

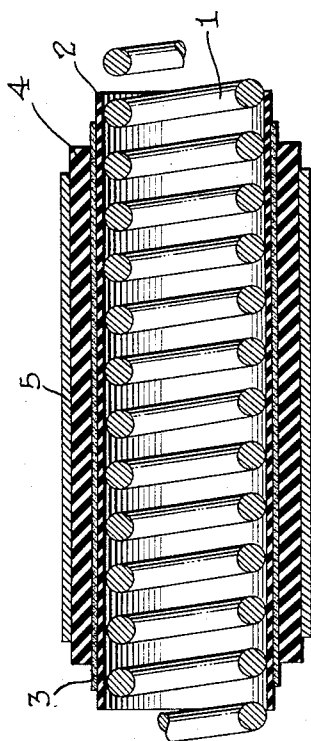
Nov. 3, 1959

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2,911,599

ATTENUATION FOR TRAVELING-WAVE TUBES

Filed April 14, 1954



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2,911,599

ATTENUATION FOR TRAVELING-WAVE TUBES

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Application April 14, 1954, Serial No. 423,076

Claims priority, application Germany April 18, 1953

1 Claim. (Cl. 333—31)

This invention relates to traveling wave tubes and particularly to the attenuation means employed with the wave transmission circuit.

It is known practice to provide a certain minimum attenuation in the wave transmission medium of traveling wave tubes, in order to safely avoid oscillation. At the same time with respect to noise-free traveling wave tubes and other power tubes, the total attenuation of the transmission circuit is not sufficiently produced by a homogeneously distributed attenuation material, but to obtain the desired attenuation there is in addition incorporated certain lumped attenuating materials. For this purpose a number of suggestions have been made which however have been found to be incapable of producing exactly reproducible and satisfactory attenuation values which do not change or are not affected by acceleration of the tube. These proposals are principally concerned with the idea of increasing the attenuation by shunting certain sections of the transmission circuit or line by lossy materials, that is substances of moderate conductivity which convert a predetermined amount of the wave as it passes through the transmission circuit into heat. In cases where the transmission circuit consists of a wire coil, according to known practice a tight fitting glass pipe provided on the inside with a thin layer of carbon, or cylindrical pieces of insulating material provided on their inner wall with a layer of carbon, are pushed over the coil. The indefiniteness of the contact between the carbon and the coil is regarded as a major disadvantage of this method. If the coil fits very exactly into the carrier of the carbon layer then the layer will be damaged at the contacting points when the coil and its carrier are assembled. If for this reason the inner diameter of the carrier of the carbon layer is made larger, then the relative position of the layer to the coil is undefined. In both of these cases, the attenuation value is sensitive to vibrations and may readily change.

For this reason according to the present invention, it is proposed to provide a capacitive coupling between the lossy layer and the coil, instead of a galvanic connection. For this purpose, thin dielectric supporting layers are inserted between the layer and the coil. The coil supporting pipe can be provided with a carbon layer from the outside, but according to experiments made, this has resulted only in slight increases of the attenuation because the lossy carbon layer is arranged in the marginal regions of the electromagnetic coil field. At the same time the dielectric acts as a shield or screen for this field.

In accordance with the present invention it is proposed to surround the coil over a predetermined section thereof with a thin foil of a dielectric material. On the opposite side of the foil there is provided a layer of lossy material (material having moderate conductivity), for example carbon, which is further surrounded by another layer of a dielectric material. These layers are pressed by means of an outer cylinder uniformly against the coils. The outer cylinder may consist for example of the two halves

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of a longitudinally split metal tube which is pressed together with the aid of two spring rings. A better outer cylinder for many purposes may consist of a bent sheet metal clip or strip which after assembly is pressed together and welded. Advantages of the arrangement according to the present invention are that there appears to be no scratching off of the carbon layer while it is being mounted, that the dielectric separating a layer between the coil and the layer of lossy material (carbon) can be kept extremely thin and that thereby there is produced a large capacitive coupling between the coil and the carbon layer. The dielectric separating layer can be made extremely thin because any movement thereof is made impossible by the pressure of the outer cylinder. A further advantage of this arrangement lies in that the coil when assembled with the other parts, forms an independent structural element whose properties will not be substantially affected when mounted in the tube.

The above-mentioned and other features and objects of this invention and the manner of attaining them will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawing in which the figure is a schematic representation of a traveling wave tube line partially cut away to show the arrangement of lossy material about a wave transmission circuit in accordance with the present invention.

Referring now to the drawing, there is shown a helical coil 1 which is surrounded by a 0.01 mm. thick mica layer 2, on which there is deposited a layer of lossy material (of a moderate conductivity) such as carbon 3. Onto this layer there is applied a mica foil 4 having a thickness of 0.08 mm. which is pressed by means of a clip or strap 5 of constantan sheet metal against the layers lying towards the side facing the coil. The attenuation value of the coil which is wound of a 0.3 mm. thick NiMn-wire with a 0.65 mm. pitch of turns when having a medium diameter of 2.6 mm. amounts, in the case of a total length of 235 mm. and a frequency of 4000 mc., to 20 db. This arrangement may be supported in the conventional manner by dielectric bars within the glass envelope of the tube. The glass envelope at its one end carries the electron gun system and at the other end the collector. The glass envelope of the tube, the dielectric mount supports, the electron gun and the collector are not shown in the accompanying drawing since these items are not required for enabling an understanding of the invention.

By the application of a concentric additional attenuation of the above described kind over a length of 17 mm., the attenuation value will rise to 42 db. To achieve a further increase of attenuation it is convenient to choose the pitch of turns of the coil within the additional attenuation length smaller than with the other length. In order to avoid extensive matching errors between the free coil and the attenuation length, the thickness of the attenuation layer may be tapered to steadily increase from the ends of the attenuation length towards the center.

It is self-evident that the lossy layer (of moderate conductivity) can be applied to the inside of the outer dielectric, that the layer of moderate conductivity can be provided by the pressure-exerting cylinder or that said cylinder can be formed by the outer dielectric layer.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the accompanying claim.

What is claimed is:

A structural component assembly for a traveling wave

tube comprising a helical transmission coil, a thin layer of dielectric surrounding said coil, a layer of lossy material on said dielectric on the side thereof opposite the coil and forming a capacity coupling thereto, said layer of lossy material being dimensioned to provide less loss at its ends than at its center, an outer layer of conductive metal pressing the above-mentioned layers against the coil and an intermediate layer between said lossy layer and said outer layer made of dielectric material.

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