

UNITED STATES PATENT OFFICE.

FRANK A. FAHRENWALD, OF CLEVELAND, OHIO, DEDICATED, BY MESNE ASSIGNMENTS, TO THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND TO THE PEOPLE OF THE UNITED STATES OF AMERICA.

PROCESS OF COATING TUNGSTEN OR MOLYBDENUM WITH NOBLE METALS.

1,236,383.

Specification of Letters Patent.

Patented Aug. 7, 1917.

No Drawing.

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(DEDICATED TO THE PUBLIC.)

To all whom it may concern:

Be it known that I, FRANK A. FAHRENWALD, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Processes of Coating Tungsten or Molybdenum with Noble Metals, of which the following is a full, clear, and exact description.

This application is made under the act of March 3, 1883, chapter 143 (22 Stat. 625) and the invention herein described and claimed may be used by the Government of the United States, or any of its officers or employees in the prosecution of work for the Government or by any person in the United States without the payment of any royalty thereon. The invention relates to a process of coating an easily oxidizable metal like tungsten or molybdenum with a non-oxidizable metal such as gold or platinum. In my copending applications filed May 31, 1916, Serial Nos. 100,996 and 100,997 I have described respectively an article consisting of a ductile and malleable tungsten or molybdenum base with an adherent coating of gold or other precious metal or alloy, and a process of making the same; this process consisting in the immersion of the article in a bath of molten coating metal whereby a very heavy coating layer is produced. This method, while resulting in an extremely satisfactory article, was unduly expensive since the coating of gold or other precious metal secured thereby was unnecessarily heavy. Also if the wire or other article were covered uniformly, as by a continuous process operation, many parts would receive a coating of gold which would not require it, thereby unnecessarily increasing the expense while if only certain portions of the article were covered the procedure was slow and tedious. Also the former or dipping process necessitated the fusion of a considerable amount of gold which was not always convenient.

The present invention comprehends a simpler, quicker, and cheaper process for effecting this coating operation whereby only those parts will be coated as need shall re-

quire and wherein that coating may be as thin as desired with reference to the purpose in view. Generally speaking my invention comprehends the employment of a flux of peculiar composition and attributes which shall contain in itself the materials necessary to cleanse and preserve unoxidized the tungsten metal, and shall itself deposit thereon the desired coating of precious metal. In developing the material for this purpose, I have found that the oxygen salt of the alkali metals form the best flux for dissolving the oxid from the surface of the tungsten or molybdenum. There are a number of these salts that can be used and any may be chosen which will form an alkali tungstate or molybdate by uniting with the oxid of these metals. I have found that sodium carbonate or better still a mixture of this with fused borax serves very satisfactorily for this purpose, although many alkali salts can be used.

To this cleansing flux I add a salt of a precious metal, for example, chlorid of gold, palladium, or platinum, or a mixture of any of these in any proportion. Similarly the finely divided metals themselves may be intimately mixed with the flux and give nearly as good results, although I prefer to employ one of their halogen salts from the fact that segregation before application is less to be feared than in the case of the metals themselves. For operative purposes, however, it is necessary only that some such metals (either in the combined or uncombined form) be added as will appear in the fused metallic condition when the flux is applied and melted under the conditions stated.

The use and action of this flux combination is then essentially as follows: The tungsten or molybdenum metals or alloys are heated and dipped into or drenched with the powdered flux causing a small amount to adhere to the hot surface. Heat in stronger degree is then applied from a blast lamp or blow pipe or other suitable means. As the temperature is raised, the alkali salts melt, react with the surface oxid, thoroughly cleansing the metal, upon which is simul-

tanuously deposited the metallic content of the flux, which has also become molten. In the case of the pulverized metal being mixed with the flux no chemical change takes place therein; in case a combined salt of the precious metal be employed, the temperature of the operation automatically causes a reduction to take place, which reduction can, of course, be assisted if desired by the employment of a suitable reducing agent in the flux. The surface thus receives a cleansing and protective treatment practically simultaneously, and may then be soldered or brazed by adding ordinary gold or precious metal solders in the usual manner. It is best to complete the operation by adding the required amount of solder and melting it down with the flux, although the operation of coating may be performed at any time in advance of the soldering if desired, or the whole operation may be performed with a single heat. Also the entire tungsten article may be coated if desired, or a portion coated and the remainder left uncoated, suitable means being employed to maintain the temperature of the uncoated portion sufficiently low to prevent oxidation, or to cover the same with a suitable flux so as to prevent the access of air thereto. The temperature of the operation should be maintained below about 1400° C., and even this temperature should be maintained for not more than about 10 to 30 seconds in the case of ductile tungsten or molybdenum since a higher temperature or a longer time tends to embrittle the metal. Of course lower temperatures can safely be maintained for a longer time but the time element should always be kept as low as convenient. The particular metal or metals incorporated in the flux can be chosen to meet desired conditions or to duplicate the solders to be used or precious metals to be united, or to secure a predetermined shade of color or a desired melting point or resistance to chemical action. If it is desired to unite tungsten to gold or if gold coated tungsten is used, the flux may contain only gold, so that the gold color may be maintained. If a platinum color be desired, palladium or platinum may be added, which also gives a stronger bond and a joint of higher melting point. In this manner pure platinum may be used in extreme cases, although its use requires very delicate manipulation since with temperatures much above 1400° C. there is danger of crystallization or annealing. Silver alone may be employed (though with slightly more difficulty in the reduction since some reducing agent like potassium cyanid is sometimes desirable as an added constituent of the flux to aid its reduction) but adheres rather weakly and appears for some unknown reason to accelerate crystalli-

zation of the tungsten, wherefore its use alone is not recommended. Palladium alone adheres very strongly and even alloys slightly, but also, when used alone, appears to accelerate crystallization though when used in company with a preponderance of gold this deteriorating effect is not observable. Gold alone has comparatively little affinity for tungsten or molybdenum and the line of contact is rather clearly defined, though it adheres reasonably well for all practical purposes and forms a most beautiful coating without any injury to the metal beneath. Its adhesion is improved by the addition of five to ten per cent. of palladium, and without inimical effects upon the tungsten so far as can be observed. Metals of the platinum group, or other refractory precious metals such as iridium, have a marked dissolving effect, so that if a true alloyed bond is desired, one or more of these metals may be employed in connection with the gold.

The metallic content of the flux may vary within very wide limits; I have obtained perfect (but very thin) protective coatings with as low as two per cent. of precious metal in the flux, although I prefer to employ a larger proportion. However by varying the constitution of the flux it is possible to produce a coating of different thicknesses upon different portions of the article, proportioning each thickness to the use or treatment the article is to undergo, and it will be apparent that very many changes in detail of my improved process may be made without departing from the scope of my invention defined in the claims hereto annexed and indicated by the prior state of the art.

Having thus described my invention, what I claim is:—

1. In the process of soldering oxidizable metals like tungsten or molybdenum the step which consists in applying the molten solder in the presence of a flux containing a fusible alkali salt and the salt of a noble metal which is reducible by heat in the presence of the remaining constituents of the flux.

2. In the process of soldering or brazing oxidizable metals like tungsten or molybdenum, the step which consists in heating said metal in contact with a flux containing an oxid-dissolving and oxygen-excluding element together with a reducible precious metal salt.

3. The process of coating tungsten or molybdenum or their alloys with a layer of unoxidizable metal such as gold or silver or alloys containing the same which consists in first applying to the tungsten or molybdenum a flux containing the oxygen salt of an alkali metal together with other substances which when heated will act to pre-

precipitate upon the tungsten or molybdenum an adherent coating of the unoxidizable metal.

4. The process of coating tungsten and
5 molybdenum with silver, gold, palladium, platinum or other noble metal, either singly or in alloyed form, which consists in heat-

ing said oxidizable metal in contact with an oxygen alkali salt to which is added the halid salt or salts of the coating metal or 10 metals desired.

In testimony whereof, I hereunto affix my signature.

FRANK A. FAHRENWALD.