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METALLIC COMPOUNDS ADAPTED TO FORM AN ELECTRICAL CONTACT

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This invention relates to improvements in metallic compounds. The invention also relates to bodies consisting of said metallic compounds. Although the compounds herein contemplated are adaptable for various uses, they are particularly advantageous for use in the formation of electrical switch contacts and the like.

Although, as will appear, my invention is useful in the formation of many different metallic compositions, it is particularly useful and advantageous in the formation of metallic compounds, having alloy characteristics, by the use of metals or elements which will not alloy in the ordinary manner. For example, I refer to a compound of silver and molybdenum, from which ingredients an alloy, in the ordinary sense, cannot be produced. In accordance with my invention, however, such non-alloyable ingredients may be compounded in a manner to obtain substantially all of the desirable characteristics of an alloy; such as homogeneity of the mixture of the ingredients, proper proportionality thereof, required hardness and electrical characteristics, etc. Moreover, in accordance with my invention the aforementioned desirable results are attained by treatment of the ingredients of the compound in a relatively simple and inexpensive manner.

I will herein describe the method of producing one of the desired compounds of silver and molybdenum; but it is to be understood that the method or technique herein disclosed is likewise applicable to the production of other similar compounds of silver and molybdenum, and to a series of compounds of silver and tungsten, silver and cobalt; as well as to a series of compounds of:

Nickel and tungsten,
Nickel and molybdenum,
Cobalt and tungsten,
Cobalt, tungsten and carbon (cobalt tungsten carbide from cobalt tungsten cyanide),
Cobalt, tungsten and chromium (stellite, from cobalt chromate and cobalt tungsten chromate),
Cobalt and molybdenum,
Copper and tungsten,
Copper and molybdenum,
Iron and tungsten,
Iron and molybdenum,
Manganese and tungsten,
Manganese and molybdenum,

and, in general, to such and other compounds containing atoms of two or more metals in each molecule. The method comprises essentially the controlled reduction of well defined poly metallic salts, such as those of the acids of chromium,

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molybdenum and tungsten by the use of hydrogen, hydrocarbon, or carbonaceous gases; and the invention also contemplates the controlled reduction by such agents of mixture of the aforementioned poly metallic salts.

An object of the invention is to provide metallic compounds having most of the desirable characteristics of alloys.

Another object is to provide for alloy characteristics in metallic compounds the ingredients of which are unalloyable in the ordinary sense.

Another and more specific object is to provide improved metallic compounds adaptable for use in the production of electrical switch contacts.

Another object is to provide electrical switch contacts and the like of novel composition.

Other objects and advantages of the invention will hereinafter appear.

One example of the method herein contemplated is as follows: To a hot saturated solution of para ammonium molybdate is added a hot solution of dilute silver nitrate, with resulting formation of a fine yellow precipitate. Such precipitate is freed of ammonium nitrate in a well known manner, then dried, and then reduced in a current or flow of dry hydrogen in steps; say, for about fifteen minutes at 400 degrees F., then for about fifteen minutes at 800 degrees F., after which the temperature is gradually raised to about 1600 degrees F., at which temperature the reduction appears to be complete. The product of such reduction is an extremely fine grained silvery powder of constant or homogeneous composition, in the sense that the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest. Powder produced in the manner just described showed a silver content of 49.2 per cent by weight.

From the foregoing it is obvious that the yellow silver molybdate (precipitate) was the para salt corresponding to silver para ammonium molybdate, or $Ag_6Mo_7O_{24}(H_2O)_x$, and that the reduced powder is the equivalent of silver molybdide, of the formula Ag_6Mo_7.

When such reduced powder is molded or compressed into suitable form for use as electrical contacts, a polished and etched specimen shows, under a microscope, an extremely fine structure in which silver and molybdenum are not distinguishable as separate components. After the molded contacts have been annealed at a temperature of 1200 degrees F. they have a hardness of about 75 Rockwell B., but by aging the same for several hours at 600 degrees F. the hardness thereof is increased to about 97 R. B. This hardening is, to a large extent at least, a strain hardening pro-

duced by the tendency toward precipitation of the silver from the silver molybdide of which the contact is composed.

The fact that the material produced in accordance with my invention is a new and different constitution of matter has been demonstrated by a comparison of a micro-photograph of such material with a similar micro-photograph of a sintered contact material made in the usual way from substantially the same percentage content of the ingredients silver and molybdenum (namely, by mixing silver powder with molybdenum powder, and pressing and sintering the mixture).

The following is a partial list of the various silver salts of molybdenum and tungsten acids—the water of crystallization being omitted from the formulae—and the final column showing the respective molybdides and tungstides:

	Silver molybdides
Silver molybdate, Ag_2MoO_4	Ag_2Mo
Silver dimolybdate, $Ag_2Mo_2O_7$	Ag_2Mo_2
Silver trimolybdate, $Ag_2Mo_3O_{10}$	Ag_2Mo_3
Silver tetramolybdate, $Ag_2Mo_4O_{13}$	Ag_2Mo_4
Silver octamolybdate, $Ag_2Mo_8O_{25}$	Ag_2Mo_8
Silver paramolybdate, $Ag_6Mo_7O_{24}$	Ag_6Mo_7
Silver tungstate, Ag_2WO_4	Ag_2W
Silver ditungstate, $Ag_2W_2O_7$	Ag_2W_2
Silver tritungstate, $Ag_2W_3O_{10}$	Ag_2W_3
Silver tetratungstate, $Ag_2W_4O_{13}$	Ag_2W_4
Silver paratungstate, $Ag_{10}W_{12}O_{41}$	$Ag_{10}W_{12}$

The compounds of silver and molybdenum, silver and tungsten, and silver and cobalt produced in accordance with my invention are especially adapted for the production of electrical contacts or contact tips, inasmuch as the inherently fine and substantially perfect (molecular) distribution of the refractory metal lattice, molybdenum, tungsten or cobalt) enables its most efficient use; so that for a given hardness and arc resisting capactiy a greater percentage of silver can be used than has heretofore been possible, with a consequent decrease in the contact resistance. Also, the aforementioned precipitation hardening which produces a strain in the silver enhances the conductivity of the latter.

After producing any one of the powders (molybdides, tungstides or chromides) in the manner herein disclosed I may add thereto and intimately mix therewith a powder of the particular soft metal constituent thereof (such as silver, copper, nickel, cobalt, iron or manganese) to increase the percentage quantity of such softer metal in the final molded article. It is, of course, preferable to employ a powder obtained by the aforedescribed reducing operation which approximates as closely as possible the desired percentages of the metallic ingredients in the final pressure molded and heat treated article.

I claim:

1. As an article of manufacture, a powder adapted for molding under pressure into suitable form for use as an electrical contact, said powder consisting of a homogeneous composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice is insured in the molded contact, said powder having a composition which is the equivalent of silver molybdide of the formula Ag_6Mo_7.

2. As an article of manufacture, a powder adapted for molding under pressure into suitable form for use as an electrical contact, said powder consisting of a homogeneous composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice is insured in the molded contact, said powder having a composition which is the equivalent of silver molybdide of the formula Ag_6Mo_7, said powder having a silver content of 49.2 per cent by weight.

3. As an article of manufacture, a pressure molded electrical contact consisting of a homogeneous powder composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice in the contact is insured, said powder composition being the equivalent of silver molybdide of the formula Ag_6Mo_7.

4. As an article of manufacture, a pressure molded electrical contact consisting of a homogeneous powder composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice in the contact is insured, said powder composition being the equivalent of silver molybdide of the formula Ag_6Mo_7, and the silver content of said contact being 49.2 per cent by weight.

5. As an article of manufacture, a pressure molded electrical contact consisting of a homogeneous powder composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice in the contact is insured, said powder composition being the equivalent of silver molybdide of the formula Ag_6Mo_7, the silver content of said contact being 49.2 per cent by weight, and said contact when annealed at a temperature of 1200 degrees F. having a hardness of about 75 Rockwell B.

6. As an article of manufacture, a pressure molded electrical contact consisting of a homogeneous powder composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice in the contact is insured, said powder composition being the equivalent of silver molybdide of the formula Ag_6Mo_7, the silver content of said contact being 49.2 per cent by weight, said contact when annealed at a temperature of 1200 degrees F. having a hardness of about 75 Rockwell B., and said contact when aged for several hours at 600 degrees F. having a hardness of about 97 Rockwell B.

7. As an article of manufacture, a pressure molded electrical contact consisting of a homogeneous powder composition of silver and molybdenum wherein the finest particles thereof contain the same proportions of silver and molybdenum as the coarsest, whereby an inherently fine and substantially perfect distribution of the molybdenum lattice in the contact is insured, so that for a given hardness and arc resisting capacity an extremely high percentage of silver may be utilized.

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