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METHOD FOR SECURING STRUCTURES IN PRECISE GEOMETRIC RELATIONSHIP

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FIG. 1

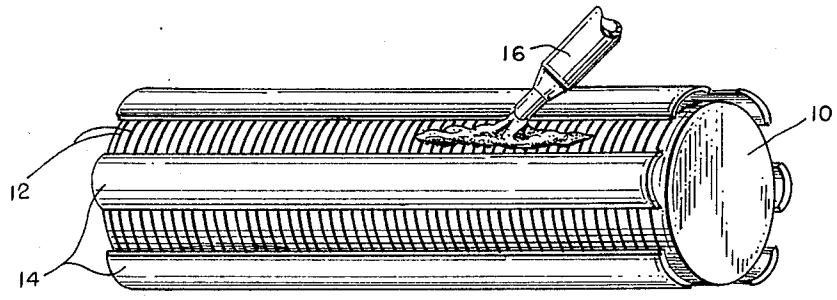
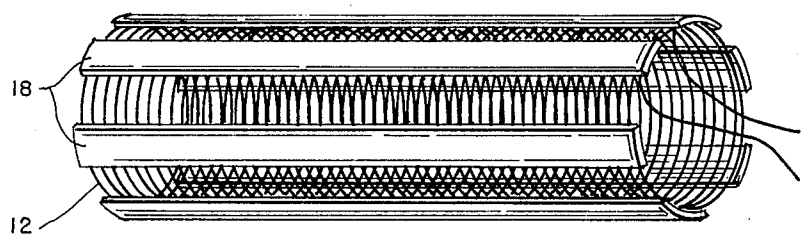


FIG. 2



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METHOD FOR SECURING STRUCTURES IN PRECISE GEOMETRIC RELATIONSHIP

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9 Claims. (Cl. 29—155.5)

This invention relates to supports for wire components and more particularly to the support of multi-filar helices for use in travelling wave tubes.

In travelling wave tubes, it is often necessary to utilize a multi-filar helix having a large ratio of helix diameter to wire diameter. For optimum operation, such helices must be accurately wound and maintained in a rugged and precise geometrical arrangement. A rigid support must be provided for the helix if the desired configuration is to be maintained during tube operation.

It is an object of the present invention to provide a wire coil which is firmly positioned and which affords a very high degree of precision in maintaining spacings, and exceptional ruggedness.

To provide a helix assembly in accordance with the invention, the wire conductor is first wound on a firm temporary supporting structure such as a mandrel provided with peripheral grooves. The conductor is wound in a manner to provide the desired helical configuration and the mandrel serves as a supporting structure for achieving this configuration. In addition, it is important that the supporting structure be of a material which is soluble in a solvent which does not affect the conductor material. It is convenient to use a supporting mandrel made of aluminum which is soluble in concentrated sodium hydroxide or hydrochloric acid solutions. Silver, copper, gold, tungsten, platinum and molybdenum are among the typical materials which can be used as the wire conductor. Thin masking details are placed against the helix extending along the supporting structure and fastened in place there. The proper choice of configuration of the masking details depends upon the extent of support necessary for the helix. The masking details should be of a material such as aluminum which is soluble in the same way as the supporting mandrel. Bands of dense alumina or other suitable ceramic are then deposited on the exposed portions of the helix by means of a plasma-jet torch.

Referring now to the drawing, there is shown in FIG. 1 an assembly which includes the temporary supporting structure or mandrel **10**, the helix **12** and the masking strips **14**. A ceramic material is then deposited upon the exposed portion or bands of the helix **12** by means of a plasma-jet torch indicated at **16**. The ceramic material may comprise alumina, forsterite, zirconia, glass or any other suitable ceramic materials. The ceramic material from the plasma-jet torch is applied until the thickness of the ceramic is built up to approximately .030 inch. After the structure has been embedded in the ceramic material, the masking strips **14** are removed and the mandrel **10** is removed by selectively dissolving it away. As hereinabove noted, the aluminum mandrel can for example, be removed by dissolving it in concentrated sodium hydroxide or hydrochloric acid solution. Removing the mandrel **10** leaves the resultant assembly as an unstressed rigid

mechanical structure and is shown in FIG. 2 with the ceramic coated portions shown at **18**. It can be appreciated that the resultant unit provides a helix of a configuration which substantially reproduces the precision of the helix as originally wound on the mandrel **10**. At no stage in its manufacture has the original configuration been materially disturbed and at all times there has been firm support therefor. The resultant assembly shown in FIG. 2 has proved to be extremely rugged. Measurements on the assembly shown in FIG. 2 have indicated that it can withstand vibration up to 150 g. in a mode perpendicular to the axis of the helix with only 0.8% change in diameter. Electrical breakdown strength was measured in vacuum at 250 v./mil between turns. It was also found that RF losses in this assembly may be held to a minimum by reducing the width of the ceramic bands.

The technique hereinabove described may also be applied to other precise support functions such as electron guns or vaned RF structures or other similar arrays of small components which can be held together by bands of material.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is therefore aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. The method for constructing a helix assembly comprising the steps of

winding a wire in a prescribed helical configuration on a support,

placing longitudinal masking details around the helix and the support and exposing longitudinal strips thereof,

coating said helix and support with a ceramic material to a thickness such that the helix and support are imbedded in said ceramic material, and removing said masking details and said support.

2. The method in accordance with claim **1** wherein said ceramic material is deposited with a plasma-jet torch.

3. The method in accordance with claim **2** wherein said ceramic material is alumina and the thickness of said coating is approximately .030 inch thick.

4. The method in accordance with claim **2** wherein said ceramic material is forsterite.

5. The method in accordance with claim **2** wherein said ceramic material is zirconia.

6. The method for constructing a helix assembly comprising the steps of

winding a wire in a prescribed helical configuration on a support,

placing a plurality of masking details around the helical wire and the support for covering a portion of the helical wire and the support and exposing narrow longitudinal strips of the helical wire and the support between successive masking details,

imbedding the helical wire and the support in a ceramic coating,

removing the masking details and dissolving the support.

7. The method in accordance with claim 6 wherein said support comprises an aluminum mandrel and said mandrel is dissolved in sodium hydroxide.

8. The method in accordance with claim 6 wherein said helical wire is copper, said support comprises an aluminum mandrel, and said mandrel is dissolved in a hydrochloric acid solution.

9. The method in accordance with claim 8 wherein said ceramic coating consists of alumina deposited by means of a plasma-jet torch to a thickness of .030 inch.

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