United States Patent Office 2,768,099 Patented Oct. 23, 1956

2,768,099

METHOD OF MAKING POWDERED COMPACTS

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No Drawing. Application October 16, 1952, Serial No. 315,210

6 Claims. (Cl. 117—213)

My invention relates to circuit breaker contacts, and more particularly to a novel method of manufacturing circuit breaker contacts to prevent the bleeding out of the infiltrant during the impregnation step commonly employed in the manufacture of powdered metal material.

Electrical contacts of the type to which my invention relates are composed of composition impregnated with a conducting metal, such compositions including powdered refractory material plus a highly conductive metal of lower melting point such as silver or copper. The refractory material when used may be tungsten, molybdenum and/or their (or other) carbides. This powder of refractory material with or without some lower melting point metal such as silver or copper is placed in a mold having the desired shape of the contact of the end result. The material is then pressed into the form of a compact as is now well known in the art. This pressed material is then sintered at temperatures and for periods sufficiently large and long to permit the particles of the powder to fuse or sinter together. This step in the manufacturing of compacts from a powdered refractory is old and well known in the art.

After the above steps have been completed, it is necessary to impregnate or infiltrate the resulting porous compact with an infiltrant of a highly conductive metal, such as copper or silver. This treatment of the initial porous sintered combination comprises the operation of impregnating the same with a highly conductive metal. One such method, well known in the art, is to place a slug of silver on the porous composition and heating this combination until the silver has melted. At this point, the highly conductive silver metal will infiltrate into the pores of the porous sintered composition.

Following this step, the contact may be prepared and welded to a contact arm of the circuit breaker in any desirable manner and forms no part of my invention. This method of making an electrical contact of refractory metal powder such as tungsten, molybdenum, etc. or their carbides, with or without some lower melting point metal, to form a porous compact, sintering the compact and impregnating this compact with silver or copper, is old and well known in the art.

The refractory compact can absorb its infiltrant of silver or copper by any one of several methods. One such method is immersing the porous refractory compact into a molten bath of silver or copper and allowing this molten metal to flow into the porous refractory compact. Another method of infiltration, well known in the art, is to place the infiltrant in a solid form on the compact or to place the compact on the infiltrant, and expose the combination to a sufficient degree of heat to melt the infiltrant and thereby enable it to seek its way into the pores of the refractory compact.

Whichever method is used, the silver or copper permeates into the compact, generally in a very short time such as a matter of minutes. However, the length of time required for the infiltrant to permeate throughout the

entire compact is determined by the size and thickness of the compact as well as by the area and volume of the porous openings.

In practice, it has been found that where the infiltration time was excessive, the infiltrant would begin to leak or ooze out of the refractory compact and then attach itself to the sides and the bottom of the compact in the form of mounds or globules. This, obviously, is a very undesirable occurrence since increased bleeding of the infiltrant increases the porosity therein.

Furthermore, the weight of infiltrant is usually precalculated so that generally the amount of the infiltrant that is used is slightly greater than sufficient to fill all of the porous channels of the refractory compact. Hence, the amount of the infiltrant which oozes out of the compact is a portion of the amount which was calculated to fill the porous openings thereof and thus a non-uniform contact will result.

The problem of bleeding during infiltration of powdered metal materials has been recognized for many years in the industry and many methods have been proposed to overcome it. One such method is to calculate the exact time required for the infiltration step and thus stop the process of infiltration before bleeding commences. However, this has been found, as above noted, to be very undesirable due to the inaccuracies and difficulties encountered in computing the exact time required. Furthermore, it has not been found an efficient or desirable manufacturing expedient to place exact time limits on the infiltration step.

The undesirable resulting effect is then eliminated by grinding, sanding or machining the product to remove the resultant mounds or globules caused by the bleeding. Although the undesirable globules are removed in this manner, it obviously is not a desirable step as it is a costly time-consuming procedure, and furthermore, requires additional steps in the manufacturing process.

I have found by experimentation that if the exterior portion of the porous refractory compact has graphite or lampblack applied thereto, a barrier will be erected to prevent the conductive material from oozing or seeping out of the pores of the compact.

With the method of my invention, it will be possible to infiltrate a powdered refractory compact with a predetermined weight of conductive material and the length of time of the impregnation step need not be critical.

Accordingly, my invention is to apply a coating of carbon to all surfaces of a compact, with the exception of the surface on which the infiltrant is placed and thereby prevent the bleeding out of the infiltrant during impregnation.

Accordingly an object of my invention is to produce an infiltrated sintered material on which there are no globules or mounds of conducting material due to bleeding during the infiltration step.

Another object of my invention is to provide an electrical contact which, when manufactured, never has excess amounts of conducting material attached to its outer surface.

A still further object of my invention is to provide a novel method of infiltration of porous refractory material such that the critical time period for infiltration is removed.

A still further object of my invention is to provide means whereby it is unnecessary to time accurately the infiltration period in order to avoid undesirable oozing out of the conductive material.

A still further object of my invention is to provide a novel method of impregnating porous compacts whereby a coating of carbon is applied to all of the area, with the exception of the area covered by the solid conductive material, prior to the impregnation step.

These and other objects of my invention will appear from the following detailed description.

In the field of powdered metallurgy, many electrical contacts are formed from a refractory in powdered form. This powder is compacted into a die and the appropriate pressure is applied to obtain a precalculated density. The compact is generally sintered and then exposed to an infiltration step wherein a metal of lower melting point than the refractory, known as the infiltrant, is absorbed into the pores of this powdered metal compact. The infiltration temperature is at or above the melting point of the infiltrant.

In electrical contacts, an infiltrant of silver or copper is absorbed into the porous refractory compact resulting in an electrical contact material which is generally used for large current applications.

One common method of infiltration is to place the infiltrant in solid form on the compact or place the compact on the infiltrant and subject this combination to a temperature which is sufficient to melt the infiltrant. This permits the silver or copper to permeate throughout the compact and fill the pores thereof. After filling these pores, continued infiltration time only results in the bleeding out of some of the infiltrant.

My invention is directed to a method or process for preventing the bleeding in such infiltrated electrical type materials.

I have found that the rubbing of carbon, generally in the form of graphite or lampblack on all exposed surfaces prior to impregnation will prevent the infiltrant from oozing or bleeding out of the pores of the compact; that is, a coating of carbon may be applied to all surfaces, with the exception of the surface on which the infiltrant is placed, which will thereby act as an obstacle or barrier for the impregnating material and thus prevent it from oozing to the exposed surfaces and forming mounds or globules thereon.

Thus, it becomes unnecessary (1) to control accurately the time period of impregnation before bleeding will occur; and (2) to eliminate the necessity of removing the excess globules which previously were formed when bleeding occurred.

Thus, by providing the compact with a coating of carbon, I can remove the critical time period of impregnation and still allow for ample infiltration time without worry of bleeding.

It will be noted that the carbon coating of graphite or lampblack may be applied to the exposed surface of the compact by rubbing it on with the hand. However, I have also found that it is desirable to apply the coating by preparing a mixture of the graphite or lampblack in carbon tetrachloride or some other similar vehicle.

Thus, this mixture may then be painted on to the exposed surfaces of the refractory compact. This method of application is very desirable for compacts having hard to reach areas such as radii undercuts or step-downs. Furthermore, the carbon tetrachloride which evaporates readily, has no deleterious effects during infiltration or on the properties of material. It has also been found that a more desirable and better coating or smearing effect on the exposed surface results when finer particles of carbon are used.

In summary, I provide a novel impregnation method in which the exposed surfaces of a sintered refractory compact are coated with a carbon surface and thereby eliminate all deleterious bleeding effects, also eliminating the critical time of infiltration.

Although for purposes of illustration I have described my invention as applied to a refractory composition impregnated with a lower melting point conducting metal, it will now be evident that my invention is applicable generally to materials in which impregnation is employed and where it is desired to prevent bleeding of the infiltrant.

I claim:

1. In a process wherein a porous article made by sintering a compact of powdered refractory material is, after sintering, impregnated with a molten metal material having a melting point lower than that of the refractory material, the improvement which comprises applying to a portion only of the surface of the sintered compact before impregnation a coating of finely divided carbon selected from the group consisting of carbon black and graphite.

2. The process of claim 1 in which the compact is coated with lampblack.

3. The process of claim 1 in which the compact is coated with graphite.

4. In a process wherein a porous article made by sintering a compact of powdered refractory material from the group consisting of tungsten, molybdenum, carbides of tungsten and molybdenum, and mixtures thereof is, after sintering, impregnated with a molten metal from the group consisting of silver and copper, the improvement which comprises applying to a portion only of the surface of the sintered compact before impregnation a coating of finely divided carbon selected from the group consisting of carbon black and graphite.

5. The method of claim 4 in which the finely divided carbon coating is applied by suspending the same in carbon tetrachloride and subsequently evaporating the carbon tetrachloride.

6. In a process wherein a porous article made by sintering a compact of powdered refractory material from the group consisting of tungsten, molybdenum, carbides of tungsten and molybdenum, and mixtures thereof is, after sintering, impregnated with a molten metal from the group consisting of silver and copper, the improvement which comprises applying to all exposed surfaces of the compact, with the exception of the impregnating surface, a coating of finely divided carbon from the group consisting of carbon black and graphite.

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