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REFRACTORY METAL COMPOSITION

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This invention relates to electric contacts.

An object of the invention is to improve the characteristics of electric contact elements containing silver.

5 Another object of the invention is to provide an improved silver base contact material consisting of silver plus more refractory constituents.

10 A still further object is to provide a new and improved contact material which can be used under severe electrical conditions without welding.

15 It is the further object of the invention to provide contacts capable of operating on high frequency at heavy current values without objectionable contact metal transfer.

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

20 The present invention comprises a 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 claims.

25 While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure, and the combination of elements without departing from the spirit of the invention.

30 The present invention comprises an improvement in silver refractory metal contact elements and especially in contact elements formed of at least 60% silver.

35 In a number of contact applications silver is mixed with refractory metal taken from the group of tungsten and molybdenum. These materials are usually prepared by mixing the powders together, pressing, and hot or cold working same into suitable forms from which contacts can be prepared.

40 It has been found that binary combinations of silver with members of the tungsten-molybdenum group especially when prepared by treating at temperatures below the melting point of silver have a definite tendency toward a preponderance of metal transfer from the anode to the cathode.

45 We have found that the addition of a third element having the alloying characteristics of nickel in preparing the compositions of silver-tungsten or silver-molybdenum or silver-tungsten-molybdenum decreases noticeably this transfer tendency.

Elements such as tin, zinc, cadmium, and cop-

per form alloys with silver but not with the refractory constituents, such as tungsten and/or molybdenum. Metals such as cobalt and iron form alloys with the molybdenum and tungsten, but not with the silver. For this reason, they do not perform the same function as nickel. While nickel is essential, the other metals mentioned may be present as dilution elements.

It has been found that it is possible to incorporate further additional elements such as iron, cobalt, manganese, silicon which also improve the alloys and reduce the transfer tendency.

It is possible to produce a much stronger combination with nickel because the nickel constituent will form an alloy with both silver and refractory metals, cementing not only the silver particles but the refractory particles as well to a greater degree than is possible in the binary combinations.

The contacts covered by the present application may be composed of the ingredients in approximately the following proportion.

	Per cent
Nickel.....	10 to 40
Tungsten and/or molybdenum.....	1 to 40
Balance.....	Predominantly silver

It has been found that material falling within the following range gives the most marked improvement over the materials of prior art.

	Per cent
Nickel.....	10 to 25
Tungsten.....	1 to 25
Molybdenum.....	1 to 25
Balance.....	Predominantly silver

As specific example of our new and preferred compositions, we list the following, all of which have been found satisfactory for certain uses:

- A—10% nickel, 5% tungsten; balance, predominantly silver.
- B—10% nickel, 20% tungsten; balance, predominantly silver.
- C—15% nickel, 15% molybdenum; balance, predominantly silver.
- D—10% nickel, 10% molybdenum, 10% tungsten; balance, predominantly silver.
- E—30% nickel, 10% tungsten; balance, predominantly silver.
- F—20% nickel, 20% molybdenum; balance, predominantly silver.

The compositions can be made as previously described by mixing the powders of tungsten, molybdenum, nickel and silver together in the

proper proportions, pressing the mixture into a slug or suitable shape under high hydraulic pressure, hot working the resulting slug to bring about a further compacting of the mixture and partial alloying of the nickel with both the silver and the refractory metal and also to produce the desired shapes from which contacts can be prepared. The resulting shapes may sometimes correspond to the contact shape desired, or may be in the form of a rod from which contacts may be cut, or a sheet from which they may be punched.

According to another method of preparation the nickel and refractory metal are first mixed and pressed together without silver or with less than the desired ultimate percentage of silver. The resulting slug may then be heated in contact with silver shot to above the melting point of the silver whereby the molten silver will penetrate into the slug and fill up the voids therein and alloy with the nickel, the nickel also alloying with the surface of the refractory metal particles. This may be followed if desired by hot or cold working and repressing and reheating or some of these steps if desired.

Also pressed refractory metal powders or refractory metal and nickel mixed powders may in some cases be impregnated with a silver nickel alloy.

It will be evident that, since the nickel alloys with both the refractory metal and the silver that a complete bonding between the low melting and high melting ingredients is obtained. Ordinarily, however, complete alloying will not take place and hence the product is still heterogeneous in nature although completely bonded together as described, due to surface alloying of the particles.

The nickel, in the proportions described, also is essential to produce a hard material. Where nickel is used in substantial proportions, above 4 or 5%, it exceeds the limit of solid solubility in the silver and acts as a precipitation hardening ingredient therein, thereby greatly hardening and strengthening the contacts.

On applications for standard relay equipment operating on a direct current at relatively high frequency it has been found that the use of alloys of the type covered by the present com-

binations will increase the critical current value or value of failures between 30 and 50% over other commercial silver refractory combinations at present available.

The combination of the present application does not transfer as readily giving transfer values of .015" in comparison to .062" on equivalent tests.

While the present invention, as to its objects and advantages, 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 claims.

What is claimed is:

1. An electric contact formed of a metal composition of 10 to 40% nickel, 1 to 40% of metal selected from the group consisting of tungsten and molybdenum, and the balance substantially all silver.

2. An electric contact formed of a metal composition of nickel, refractory metal selected from the group consisting of tungsten and molybdenum and the balance predominantly silver, said refractory metal being present in the form of fine particles interspersed with an alloy comprising said silver and nickel, said nickel also forming a surface alloy with the refractory metal particles and being present in said silver alloy in proportions exceeding the solid solubility limit of nickel in silver and not exceeding 40% of said composition, whereby a part of said nickel exists in said alloy as a dispersed phase.

3. An electric contact formed of a mass of refractory metal powders selected from the group consisting of tungsten and molybdenum bonded with a silver alloy containing nickel as an essential ingredient therein, said refractory metal constituting 1 to 40% of the total composition, said nickel constituting 10 to 40% thereof and the balance being substantially all silver, said nickel being alloyed with the surface of said tungsten particles and being present in said silver alloy in part as a solid solution and in part as a disperse phase.

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