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Schreiner et al.

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[54] **BONDED MATERIAL FOR ELECTRICAL CONTACT PIECES**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 839,050, July 3, 1969, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **29/182.5;** 252/514; 252/519; 252/521

[51] **Int. Cl.²** **B22F 1/00;** H01B 1/02

[58] **Field of Search** 29/182.5, 182.2; 75/206; 752/514, 519, 520, 521

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[57] **ABSTRACT**

Bonded or compound material for electrical contact pieces, consisting of silver as an original metal with up to 20% by weight of at least one finely divided metal oxide, such as CdO, SnO_2, ZnO, MgO and/or NiO, and up to 15% by weight of finely divided lead.

1 Claim, 3 Drawing Figures

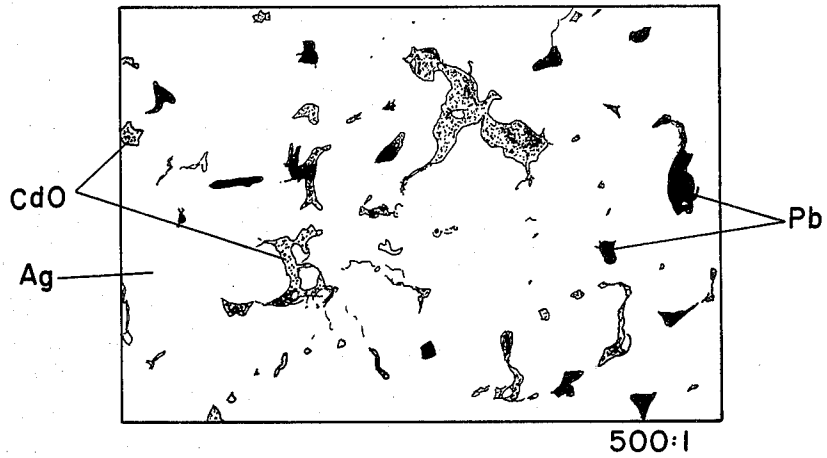


FIG.1

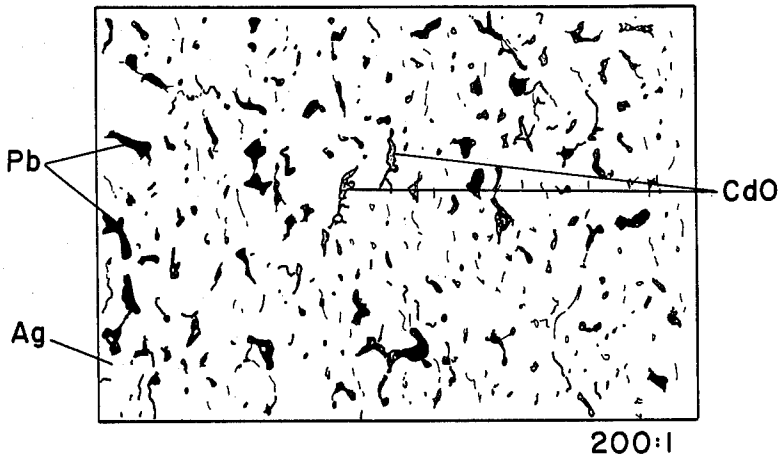


FIG.2

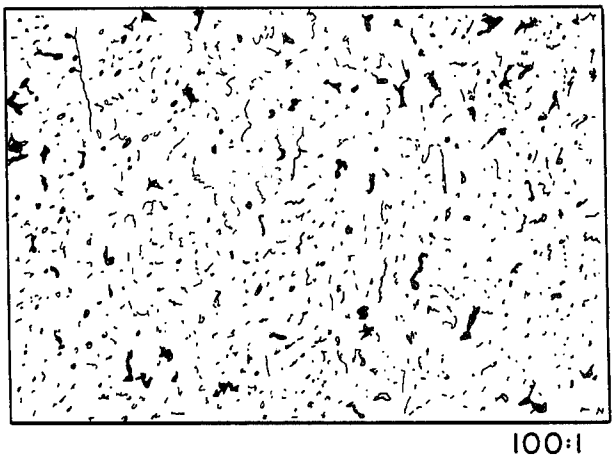


FIG.3

BONDED MATERIAL FOR ELECTRICAL CONTACT PIECES

This is a continuation-in-part application of application Ser. No. **839,050,** filed July **3, 1969** now abandoned.

AgNi **10** and AgCdO **10** are frequently used as bonded or compound material for electrical contact pieces. These contact pieces cannot completely prevent the welding of the contact pieces, particularly in short-circuit switching conditions, during the switching-on and switching-off of short circuits. In the case of automatic switches or power-protection switches, this fact can lead to disturbances of the operation or to failure of the apparatus.

Even the known sinter materials used for electrical contact pieces which are comprised of silver with **0.5** to **20%** lead content, wherein the lead is finely distributed in the silver sinter and is essentially embedded in an undissolved condition, do not yield sufficiently satisfactory results during the operation of air-controlled AC automatic devices or automatic switches.

To reduce the welding tendency, sintered materials were suggested whose original or base material of silver contained metal oxide and graphite particles which had been very uniformly installed. Although this material helped to reduce the welding property, it increased the burn-off.

The object of the present invention is to provide a compound or bonded material, which is particularly suitable for electrical contact pieces and which does not entail the aforementioned disadvantages. The bonded material, according to the invention, is comprised of silver as the original metal, into which from **0.5** to **20%** by weight of at least one finely divided metal oxide and from **3** to **15%** by weight of finely divided lead, preferably between **3** and **10%** by weight, are uniformly embedded. Electrical contact pieces comprised of bonded material of the present invention comply with all switching requirements for the most minute automatic switches, without welding of the contact pieces. In addition to the small welding property associated with switches during short circuits, particular mention should be made with regard to the small contact burn-off under rated current, and the relatively low contact resistance as well as the slight contact heating, caused thereby.

Particularly suitable metal oxides are, for example, CdO, SnO_2, ZnO, MgO or NiO. One or several of the metal oxides can be embedded, in fine distribution, along with the lead, in the original silver metal. Especially favorable were found to be electrical contact pieces comprised of combinations AgCdO **10** Pb **5;** Ag-SnO_2 **6** Pb **5;** AgMgO **1** NiO **1** Pb **10,** whereby the numbers relate to % by weight. The numbers used with other materials in the specification have the same meaning. Of the metal oxide component of the bonded material of the invention, the preferred range for CdO, SnO_2 and ZnO is **5%** to **15%** by weight, and for MgO and NiO is **0.05%** to **2%** by weight.

The indicated advantages appear to be obtainable through the special structural build-up, in a composition according to the invention. This can be obtained for example by mixing fine-grained electrolysis-silver powder or precipitated silver powder with a finely divided metal oxide and a lead powder $< 60\ \mu m$. Following an intensive blending, this is condensed by pressing into a contact-stable pressed body.

However, the AgMeO powder, wherein Me represents a metal such as Cd, Mg, etc., can also be produced as a bonded powder, through precipitation mixing. The bonded powder is virtually blended with a lead powder $< 60\ \mu m$ and the powder mixture is condensed, by pressing, into a compressed body with stable edges. The precipitation mixture, e.g., of AgCdO bonded powder, can be obtained from an aqueous solution of the nitrates, with NaOH, by precipitating the hydroxides with NaOH and thereafter thermally dissociating the hydroxides in an oxidizing atmosphere.

Finally the silver-metal oxide bonded powder (e.g., AgCdO **10** powder) can be produced through a mechanical break-up of the melt of AgMe (e.g., AgCd **9** alloy), which can result from blowing apart or from a mechanical reduction of falling molten stream (centrifugal powder or pressure atomizer powder). Following the interior oxidation of the AgMe powder into AgMeO (e.g., AgCdO **10**), the bonded powder is mixed with lead powder $< 60\ \mu m$ and the mixture is condensed, by pressing, into a compressed body with stable edges.

The rest of the method is the same in all cases. The compressed body is sintered in a neutral atmosphere (nitrogen or argon) and is stabilized thereby. The sintered, formed contact body can be calibrated by subsequent cold pressing and be further compressed thereby.

In an example of the bonded or compound material of the invention, AgCdOPb was formed from a starting material consisting of a powder mixture of AgCdO **10%** by weight and Pb **5%** by weight. The powder mixture was compressed at a pressure of **6** tons/cm^2. A pressure density of **9.3** to **9.7** g/cm^3 and a degree of volumetric filling that was **0.907** to **0.946** resulted therefrom. Subsequently, the compressed mixture was sintered at a temperature of **650**°C in a nitrogen atmosphere for a period of **30** minutes. The resulting density was **8.5** to **8.9** g/cm^3, corresponding to a degree of volumetric filling of **0.830** to **0.868.** The sintered body had from **15** to **17%** pores. In a subsequent compression at **6.8** t/cm^2, the sintered body attained a theoretical density of **10.25** g/cm^3.

The invention, together with additional objects and advantages thereof, will be more clearly understood from the following description of the bonded material when read in connection with the accompanying drawing, wherein:

FIGS. **1, 2** and **3** are micrographs of the structure of the bonded or compound material AgCdOPb respectively at magnifications of **500 : 1, 200 : 1** and **100 : 1.**

Referring now to the Figures of the drawing, there is shown therein metallographically an example of the bonded or compound material of the invention. In the view of largest magnification of FIG. **1,** the silver matrix of the material AgCdOPb appears white, while the discrete lead inclusions are shown as finely divided black particles, and the metal oxide, CdO, is gray as well as linear in appearance. From FIGS. **2** and **3** of lesser magnification it is plainly apparent that the lead and the CdO are substantially uniformly distributed over the entire cross section containing the matrix of Ag.

A particular advantage of the contact pieces according to the present invention is in the coating of the conventional carrier metals. While, for example, contact pieces comprised of AgCdO **10** must be plated, because of their poor wettability, with a layer of a good

solderable metal, the AgCdO Pb (AgMeO Pb) appears to have, even as a one-layer contact piece, during its hard soldering upon a conventional carrier metal, such as copper, brass, bronze, CuBe, etc., an impeccable wetting through the hard solder and, therefore, excellent soldering characteristics. The good wettability during hard soldering, which can be effected for example at **615**°C, is ensured by the uniformly distributed lead. The hard soldering can also be effected, e.g., with silfos solder (a phosphorus-containing silver hard solder). Contact pieces, which are in a sintered state, are also suitable for hard soldering upon the carrier metal. The final condensation into the virtually pore-free contact pieces results during the soldering process, on a welding machine, whereby heating is effected by two metallic electrodes, with a direct current passage, by means of contact pressure across the electrodes or, immediately following the hard soldering, by a subsequent cold pressing process.

We claim:

1. Bonded material, particularly for electrical contact pieces, consisting of silver, from **0.5** to **20%** by weight of one finely distributed metal oxide selected from CdO, SnO_2, ZnO, MgO and NiO and mixtures thereof, and from **3** to **15%** by weight of finely divided lead uniformly embedded in said silver.

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