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INTERNALLY OXIDIZED RIVET CONTACT

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FIG. 1.

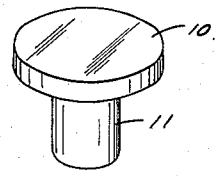
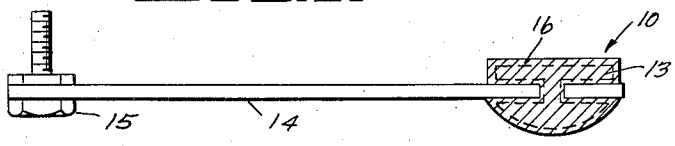


FIG. 2.



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INTERNALLY OXIDIZED RIVET CONTACT

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5 Claims. (Cl. 200—166)

This invention relates to internally oxidized electrical contacts generally most suitable for repetitive make-and-break type applications, and more particularly, to rivet-type contacts composed of internally oxidized silver-cadmium alloys.

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 wear resistance, 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 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.

The internal oxidation method has been found to produce contacts of greater ultimate strength, density, ductility and resistance to electrical erosion than those made by powder metallurgy techniques. However, certain contacts, particularly those of the rivet type, which are to be attached to the contact supporting means by mechanical impact, and which have a substantial depth of internal oxidation, are not sufficiently strong to withstand such impact.

Thus, oxidation of such contacts to depths heretofore considered desirable has rendered the shank of the rivet brittle so as to prevent good heading. When the shank is headed over onto the contact support with the completely or deeply oxidized shank, there is a very brittle broken appearance of such headed over portion which makes its support very casual and also subject to loosening under the repeated mechanical impacts of repetitive operations. Therefore, the process of internally oxidizing rivets to the extent heretofore practiced makes a very poor mechanical joint.

It has been found that such depth of penetration of oxide is both unnecessary and deleterious and that contacts comprising silver and internally oxidized cadmium oxide alone, or in combination with zinc, tin or magnesium oxides, show unexpected advantageous properties when the internal oxidation is limited so that the surface of the contact in effect receives only a superficial oxidation. Rivet contacts of this type have been found to possess unexpected strength, are economical to manufacture and have other advantages hereinafter referred to.

Accordingly, it is an object of the present invention to provide a contact of the silver-cadmium type which is internally oxidized to a limited depth thereby affording such contact properties superior to the products of the prior art in which the internal oxidation of the contact is either complete or carried out to a substantial depth.

Another object of the present invention is to provide an economical method for the production of internally oxidized contacts made from silver-cadmium alloys, silver-cadmium-zinc alloys, silver-cadmium-tin alloys or silver-cadmium-magnesium alloys.

Still another object is to provide a rivet-type contact of the silver-cadmium type which is superficially internally oxidized and has an impact resistance sufficiently high to allow for ready attachment to a supporting member by mechanical impact means.

These and other objects of the present invention will become more apparent when taken in connection with the following description and drawings, in which:

Figure 1 is a perspective view of a rivet-type contact herein referred to.

Figure 2 represents a sectional view showing how the rivet contact may appear when attached to a supporting arm.

Essentially, the present invention involves a contact and, specifically, a rivet-type contact comprising silver and cadmium oxide in which the oxide particles are formed by the superficial internal oxidation of a silver-cadmium alloy. Such internal oxidation is limited to a depth of .005 inch. In one embodiment the alloy from which the contacts are produced may have incorporated therein minor amounts of zinc or magnesium.

The alloy from which the contacts are formed is heated in air or in an oxidizing atmosphere at temperatures between about 600° F. and below the melting point of the alloy. Oxygen is absorbed into the alloy and combines with the cadmium to form cadmium oxide, but will not combine with the silver. Thus, the surface of the contact contains a mixture of silver and finely divided cadmium oxide particles. When zinc is added to the composition, it is usually present in the alloy in an amount up to about fifty percent of the cadmium present. The advantages of adding zinc to such contacts are more particularly set forth in copending application Serial No. 579,462, filed April 20, 1956, which is owned by applicant's assignee.

When magnesium is added to increase the hardness of the alloy, it is included in amounts of from 0.1 to 1 percent. Tin may also be added to the alloy in these amounts.

Generally, the alloy composition will comprise by weight, 80 to 95 percent silver, 5 to 15 percent cadmium and if the zinc, tin or magnesium are present, they are in the alloy in the amounts hereinabove referred to and the percentage of cadmium is correspondingly decreased. The alloy is then internally oxidized in air or other oxidizing atmospheres so that there is at least a superficial oxidation on the surface of the contact.

Referring now to the drawings and first to Figure 1, it is seen that the rivet contact which is herein referred to includes a head portion **10** and shank portion **11**. After the shank is placed through an opening in a copper spring or other conductive contact support, it is peened over by means of a hammer or other special tool and the contact then has the appearance indicated in Figure 2.

From Figure 2, it is seen that the peened contact **13** has a flattened shape and is readily secured within an opening of the contact carrying arm **14**. The other end of this arm is attached to a suitable rigid or movable support **15**.

The dotted lines **16** give a perspective indication of the extent to which the contact may be internally oxidized. Actually, since the internal oxidation is only superficial and should not exceed .005 inch, a study of the cross-section of the contact would show only an extremely thin surface layer to have been oxidized.

It should be understood that only one example of the

rivet type contact is illustrated, and other embodiments are contemplated to be within the scope of the present invention. For instance, the shank of the rivet may have therein a hollow cylindrical opening into which a fitted peening tool may be placed. The mechanical impact from the peening operation then spreads the shank outwardly from this opening.

The superficial oxidation process which is carried out so that only superficial oxidation is obtained is accomplished by limiting the time and temperature of the oxidation process. Generally the time-temperature relationship will depend on the size of the contact, the type of furnace, and the amount of oxygen in the atmosphere.

To be more specific, however, it has been found that oxidation in air between 1500° F. and 1600° F. for about one-half to two hours produces contacts having the desired depth of oxidation.

An example of a specific contact material which has been particularly successful is one containing 91 percent silver, 7 percent cadmium and 2 percent zinc prior to oxidation. The alloy was formed into rivet shaped contact pieces having a head ¼ inch in diameter and 1/16 inch thick, and a shank 5/64 inch long having a diameter of 3/32 inch.

The pieces were exposed to a temperature of 1600° F. for one hour in a laboratory furnace. After being cooled, the oxidized contact was readily attached to a supporting arm by peening without any evidence of mechanical failure. Moreover, its current-interrupting ability on repetitive make-and-break operations was found to be equal to or better than that of more thoroughly oxidized contacts of the same composition.

The advantages inherent in internal oxidation of the zinc and cadmium to a limited depth are first and most important due to the fact that the alloy portion of the contact is considerably stronger than the silver-cadmium-zinc oxide portion. This additional strength is quite desirable in rivets of the type referred to above which are peened over for attachment to supporting springs. The rivet with a superficially oxidized layer can be suitably and firmly attached to its support because the bulk of the volume of material in the shank is the alloy which is well adapted to riveting procedures. At the same time, the superficially oxidized contact of the present invention has equal endurance, less erosion, and longer life than similar deeply oxidized contacts.

It might be expected that such superficial oxidation of the rivet would weld or stick after the first few operations when the cadmium oxide superficial layer has been worn away. Surprisingly, I have found that this oxidation progresses under arcing conditions so that, once having been superficially oxidized, the oxidation progresses through to the full depth of the rivet head. Thus on endurance tests the life of the contacts is even greater than is the case when the rivet is oxidized to a fuller

depth. The strong alloy center tends to prevent tearing away of large portions of the surface.

Moreover, the superficial oxidation, while leading to these advantages, results in a contact having less tendency for welding and sticking than a contact consisting of a pure silver-cadmium alloy. It has been found, for example, that a superficially oxidized silver-cadmium contact will have the ability to interrupt a much larger current than a silver-cadmium alloy contact. In addition to the above advantages, superficial oxidation also provides for a more economical, less time consuming method of making rivet contacts.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of this invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein, but only by the appended claims.

I claim:

1. A rivet-type electrical contact comprising an alloy of 85 to 95 percent silver, 5 to 15 percent cadmium, zinc present in an amount up to about 50 percent of the cadmium present; the contact surface thereof containing a mixture of precipitated cadmium oxide and zinc oxide to a depth not exceeding .005 inch.

2. The contact of claim 1 in which the contact alloy contains from 0.1 to 1 percent of a metal from the group consisting of magnesium and tin.

3. An electrical contact suitable for repetitive make-and-break type applications and secured by peening through an opening in a conductive, contact supporting arm consisting of an alloy of about 91 percent silver, 7 percent cadmium and 2 percent zinc in which the cadmium and zinc are internally oxidized to a depth not exceeding .005 inch.

4. A rivet-shaped electrical contact comprising an alloy of 85 to 95 percent silver, 5 to 15 percent cadmium, zinc present in an amount up to about 50 percent of the cadmium present; the contact surface thereof containing a mixture of precipitated cadmium oxide and zinc oxide to a depth not exceeding .005 inch.

5. A rivet-shaped electrical contact comprising an alloy of 85 to 95 percent silver, 5 to 15 percent cadmium, zinc present in an amount up to about 50 percent of the cadmium present; all of the exposed surfaces thereof containing a mixture of precipitated cadmium oxide and zinc oxide to a depth not exceeding .005 inch.

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