used.

In the accompanying drawings constituting a part hereof and in which like reference characters designate like parts,

Fig. 1 is a curve showing the expansion and contraction of an irreversible nickel steel alloy;

Fig. 2 is a curve showing the expansion and contraction of a reversible nickel steel alloy;

Fig. 3 is a curve showing the contraction of a composite of the reversible and irreversible nickel steel alloys, the curves of which are illustrated in Figs. 1 and 2;

Fig. 4 is a longitudinal cross-section of a lead wire made in accordance with this invention;

Fig. 5 is a transverse section of the same;

Fig. 6 is a longitudinal cross-section of a lead wire made in accordance with a modification of my invention, and

Fig. 7 is a transverse section of the same.

When an irreversible nickel steel is heated, it follows the heating curve 1 shown in Fig. 1 and, upon cooling, follows the curve 2, the two curves being common along the line 3. The reversible nickel steel, upon heating or cooling, follows the curve 4 shown in Fig. 2. By combining reversible and irreversible nickel steels, there is obtained a composite material, the contraction cooling curve 5 of which is different from the curves 1, 2 and 4 and follows rather closely the contraction curve 8 of hard glass.

I preferably provide an irreversible nickel steel alloy containing approximately 12% nickel forming a core 9 therefrom and surround the same with a sheath 10 of a reversible nickel steel containing approximately 40% nickel. The outside diameter of the sheath 10 is approximately twice that of the core 9. A lead wire of this material follows the contraction curve 8 of hard glass very closely below an annealing temperature of 600° designated as point 7 on Fig. 3, thus providing a material for lead wires which induces practically no strain in the material after annealing.

In order to suitably modify the characteristics of the composite wire, which I utilize for lead wires for glass vacuum apparatus, I may add other elements which control or modify the characteristics of expansion thereof and their physical or chemical properties. For instance, I have applied coatings of chromium or other refractory materials, such as tungsten or molybdenum to prevent oxidation of the wire during the glass-blowing operations and to provide a good bond between the wire and the glass. The physical characteristics of the alloys may be modified by the addition of various metals, such as cobalt, chromium, tungsten, molybdenum, vanadium, titanium or carbon which may be alloyed with one or all of the component alloys of the composite wire.

Although I have described a specific embodiment of my invention comprising a reversible and an irreversible nickel steel of certain specific proportions, it is to be understood that my invention is not limited to nickel steels nor to the proportions stated but that my invention is directed broadly to a lead wire including alloys having inversions in their length-temperature curves. Although I have described the composite wire having a core of reversible alloy and a sheath of irreversible alloy, it is obvious that the positions of the alloys may be interchanged and that the form of the wire may be modified, as desired. For instance, I may provide a composite wire consisting of strips of material held together in any suitable manner in place of a core and a concentric sheath thereon as shown in Figs. 6 and 7. These and various other changes may be made in my invention without departing from the scope thereof.

I claim as my invention:

1. A lead wire for glass apparatus comprising a plurality of layers of nickel steels, at least one of said layers having reversible and at least one of said layers of steel having irreversible temperature-expansivity characteristics.

2. A lead wire for glass apparatus comprising a core member and a sheath member, one of said members being a reversible and the other member being an irreversible nickel steel.

3. A lead wire for glass apparatus comprising a core of 12% nickel steel and a sheath of 40% nickel steel.

4. A lead wire for glass apparatus comprising a core of 12% nickel steel and a sheath of 40% nickel steel, the outside diameter of the wire being approximately twice the diameter of the core.

5. A lead wire for glass apparatus comprising a body of iron alloy having a reversible temperature-expansion curve and a body of iron alloy having an irreversible temperature-expansion curve said bodies being combined into a laminated wire having a uniformly low coefficient of expansion over a wide range of temperature.

6. A lead wire for glass apparatus comprising a body of iron alloy having a reversible temperature-expansion curve and a body of iron alloy having an irreversible temperature-expansion curve said bodies being combined into a laminated wire having a uniformly low coefficient of expansion over a wide range of temperature up to about 600° C.

In testimony whereof, I have hereunto subscribed my name this 31st day of October 1921.

PORTER H. BRACE.