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DEMOUNTABLE FILAMENT ASSEMBLY

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2 Sheets-Sheet 1

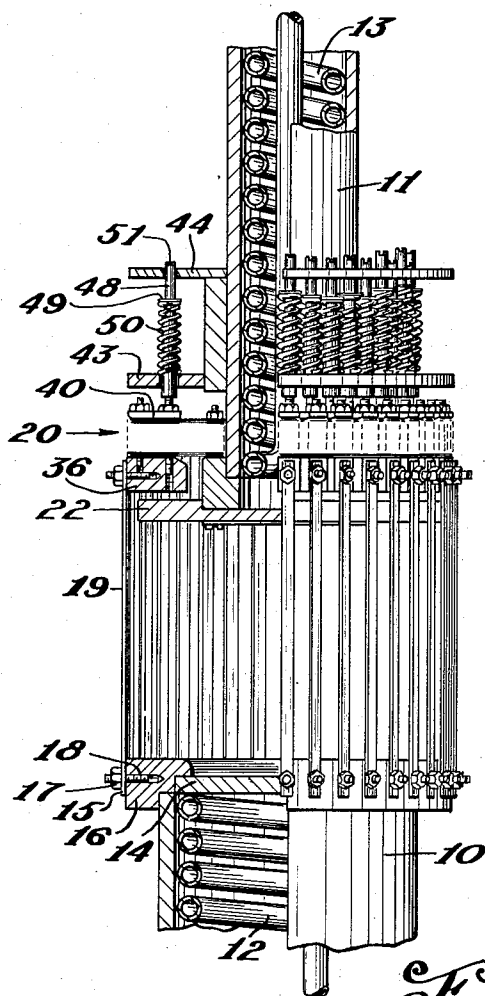


Fig 1

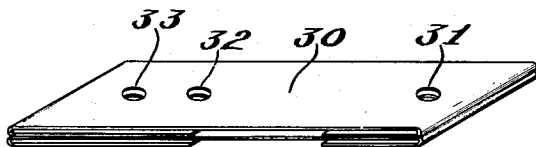


Fig 3

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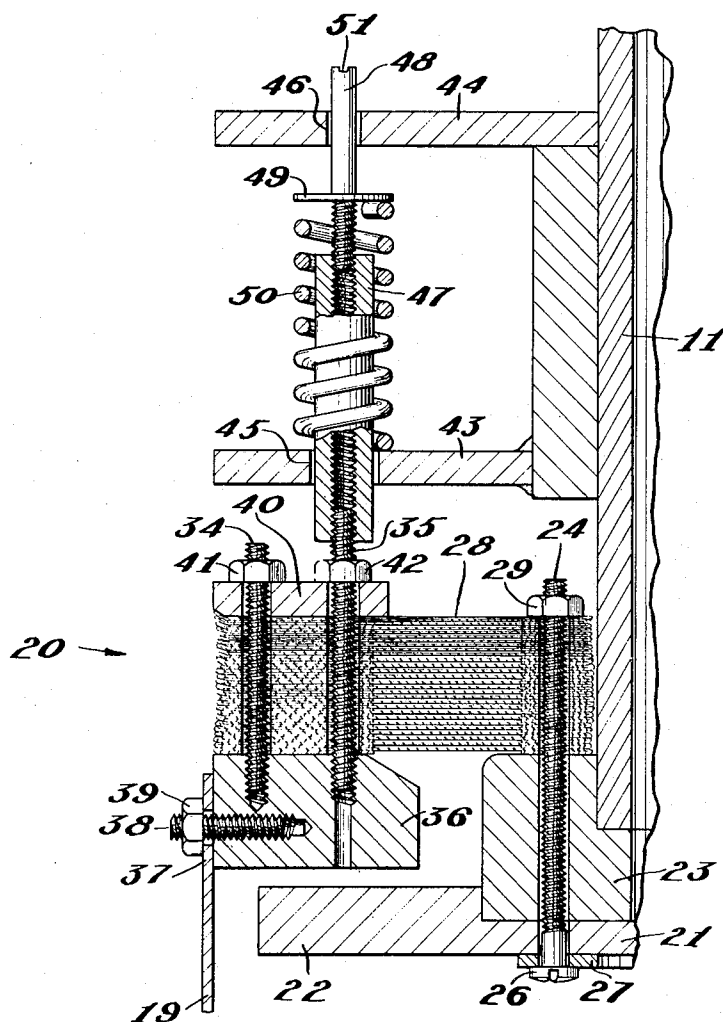


Fig. 2

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DEMOUNTABLE FILAMENT ASSEMBLY

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4 Claims. (Cl. 313—273)

This invention relates in general to filaments for electron tubes, and in particular to filaments of extremely high current capacity for tubes of the resonatron type where the average power may be as high as 50 kilowatts.

The development of electronics has led to the design of higher and higher powered tubes until presently, tubes are being built which develop 50 kilowatts average power. With such large tubes, extremely large cathode current is required and the extreme heat generated by such cathodes must be removed so as to prevent the internal elements of the tube from melting.

The present invention comprises a high current filament which is maintained cool enough to prevent injury to the filament and in which the active elements of the assembly are prevented from bowing or being deflected.

Further objects, features and advantages of this invention will become apparent from the following description and claims when read in view of the drawings, in which:

Figure 1 is a view of the filament assembly of this invention with one-quarter of the assembly removed to show the internal construction,

Figure 2 is a detailed view of the filament and supporting portion, and

Figure 3 is the detailed view of the pantograph of the invention.

Figure 1 illustrates a lower supporting cylinder 10 and an upper supporting cylinder 11 which are cooled, respectively, by water pipes 12 and 13. A lower cover plate 14 closes the upper end of tube 10 and serves as a heat shield from the direct radiation of the filament.

The lower ends of the filaments 15 are connected to a collar 16 by nuts 17 threadedly received on pins 18 which are mounted in the collar 16. The collar 16 is supported by cylinder 10.

The active portions 19 of the filament extend upwardly to an upper supporting assembly designated generally as 20 and which is attached to the upper cylinder 11.

The upper supporting assembly is shown in detail in Figure 2. An end cover plate 21 covers the lower end of the cylinder 11 and extends outwardly therefrom to form a heat shield flange 22. A second collar 23 is mounted between the lower end of the cylinder 11 and the plate 21 and is formed with an opening through which a bolt 24 passes. The bolt passes through a stainless steel ring 27 which rests on the plate 21. The head 26 of the bolt engages the ring 27.

The upper end of the bolt passes through one end of a pantograph assembly 28 and a nut 29 is received thereon to clamp the pantograph assembly together. The pantograph assembly 28 comprises a plurality of flexible heat and electrical conducting members formed in the manner shown in Figure 3.

Copper strips 30 have each end folded under to form spacers so that the center portions will be free to slip relative to each other. One end of the pantograph assembly is formed with an opening 31 through which the bolt 24 passes and the other end is formed with a pair

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of openings 32 and 33 through which bolts 34 and 35 pass. The lower ends of bolts 34 and 35 are threadedly received in a block 36 which supports the upper end 37 of the filament 19. A bolt 38 is received in the block 36 and a nut 39 clamps the upper end of the filament to the block.

A block 40 is mounted to the upper end of the pantograph and bolts 34 and 35 pass therethrough. Holding nuts 41 and 42 clamp the block 40 to the pantograph assembly.

A pair of annular brackets 43 and 44 extend outwardly from the cylinder wall 11 above the pantograph assembly and are formed with axial aligned openings 45 and 46. A threaded sleeve 47 threadedly receives the upper end of the bolt 35 therein and passes up through the opening 45. A threaded pin 48 extends through the opening 46 and is threadedly received in the collar 47. The pin 48 carries a shoulder 49 which engages the upper end of a spring 50 which is clamped between the upper portion of the member 43 and the shoulder 49. The upper end of the pin 48 is formed with a slot 51 into which a screw driver may be inserted for adjusting the tension of the spring.

Due to the extremely high temperatures developed during operation of the filament, which might be 2700 Kelvin for the active portions 19, it is necessary that a large amount of heat be transferred through the pantograph assembly 28.

The nuts 29, 39, 41 and 42 are made of stainless steel and bolt 38 is made of Kovar which has a lower coefficient of thermal expansion than does the copper block 36 in which it is mounted. Kovar is an alloy which has the same coefficient of thermal expansion as glass, and comprises from 28 to 30 percent nickel; 15 to 18 percent cobalt; and the remainder iron. Thus, when subjected to heating, the bolt 38 and nut 39 will have a tightening effect on the end of the filament 19. This prevents a bad contact between the filament and the block.

The spring 50 might be made of tungsten which has a high resistivity to heat so that its tension will not be substantially decreased when heated.

Applicant has built a tube which uses a filament assembly such as shown in Figure 1 wherein the active tungsten filaments 19 are 6 inches in length, one-quarter inch wide, and 0.040 inch thick. Thirty-six filaments are mounted about the circumference. Each filament draws 350 amperes and the total heating current is 12,000 amperes at 5 volts, 60 cycle A. C. The total power for heating is near 60,000 watts. The filament has passed numerous tests, one in which the filament was operated for 300 hours continually without failure.

The spring 50 maintains the filament under constant tension which might be approximately 10 pounds so that it is not deflected when heated due to thermal expansion and grain growth, and it also is not displaced relative to the center line of the filament assembly. The action of the pantograph assembly 28 gives a parallel motion upwardly with the transverse motion being very small. This maintains a symmetry of the filament assembly and does not substantially increase the cathode to plate distance.

Although the invention has been described with respect to particular embodiments thereof, it is no to be so limited as changes and modifications may be made therein which are within the full intended scope of the invention, as defined by the appended claims.

We claim:

1. A filament basket comprising a lower supporting cylinder, an upper supporting cylinder, a plurality of filaments with their lower ends attached to the lower supporting cylinder, a plurality of blocks each connected to the upper end of one of said filaments, a pair of annular

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brackets attached to the upper supporting cylinder, a plurality of sleeves each connected to one of said blocks and each passing up through an aligned opening formed in one of the brackets, and a spring mounted over each of said sleeves and engaged with one of said brackets to place the individual filaments under tension.

2. Filament tension means comprising, a lower supporting member, an upper supporting member, a filament with its lower end attached to the lower supporting member, a plurality of sheets of flexible material connected to said upper supporting member, a block attached to the upper end of said filament, said sheets attached to said block, a bracket attached to said upper supporting member, a sleeve threadedly connected to said sheets and extending through an opening formed in said bracket, and a spring biasing means urging said sleeve member upwardly.

3. A filament assembly comprising, a lower supporting cylinder, an upper supporting cylinder, a plurality of filaments with their lower ends attached to the lower supporting cylinder, a plurality of blocks, the upper ends of said filaments attached to said blocks, a plurality of assemblies of sheets of flexible material, one end of each assembly of sheets attached to the upper supporting cylinder, the other end of each of said assembly of sheets attached to said blocks, a bracket generally annular in

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shape passing around said upper supporting cylinder above said sheets, and a plurality of spring biasing means passing through said bracket and engaging said sheets to maintain the filaments under tension.

4. Filament tensioning means comprising, a lower cylinder, an upper cylinder, a plurality of filaments with their lower ends attached to the lower cylinder, a plurality of blocks connected to the upper ends of said filaments, a plurality of flexible sheet assemblies, one end of each of said assemblies connected to the upper cylinder member and the outer ends connected to said blocks, a pair of annular brackets mounted to said upper cylindrical member above said assemblies, a plurality of lead screws extending upwardly from said blocks, collars threadedly received on each of said lead screws, a second plurality of lead screws threadedly received in said collars and each formed with a shoulder, and a spring mounted between each of said shoulders and said first bracket.

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