

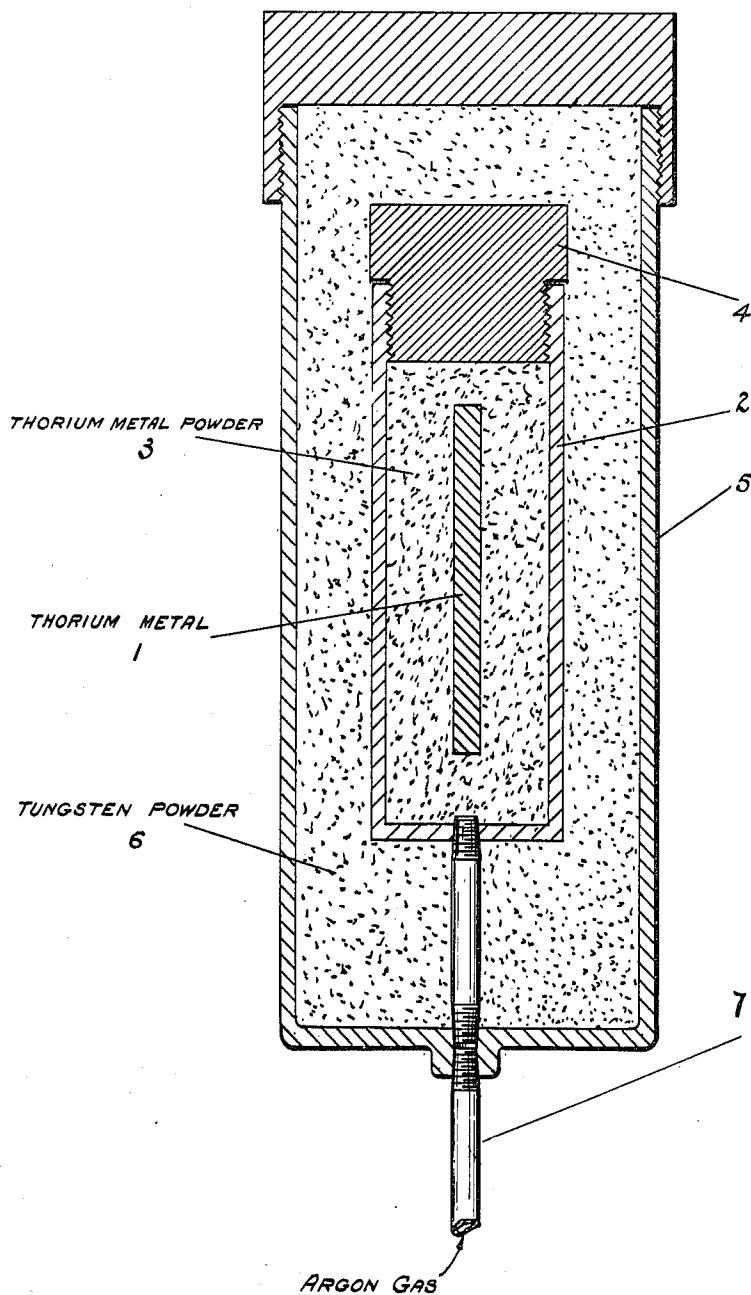
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ANNEALED THORIUM AND METHOD OF MAKING THE SAME

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ANNEALED THORIUM AND METHOD OF MAKING THE SAME.

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This invention relates to a process of annealing metals and more particularly to a process and apparatus suitable for annealing readily oxidizable metals, such as thorium, uranium, tantalum, zirconium and the like.

As a specific example, the metal thorium will be referred to hereinafter, however it is to be understood that the present process is useful in connection with the annealing of other metals, especially those which readily combine with nitrogen, oxygen and the like upon exposure thereto, particularly when in the heated condition.

The ordinary processes of annealing are not suitable for metals such as thorium for the reason, if a metal of this character is heated in an atmosphere of nitrogen or oxygen, it either combines with or absorbs such gases to such an extent that the metal loses the properties upon which workability depends.

The present invention offers a simple and inexpensive process for accomplishing the annealing of such active metals as thorium. This process stated generally, comprises heating the metal to the desired temperature while surrounded by active materials which readily combine with impurities such as nitrogen, oxygen, and the like and which materials do not combine with the metal being annealed.

More specifically the process comprises surrounding the metal product by the powder of an active metal and encasing the same in a bomb and then surrounding the bomb with another active metal powder and enclosing the same in another and larger bomb. The bombs may then be brought to the desired temperature to effect the annealing of the metal product without any combination taking place between the metal product and the gases in the surrounding atmosphere.

Therefore, it is an object of the invention to provide a process for annealing metals of the class which readily become contaminated or lose the property upon which workability depends when exposed to the air when in a heated state.

Another object of the invention is to provide a suitable apparatus for annealing such metals as thorium, tantalum, uranium, zirconium, and the like.

Other objects of the invention will become apparent as the following description is read when taken in connection with the accompanying drawing in which the single figure

is a longitudinal sectional view of the apparatus in which the annealing process may be practiced.

Referring to the drawing, a thorium metal product 1 comprising a swaged rod of thorium which has been worked cold, is placed centrally within a cylindrical iron bomb 2 and surrounded by metal powder 3, preferably thorium. The end of the bomb may then be sealed by metal plug 4 threaded into the end of the bomb, it being preferable to first place a mixture of graphite and water on the threads in order to provide a hermetic seal.

This small bomb may then be placed in a larger bomb 5 and the latter packed with well-reduced tungsten metal powder 6. The bomb 5 is then sealed in a manner similar to the first bomb.

The bombs thus prepared are placed in a gas or other furnace and heated to about 1000° C. and held at that temperature for approximately 45 minutes. When cold, the bombs are opened and the metal product removed.

The purpose of surrounding the metal product with thorium powder is to prevent contamination of the product since the thorium powder will combine with oxygen and the like to form stable compounds which do not dissociate at the annealing temperature. Furthermore, it is desirable to employ a metal powder or clean-up material which will combine with the impurities at a temperature below that at which the thorium metal product becomes heated sufficiently to combine with such impurities. It will be seen, therefore, that the object which I desire and do attain, is to provide an atmosphere surrounding the thorium metal product which does not contain any contaminating gases at the time the heating of the thorium is affected. It is also a factor to select the proper clean-up material, that is one which forms with the gaseous impurities a stable compound which does not dissociate at the temperature to which the thorium product is heated during annealing.

The purpose of surrounding the inner bomb with tungsten is to prevent the air from passing into the inner bomb in the event the plug 4 should not remain perfectly tight. Obviously, if the plug is properly designed and fitted in the end of the inner bomb, the external bomb need not be employed.

The following tests on a Rockwell testing machine made on certain specimens show the

hardness before annealing and after annealing.

Before annealing	After annealing
B-75	B-32
B-72	B-35
B-81	B-30
B-74	B-27
B-77	B-28
Average B-76	B-30

These hardness figures show a material softening of the worked thorium by annealing the same in accordance with the present invention.

If desired, a small quantity of calcium may be placed with the thorium metal powder in the inner bomb for the purpose of combining with and removing any nitrogen which might be present or enter the bomb during the annealing process. In case calcium or similar low melting point clean-up materials are employed, it is desirable to arrange the same within the inner bomb so that it does not come into contact with metal product.

Although I have given a specific example of the temperature and duration of heating, it is obvious that variations may be made therein, depending upon the hardness of the initial product, the history of its previous heat treatment, size of the sample, and the like.

As indicated in the drawings, the bombs may be provided with a conduit 7, for the purpose of introducing an inert gas such as argon within the inner bomb.

Modifications of the process may occur to those skilled in the art, however, such modifications are contemplated by me as come within the scope of the invention as defined in the appended claims.

What is claimed is:

1. The method of annealing worked bodies of highly reactive rare refractory metals which comprises surrounding the said worked body in a hermetically sealed container with finely divided chemically reactive materials non-contaminating and inert with respect to the metal body being annealed but capable of combining with residual atmospheric gases within the container to form stable compounds at the temperature of annealing, and thereafter heating the container and contents to the annealing temperature for the desired interval of time.

2. The method of annealing worked bodies of highly reactive rare refractory metals which comprises heating the same to the annealing temperature in an inert environment, hermetically sealed with respect to the atmosphere, while surrounding the metal body with finely divided chemically reactive materials inert with respect to the refractory metal being annealed but capable of combining with the residual atmospheric gases of the inert environment to form stable compounds at the temperature of annealing.

3. The method of annealing mechanically worked thorium which comprises embedding the metal body in a container with a chemically reactive substance inert with respect to the thorium metal but reactive with and forming stable non-dissociable compounds with residual atmospheric gases therein, hermetically sealing the container, and heating the mass to the annealing temperature for the desired length of time.

4. The method of annealing mechanically worked thorium which comprises embedding the metal body in a container with a chemically reactive material, inert with respect to the thorium metal but reactive with respect to residual gases contained therein to form compounds therewith stable at the temperature of annealing, displacing the atmospheric gases in the container with an inert gas, and thereafter heating the container to the annealing temperature for the desired length of time.

5. The process of annealing mechanically worked thorium which comprises embedding the worked article in thorium powder containing a proportion of a suitable gas clean-up agent such as calcium, hermetically sealing the container and thereafter heating to the annealing temperature for the desired length of time.

6. The process of annealing mechanically worked thorium which comprises embedding the worked article in a sealed container with thorium powder containing a proportion of a suitable gas clean-up agent such as calcium, displacing the atmospheric gases with an inert environment, and thereafter heating to the annealing temperature for the desired length of time.

In testimony whereof, I have hereunto subscribed my name this 27th day of February, 1926.

WILLIAM BENJAMIN GERO.