May 6, 1941. C. W. KEITEL 2,241,262

ELECTRICAL CONTACT

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Fig. 1

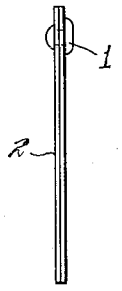
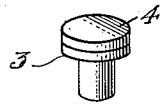


Fig. 2



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ELECTRICAL CONTACT

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This invention relates to electrical contact elements suitable for use in making and breaking of electric current, and is directed primarily to the improvement of electrical contacts consisting of silver and silver alloys.

Electrical contacts should have high current carrying capacity and low surface contact resistance. They should be resistant to oxidation and have great mechanical strength. In operation they should be subject to as little metal transfer as possible so as to avoid pitting and sticking. High melting point also is desirable as it decreases the deleterious consequences of arcing.

Electrical contacts are usually manufactured of platinum, alloys of platinum, tungsten or silver. Of these metals, fine silver has found the widest use, as it is relatively cheap, has excellent current carrying capacity and does not oxidize easily. Silver contacts, however, are subject to the disadvantage that their contact resistance may increase in use, for instance in the presence of sulphurous gases and that they tend to stick particularly when the current used is too high. Furthermore, such contacts are deficient in hardness.

Various attempts have been made to overcome the disadvantages of silver contact elements by incorporating metal carbides, cadmium, magnesium, gold, palladium, platinum and others, but no thorough success has been obtained by any of such additions. The addition of base metals increases the tendency to build up surface resistance and usually decreases the melting point. The admixture of precious metals is usually beneficial, but attempts heretofore made to incorporate precious metals have not succeeded in eliminating the shortcomings of silver contacts to a satisfactory degree.

A prime object of my invention is to provide a novel and improved electrical contact element that shall be hard, shall have high current carrying capacity, low surface contact resistance, high melting point, resistance to oxidation, a minimum tendency to pitting and sticking and great mechanical strength.

Other objects are to provide such an electrical contact that shall be free from the objections to the known silver contact elements but shall possess the desirable characteristics of silver contacts; and to obtain other advantages and results as will be brought out by the following description.

I have now found that the properties of silver contacts can be improved considerably by the incorporation therein of refractory metals of the platinum group, comprising the metals ruthenium, rhodium, iridium and osmium, particularly ruthenium. These metals do not form completely homogeneous solid solutions with silver and for this reason contacts of silver combined with such metals can be provided by melting only when small percentages of the refractory metals above mentioned are incorporated, such as up to about 10%. Contacts of silver combined with large percentages of ruthenium or other refractory platinum group metals, therefore, are manufactured by powder metallurgical methods.

The admixture of even small amounts of such refractory metals, for instance, 0.5% ruthenium, has been found to increase the hardness and melting point of silver contacts and to decrease sticking. Electrical contacts according to my invention may comprise small amounts of one or more of the refractory platinum group metals, for instance ruthenium, either alone or in combination with another one or more of such metals as rhodium, osmium and iridium, in amounts up to 10% or 15%, or they may contain larger amounts of such metals, for instance up to over 90%. In all cases the crystal structure of the alloys is finer than that of pure silver. In cases where the refractory platinum group metal content is high, such as 90% or 95%, the construction material for my contacts is of course produced by powder metallurgical methods, the silver serving essentially as a binder for the refractory platinum group metal or metals particles.

Electrical contacts according to my invention have a great variety of useful applications. They have high current carrying capacity and low surface contact resistance. They have greater hardness, greater mechanical strength, and higher melting point than silver contacts, and have been found to resist deformation and sticking to a considerable degree.

My invention is equally applicable to electrical contacts of palladium or alloys of silver such as alloys of silver and palladium. In the case of electrical contacts of an alloy of palladium and silver in equal amounts the addition of for instance 1% ruthenium increases the Rockwell B. hardness from 44 to 62 when cast, from 93 to 95 when hard, and from 51 to 63 when annealed at 800° C. for 30 minutes.

The crystal structure of my contacts is finer, pitting and sticking decreased, and hardness, mechanical strength and melting point are increased. Decrease of crystal size in pronounced

degree was observed even with admixtures of as little as 0.1% ruthenium.

Electrical contacts are often manufactured of composite metal in which the contact element itself comprises a thin effective surface of the electrical contact metal backed or supported by base metals usually of lower cost than the metal of the electrical contact. Tungsten contacts have thus been backed by copper in United States Patent No. 1,089,907, by steel or iron in United States Patent No. 1,181,742, or by nickel and nickel alloys in United States Patent No. 1,155,426; precious metal contacts have similarly been backed by less expensive metals, such as silver or platinum contacts backed by copper in German Patent No. 203,904, gold or platinum contacts backed by nickel or steel as in United States Patent No. 1,469,043, or silver contacts backed by Monel or stainless steel as for instance described in United States Patent No. 1,925,856. It should be understood, therefore, that my electrical contacts may also be manufactured from composite metal so that the effective contact surface consists of the alloys described by me and backed, in accordance with old well-known practice, by another dissimilar metal, such as nickel, Monel, iron, steel, stainless steel, and so forth.

For the purpose of illustrating possible preferred embodiments of my invention, I have shown two forms of contacts in the accompanying drawing in which

Figure 1 is a fragmentary side elevational view of a thermostatic switch having one form of contact element attached thereto, and

Figure 2 is a perspective view of another type of contact element embodying my invention.

As above indicated, my invention may be embodied in various structural forms of electric contact elements for many different types of electrical apparatus, and the specific embodiments herein illustrated should be understood as being only as examples of two possible types of contact elements.

In Figure 1, the contact element 1 is shown as having its shank riveted or otherwise suitably secured to a bimetallic thermostatic strip 2.

In Figure 2 I have shown the contact element as comprising a base or backing 3 of a base metal or base metal alloy, and a facing disc or contact surface 4 formed of the alloy of my invention. The facing disc 4 may be secured to the backing or body 3 in any suitable manner as by welding or soldering.

Having thus described my invention, what I claim is:

1. An electrical contact element formed of a metal taken from the group comprising silver and palladium, combined with at least one metal taken from the group comprising ruthenium, rhodium, iridium and osmium.

2. An electrical contact element formed of silver combined with ruthenium.

3. An electrical contact element formed of silver combined with ruthenium, the ruthenium constituting from 0.1% to 95% of the whole and the remainder being silver.

4. An electrical contact element formed of an alloy of silver and ruthenium containing up to 15% ruthenium, the remainder being silver.

5. An electrical contact element formed of silver combined with ruthenium, the ruthenium constituting the major proportion, and the remainder being silver.

6. An electrical contact element formed of an alloy of silver, palladium and ruthenium.

7. An electrical contact element formed of an alloy of silver combined with ruthenium.

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