Oct. 2, 1928. 1,685,915

W. B. GERO

FABRICATION OF METALLIC THORIUM

Filed May 25, 1926

FIG. 1

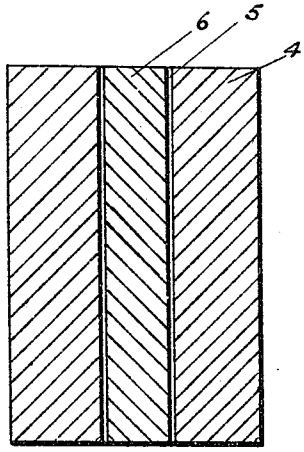


FIG. 2

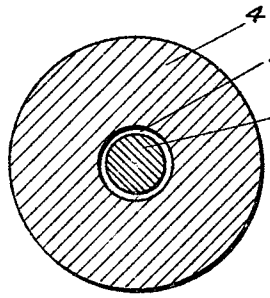
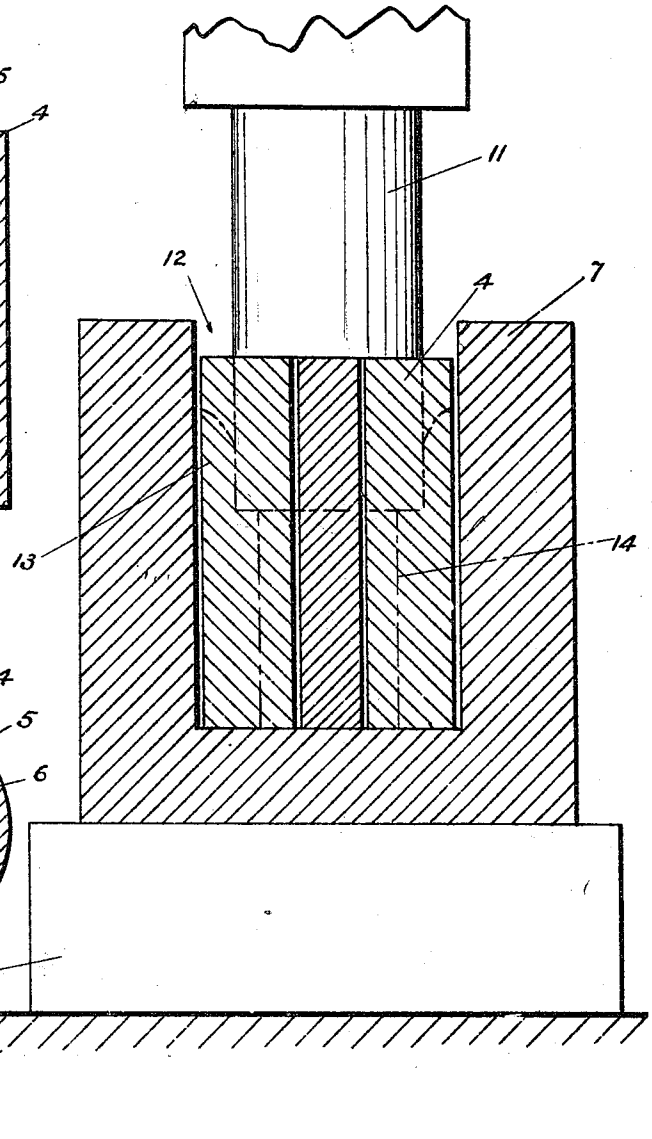


FIG. 3



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FABRICATION OF METALLIC THORIUM.

Application filed May 25, 1926. Serial No. 111,516.

This invention relates to a method of compacting metals, such as thorium, uranium, zirconium and the like.

The rare refractory metals, thorium, uranium, zirconium and the like have a strong affinity for oxygen, nitrogen, and other gases, and when thus contaminated are difficult to mechanically work. Furthermore, these metals cannot be heated in the presence of oxygen without contamination and when thus contaminated they cannot be satisfactorily fabricated by the ordinary mechanical working processes in order to compact the same.

It is especially desirable in the use of such metals as thorium and uranium as target material in X-ray tubes, that the metal be as compact as is possible to obtain. The more compact the metal is the greater will be the output of X-rays. Furthermore, not only is the X-ray output increased but in addition, the thermal conductivity is greatly increased, since the more free the metal is of voids the greater will be its heat conductivity.

In view of the foregoing it is an object of my invention to provide a method of manufacturing a very compact body of a rare refractory metal.

A more specific object of my invention is to provide a method of compacting thorium.

Other objects of the invention will become apparent as the following description is read in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical section of a slug of a relatively soft metal containing the metal to be compacted;

Fig. 2 is a transverse section of the slug shown in Fig. 1; and

Fig. 3 is a vertical section of the slug of metal positioned in a hydraulic press.

The invention briefly stated comprises subjecting the metal to be compacted to compression while constraining the metal during such compression. More specifically this is accomplished by enclosing the metal to be compacted in a soft metal casing such as lead and inserting the slug and contained metal in a mold of iron and thereafter subjecting the slug to the compressive action of a plunger while permitting the softer metal to flow up and around the plunger.

Referring to the drawings for a better understanding of my invention a lead slug 4 approximately one inch in diameter and about 1.5 inches long may be cast and a hole 5 drilled centrally and longitudinally thereof. The hole may preferably be of such size that the metal 6 to be compacted fits the same fairly snugly. The slug and the contained metal may then be placed in an iron mold 7 of a size to fit the slug therein. The mold and contained slug may then be positioned on the bedplate 8 of a hydraulic press 9 and a plunger 11 of the press thereafter inserted into the open end 12 of the mold. The plunger should be of such size with respect to the opening in the mold that it leaves a space of about $\frac{1}{32}''$ of an inch around the plunger. A pressure of 25 tons per square inch may first be applied and this pressure gradually increased to approximately 90 tons per square inch. The lead, upon increasing the pressure, is extruded around the plunger in the form of a tube 13 (shown in dotted outline), while the thorium takes the form indicated in dotted lines 14 in Fig. 3. The deformation of the thorium occurs under the restraining but yielding influence of the surrounding lead and compressed bodies thus formed are found to be smooth without any evidence of cracking. The lead casing may be readily stripped from the compacted metal.

It further appears that a pressed or compacted thorium slug prepared in accordance with the foregoing method may be further compacted without the employment of a restraining metal since I have taken such a compacted piece of metal and subjected the same to further compression. This latter step may be found desirable if it is preferable to obtain a perfectly smooth body free from any irregularities produced by the lead.

Although I have specified the employment of an iron mold it may be desirable to dispense with the mold and merely enclose the thorium or other rare refractory metal in a soft metal, such as lead, aluminum or copper and directly press the same in a hydraulic press.

It will be apparent from the foregoing that the principal feature underlying my invention is to compress the metals under such conditions that its freedom to flow is yieldingly opposed, preferably by the employment of a softer surrounding metal, and thus avoid the formation of cracks in the compacted metal.

As an alternative method for compacting such metals as thorium without cracking, the thorium metal may be worked cold in accord-

ance with the usual swaging process to a point where hair line cracks begin to show. This material, after machining to uniform diameter, may be placed in a mold slightly larger and subjected to a pressure of about 180 tons per square inch. The thorium flows until it occupies the entire internal cross-section of the mold. A piece of thorium 30.5 millimeters long and having a diameter of 9.3 millimeters and weight of 23.15 grams will be found, after being treated in accordance with the foregoing process, to increase in density from 11.18 to 11.23.

Still another method of compacting the metal is to employ a succession of molds so graduated that the deformation in each will not be sufficient to cause cracking before the sides of the mold constrains the edges. This method, though satisfactory, is tedious and expensive.

Modifications of the invention may occur to those skilled in the art, but such modifications are contemplated as come within the spirit and scope of my invention as defined in the appended claims.

What is claimed is:

1. The method of compacting a rare refractory metal which comprises subjecting the metal in a coherent state to pressure and yieldingly restraining the flow of the metal while being pressed.

2. The method of compacting thorium and the like which comprises subjecting the metal in a coherent state to pressure and yieldingly restraining the flow of the metal while being pressed.

3. The method of compacting a rare refractory metal which comprises surrounding the metal in a coherent state with a material capable of yielding but which will restrain the flow of the metal and then subjecting the encased metal to pressure.

4. The method of compacting a rare refractory metal which comprises encasing the metal in a coherent state in a soft metal and then subjecting the metal and the casing material to pressure.

5. The method of compacting a rare refractory metal which comprises encasing the metal in a coherent state in lead and then subjecting the metal and the lead to gradually increasing pressure until the lead extrudes to a slight extent.

6. The method of compacting a rare refractory metal which comprises encasing a metal in a coherent state in lead, subjecting the encased metal to pressure, and then removing the lead.

7. The method of compacting thorium which comprises surrounding the thorium in a coherent state with lead, subjecting the two bodies to pressure of sufficient degree to produce the desired compactness, and then removing the lead.

In testimony whereof, I have hereunto subscribed my name, this 24th day of May, 1926.

WILLIAM BENJAMIN GERO.