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P. G. CHEVIGNY

2,397,533

METHOD OF MAKING CATHODES

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Fig. 1.

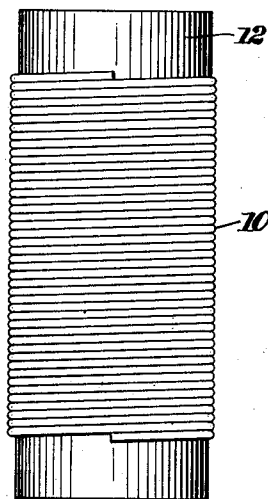


Fig. 2.

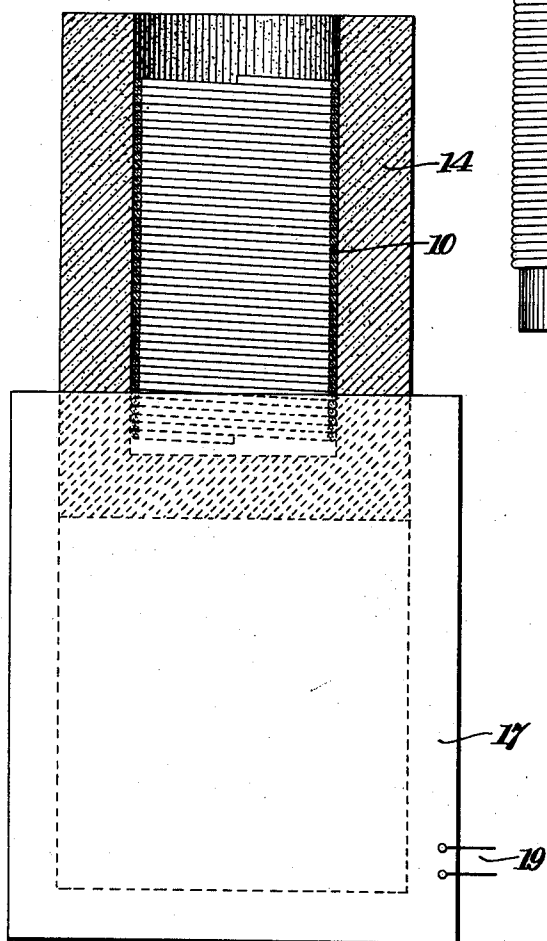
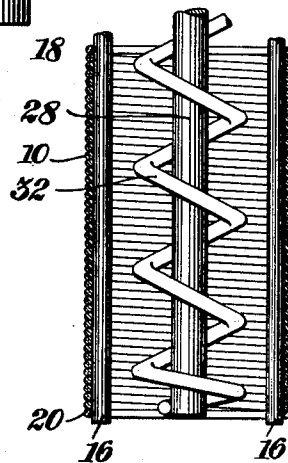


Fig. 3.



INVENTOR.
PAUL G. CHEVIGNY

BY

Charles E. Rumpf
ATTORNEY

UNITED STATES PATENT OFFICE

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METHOD OF MAKING CATHODES

Paul Georges Chevigny, New York, N. Y., assignor to Federal Telephone and Radio Corporation, Newark, N. J., a corporation of Delaware

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5 Claims. (Cl. 148—13.1)

This invention relates to improvements in methods of making cathodes, and more particularly to the setting and carburization of spiral thoriated tungsten cathodes adapted for use in vacuum tubes and the like.

The primary object of my invention is to provide a simple method for pre-setting and carburizing a spiral tungsten cathode with a minimum amount of distortion, so that the final carburized cathodes will be dimensioned within relatively accurate limits.

Other objects and advantages of the present invention will appear from the following detailed description thereof, taken in connection with the accompanying drawing in which:

Fig. 1 is a vertical view illustrating the step of winding a cathode on a mandrel;

Fig. 2 is a vertical view partly in section, showing the cathode in a carburizing sleeve and partially within a heating device;

Fig. 3 is a vertical cross-sectional view showing the mounting of the finished spiral cathode on its supporting structure.

In accordance with the proposed method of forming spiral cathodes, it is desirable before carburization, to set the spiral winding in its final form as much as possible. To effect such setting, the winding 10 which may be of thoriated tungsten wire is wound upon a suitable mandrel 12 which is preferably, but not necessarily, formed of molybdenum. The mandrel 12 has an outside diameter equal to the desired inside diameter of the final cathode and the length of the cathode is determined by the number of turns wound on the mandrel. The turns may be either closely spaced, as illustrated in Fig. 1, or more widely spaced, as desired. After the wire is wound on the mandrel 12 to form the cathode 10, the mandrel is heated to a temperature of approximately 2000° C. in a hydrogen atmosphere. This heating may be accomplished in any suitable manner but preferably by the heating effect of induced high frequency currents.

After the cathode 10 has been set, the spiral structure is slid into the smooth bore of a graphite sleeve 14. The sleeve is coated with a colloidal solution of graphite in water known as "Aquadag," and the whole structure is dipped into this "Aquadag" or coated inside with the same material. The graphite sleeve 14 together with the enclosed cathode 10 is then placed into a suitable heating device 17 which may be a high frequency coil supplied with power through leads 19 and again heated in a hydrogen atmosphere to a temperature of approximately 2000° C. This

heat is maintained until a carburization of at least 40% is obtained. The enclosing graphite sleeve 14 prevents radial expansion and distortion of the cathode during the heating operation.

After the cathode has been carburized it can be removed from the sleeve as a carburized self-supporting cathode structure of predetermined dimensions. This permits cathodes of this type to be easily and quickly mounted upon suitable supports in vacuum tubes and the like. Fig. 3 illustrates a preferred arrangement for mounting such a pre-set, carburized cathode. I have there shown a plurality of supporting rods 16 whose common outer circumference is equal to the inner circumference of the finished cathode. A ring 18 is rigidly attached near one end of the supporting rods 16, of which there may be, for example, four in number. The spiral cathode 10 is then slid over the rods 16 until one end rests against the ring 18. A second ring 20 is then slid over the rod 16 against the other end of the cathode spiral 10 and rigidly attached to the supporting rods. The cathode 10 is thus rigidly held in place on the rod 16 against endwise motion between rings 18 and 20 and will have no radial movement by virtue of the close fit of the spiral about its supporting rods. Within the cathode 10 there may be provided a central supporting rod 28 carrying a filament winding 32 for energizing the cathode by radiation or by bombardment.

As previously mentioned, while the cathode spiral 10 has been illustrated as a closely wound spiral, the invention is equally applicable to the making of cathode structures in which the turns are spaced from one another, for example, the turns may be spaced so that a composite cathode formed of two or more interwound spirals could be formed, with the result that the final cathode structure would have a substantially continuous emitting surface similar to that of a single closely wound cathode. The formation of a cathode with closely wound turns forming a continuous emitting surface is particularly advantageous where the cathode is to be energized from an enclosed filament by bombardment.

The particular manner of mounting the cathode made in accordance with the method of the present invention and described above, forms no part of the present invention, but is more fully described in my copending application S. N. 474,968, filed February 2, 1943.

While I have described with some particularity the specific steps in making a cathode in accordance with the preferred method of the present

invention, and furthermore, in connection with the making of a certain type of spiral cathode, it is contemplated that the invention is applicable to the making of other types of spiral cathodes and that the method may include various changes and modifications as will be apparent to those skilled in this art.

I claim:

1. The method of making a spiral cathode which includes the steps of winding the cathode into the desired shape on a mandrel, setting the winding, removing the set winding from the mandrel and coating it with a colloidal graphite solution, covering the inside of a smooth graphite sleeve with the colloidal graphite solution, sliding the winding into the sleeve, heating the sleeve in a hydrogen atmosphere until a 40% carburization of the cathode is obtained, and then removing the cathode from the sleeve.

2. The method according to claim 1, in which the step of setting the cathode is effected by set-

ting the mandrel in a hydrogen atmosphere at a temperature of approximately 2000° C.

3. The method according to claim 1, in which the sleeve is heated to about 2000° C.

4. The method according to claim 1, in which the step of setting the cathode is effected by heating the mandrel in a hydrogen atmosphere at a temperature of 2000° C., and in which the sleeve is heated to about 2000° C.

5. The method of making a spiral cathode, which includes the steps of winding the cathode into the desired shape on a mandrel, setting the winding, removing the set winding from the mandrel and coating it with a colloidal graphite solution, covering the inside of a smooth graphite sleeve with the colloidal graphite solution, sliding the winding into the sleeve, heating the sleeve in a hydrogen atmosphere for carburizing the cathode, and then removing the carburized cathode from the sleeve.

PAUL GEORGES CHEVIGNY.