

UNITED STATES PATENT OFFICE

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ALLOY

No Drawing.

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This invention relates to alloys for the manufacture of resilient wire, and particularly to an alloy which may be used in the manufacture of wire to resiliently support the ends of the filament in a radio vacuum tube.

A resilient support for the filaments of vacuum tubes must be made of such material that it will maintain its resiliency under considerable heat and at the same time be free of occluded gases and subject to a minimum of deterioration during the operation of the tube. Such a wire must also be readily workable so that it can be bent up into proper shape, such as a hook for supporting the end of the filament.

Heretofore it has been difficult to find a wire which would answer all of the requirements, inasmuch as the wire was either too brittle and considerable waste was encountered due to breakage of the wire when bending it into the proper form, or the wire was not resilient enough to maintain the proper tension on the filament, or it was not suitable to be used in a vacuum tube for other reasons, such as the evolution of gases which might interfere with the operation of the tube.

It is therefore one of the objects of the invention to provide an alloy which may be readily worked and drawn and which will maintain its resiliency under relatively high temperatures and at the same time be free of occluded gases.

Other objects of the invention will be apparent as the description thereof proceeds.

The alloy comprising the invention is composed of molybdenum, tungsten and chromium, the latter two being in relatively small proportions. In manufacturing the wire out of this alloy, I first take a quantity of powdered molybdenum and add to it a small percentage of tungsten and about one per cent of chromium, all of these metals being in powdered form, or I may mix the first two as reducible compounds, reducing them together before adding the chromium which forms a more intimate mixture. The three metals are then thoroughly mixed, as in a ball mill, until they are evenly distributed

throughout the mass, whereupon the metal thus formed is placed in a die and put into a hydraulic press where it is subjected to a pressure of some forty tons. This compresses the metal into an ingot or slug which resembles a solid bar of metal but which is more or less brittle, due to the fact that the particles of metal are only physically bonded together. The slug is then placed in a furnace and a high current of preferably over 700 amperes is run through it, raising the temperature to a considerable degree which sinters the metals so that adjacent corners of the particles flow slightly into each other, causing greater adherence of the particles, while still they do not completely flow into each other to form a solid metal slug.

The slug, having been sintered, is now free to be worked, and I pass it through several swaging machines to successively decrease its diameter and increase its length, maintaining a high temperature at the same time, and when the length becomes such that it is inconvenient to swage it, I pass the metal through a succession of drawing dies until the diameter has been decreased to the size of wire desired, which is somewhere in the neighborhood of ten thousandths of an inch. The wire, of course, is heated before it passes through each die to maintain it at red heat during the drawing operation.

Any desired amount of tungsten may be used, but I have found that good results are obtained by using in the neighborhood of ten per cent of the whole in the first mixing step wherein molybdenum and tungsten are reduced, although I do not desire to limit the amount to this figure. The amount of chromium added depends considerably upon the size desired for the finished wire. I have found that one per cent of the entire mixture permits drawing of very fine wires, while if the percentage of chromium is increased it becomes more and more difficult to draw the wire down to the smaller sizes. The chromium may be added, therefore, in amount depending on the size desired, for ordinary requirements not exceeding five per cent.

The wire thus formed is resilient and very hard but still may be bent about small radii

and otherwise worked without breaking it. The wire is readily adapted to be used in vacuum tubes, inasmuch as it does not occlude gases or tend to deteriorate in the normal operation of the tube.

Having thus described the invention, what I desire to secure by Letters Patent is:

1. An alloy consisting of ninety per cent by weight of molybdenum, nine per cent by weight of tungsten, and one per cent by weight of chromium.

2. An alloy consisting of approximately 90% by weight of molybdenum, 5 to 9% by weight of tungsten, and 5 to 1% by weight of chromium.

In testimony whereof, I affix my signature.

ALBERT E. MacFARLAND.