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FILAMENT STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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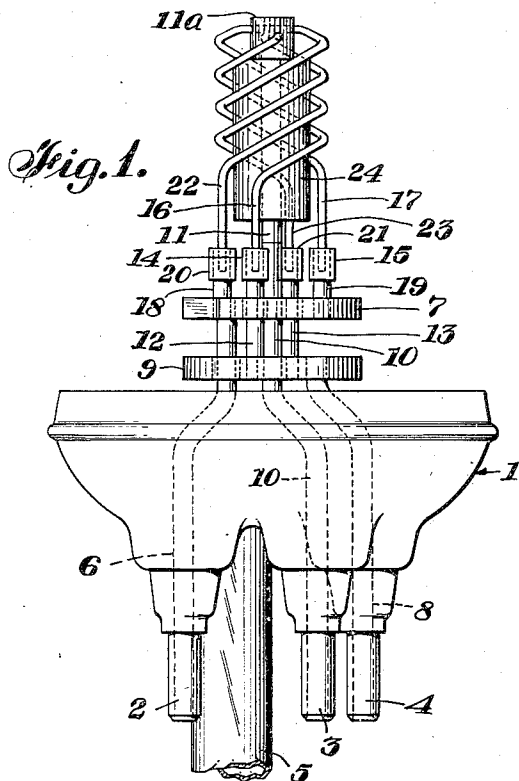
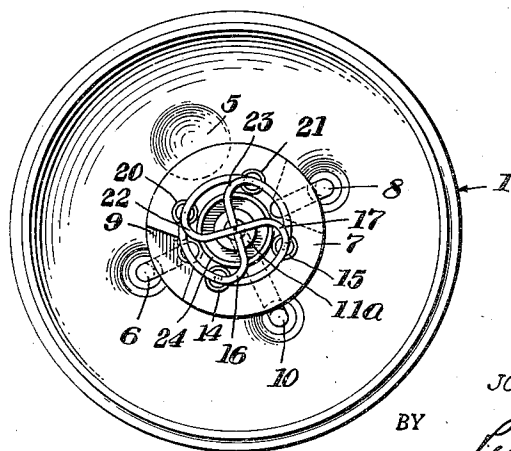


Fig. 2.



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DISCHARGE DEVICES

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This invention relates to filament structures for electron discharge devices and more particularly to a filament structure for vacuum tubes operating at very high frequencies above 1000 megacycles.

In conventional types of tubes the common methods of filament assembly, such as a quadra-filar filament, result in a cessation of oscillations above a certain critical frequency, which is due to the limiting factor of the series resonance of the filament circuit. In order for the circuit to be resonant the inductive reactance and the capacitive reactance should be equivalent at the required operating frequency. It is possible to construct filaments of various forms which will operate satisfactorily at the highest frequencies encountered. While thus increasing the frequency characteristic, there are advantages, however, in adhering reasonably closely to that structural design and related power consumption which have become more or less conventional. I have found, accordingly, that these desired conditions may be fulfilled by modifying the inductive field in the vicinity of the filament. In doing so, electrostatic conditions may be modified also, the overall result being effectively to raise the resonance point of the filament. One simple and practical structure for accompanying my purpose is a cylinder placed in the inductive field of the filament.

This cylinder will therefore have the following effects on the filament coil; First it will decrease the inductance, and second, it will increase the capacitive coupling between the turns of the filament. The result is that the inductive reactance and the capacitive reactance will be equivalent at a higher frequency, resulting in a pure resistance in the circuit, allowing maximum dissipation of energy.

Through the use of my invention filaments normally operative at frequencies in the neighborhood of 850 megacycles may be used in tubes to be operated at frequencies in excess of 1000 megacycles.

It is an object of my invention to enable conventional filament structures having resonant frequencies below a certain critical frequency, say 850 megacycles, to be operated at frequencies of 1000 megacycles and higher.

It is a further object of my invention to provide a method of assembly enabling a multi-filar filament of a type hereinafter described to be used at considerably higher frequencies than would be possible without the use of my method of assembly.

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It is interesting to note that the addition of a cylinder within the field set up by the filament structure does not in any way reduce the efficiency of the circuit as regards voltage and current requirements.

A better understanding of my invention may be had by reference to the drawings in which:

Fig. 1 is an elevational view partly in section of a quadra-filar filament structure and assembly;

Fig. 2 is a top plan view showing the upper electrical connection point of the filaments at the top of the supporting rod;

Referring to Fig. 1 there is shown a conventional glass tube base 1 having prongs 2, 3 and 4, and seal-off tube 5. Lead 6 extends upwardly from prong 2 to support a circular plate 7 having four spaced holes therein. Lead 8 extends upwardly from prong 4 to support a circular plate 9 having two spaced holes therein. Lead 10 extends upwardly from prong 3 through, and insulated from, plates 7 and 9 to form a supporting rod 11 having a castellated expanded portion 11a at the uppermost end. Extending upwardly from plate 9 are two leads 12 and 13 passing through, and insulated from plate 7, and having terminals 14 and 15 for connection to the ends of filament strands 16 and 17. Plate 7 which is supported by lead 6 in turn has two short leads 18 and 19 having similar terminals 20 and 21 for connection to filament strands 22 and 23. Filament strands 16, 17 and 22, 23 have a common junction point at their uppermost ends at castellated portion 11a, which forms the return lead for the filament current. The filaments are helically wound, and positioned within the helical winding is a cylinder 24 which may be of conductive material such as tantalum. This cylinder is supported at the uppermost end by welding or brazing to the castellated portion 11a. The cylinder is spaced equi-distant at all points from the filament strands. This method of assembly ensures a quadra-filar filament which will be rigid so as to maintain the proper spacing between itself and the cylinder within its field.

Fig. 2 being a top plan view of this assembly shows the relation of the starting points and ends of each filament strand. The lead 10 connected to prong 3 may act as the return lead for the filament and also a method for removing R.-F. energy from the cylinder.

The cylinder is spaced as close to the filaments as mechanical tolerances will permit. The larger the diameter of the cylinder the higher the frequency at which the structure will operate. The

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proximity of cylinder and filament strands forms a capacity coupling and decreases the inductance of the filament winding enabling operation at a higher frequency. As the cylinder does not enter into electrical computations regarding voltage and current requirements, this method of construction does not materially reduce the efficiency of the circuit.

In the drawings and description I have shown that this cylinder may be placed within the windings of a quadra-filar filament structure. Similar results will be obtained by the recision of this cylinder within structures containing a larger number of strands such as a sexta-filar filament. It may not be necessary for the cylinder to be hollow, but for use at ultra high frequency, the cylinder should preferably be hollow to decrease weight, and to prevent retention of heat or stress set up by excessive heat.

While I have described the principles of my invention in connection with specific apparatus and a particular filament structure, it is to be clearly understood that this disclosure is made by way of example only and many variations in the details thereof and in the structure assembly may be had without departing from the scope of my invention as set forth in the objects of my invention and the accompanying claims.

I claim:

1. A filament structure comprising filamentary means defining a hollow cylindrical space, a support for said filamentary means mounted axially in said space, and a conductive cylinder mounted within said hollow space between said support and said filamentary means to increase the electrical resonant frequency of said filamentary means.

2. A filament structure comprising helical filamentary means defining a hollow space, a support for said filamentary means mounted axially in said space, and a conductive member mounted within said hollow space between said support and said filamentary means to increase the electrical resonant frequency of said helical filament.

3. A filament structure for electron discharge devices comprising a helical filament defining a hollow space, supporting and electrical coupling means mounted in said hollow space for the transfer of energy through said filament, and a conductive member mounted in said hollow space in close proximity with said filament but spaced therefrom to increase the electrical resonant frequency of said helical filament.

4. A filament structure for electron discharge tube devices comprising a helical filament means defining a hollow cylindrical space, a conducting support for said filament mounted in said hollow space, and a conductive cylinder mounted within said hollow space about said support adjacent said filament for increasing the electrical resonant frequency of said filament, said support being connected to said filament and said cylinder for transfer of electric energy therethrough.

5. A filament structure for electron discharge devices comprising a plurality of filaments, each forming a helix defining a common hollow cylindrical space, a conducting support for said filaments mounted in said hollow space, and a conductive cylinder mounted within said hollow space about said support and adjacent said filaments for increasing the electrical resonant frequency of said filaments, said support being con-

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nected to said filaments and said cylinder for transfer of electric energy therethrough.

6. A filament structure for electron discharge devices comprising a plurality of helical filaments located around a hollow conductive cylinder mounted within the helix formed by said filament and spaced therefrom to increase the electrical resonant frequency of said helical filaments, said filaments being supported by a conductive rod extending through and beyond the ends of said cylinder.

7. A filament structure according to claim 6 wherein is included a conductive connection between said filaments, said rod and said cylinder.

8. A filament structure according to claim 6 wherein said rod and said cylinder are conductively inter-connected and said filaments and said rod are conductively inter-connected at the end of this rod.

9. A filament structure for electron discharge devices comprising a plurality of co-axial interleaved helical windings having respective ends thereof lying substantially within a common plane, a cylinder, a supporting rod mounting said cylinder co-axially with said windings, and means aligning and supporting said respective ends in predetermined relation to each other and to said cylinder.

10. In combination a quadra-filar filament structure, a conducting rod supporting said structure and electrically connected thereto, and a hollow conductive cylinder mounted inside said filament structure having its cylindrical surface equidistant from the filament strands at all points thereof and adjacent to said strands to increase substantially the natural electrical resonant frequency thereof.

11. A filament structure for electron discharge devices comprising a plurality of interleaved helical filaments, a conductive rod supporting said filaments, and a hollow conductive cylinder mounted internally of the helix formed by said interleaved helical filaments and supported by said conductive rod, said conductive cylinder being spaced adjacent said helical filaments to increase the electrical resonant frequency thereof.

12. A filament structure for electron discharge devices comprising filamentary means defining a hollow cylindrical space, a conducting rod supporting said filamentary means mounted in said space, and mounted between said rod and said filamentary means in spaced relation therefrom means arranged between said rod and said filamentary means substantially increasing the capacitive coupling between adjacent portions of said filamentary means.

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