

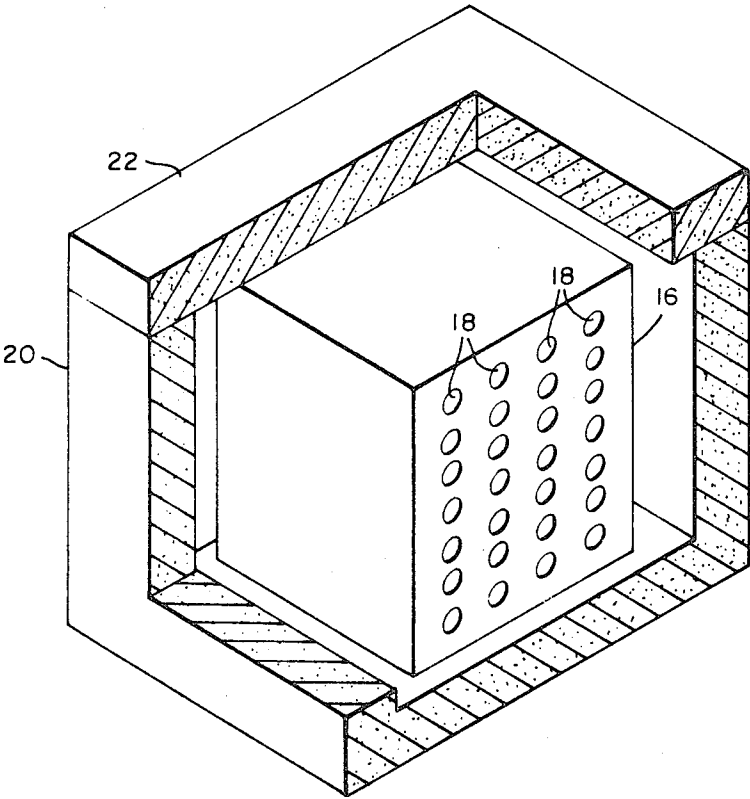
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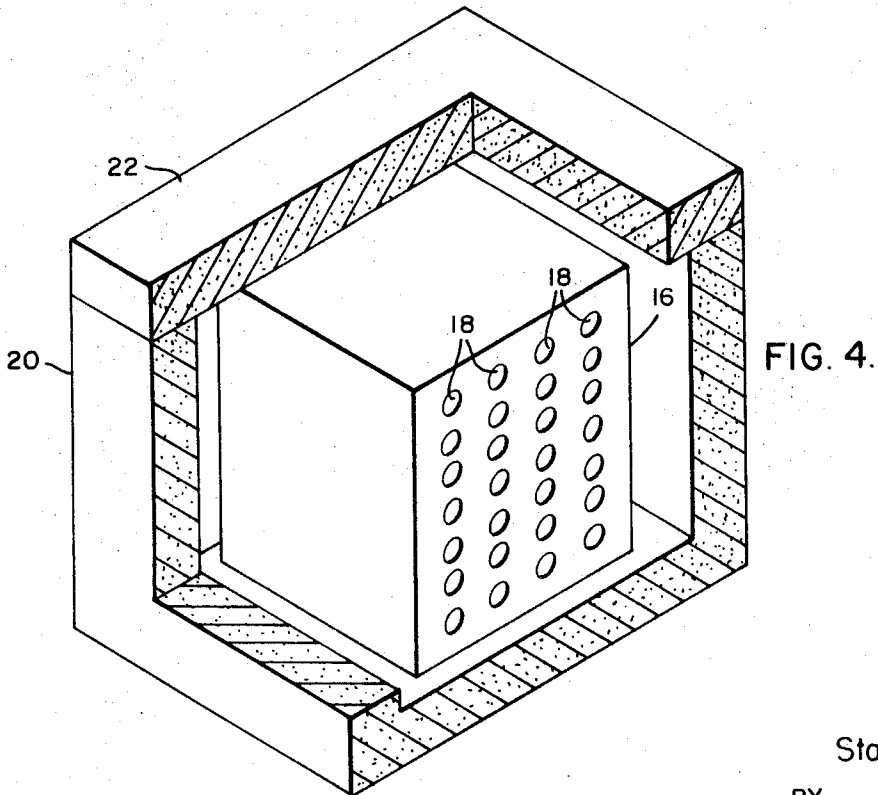
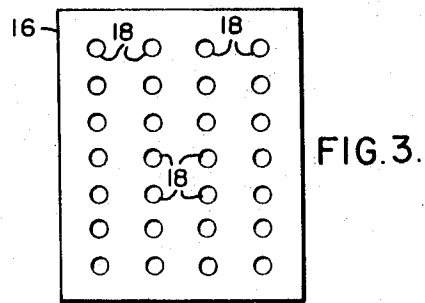
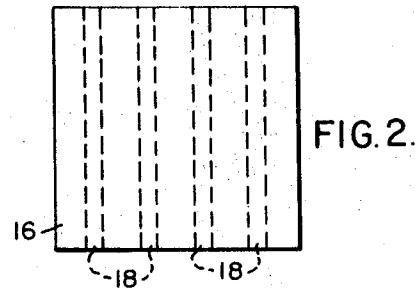
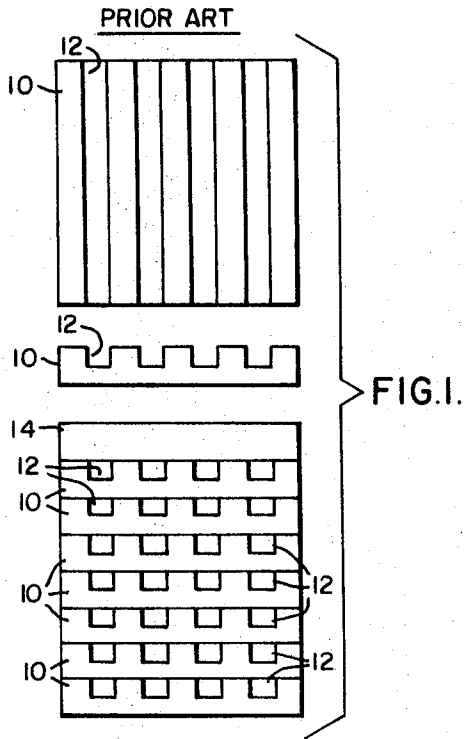
[56] References Cited
UNITED STATES PATENTS
2,410,060 10/1946 Goodale 148/13.1
3,411,959 11/1968 Corth 148/13.1
Primary Examiner—Gerald A. Dost
Attorneys—A. T. Stratton, W. D. Palmer and Blair Studebaker

[54] CARBON MOLD FOR MANUFACTURE OF
TANTALUM CARBIDE FILAMENTS
4 Claims, 4 Drawing Figs.

[52] U.S. Cl. 266/5,
148/13.1
[51] Int. Cl. C21d 1/06
[50] Field of Search 266/2, 5;
148/13.1, 13.2

ABSTRACT: A mold form for use in the carbiding of filament coils which substantially comprise tantalum and which mold form comprises a carbon block having a plurality of cylindrical bores therethrough. Each of the cylindrical bores are of a diameter only slightly larger than the external diameter of the filament coil which it is adapted to receive.





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CARBON MOLD FOR MANUFACTURE OF TANTALUM CARBIDE FILAMENTS

BACKGROUND OF THE INVENTION

This invention relates to the carbiding of tantalum and tantalum alloy coil filaments and more particularly to a mold form for use in the carbiding operation. The process of carbiding tantalum and tantalum alloy filaments for incandescent lamps is well known and is becoming more prominent in the manufacture of high output projection lamps. One method for carbiding tantalum and tantalum alloy filaments is described in detail in U.S. Pat. No. 3,411,959 entitled Method For Producing Tantalum Carbide and Tantalum-Alloy Carbide Filaments by Richard Corth which is owned by the assignee of this application. An alternative method of rapidly carbiding tantalum or tantalum alloy parts is disclosed in application Ser. No. 698,962 filed Jan. 18, 1968, which application is also owned by the assignee of the instant application.

In each of the aforementioned methods the tantalum or tantalum alloy member is supported in a firing container consisting essentially of carbon which forms alone or in conjunction with nitrogen the only component or components which will react with the tantalum during the carbiding process.

Because of its extreme brittleness it is almost impossible to fabricate tantalum carbide or tantalum alloy carbide wire into filaments and the metallic wire must therefore be fabricated into its final coil configuration prior to carbiding. Carbiding in a carbon block as disclosed in the above-referenced U.S. Pat. is a substantial improvement, from a commercial standpoint, to carbiding the filament after it is mounted in a completed lamp. It has been found, however, that the specific mold form employed in the prior art practice is not wholly satisfactory. The prior art mold form includes a slotted carbon tray or rack in which coils are placed in the slots and then covered with a flat carbon slab or the flat bottom of a second carbon tray or rack which in conjunction with several such trays or racks are stacked in layers and wired together to form the entire mold. This wired mold form is then placed in a carbon crucible. During diffusion of the carbon into the tantalum tantalum alloy material a volume expansion of about 10 percent occurs and it is necessary to restrain the filament to some extent during this expansion so that distortion caused thereby is minimized. It has been further found that the slotted, layered, carbon block of the prior art permits some distortion because of inconsistency between the coil cross-sectional area and the slot cross-sectional area. In almost every instance some of the coils fabricated in each run using the prior art container are not suitable for use in lamps due to distortion with respect to the longitudinal axis of the coil which occurs during the carbiding of the material.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a carbon mold form which will produce straighter and more uniform coils during the carbiding operation.

It is another object of this invention to provide a carbon mold form at significantly lower cost.

It is a further object of this invention to provide a mold form for the carbiding of tantalum and tantalum alloy filaments which experiences more uniform mold wear and therefore results in longer mold form life.

The foregoing objects and others are accomplished in accordance with the present invention by providing a mold form for use in the carbiding of tantalum and tantalum alloy filament coils which comprises a carbon block having a plurality of cylindrical or tubular bores therethrough, each of which is of a diameter only slightly larger than the external diameter of the filament coil.

BRIEF DESCRIPTION OF THE DRAWING

The above recited objects, and others, along with many of the attendant advantages of the present invention will become more readily apparent and better understood as the following detailed description is considered in connection with the accompanying drawings, in which:

FIG. 1 is illustrative of the prior art and includes top and side views of a single tray and an end view of a seven tray stack;

FIG. 2 is a top view of the carbon mold of the present invention;

FIG. 3 is a side elevational view of a carbon mold form constructed in accordance with the present invention; and

FIG. 4 is an isometric view partly broken away illustrating the mold form of the present invention disposed in a heating position in the carbon crucible.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the carbiding of tantalum and tantalum alloy filaments the filament is first supported in a carbon firing container. In accordance with the one method, the carbon firing container containing the tantalum or tantalum alloy filaments is rapidly heated in a vacuum or inert gas atmosphere to about 1,500° C. to stress relieve the wire. Immediately after stress relief the carbon firing container is heated in a carbon crucible in an atmosphere consisting essentially of carbon as the only reactive constituent and argon as the only inert constituent, at a temperature which is below the eutectic melting temperature of the tantalum-carbon (2,800° C.) but which is sufficient to cause carbon to diffuse into the filament in an amount less than that required to form stoichiometric tantalum carbide. The firing container is then rapidly heated to a final heating temperature in excess of the melting temperature of the eutectic but less than the melting temperature of the now partially carbided filament. This final heating temperature is maintained for a predetermined period of time which is sufficient to cause additional carbon to diffuse into the filament to form a stoichiometric tantalum carbide. An alternative method is to heat the carbon firing container containing the tantalum or tantalum alloy coils to a temperature of at least about 1,800° C. with this heating atmosphere consisting essentially of carbon and nitrogen as the reactive gaseous constituents. In accordance with this method the heating is continued until the filament reaches a gold color. The addition of nitrogen has been found to have a significant effect in promoting the carbiding but the ratio of nitrogen to inert gas is not particularly critical. This ratio of nitrogen to inert gas is preferably somewhere between from about 10/90 to about 60/40.

As has been previously noted the foregoing methods have been accomplished by employing a carbon mold form preferably formed of graphite and constructed as illustrated in FIG. 1. This prior art mold form consisted of a plurality of trays or support members 10 which contained a plurality of slots or grooves 12 therein. In practicing the aforementioned processes the filament coils were placed in the slots 12 in a tray 10 and a second tray placed over the first to thereby enclose the coil throughout its longitudinal extent. After several of the trays were filled and stacked a top cover plate 14 was placed over the top tray to cover the uppermost slots 12 and the entire stacked structure wired together prior to the placing of the mold into the carbon crucible.

Referring now to FIGS. 2 and 3, there is illustrated the carbon mold form of the present invention which is preferably a graphite block 16 having a plurality of tubular apertures 18 bored therethrough. Each of the tubular apertures 18 extend entirely through the block 16 and are preferably of a diameter just slightly in excess of the diameter of the tantalum or tantalum alloy filament coils which are to be carbided. The necessity for the tubular apertures 18 being slightly larger than the coil filament diameter is two-fold. During the heating of the filament to produce the infusion of carbon into the tantalum or tantalum alloy coil the metal will necessarily expand. A suf-

sufficient differential in diameters must be provided to allow for such expansion but not permit coil distortion, for example, about 6 percent. In addition, the diameter of the filament coil will be slightly, almost immeasurably increased due to the infusion of carbon therein and therefore sufficient clearance must be available to remove the carbided tantalum filament from the apertures after the filament coils are cooled. The internal diameter of the aperture or bore should not be more than 10 percent greater than the external diameter of the filament coil. Preferably the internal diameter of the bore should be about 6 percent greater than the external diameter of the filament.

As a specific example it has been found that for carbiding tantalum or tantalum alloy filament coils having an outside diameter of 0.050 inch, it is necessary that the diameter of the tubular bore be about 0.053 inch to permit the filament coils to be withdrawn after the carbiding process has been accomplished.

With the rectangular slots of the prior art mold forms filament coils will necessarily deform during expansion because of the noncircular aspect of the aperture as well as the excessive clearance in certain areas with respect to the filament coil diameter.

FIG. 4 illustrates a carbon block mold form 16 having tubular apertures or bores 18 therethrough and which is disposed in a carbon crucible which comprises a box form 20 and a lid or closure member 22.

As described previously the coils are inserted in each of the apertures 18 in the carbon block 16 and the carbon block is

then placed in the crucible 20 and the lid 22 of the crucible closed. After the appropriate heating cycle in either a carbon or a carbon-nitrogen atmosphere, the crucible is cooled to room temperature and the coils will have returned from their expanded configuration to substantially their original configuration and they then may be removed from the apertures 18.

The mold form of this invention is far cheaper to manufacture than the prior art multirack, stacked molds. The coils produced by use of the new mold form are much straighter and more uniform and a portion of each run does not have to be scrapped due to excessive distortion. In addition, the mold form wears uniformly and therefore results in a longer mold life.

I claim:

1. A mold form for use in the carbiding of filament coils which substantially comprise tantalum and which mold form comprises a carbon block having a plurality of cylindrical bores therethrough, the diameter of said cylindrical bores being only slightly larger than the diameter of the filament coils to be carbided therein.

2. A mold form according to claim 1 wherein the diameter of said cylindrical bores is less than 10 percent greater than the diameter of the filament coils to be carbided therein.

3. A mold form according to claim 1 wherein the diameter of said cylindrical bores is about 6 percent greater than the diameter of the filament coils to be carbided therein.

4. A mold form according to claim 1 wherein said carbon block is graphite.