

UNITED STATES PATENT OFFICE

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METHOD OF SINTERING TITANIUM AND
LIKE METALS

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This invention relates to a method of sintering bars, compacts or the like of metals which react with oxygen, nitrogen, hydrogen and the like at temperatures incident to sintering treatment and more particularly to the treatment of titanium.

When sintering such reactive metals at temperatures above say 800° C. they tend to react with oxygen, nitrogen and like gases surrounding them to form stable compounds which go into solid solution in the metal, imparting thereto undesirable physical properties. Heretofore the practice has been to sinter the compacts, briquettes or bars in a vacuum sufficiently high to prevent such contamination. It is difficult and expensive to maintain effectively the required vacuum conditions in commercial operation.

In accordance with the present invention the metal bars, compacts or briquettes of titanium are sintered in the presence of an alkaline earth metal which is more reactive to the contaminating gases than the metal under treatment. Calcium is preferred but magnesium, lithium, strontium and barium may be used. The compacts may be sintered while submerged in molten calcium or other alkaline earth metal or they may be sintered in an atmosphere of such metal in vapour form. Argon or other inert gas may be combined with the vapour of the alkaline earth metal to provide the protective sintering atmosphere.

The following specific examples are illustrative of the operation of the invention.

Titanium powder is pressed into compact or briquette form, by usual powder metallurgy methods, for sintering. Lubricants should not be used during the pressing operation.

When sintering in molten metal the compacts and calcium metal are placed in a container of mild steel. The container is closed and placed in the upper cool zone of a sintering furnace. The furnace is closed, evacuated and filled with argon to a pressure in excess of atmospheric and the container is lowered into the hot zone of the furnace maintained at about 1000° C. When sintering is complete the container is raised into the cool zone of the furnace where the metal is allowed to cool before it is removed from the furnace and container. The sintering treatment renders the compressed mass of metal powder practically solid and in this form the tendency to react with contaminating gases is substantially eliminated. Even if the sintered compact is exposed to the air at relatively high temperature the contamination is superficial. Thus the sintered compact may be readily cooled sufficiently

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before exposure to the atmosphere. Alternatively the compacts may be placed in a mild steel basket and lowered into a bath of molten calcium under a protective covering of argon. When sintering is complete the basket is raised allowing the molten calcium to drain back into the bath.

When sintering in vapour of calcium the container carrying the compacts is suspended above the bath of molten calcium during the heat treatment above described. In this procedure it is necessary to use only sufficient calcium to saturate the atmosphere within the furnace.

Any of the protecting alkaline earth metal adhering to the sintered compacts may be readily removed by treatment with dilute hydrochloric acid. When sintered in calcium vapour very little of the protecting metal adheres to the compacts.

The time and temperature required for sintering in this manner are substantially the same as used in the usual high vacuum sintering procedure. However, the method is more economical than the high vacuum method and because the calcium completely eliminates reaction of the metal being sintered with oxygen, nitrogen and the like, the physical properties of the sintered metal are improved.

Other metals like sodium, cadmium and lead have been tried but they have been found relatively ineffective and unsuitable for sintering titanium which is particularly reactive to oxygen and nitrogen. The alkaline earth metals, and particularly calcium, have been found to have a greater affinity for the reacting gases than titanium.

While the invention has been described with particular reference to titanium, it is equally applicable to other reactive metals like zirconium, vanadium, hafnium and chromium.

What I claim is:

1. A method of treating titanium and like reactive metal powder which comprises compressing the powder into compacts, placing the compacts and a mass of alkaline earth metal in a closed zone, evacuating air and filling the closed zone with an inert gas, heating to render the alkaline earth metal fluid to intimately surround the compacts and while maintaining the compacts completely surrounded with the fluid alkaline earth further heating at a temperature of about 1000° C. to sinter the powder and render the compacts solid and resistant to oxidation.

2. A method as defined in claim 1 wherein the compacts are immersed in a bath of molten cal-

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cium while heating to sinter the compacted powder.

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