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INTERNALLY OXIDIZED ELECTRICAL CONTACT 5

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This invention relates to an internally oxidized electrical contact generally most suitable for repetitive make-and-break type applications. More particularly, it concerns an internally oxidized silver-cadmium-zinc alloy which provides advantages not heretofore attainable. Internal oxidation is a term well known to the art, and, in this instance, refers to the selective oxidation of elements which alloy with silver, which oxidation penetrates progressively inwardly into the alloy at a rate depending on temperature, time, oxygen concentration, and alloy composition. The oxygen is absorbed within the alloy and a uniform dispersion of the oxide of the solute element is formed therein.

Electrical contacts suitable for repetitive make-and-break type applications must have, in addition to good conductivity, the properties of not welding or sticking upon repeated opening and closing of the circuit. Moreover, they must have a high resistance to wear and loss of material per operation must be low.

These results are not attainable with pure silver because of its softness, relatively low melting point and its tendency to weld or stick when interrupting overloads. To overcome this difficulty, many attempts have been made to alloy silver with various other metals which are harder, stronger, and of higher melting point. It has also been proposed to mix other material with the silver by means of powder metallurgy techniques so that a mixture rather than an alloy is obtained. One material which has been added to silver contacts is cadmium oxide, which has been incorporated in the contact by powder metallurgy methods or by the internal oxidation of a silver-cadmium alloy. Such contacts, although they have been considered an advance over previous developments, are still found to be subject to the dangers of welding, sticking and excessive arcing under more severe operating conditions.

The present invention overcomes these difficulties by providing a contact in which the contacting surface comprises a mixture of silver, cadmium oxide and zinc oxide while the interior of the contact is a silver, cadmium, zinc alloy.

Accordingly, it is a primary object of this invention to provide an internally oxidized electrical contact material which is particularly suitable for repetitive make-and-break operations and which has outstanding qualities of wear resistance and resistance to sticking, fusing or welding.

This and other objects will become more apparent from the description which follows:

Essentially, this invention involves a novel electrical contact which is obtained through the internal oxidation of a silver-cadmium-zinc alloy. While it has been known to internally oxidize silver-cadmium alloys, it has been unexpectedly found that the three-component alloy provides results heretofore unattainable in silver-cadmium contacts.

Generally, the alloy composition will comprise by weight 80 to 95% silver, 5 to 15% cadmium and an

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amount of zinc up to about 50% of the cadmium present. The alloy of this composition is then internally oxidized in air or any other suitable oxidizing atmosphere at elevated temperature, the time and temperature being dependent on the desired depth of oxidation, as hereinafter set forth.

Actually, the depth of oxidation need only be superficial, i. e., of the order of .001 inch up to .005 inch, when it is desirable to maintain in the contact a greater proportion of the relatively strong unoxidized alloy, provide for more economy in the oxidation process, and at the same time diminish the tendency of the contact to weld or stick.

Although the zinc in the alloy does not oxidize to zinc oxide as rapidly as the cadmium converts to cadmium oxide, it has been found that the addition of zinc in our composition greatly improves the properties of the contact material which will allow it to open and close repeatedly on relatively high currents without welding or sticking, assist in quenching any arc which may exist on opening the circuit, and keeping the loss of material per operation to a minimum.

The present material containing an internally oxidized silver-cadmium-zinc alloy was compared with both internally oxidized silver-cadmium materials and a pressed and sintered silver-cadmium oxide contact by identical tests carried out in a 400 ampere, 7.5 volt, 3-pole D-C. contactor.

The table below shows the number of operations obtained on each of these materials. Although the oxidized silver-cadmium-zinc alloy was worn, it appeared that even at the end of the test runs there was some life left in these contacts. In the tests the load was shifted from pole to pole so that the contacts were subjected to electrical load only once for each three operations of the device.

	Load operations	Mechanical operations	Total operations
Contact formed from Pressed and Sintered Silver-Cadmium Oxide Particles.....	267,000	534,000	801,000
Partially Internally Oxidized Silver-Cadmium Contact.....	312,000	624,000	936,000
Partially Internally Oxidized Silver-Cadmium-Zinc Contact..	456,000	912,000	1,368,000

The data above clearly indicate the superiority of the present contact in its ability to withstand repeated make-and-break duty. Thus, the contact of the present invention shows less tendency for sticking, welding or arcing and in general is more suitable for operations of this type.

The particular contact material used in the above tests contain 91 percent silver, 7 percent cadmium and 2 percent zinc prior to oxidation. After oxidation to a depth of .024-.025 inch, the internally oxidized portion would contain about 90 percent silver, 7.5 percent cadmium oxide and 2.5 percent zinc oxide.

The contacts of the present invention may be produced in any suitable furnace supplied with an oxidizing atmosphere which may comprise either pure oxygen, air, or oxygen enriched air. The furnace temperature will generally be between 1400° F. and 1600° F. and the time of oxidation between one and sixty hours. Of course, the temperature-time relationship will vary depending upon the particular depth of oxidation desired.

For example, in one instance a temperature of 1600° F. for approximately one hour oxidized a contact of 3/4" diameter and 3/32" thick to a depth of .005". Other tem-

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perature-time data on the present internally oxidized contacts are as follows:

Oxidation Temp.	Time, hours	Air Flow, ft. ³ /hr.	Depth of Internal Oxidation
1,575° F.	22.5	75	.015
1,575° F.	46.5	75	.023

The internal oxidation may be superficial, as noted above, or complete. Ordinarily, however, it is preferred to limit the depth of oxidation to about .030 inch in order to minimize processing costs and retain a body of relatively strong unoxidized alloy in the contact structure.

Although we have described a preferred embodiment of our invention, it will now be obvious that many modifications and variations may be made by those skilled in the art, and we, therefore, prefer to be limited not by the description herein, but only by the appended claims.

We claim:

1. An electrical contact comprising an alloy of 85-95% silver, 5-15% cadmium, and zinc present in an amount up to about 50% of the cadmium present, the contact surface thereof containing a mixture of precipitated cadmium oxide and zinc oxide.

2. An electrical contact comprising an alloy of 85-95% silver, 5-15% cadmium, and zinc present in an amount up to about 50% of the cadmium present, the contact surface thereof being superficially oxidized to contain a mixture of precipitated cadmium oxide and zinc oxide to a depth of about .005 inch.

3. An electrical contact suitable for repetitive make-and-break type applications consisting of an alloy of about 91% silver, 7% cadmium, and 2% zinc, in which

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the cadmium and zinc are internally oxidized to a depth of about .024-.025 inch.

4. The method of treating an electrical contact comprising an alloy of silver, cadmium, and zinc and containing 85 to 95% silver, 5 to 15% cadmium and zinc present in an amount up to about 50% of the cadmium present to improve the wear and arc resistance properties of the contact-making face of the contact, which comprises heating the contact in an oxidizing atmosphere at a temperature of from 1500° F. to 1800° F. for from one to sixty hours so as to oxidize the cadmium and zinc content of the alloy inwardly to a depth of up to about .030 inch.

5. The method of treating an electrical contact comprising an alloy of silver, cadmium and zinc, and containing 85 to 95% silver, 5 to 15% cadmium, and zinc present in an amount up to about 50% of the cadmium present, which comprises heating the contact in an oxidizing atmosphere at elevated temperature so as to partially internally oxidize the said contact.

6. An electrical contact suitable for repetitive make-and-break type applications consisting essentially of 85 to 95% silver, 5 to 15% cadmium, and zinc present in an amount up to about 50% of the cadmium present, the contacting face thereof being internally oxidized to a depth not exceeding .030 inch thereby forming within said oxidized portion, uniformly dispersed particles of cadmium and zinc oxide.

References Cited in the file of this patent

UNITED STATES PATENTS

2,654,945	Richardson et al.	Oct. 13, 1953
2,673,167	Vines	Mar. 23, 1954