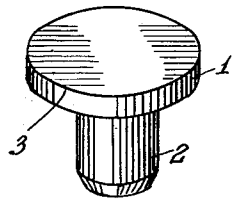
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ELECTRICAL CONTACT ELEMENTS

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ELECTRICAL CONTACT ELEMENTS

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This invention relates to electrical contact elements suitable for use in the making and breaking of electric current and is concerned in particular with the improvement of electrical contacts of silver.

Electrical contacts of fine silver have excellent current carrying capacity and excellent heat conductivity. Such electrical contacts of fine silver when used in air or other atmosphere containing oxygen are subject to the disadvantage that they tend to stick together, particularly when heavy electric currents are employed, so that in many cases such contacts have a relatively short life, especially under severe operating conditions, e. g. in cases of high inrush currents or heavy overload.

Various proposals have been made to improve silver contacts by alloying with the silver other metals or metal compounds.

Silver alloys including base metals, although they may tend to increase the life of the contacts, are disadvantageous under certain conditions in that they tend to increase the resistance of the contacts and otherwise deleteriously affect the properties of silver.

Silver contacts with inclusions of base metal oxides have a higher resistance than fine silver and cannot conveniently be formed into the numerous types and shapes of electrical contacts. In many cases it is difficult to maintain a uniform composition, any variation of which would impair the reliability of performance.

It is known that contacts of fine silver develop arcing and sparking which vaporizes the silver on the face of the contacts and the contacts are, therefore, subject to erosion. However, when the evaporation of the silver takes place in an oxygen containing atmosphere, some oxidization of the vapor takes place which at least to some extent tends to quench the arc developed, but not sufficiently to prevent erosion of the contact face. Consequently, since the vaporization of the contact metal in an oxygen containing atmosphere possesses arc quenching properties, it was found that an application of mercury to the silver face increased the arc quenching potential of the contacts because the silver amalgam formed by the application of such mercury to the silver vaporized more readily and produced mercury oxide vapor which considerably increased the arc quenching properties while substantially inhibiting deterioration of the silver face. However, even such contacts having a silver amalgam face or layer or when totally amalgamated are not sufficient under all conditions including performance under relatively high temperature and low temperature conditions with high and low currents to provide for extremely low sticking characteristics.

It is one object of this invention to provide an electrical contact which shall have the high thermal and electrical conductivity and other desirable properties associated with silver contacts, but which shall have a lower tendency to stick than encountered in the case of silver contacts. It is a further object of this invention to provide such electrical contacts which shall be capable of being employed with high and low currents and which

shall have a long useful life even under severe operating conditions. Other advantages and results will be brought out in the description hereinafter following and the drawing forming a part hereof illustrating a perspective view of one type of contact herein contemplated.

In accordance with the invention, the electrical contact, or at least one contact in a pair of cooperating contacts, designed to operate especially in an oxidizing atmosphere, comprises a body portion 1 of silver or copper or alloys thereof, e. g. silver-copper, silver-tin, silver-palladium, silver-cadmium, etc., bonded to a shank or backing 2 and provided with an amalgam contact surface 3 comprising essentially an amalgam taken from the group consisting of silver and copper amalgams having incorporated therein from 0.1% to 5% of a third metal which upon vaporization forms an oxide more stable than mercury oxide. For example, we have found that the addition of such third metal to a silver amalgam provides in addition to the mercury vapor and mercury oxide vapor, developed in the operation of the contacts, a more stable oxide less easily reduced to metal than mercury oxide and which noticeably improves the non-sticking properties of the contacts.

Conventional contact testing apparatus was employed for comparison purposes and it was found that a pair of fine silver rivet contacts, ¼" diameter, operating 40,000 times at 30¼ amperes, 115 volt A. C. resistance load, gave 210 sticks, and the same contact provided with a silver amalgam contact surface gave 80 sticks. However, under identical conditions a silver contact having a silver amalgam face containing 1.045% cadmium gave 16 sticks in 40,000 operations, a silver amalgam face containing 0.8% tin gave 6 sticks, and a silver amalgam face containing 0.5% palladium gave 2 sticks.

We have found that the addition of such third metal to the silver amalgam made it possible to provide a contact which had a low voltage drop as opposed to the conventional silver-base metal oxide contacts with the oxide dispersed therethrough, but which was nevertheless operable under conditions where heretofore such oxide dispersal contacts have been used. The tests have shown that the millivolt drop at the end of the test passing 10 amps. was 4–6 mv., the same as for fine silver.

The amalgam of the present invention penetrates the surface of the silver contact to which it is applied until it is absorbed to the extent of forming a hard saturated silver alloy face which is quite stable and may be stored for any length of time without losing any of its characteristic properties. Such contacts can be soldered, welded or otherwise bonded to a base and, by such operations a little mercury may be lost by evaporation, there is always sufficient remaining to function without impairing the improved contact performance.

The electrical contacts according to the invention possess high current carrying capacity, excellent heat conductivity, and excellent resistance to oxidation. Such contacts have low surface resistance and the tendency to stick is extremely small. Metal loss and transfer is kept within very small limits and the life of such contacts is greatly in excess of that of silver contacts as heretofore known. A small quantity of the mercury contained in the amalgam tends to vaporize during the operation of the contacts, and in the presence of the electric arc, with the result that a cloud of mercury vapor covering the contact surface forms with the oxygen of the oxidizing atmosphere mercury oxide and an oxide of the third metal which, being electrically non-conductive, assists in quick extinction of the electric arc, thus avoiding deterioration of the contact surface. The immediate extinction of the arc is a prime factor in eliminating sticking and preserving the life of the contact.

The contacts according to the invention are useful even

where heavy electric currents, such as currents in excess of 15 volts and 15 amp., are employed. The voltage drop between the electrical contacts is low so that little heat is developed at the point of contact.

The beneficial effect of the presence of the mercury and the third metal oxide in the amalgam is persistent. The expectation would be that the mercury in the amalgam contact surface being adapted and designed to vaporize, would either evaporate or diffuse completely. It was found, however, that the vaporized mercury together with the oxide of the third metal redeposits on the surface of the contact on extinction of the arc, thus recombining with the silver and the third metal to form amalgam containing the third metal oxide and continuing its effective function.

What we claim is:

1. An electrical contact element comprising predominantly a body portion of a metal taken from the group consisting of silver and copper, and a layer of amalgam on a face thereof, said amalgam consisting of at least one of said metals together with from 0.1% to 5% of another metal the oxide of which is more stable than the oxide of mercury.

2. An electrical contact element according to claim 1, wherein said other metal is cadmium.

3. An electrical contact element according to claim 1, wherein said other metal is tin.

4. An electrical contact element according to claim 1, wherein said other metal is palladium.

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