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MATERIAL FOR ELECTRIC CONTACTS

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The present invention relates to a method for production of a material of pure rhenium for electric contacts and contacts produced of said material.

Electric contacts of pure rhenium and alloys of rhenium and other metals with high fusing point, for example ruthenium or platinum, have very good properties and can be used with current intensities up to about 10 amp. without appreciable tip formation and matter transfer, and with unnoticeably small coherer voltage. Such results have been obtained with tests comprising 100 millions breaks. A contributory cause to said good results with contact material comprising rhenium may be attributed to the fact, that the low rhenium oxides are good conductors and that the high oxides, which are not so good conductors, have a relatively high vapor pressure whereby the high oxides are caused to disappear by evaporation.

Rhenium would thus be an excellent substitute for wolfram in the tungsten contacts used until now, which after a long use are deteriorated owing to tungsten oxide, which is formed on the contact surfaces, being a bad electric conductor. What has until now made the use of rhenium impossible has been the high price of said metal (which is about the same as the price of platinum). By suitable procedures the present invention intends to make the use of rhenium in electric contacts possible.

It has been proposed to produce contacts by pressing the metal powder to bodies of the desired shape and thereafter sintering the bodies in vacuum or in reducing or indifferent gas at temperatures lying slightly below the fusion temperature.

These methods have however not made it possible to reduce the price, so that the contacts could be more usual in the practical use.

By pressing and sintering according to the invention, however, a metal is obtained having such great porosity and thereby so low specific weight, that the price per unit of volume becomes sufficiently low, the mechanical resistance for use as contacts thereby not becoming too low.

According to the invention the rhenium powder is reduced in a hydrogen atmosphere, pressed at a pressure lying between 6000 and 9000 kg./cm.^{2}, suitably about 8000 kg./cm.^{2} and thereafter sintered at a temperature lying at least 1000° C. below the fusion temperature (3150° C.). The low sintering temperature has the advantage of cheaper production costs and decreased risks for defiling.

A good sintering result at such a low temperature is dependent on the rhenium powder used. We have found that the powder must be fine-grained so that at least 70% of the grains have a diameter not exceeding 0.004 mm. Such powder is produced through reduction with H of $ReKO_4$ at a temperature between 400° and 600° C. For tests, sintering temperatures lying between 1700° C. and 2150° C. have been used, and the sintering time has been varied between 3 and 30 minutes, good results having thereby been obtained. It may be sufficient in

many cases to sinter the powder at for example 1800° C. during 5–10 minutes. With such a method, it is possible to produce a material with sufficient mechanical resistance having a porosity of 40%, whereby the following advantage is obtained: the quantity of contact material used for one contact is smaller and thus cheaper, and, owing to the use of a lower temperature, the method itself is also cheaper. With this method, it is suitable to give the material a shape, by pressing and sintering, which differs as little as possible from the shape of the desired contact. The rhenium contacts of the type having a plain and a convex side are pressed in hardened steel dies. The die with a concave surface is moved against a stationary die. Thus the surface of the convex side, the working side, of the contact gets a greater density and hardness than the other parts of the contact. Should both surfaces be used as working surfaces and thus formed convex, both dies are moved against each other. The pressing operation takes place at room temperature and at a pressure of 6000–9000 kg./cm.^{2}.

By using fine-grained rhenium powder as mentioned above and a pressure of 6000–9000 kg./cm.^{2} the sintering is obtained, according to an embodiment of the invention, during 10–25 minutes at a temperature of 1850° ±40° C. Thereby it is possible to use an electric furnace with tungsten—or molybden resistors in Al_2O_3 tubes. On the average the porosity will be 12–30% which is sufficient for contact loads up to about 5 amperes. For contacts which are designed for higher loads an average porosity of only 5–12% is preferable, which is obtained by sintering at a temperature of 2100° ±40° C., e. g. when producing small contacts with a diameter of about 2 mm. with a sintering time of 5–10 minutes. At such high temperatures it is not possible to use a furnace with Al_2O_3 tubes. In this case it is necessary to use a furnace with carbon tubes, which, however, causes an increase in the costs and a risk of defiling the contact material with carbon. Such impurities cannot be removed.

The contact is fastened to a bearer, e. g. a contact spring, by soldering or welding. When soldering is used the contact is first copperplated through electro-deposition. The welding methods are cheaper and stronger than soldering. The contact which is to be welded to a bearer must have a convex surface at the welding point. It is possible to use resistance-welding. The best results, however, have been obtained in using condenser-welding. This welding method is generally known as regards other metals. An electric current from a condenser battery is discharged over the welding point at the moment when the two surfaces, which are to be welded together, touch.

As example a little contact design for 5–10 a. and 24 v. with a diameter of 1.6 mm., a thickness of 0.5 mm. and convex surfaces with 4 mm. radius is welded with a condenser of 7000μ F. and an electrode pressure of 5–10 kg. This method is cheap and it is easy to arrange an automatic production.

We claim:

1. The method of producing electric contact material made of rhenium only, for use in electric switching means comprising the steps of subjecting discrete rhenium particles at least 70% of which have a diameter of at most 0.004 mm., at room temperature to a pressure between 6000 and 9000 kg./cm.^{2} for forming a compacted porous rhenium body having a porosity between 5 and 40 percent, and sintering said porous body for a period of 5 to 25 minutes at a temperature between 1800° and 2150° C. for imparting a mechanical resistance sufficient for the purpose to said porous body.

2. The modification of the method according to claim 1 comprising the step of sintering said porous body for

a period of 10 to 25 minutes at a temperature between 1850° C. ±40° C.

3. The modification of the method according to claim 1 comprising the step of sintering said porous body for a period of 5 to 10 minutes at a temperature between 2100° C. ±40° C.

4. In the method according to claim 1, the step of applying said pressure to the rhenium particles and shaping the same in form of contacts having a convex contact-making surface by means of a steel die to impart to the said surface a density higher than that of the remaining part of the porous body.

5. An electric contact material in form of a comparatively porous body composed of coherent rhenium particles at least 70% of which have a diameter of at most 0.004 mm., the porosity of said body being between 5% and 40%.

6. An electric contact material according to claim 5, wherein the said contact material is in form of a contact having a convex contact-making surface, the said surface having a density higher than the density of the remaining part of the contact.

References Cited in the file of this patent

UNITED STATES PATENTS

1,282,122	Pfanstiehl	Oct. 22, 1918
1,359,353	Gebauer	Nov. 16, 1920
1,829,756	Noddack et al.	Nov. 3, 1931
2,214,902	Herriger	Sept. 17, 1940
2,422,439	Schwarzkopf	June 17, 1947

OTHER REFERENCES

Inorganic Syntheses (vol. I), Booth, first edition, published 1939 by McGraw-Hill Book Co., Inc. Pages 176 and 177 are relied on.

Materials and Methods, July 1946, pages 98–102. (Original in Scientific Library.)

Treatise on Powder Metallurgy, Goetzel-Goetzel, volume II, published 1950 by Interscience Publishers, Inc., New York. Page 709 is relied on.