W. D. COOLIDGE.

METHOD OF MAKING COMPOSITE METAL BODIES.

APPLICATION FILED AUG. 21, 1912.

1,162,339. Patented Nov. 30, 1915.

Fig. 1.

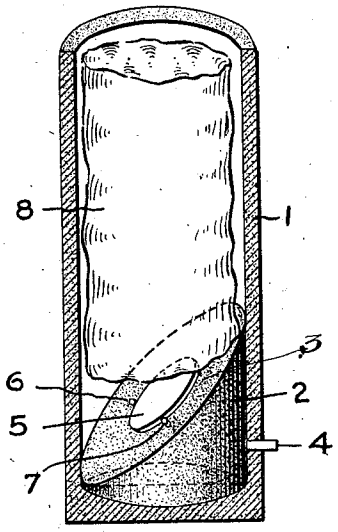
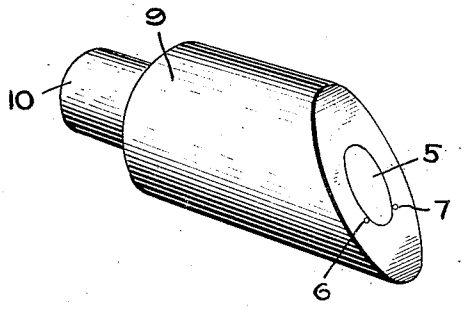


Fig. 2.



WITNESSES:
Margaret E. Hoolley
Adeline R. Grupe

INVENTOR:
WILLIAM D. COOLIDGE,
BY Albert G. Davis
HIS ATTORNEY.

UNITED STATES PATENT OFFICE.

WILLIAM D. COOLIDGE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF MAKING COMPOSITE METAL BODIES.

1,162,339. Specification of Letters Patent. Patented Nov. 30, 1915.

Application filed August 21, 1912. Serial No. 716,206.

To all whom it may concern:

Be it known that I, WILLIAM D. COOLIDGE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Methods of Making Composite Metal Bodies, of which the following is a specification.

My present invention relates to a process of joining metals. Though the method or process is of general application I find it particularly useful in making joints between copper or other low melting point metal and a body of material such as wrought tungsten, the qualities of which are apt to be injured if the body is submitted to an excessively high temperature.

One particular use to which my invention may be put is in the manufacture of X-ray targets in which a massive body of copper is commonly employed to which in some suitable way the target proper, usually of refractory metal, is fastened. This has heretofore been done by ordinary soldering methods, but these methods are objectionable.

My invention in one of its aspects consists of an X-ray target in which the active face is formed of wrought tungsten adhering to a mass of copper without intervening soldering material. In other words, the wrought tungsten is autogenously joined to the copper and this I accomplish in such a way that the tungsten itself is at no time heated to such a temperature as would impair the characteristics of the wrought metal. Where my invention is applied to the manufacture of such an X-ray target, I may proceed as follows, reference being had to the accompanying drawings in which—

Figure 1 illustrates an apparatus for carrying out my invention and Fig. 2 an X-ray target representing one form of embodiment of my invention.

I have found that it is possible under suitable conditions to cast copper into contact with a body of wrought tungsten so that, upon cooling, the copper will be found to have wet the surface of the tungsten and to be strongly adherent thereto. This has heretofore been done by me as set forth in my prior application, Serial No. 685,113, filed March 20, 1912, by placing the copper and the tungsten to be joined thereto in a suitable crucible or other container, and heating the parts in a vacuum furnace not only to the melting point of copper but to a very much higher temperature in order to drive out all of the gas in the copper so as to avoid oxidation of the surface of the tungsten which would otherwise interfere with the joining of the parts. Instead of heating the copper in a vacuum furnace as described the degasifying of the copper can be done by a boronizing process as set forth in U. S. Patent to E. Weintraub, No. 1,023,604, April 16, 1912, consisting for example in the addition to the copper either of boron or of boron oxid of a state of oxidation lower than the anhydrid, and heating the parts to a high temperature. Copper thus treated is homogeneous, free from blow-holes and sound in structure. While both of these methods serve effectively to produce good joints between the tungsten and the body of copper, they both have the disadvantage that the temperature necessary for the degasifying is so high as to impair the qualities of the wrought tungsten. To avoid this disadvantage, I degasify the copper or other metal separately, as by the use of the boronizing casting process above mentioned. The degasified copper is then cast into sticks or pieces of convenient size. These sticks or pieces are then placed in a mold along with the tungsten body into contact with which it is desired to cast the copper, and the mold and its contacts are placed in a vacuum furnace to avoid the action of oxygen and heated to the melting point of copper. The copper, already degasified, flows against and about the tungsten body, wets the surface thereof, and upon cooling will be found to have formed a perfect joint therewith. The wrought tungsten, not having been excessively heated by this method of procedure, retains its properties unimpaired or substantially so.

In Fig. 1 of the drawings, I have shown a mold intended especially for producing X-ray targets by this method.

The container or mold for the metal to be melted consists of a cylindrical vessel 1 closed at the bottom and made preferably of artificial graphite though other suitable material may be employed if desired. In the bottom of this mold or container, is placed a block of graphite 2 of cylindrical shape but having its top surface cut off at an angle, as indicated. This leaves the upper

surface 3 of the filler or block 2 of elliptical form corresponding with the desired shape and angle of the face of the target, which is cast in this mold. The filler or block 2 is held in place during the casting operation by a small pin 4, which passes through the wall of the mold 1 and enters a hole drilled in the block 2. This is for the purpose of preventing the block 2 from being floated out of the mold by the molten metal.

The small disk of wrought tungsten which is to form the active surface of the X-ray target is held in place, during the casting operation, on the center of the surface 3 of the block 2. This tungsten target proper is indicated at 5, and a convenient means for holding it in place may consist of two small pins 6 and 7 of tungsten wire held in corresponding holes drilled into the block 2 so that the disk 5 will be supported between them. The parts as thus described constitute the arrangement of the mold before the metal is inserted. The copper metal of which the body of the target is to be formed is previously prepared preferably in a piece which may be loosely inserted in the mold. The metal thus used is metal which has been previously degasified preferably by the use of the boron treating process referred to above. A piece of such metal in place ready for the melting operation is indicated at 8. The parts being thus assembled, the mold and its contents are heated in a vacuum furnace of any suitable form such as that disclosed in patent of Arsem, No. 785,535. Obviously, as many such molds may be heated at one time as may be desired and as the capacity of the furnace may permit, so that the process may be practised on a large scale. After the molds are placed in the vacuum furnace the temperature is raised until the copper is well melted but it is not raised any higher than necessary for this purpose so as to avoid injuring the wrought tungsten by depriving it more or less of the characteristics of density, strength, fibrousness and toughness due to its mechanical working. The copper having been melted as described fills the mold closely, wets the surfaces of the tungsten and runs into close contact therewith. Upon cooling and removal of the mold from the furnace the parts are readily disassembled and the cast member is then machined into suitable form such as indicated in Fig. 2. In this form the X-ray target is turned down to a cylindrical shape at 9 and with a shank 10 for attachment to the supporting means for the target. The tungsten surface of the target is indicated at 5 as before and the pins which support it during the casting operation are indicated, as before, at 6 and 7. These pins remain in the target and are machined off during the operation of smoothing up the face of the target.

While I have described my invention with particular reference to its application to the manufacture of targets of X-ray tubes, and while one of the embodiments of my invention consists of a target so made and having the novel properties not heretofore obtained, my invention is nevertheless applicable for many other purposes where a body of metal such as copper is to be provided with a working surface say of wrought tungsten, as in the manufacture of electrical contacts and the like, and I therefore do not wish to be limited to the exact details as set forth herein.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The method of producing a composite metal body, one of the metals being a wrought metal and the other having a melting point of relatively low value, which consists in degasifying the low melting point metal and after it has been degasified bringing it while in a molten condition into contact with the wrought metal, at a temperature not materially higher than the melting point of the degasified metal.

2. The method of producing a composite metal body, one of the metals being a wrought metal, and the other having a melting point of relatively low value, which consists in degasifying the low melting point metal and after it has been degasified bringing it while in a molten condition into contact with the wrought metal in a vacuum, at a temperature not materially higher than necessary to secure fluidity of the degasified metal.

3. The method of producing a composite metal body, one of the metals being wrought tungsten, and the other having a melting point of relatively low value, which consists in degasifying the low melting point metal and after it has been degasified bringing it while in a molten condition into contact with the wrought tungsten, the temperature of the molten metal being not substantially greater than that necessary to secure fluidity of the metal.

4. The method of casting copper into contact with wrought tungsten which consists in first degasifying the copper, and then bringing the copper thus degasified, at a temperature not materially above the melting point of copper, into union with the wrought tungsten, whereby a composite metal body is produced.

5. The method of producing a composite metal body, one of the metals being a wrought metal, and the other a relatively low melting point metal which consists in bringing the low melting point metal into union with the wrought metal at a temperature not materially higher than that of the melting point of the lower melting point metal, the low melting point metal having

been previously degasified whereby the wrought metal is not at any time during the process brought to a temperature higher than that corresponding to about the melting point of the low melting point metal.

6. The method of producing a composite metal body, one of the metals being of wrought tungsten, and the other of copper which consists in bringing the copper into union with the wrought tungsten at a temperature not materially higher than that of the melting point of the copper, the copper having been previously degasified, whereby the wrought tungsten is not at any time during the process brought to a temperature higher than that corresponding to about the melting point of the copper.

7. The method of uniting wrought tungsten with copper, while retaining the physical properties of the wrought tungsten, which consists in first treating the copper with oxidizable boron material to degasify the copper and then bringing the copper in a molten condition into contact with the tungsten in a vacuum at a temperature not substantially higher than that necessary to secure fluidity of the copper.

In witness whereof, I have hereunto set my hand this 20th day of August, 1912.

WILLIAM D. COOLIDGE.

Witnesses:

BENJAMIN B. HULL,

MARGARET E. WOOLLEY.