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2,837,442

METHODS OF CHROMIZING MOLYBDENUM TUNGSTEN AND THEIR ALLOYS

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This invention relates to methods of depositing a layer of metal upon a dissimilar base. More particularly it relates to methods of depositing a shiny glossy coating rich in chromium upon a metal such as molybdenum, and tungsten alloys thereof as well as tungsten or molybdenum rich composites by thermo-chemical techniques.

While we are aware that chromizing of various metals and quasi-metal bases has been proposed and in certain cases actually employed, so far as we are informed the chromium-rich layers deposited by known processes have been characterized by being dull in appearance. Generally speaking, techniques of chromizing, that is thermo-chemical methods of applying a chromium-rich layer on a base while the base is embedded in a high temperature retort containing a powdered pack of chromium or ferro-chrome, an inert filler, a halide or a halide yielding material are disclosed in United States Patent 2,536,774 (Samuel) and in our co-pending application, Serial Number 505,468, filed April 30, 1955. Hereinafter when chromizing is referred to it will be understood that the treatment envisaged generally follows the methods set forth in these references, using substantially similar apparatus, with such difference in conditions as are more particularly set forth below.

We have surprisingly discovered, contrary to our prior experiences and the prior disclosures of which we have knowledge, that one may achieve a shiny glossy coating of a chromium-rich layer on metals such as molybdenum, tungsten and the like by subjecting them to the presence of a powdered chromizing pack at elevated temperatures such as at least about 1900° F. and for periods of several hours. The chromizing pack may contain a source of chromium such as pure or commercial grade chromium or ferro-chrome, an inert filler such as clay, kaolin, alumina and the like, an elemental halogen and/or a halide such as ammonium iodide, chloride, bromide or fluoride and, significantly, a liberal quantity of free iron or a low carbon steel. The latter components may be present in the pack in the form of a powder, as small granules or small pieces. We found that base metals so treated exhibited good oxidation resistance. Apparently a ternary surface alloy about 0.002" thick of iron, chromium and the base is formed.

In a presently preferred embodiment we employ a chromizing pack of approximately 60% ferro-chrome, 30% kaolin (preferably low in moisture content), a fraction of a percent of ammonium iodide and about 10% of 100 mesh iron powder, the temperature in the retort being maintained at at least 1900° F. and the reaction period being about 4-8 hours.

It will be appreciated by those skilled in the chromizing art that variations in the specific conditions specifically set forth may be made such as in degree of fineness of the powdered pack, retort design, and in the proportions of the pack, bearing in mind the particular gloss effect de-

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sired on a given piece or pieces to be treated. Moreover, it is also to be noted that variations in the pack composition may be made e. g. one may have from about 3-20% iron in the pack with the source of chromium and the filler also being appropriately adjusted. In any event, a small proportion of halogen or halide compound is needed in the treatment.

For example, we have successfully formed a glossy, shiny chromium-rich layer on cup-shaped gyroscope rotors approximately 1 5/8" in diameter by 1" high. In this instance this base material chromized was a so-called heavy metal which is believed to contain 94% tungsten, the balance being copper and nickel. In this example, the desired glossy chromium rich surface coating could not be achieved by electroplating techniques due to the complex shape of the pieces treated, the size tolerances to be maintained and the inherent danger that electrically deposited chromium plating tends to peel. The conditions of chromizing employed herein were as described above, using in this instance small pieces of steel (S. A. E. 1020) rather than a powder or granules.

Having now particularly described our invention what we claim is:

1. The method of applying a shiny glossy chromium rich layer on an underbase metal selected from the class consisting of molybdenum, a molybdenum alloy, tungsten, and a tungsten alloy which comprises maintaining said underbase metal at an elevated temperature of about 1900° F. for a period of several hours in a substantially oxygen-free atmosphere while the underbase metal is in the presence of a powdered chromizing pack comprised of ferro-chrome, an inert filler, a volatile halide and a minor quantity of free iron, the amount of said free iron being at least 3% of said pack.

2. The method of applying a shiny glossy chromium rich layer on an underbase metal selected from the class consisting of molybdenum, a molybdenum alloy, tungsten and a tungsten alloy which comprises maintaining said underbase metal at an elevated temperature of about 1900° F. for a period of several hours in a substantially oxygen-free atmosphere while the underbase metal is in the presence of a powdered chromizing pack comprised of chromium, an inert filler, a volatile halide and a minor quantity of free iron, the amount of said free iron being at least 3% of said pack.

3. The method of forming a shiny glossy chromium rich layer on an underbase metal selected from the class consisting of molybdenum, a molybdenum alloy, tungsten, and a tungsten alloy which comprises maintaining said underbase metal at a temperature of at least 1900° F. for a period of several hours in a substantially oxygen-free atmosphere while the underbase metal is embedded in a powdered chromizing pack containing a minor quantity of free iron, the amount of said free iron being at least 3% of said pack.

4. The method according to claim 3 wherein said free iron comprises 3 to 20% by weight of said pack.

5. The method according to claim 3 wherein said pack contains an ammonium halide, ferro-chrome and baked kaolin.

References Cited in the file of this patent

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