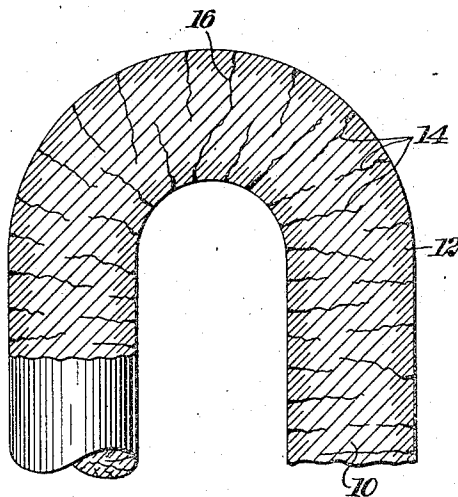
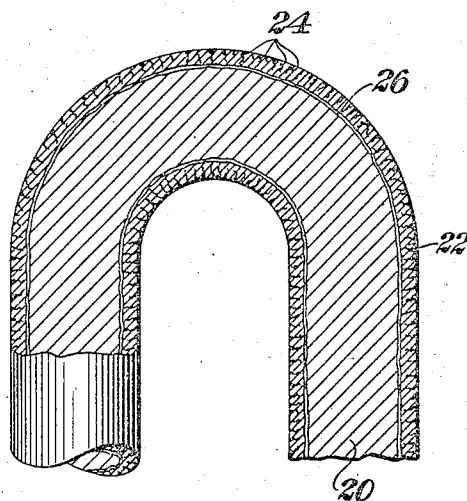


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CARBURIZED FILAMENT AND METHOD
FOR TREATING THE SAME
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2,450,007

Fig: 1.*Fig: 2.*

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CARBURIZED FILAMENT AND METHOD FOR
TREATING THE SAME

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1 Claim. (Cl. 250—27.5)

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This invention relates to improvements in carburized filaments and methods for treating the same, and more particularly to an improved method for reducing the brittleness of carburized tungsten filaments.

An object of this invention is to provide a pliable carburized tungsten filament.

Another object of this invention is to provide a method for reducing the brittleness of any carburized wire.

Still another, more comprehensive object of this invention is directed to a method for re-straightening carburized tungsten filaments.

Further objects and advantages of the present invention will become apparent from the following description of a preferred method, illustrated by way of example in the accompanying drawing, in which:

Fig. 1 is a cross-section of an untreated carburized tungsten wire; and

Fig. 2 is a similar cross-section of a tungsten wire treated in accordance with the method of this invention.

The carburization of tungsten or thoriated tungsten filaments is a step which has become common practice in the filament art. After the filaments have been formed they are heated in a carburizing atmosphere resulting in a thin layer of carburized tungsten surrounding an inner core of relatively pure metal. In most instances, however, the carburization process tends to distort the filaments so that a re-straightening of the same is necessary. Before such re-straightening process the filaments have a tendency to break since they have become brittle. The reason for this brittleness and breakage, apparently, is that small cracks and fissures are formed in the outer carburized layer which extend through this layer and terminate on the virgin metal beneath. Cold bending of the wire results in high local stresses at the roots of the cracks, the stresses on the core reaching limiting values sufficient to cause breaking thereof, and accordingly, a breaking of the entire filament. Fig. 1 illustrates, in a greatly enlarged cross-section, such a filament having an inner core 10 and a carburized layer 12. The cracks 14 appearing in the carburized layer 12 are shown as extending into the core 10, particularly where the wire is sharply bent resulting, in certain instances, in a through crack such as indicated at 16.

According to the method of the present invention the effective brittleness of the filament is reduced and breakage is prevented by flashing or otherwise heating the carburized filament in a

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medium inert to the carburized filament, for example, a gas such as hydrogen or helium, and bending the filament into shape while the same is still hot and is still in the inert medium. This heating of the filament makes the inner core too ductile to break and the moving of the wire resulting from the re-straightening of the filament while hot results in shearing stresses which tend to separate the core from its outer carburized sheath. The net result of this lamellar fracture is that stresses resulting from the radial fractures in the carburized layer are no longer localized and core fracture liability is accordingly reduced. Additionally, the hydrogen flash after carburization appears to alter the crystal structure of the carbide layer and, after bending, viewed under the microscope the layer shows a very marked fine grain fracture pattern, the whole surface being "crazed." It might be said that in the case of the treatment according to the present invention, the carbide layer acts as a true coating, whereas in the case of untreated wire it is merely a fractured surface applying stresses to the inner core at relatively few cleavage points. The minute "crazing" accordingly prevents localization of stresses at a few selected points, and hence under distortion, such as bending, the core in addition to now being more ductile is not subjected to as high localized stresses.

A filament which has been treated in accordance with the present invention is illustrated by way of example in Fig. 2. It shows an inner core 20 of substantially virgin metal surrounded by an outer tungsten carbide layer 22 filled with a relatively large number of minute cracks 24. The lamellar separation between the outer layer 22 and the core 20 is indicated on an exaggerated scale at 26. This separation between the outer layer and core also prevents the cracks 24 from extending into the inner core 20, in contrast to the direct penetration of the cracks, as illustrated in Fig. 1.

While the principles of this invention are particularly useful in connection with the formation of carburized tungsten filaments, and more specifically, the step of re-straightening such filaments, it is apparent that the method in its produced aspect is applicable for reducing the brittleness of any carburized wire, whether used for a filament or for some other purpose.

Accordingly, while I have described above the principles of my invention in connection with a certain specific application, it is to be clearly understood that this description is made only by

Way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claim.

What is claimed is:

A wire for mounting in an electronic discharge device consisting of a tungsten-containing core surrounded by an outer layer of thoriated tungsten carbide having a crazed surface and no connection other than surface contact connection with said core.

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