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ALLOY MATERIAL FOR ELECTRICAL CONTACTS

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This invention relates to metallic bodies of a character frequently described as "alloys", but which are particularly adapted for service as electrodes in electrical contactors and the like by reason of their non-arcing and non-oxidizing characteristics, and to the process of making the same.

The object of the invention is to provide an improved metallic product of the character described, which shall possess the desired characteristics in a relatively high degree, and which shall also have relatively great wear resistance together with a relatively small electrical resistance.

Another object is to provide an improved method for the compounding of metallic components, entering into a metallic body.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

This application is a continuation in part of our co-pending application, Serial No. 52,690, filed August 26, 1925.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others, and the product possessing the features, properties, and the relation of constituents, which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

In the practice of the present invention the interstices of a body of a relatively refractory metal which does not of itself possess the desired characteristics are substantially filled with one or more metals of lower melting point in a manner which gives a resulting product having the desired characteristics. This refractory metal body comprises a base and is selected to have a relatively high melting point with respect to the impregnating metal or metals and is adapted to impart the desired rigidity to the electrical contacts together with wear-resisting qualities. Metals adapted for this service are, for example, tantalum, molybdenum and tungsten, which metals have an atomic weight greater than 95. Those metals which have the higher melting points are preferred.

To form the metal base here employed, particles of the refractory metal, for example, purified tungsten-powder from hydrogen furnaces, is pressed into a slug or bar by means of the application of suitable pressure. The resulting slug or bar is porous, although with the application of sufficient pressure such slug or bar may be made to appear substantially homogeneous to the naked eye. Slugs or bars, thus produced, may have on the average of say 40% of voids.

The porous metallic base or slug is next filled with the impregnating metal which is of a character that imparts the desired electrical characteristics. Metals which are adapted to impart the non-arcing and non-oxidizing characteristics are the so-called "noble" metals, for example, silver and gold and the metals of the platinum group, namely, platinum, iridium, osmium, palladium, rhodium and ruthenium.

To impregnate the refractory metallic slugs or bars with these metals, advantage is taken of the retentivity or capillary attraction of the voids or pores in the slugs for the impregnating metal. To utilize this effect, such metal must be liquefied; to this end, the slugs or bars are placed in a suitable vessel and surrounded with sheets or bodies in other form of the impregnating metal and heated to a temperature at or above the melting point of the impregnating metal, but below that of the refractory metal base.

Along with the impregnating metal it is preferable that there should enter the voids or pores of the slug a relatively small amount of additional material adapted to impart, or otherwise qualify, the characteristics of the resulting product; for example, the hardness of the impregnated and impregnating material is a characteristic which may be controlled in this manner, the hardness otherwise naturally resulting being either increased or decreased by the addition of suitable materials. The amount of additional material, such as, for example, hardening material, should be present in an amount up to about 3 per cent by weight of the refractory metallic base.

It has been ascertained that the composi-

tion of the vessel, if made of the usual materials, together with that of the surrounding atmosphere, within certain limits, affects the characteristics of the metallic body produced, as generally a small percentage of the material of the vessel and of the gases of the atmosphere are taken up by the melted metal in the vessel; the material of the vessel probably being taken in by dissolving some of the same from the walls of the vessel. When this is not desired a very refractory vessel must be chosen.

Carbon, particularly in the form of lamp black, among others, has been found to impart hardness to the impregnated and impregnating substances in the pores or voids of the slug. A vessel of carbon—for example, one made of refined carbon or lamp black—when operated in a neutral atmosphere, has been ascertained to be a suitable medium for thus hardening the resulting product.

Hydrogen, on the other hand, has a softening or annealing effect on the product; consequently, an atmosphere of hydrogen about the treating vessel during treatment can be utilized to impart this characteristic. Other gases adapted to serve as the atmosphere for the vessel, but which are more or less neutral, are nitrogen, argon and carbonaceous gases. The latter gases, if occluded, absorbed or otherwise present in sufficient quantities in the pores of the base, can of themselves produce varying degrees of hardness independently of the composition of the vessel. Thus, by varying the nature of the surrounding atmosphere, together with the selection of a suitable vessel, the characteristic qualities of the resultant product may be substantially completely controlled.

The resulting metallic product is relatively uniform in texture, and possesses—particularly, tungsten-platinum bodies—the desired properties to a high degree. Contacts or other electrodes of tungsten-platinum are adapted to be placed in electrical contact service where the requirements are relatively severe; for example, such contacts may be used on vibrator arms, where relatively large electrical currents are being substantially continuously interrupted.

In service of this character the currents are quickly interrupted and the circuit definitely broken substantially instantaneously, where tungsten-platinum contacts are used, as contactors made of this metallic body are substantially non-arcing. The steadiness of the current when the contact is closed is not interfered with by the contact, as it is always bright and is non-oxidizing and hence introduces substantially only a constant resistance at the point of contact.

The impregnating metal or metals may be introduced by the process of the invention in varying amounts, the upper limit of the relative amounts being a function of the relative retentivity or capillary attraction of the refractory metallic slug or bar for the lower melting point metal. As this retentivity or attraction is, as a rule, inversely proportional to the size of the voids, and as the voids decrease in size, the amount of metal that may be added directly decreases; there is, however, an upper limit to the amount of metal which may be added to the refractory bar or slug. In the present practice this limit is in the neighborhood of 40% to 50%.

The following are examples of the compositions of metallic bodies produced in accordance with the invention, the respective proportions being given in percent. by weight:

Example I

Tungsten	60 %
Gold	39.7%
Carbon	.3%

Example II

Tungsten	70 %
Platinum	29.5%
Carbon	.5%

Example III

Molybdenum	50%
Platinum	49.95%
Hydrogen	.05%

Example IV

Tantalum	61%
Palladium	38.9%
Hydrogen	.1%

Example V

Tungsten	72%
Silver	27.5%
Carbon	.5%

Since certain changes in carrying out the above process, and certain modifications in the composition which embodies the invention, may be made without departing from its scope, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A metallic body comprising in preponderating amount, a refractory porous metallic base having its pores impregnated with one or more of the metals silver, gold and the metals of the platinum group, with which is incorporated material comprising one or more of the elements carbon, nitrogen, argon and hydrogen, in an amount up to about 3 per cent by weight of the base adapted to react with the metal of the porous base and temper the same.

2. A metallic body comprising in preponderating amount, a refractory porous metal-

lic base, having its pores impregnated with a metal of the platinum group with which is incorporated a tempering material comprising one or more of the elements carbon, nitrogen, argon and hydrogen in an amount up to about 3 per cent by weight of the base.

3. A metallic body, comprising in preponderating amount, a porous base of metallic tungsten having its pores impregnated with one or more of the metals silver, gold and the metal of the platinum group, with which is incorporated an amount of tempering material comprising one or more of the elements carbon, nitrogen, argon and hydrogen in an amount not greater than about 3 per cent by weight of the base.

4. A metallic body comprising, in preponderating amount, a porous base of metallic tungsten having its pores impregnated with a metal of the platinum group, with which is incorporated tempering material comprising one or more of the elements carbon, nitrogen, argon and hydrogen in an amount not greater than about 3 per cent by weight of the base.

5. A metallic body comprising in preponderating amount, a refractory, porous metallic base comprising one or more of the metals tantalum, molybdenum and tungsten, having its pores impregnated with one or more of the metals silver, gold and the metals of the platinum group, with which is incorporated a tempering material comprising one or more of the elements carbon, nitrogen, argon and hydrogen in an amount up to about 3 per cent by weight of the base.

6. A metallic body comprising in preponderating amount, a porous base comprising metallic tungsten having its pores impregnated with silver with which is incorporated a tempering material comprising carbon in an amount up to about 3 per cent by weight of the base.

7. A metallic body comprising a porous base of partially carburized tungsten and an auxiliary binding constituent comprising silver impregnating said base, said partially carburized tungsten including carbon in an amount of about .5 per cent by weight of the body.

In testimony whereof we affix our signatures.

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