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PROCESS FOR THE PRODUCTION OF A COMPOUND METAL.

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This invention relates to a new process for producing compound metal articles and especially leading-in wires for incandescent electric lamps.

5 An object of this invention is a process of producing a compound metal which will have exactly a predetermined coefficient of expansion.

10 A special object of the invention is a method of producing a clad metal having no air spaces between the layers of the metals comprising the compound.

15 Such a compound metal article is valuable for many purposes but particularly so as a lead-in wire for incandescent lamps. It allows the use of any kind of glass for the bulb of the lamp without being limited to a definite co-efficient of expansion, because, by this process, a wire can be produced which will 20 meet all the requirements of a good lead-in wire, including a co-efficient of expansion close enough to that of the glass selected to maintain an air-tight seal between it and the glass throughout the range of temperature 25 to which an incandescent lamp is subject.

Platinum has been displaced as a lead-in wire for incandescent electric lamps by composite metals of which an example is a copper-coated nickel steel wire. Obviously the 30 contact between the copper and the nickel steel core must be close enough to prevent air from passing between them when the wire is sealed into a lamp. Present processes of manufacturing such a composite wire frequently produce it with pockets of air be- 35 tween the layers at some parts. The presence of this air gives the wire a different coefficient of expansion where a pocket exists. Defective wire of this sort, when used in a 40 lamp, permits air to leak into the bulb and, therefore, causes the lamp to have a short life.

45 A good leading-in wire should be free from pockets and have a coefficient of expansion substantially equal to that of the glass into which it is sealed.

With a nickel steel alloy of a given composition, the coefficient of expansion of the copper-coated nickel steel wire depends on 50 the relative thickness of the metals composing it. The coefficient of expansion of such wire may be largely controlled by regulating the amount of copper deposited upon the core.

55 Other defects of present practice in mak-

ing composite wire of the nature described are the great difficulty in regulating the thickness of the copper coating and the non-uniform thickness of copper around the perimeter of the wire.

60 The method of practicing my invention by which I have overcome the defects of previous processes, is as follows:

A rod of nickel steel about 400 mil in diameter and 5 ft. long is cleaned in an alkali, followed by a cleaning in an acid to remove metallic oxides and scales. The rod is then electroplated with copper about 1 mil in thickness in a preliminary bath of the following composition: 70

	Grams.
Sodium sulphite (Na_2SO_3)	20
Sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$)	20
Sodium bisulphite (NaHSO_3)	20
Cupric acetate ($\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot \text{H}_2\text{O}$)	20
Potassium cyanide (100% KCN).	
Water, 1 liter.	

75 The current density used is from three tenths (0.3) to one (1) ampere per square decimeter. The copper-plated rod is then electroplated with copper to the desired thickness in another bath of the following composition:

80 Copper sulphate, 480 gms.; sulphuric acid, 300 gms.; water, 3 liters.

The temperature of the bath is preferably about 50° C. The current density in this operation is from five (5) to ten (10) amperes per square decimeter and the rod is 85 rotated while being plated.

The plated rod is then heated to a temperature which causes incipient fusion of the copper whereby it becomes more adhesive to the core. The rod is next drawn to 90 finished sizes, through dies in the usual manner.

If desired, a coating of zinc, or other metal which has a melting point lower than copper and which will alloy with both the nickel steel and the copper, may be put on the core before depositing the copper, in order to make the copper coating more adherent. However, it is not necessary to use a metal between the nickel steel core and the 105 copper.

From the foregoing it will be apparent that my invention provides a quick and accurate method for manufacturing a composite wire which shall have exactly the coeffi- 110

cient of expansion desired, inasmuch as the thickness of the copper plating may be exactly controlled by measuring the amount of current passed through the plating circuit and the time during which it is passed, both of which quantities may be accurately measured. This method also results in a uniform thickness of copper over the whole surface of the wire.

10 It will be understood that, while I have described the process for the production of a copper-clad nickel steel wire, my invention is applicable to other suitable metals.

What is claimed is:

15 1. A step in the process of producing a composite metallic body which consists in electroplating on a metallic core another metal of such thickness as to give to the composite body a predetermined coefficient
20 of expansion.

2. The process of producing a composite metallic body which consists in electroplating on a metallic core another metal of such thickness as to give to the composite body a
25 predetermined coefficient of expansion, and heating the deposited metal to incipient fusion.

3. The process of producing a composite metallic body which consists in electroplating a core of nickel steel with copper and heating the said copper to incipient fusion.

30 4. A method for accurately controlling the coefficient of expansion of a composite wire which consists in electrolytically depositing on a metallic core a predetermined
35 amount of another metal.

5. The method of producing a composite

metallic body which consists in first cleaning said body with an alkali and then washing said body with an acid, thereafter electroplating a thin coating of copper from a cyanide bath and depositing on the said coating a second coating from a sulphate bath and thereafter heating said body to cause incipient fusion of the coatings
45 thereon.

6. As an article of manufacture, a composite wire free from pockets between the layers thereof.

7. As an article of manufacture, a composite wire composed of constituent layers having their adjoining surfaces in intimate contact, whereby pockets between said layers are obviated.

8. As an article of manufacture a composite wire free from pockets between the layers thereof and having a predetermined coefficient of expansion.

9. As an article of manufacture a composite wire free from pockets between the layers thereof, comprising a core of nickel steel and a sheath of electrolytically deposited copper.

10. As an article of manufacture a composite wire free from pockets between the layers thereof and having exactly a predetermined coefficient of expansion, comprising a core of nickel steel and a sheath of electrolytically deposited copper.

In testimony whereof, I have hereunto
70 subscribed my name this third day of January 1921.

EMILIO ROMANELLI.