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METAL COMPOSITION

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1 Claim. (Cl. 75—134)

This invention relates to tungsten metal compositions particularly those suitable for electrical contact purposes.

It is an object of this invention to improve the characteristics of tungsten metal compositions having a high melting point.

It is a further object of this invention to produce a material which will retain a low contact resistance during long periods of operation.

Other objects of the invention will be apparent from the following description taken in connection with the appended claim.

The present invention comprises the combination of elements, methods of manufacture, and the product thereof brought out and exemplified in the disclosure, hereinafter set forth, the scope of the invention being indicated in the appended claim.

In the prior art, many contact materials and electrodes have been proposed which supposedly give good electrical conductivity and sufficient resistance against wear and oxidation. Metals which have been used for contact purposes, for instance, were silver, copper, platinum, tungsten, or alloys and metal compositions which consist principally of tungsten and copper, plus tungsten and silver. Recently also alloys or compositions consisting of molybdenum carbide and silver or copper, have been proposed.

In the course of my investigation I have discovered that by adding metals having a very high vapor pressure at comparatively low temperatures to a refractory base excellent contacting materials could be produced. I have found that the boiling point of the metals which are most desirable for alloying with a refractory base should be below 1000 degrees C. The materials which suit this condition best are cadmium and zinc, and of the two, cadmium has the lowest boiling point and shows the best characteristics when used in connection with a refractory base for contact purposes.

According to the present invention, I therefore provide a metal composition of tungsten, a metal of the group consisting of cadmium and zinc, and silver. The above mentioned ingredients can be used in the following permissible range of proportions:

	Per cent
Tungsten.....	40 to 70
Metal of the group consisting of zinc and cadmium.....	0.5 to 5
Silver.....	Balance.

I have found that small percentages of such

metals as iron, cobalt, nickel and manganese may be present without materially changing the characteristics of this new contacting material. It is also possible that small quantities of a noble metal taken from the palladium or platinum group may be included in the composition.

Compositions of the type contemplated can be made by mixing tungsten and silver very intimately, and then pressing them to a high density. The pressed bars are sintered in a hydrogen furnace, and after sintering, they are impregnated with either zinc or cadmium. This may be done by placing zinc or cadmium on top of the pressed bar and stoking it through the furnace at a temperature of 650 to 750 degrees C. If cadmium is being used, then the preferred temperature is 650 degree C., on account of the low boiling point of cadmium. In the case of zinc, this temperature may be increased to 750 degrees C. or slightly higher.

The advantage of such a metal composition to which substantial quantities of cadmium have been added, consists in the property of cadmium to prevent the excess formation of metallic oxides which are usually encountered in contact applications. Due to the contact arcs or contact sparks, very high local temperatures are reached in certain places on the contact. The contact arc or contact spark ionized the air and the oxygen and nitrogen of the air are very active in forming oxides or other compounds with the contact metals. These oxides have usually a very high contact resistance. A scientific explanation of the action of cadmium has not been thoroughly studied, but actual tests have shown that under the same test conditions, a material prepared according to this disclosure will show a contact resistance which is only a fraction of that of the materials used without the addition of cadmium. It is possible that the action of cadmium can be explained on account of the dissociation of cadmium oxide at red heat or it is possible that the contact spark and arc are deionized, which increases the life of the contacting members.

Several methods of manufacture are possible to produce metallic bodies of the nature described. In addition to the method already cited it is possible to produce silver-cadmium alloys which have a very low melting point and which might be used for impregnating the tungsten base. It might be found necessary to add special ingredients which will lower the melting point of such materials to below 500 degrees C. Elements which are helpful in that respect are

magnesium, phosphorus, arsenic, antimony, germanium, indium.

It is also possible to take the various powders, such as tungsten powder, silver powder and cadmium powder and press same together under very high pressure. It has been found possible, under certain conditions, to compress the materials at an elevated temperature, and the temperature range in which the best results were obtained is from 100 to approximately 500 degrees C. If such elevated temperatures are used and pressure is applied, then a much denser product will be obtained because the yield point, or the "flow" point of the metal powders is lowered sufficiently to produce an actual amount of cold deformation and instantaneous recrystallization. Such recrystallization will cement the various powders very tightly together and the material is subsequently heated, diffusion will proceed very rapidly and a perfect material can be obtained.

Under certain conditions, it has also been found advisable to either impregnate or sinter the metal body containing cadmium under pressure. This will materially decrease the loss of cadmium due to a volatilization. A container can be made out of a special steel or a nickel-

chromium alloy, which is heat resistant. During sintering at a temperature higher than the boiling point of either cadmium or zinc, part of the latter two elements are volatilized and exert sufficient pressure to prevent further volatilization at this particular temperature.

It is contemplated that other ingredients may be present in the compositions, either as impurities or as diluents which do not materially affect the important properties of the material, while still following the present invention.

While the present invention as to its objects has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby, but it is intended to cover the invention broadly within the spirit and scope of the appended claim.

What is claimed is:

A metal composition wherein a mass of substantially non-alloying particles of tungsten are bonded by an alloy of lower melting point than said tungsten, said composition containing 40% to 70% tungsten, from 0.5% to 5% of metal selected from the group consisting of cadmium and zinc, balance substantially all silver.

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