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PROCESS FOR MAKING ELECTRICAL CONTACTS

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This invention relates generally to electrical contacts and particularly to a process for making the same.

It has heretofore been suggested to impregnate a sintered mass of refractory material such as tungsten, molybdenum, tantalum or the like with a metal having a lower melting point and appreciably greater conductivity such as copper, silver or the like. The sintering of the refractory material is usually accomplished in a graphite form or mold in order to introduce carbides into the material for hardening the refractory materials.

In the manufacture of the electrical contacts wherein a graphite form or mold is utilized in sintering the refractory material, it is difficult to impregnate the sintered refractory material with the lower melting metal because of a carbide layer which forms on the outer surface of the refractory body during the sintering. The carbide layer thus formed materially reduces the rate of the penetration or impregnation of the lower melting metal in the sintered refractory body.

The contact surfaces of the electrical contacts produced by impregnating a sintered porous refractory body with a lower melting metal are usually machined to remove the excess coating of the lower melting metal from the face of the contact to expose the harder refractory material. Contacts produced by such processes have not been entirely satisfactory in their adaptation in the electrical industry, because of a deficiency in one or more of the electrical or physical characteristics essential in electrical contacts.

An object of this invention is to provide a process for making contacts for use in electrical apparatus.

Another object of this invention is to provide for so sintering a porous refractory body that it may be easily impregnated with a lower melting metal for producing an electrical contact.

Another object of this invention is to provide a process for exposing a hard, wear resistant, non-welding contact surface in electrical contacts formed from a refractory metal having a high melting point and a metal having a lower melting point.

In practicing the process of this invention, a porous refractory metallic body or base having a high melting point is impregnated with a metal having a lower melting point. In making the porous base, a refractory material having a high melting point such as tungsten, molybdenum, tantalum or the like may be powdered or pul-

verized by any suitable means and placed in a suitable graphite container or mold of predetermined shape corresponding to a desired electrical contact form. A graphite mold is usually employed in making the electrical contacts of the described composition in order to introduce carbides into the refractory material for hardening the refractory.

Where desired, the pulverized or powered refractory material in the graphite container or mold may be placed under pressure in order to compact the powders. The pressure employed in compacting the refractory material in the container will depend upon the amount of the lower melting metal which it is desired to introduce into the refractory body. Where a small pressure is employed in compacting the refractory powders, a more porous body will be obtained when subjected to the treatment hereinafter described than is obtained where large pressures are employed.

In order to insure the securing of a porous structure in the refractory body, suitable vaporizable material may be intimately mixed with the refractory powders and included in the powders when the refractory material is placed in the graphite mold. A material which has been found to be suitable for this purpose is a solution of camphor-in-ether. This material is easily vaporized and when the refractory body is subjected to the heat treatment hereinafter described, will vaporize and leave a porous sintered refractory structure remaining.

In order to render the refractory material so rigid that it may be moved without breaking, the powdered refractory material in the graphite mold may be subjected to a temperature below the melting temperature of the refractory material for a very short time sufficient only to effect a partial sintering of the powdered refractory material. The length of time within which the partial or pre-sintering of the refractory powders may be accomplished may be easily ascertained through experiments, since the time varies in accordance with the refractory material employed and the size of the body prepared. The partial sintering of the refractory is usually accomplished in a vacuum to prevent flaking of the graphite mold.

Although it is desired to introduce carbon into the refractory material to harden it, the carbon content should be controlled to prevent the formation of a carbide layer in the surface layer of the refractory body. This is because the carbide layer impedes the filling of the refractory

body with the lower melting metal as herein-after described, and is, therefore, detrimental to the body.

In order to prevent the introduction of too much carbon and to prevent the formation of a carbide layer in the surface layer of the refractory body, the refractory body may be removed from the graphite mold when it is partially or pre-sintered to the degree necessary to render it sufficiently rigid for movement without breaking, as hereinbefore described. The completion of the sintering of the refractory body may then be accomplished at a temperature below the melting point of the refractory material with the refractory body removed from the graphite mold.

In order to impregnate the porous refractory body with a low melting metal, the sintered refractory body may be placed in a suitable vessel lined with sheets or bodies of the low melting metal and heated to a temperature at or above the melting point of the lower melting metal but below the melting point of the refractory base. When subjected to a temperature above the melting point of the lower melting metal, the lower melting metal flows by capillary attraction into the voids or pores of the sintered refractory body, filling the body and imparting a coating of the lower melting metal over the surface layer of the refractory body. Impregnation or filling of the refractory body may also be obtained by immersing the porous sintered refractory body into a vessel containing a liquid or molten bath of the lower melting metal for a sufficient length of time to secure the desired impregnation.

In filling or impregnating the porous refractory body, the surface or contacting layer of the refractory body is filled and covered with the lower melting metal. Such a coating on the contact surface of an electrical contact is highly undesirable since in use, a welding of the lower melting metal in and covering the contact surface of cooperating contacts is found. In order to remove the undesirable coating of lower melting metal from the contact surface, the contact may be machined or polished by any suitable means. This treatment, however, leaves a thin layer of the lower melting metal stroked on the contact surface.

In order to provide an electrical contact having a non-welding, hard, wear resistant contact surface, the machined surface layer of the filled refractory body may be subjected to a treatment to remove the lower melting metal from the contact surface layer of the contact. A treatment which has been found satisfactory for removing the lower melting metal from the surface layer of the contact is to immerse the surface layer of the filled refractory body in an acid which attacks the lower melting metal more readily than it attacks the refractory material for a sufficient length of time to remove the desired amount of the lower melting metal.

In a particular modification of this invention, a porous body of tungsten impregnated with copper in the manner hereinbefore described was immersed in fuming nitric acid for a period of time of between 10 and 20 seconds. This treatment was satisfactory for removing the lower

melting metal or copper from the filled surface layer of the tungsten body providing a non-welding electrical contact having an extremely hard, wear resistant contact surface of tungsten.

By practicing the process of this invention, electrical contacts having good electrical and physical characteristics may be obtained. Complete and fast impregnation of the porous refractory body may be obtained because of the absence of a carbide layer in the surface layers of the sintered refractory body. Non-welding and hard, wear resistant characteristics are found in the electrical contact because of the absence of the low melting metal in the contacting surface of the contact.

Although this invention has been described with reference to a particular embodiment thereof, it is, of course, not to be limited thereto except insofar as is necessitated by the prior art and the scope of the appended claims.

I claim as my invention:

1. A process for making electrical contacts from a powdered refractory material having a high melting point and a metal having a lower melting point, comprising the steps of, subjecting the refractory material in a graphite container to a temperature below the melting point of the material for a sufficient length of time to effect a partial sintering of the powdered material to render it sufficiently rigid whereby it may be moved as a unit without breaking, completing the sintering of the refractory material after it has been removed from the graphite container to produce a porous sintered refractory mass free from carbides at its surface, impregnating the porous refractory mass with a metal having a lower melting point than the refractory material, the lower melting metal filling the refractory material and covering the surfaces of the mass, and immersing a surface of the mass filled with the lower melting metal in an acid for removing the lower melting metal from the surface to expose the hard, wear resistant, contact surface of refractory material.

2. A process for making electrical contacts from a powdered refractory material having a high melting point and copper, comprising the steps of, subjecting the refractory material in a graphite container to a temperature below the melting point of the material for a sufficient length of time to effect a partial sintering of the powdered material to render it sufficiently rigid whereby it may be moved as a unit without breaking, completing the sintering of the refractory material after it has been removed from the graphite container to produce a porous sintered refractory mass free from carbides at its surface, impregnating the porous refractory mass with copper, the copper filling the porous refractory material and covering the surfaces of the mass, machining a surface of the mass to remove the copper covering it, and immersing the machined surface of the mass filled with copper in fuming nitric acid for a period of time of between 10 and 20 seconds for removing the filling of copper from the surface to expose a hard, wear resistant contact surface of refractory material.

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