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FILAMENT ASSEMBLY STRUCTURE

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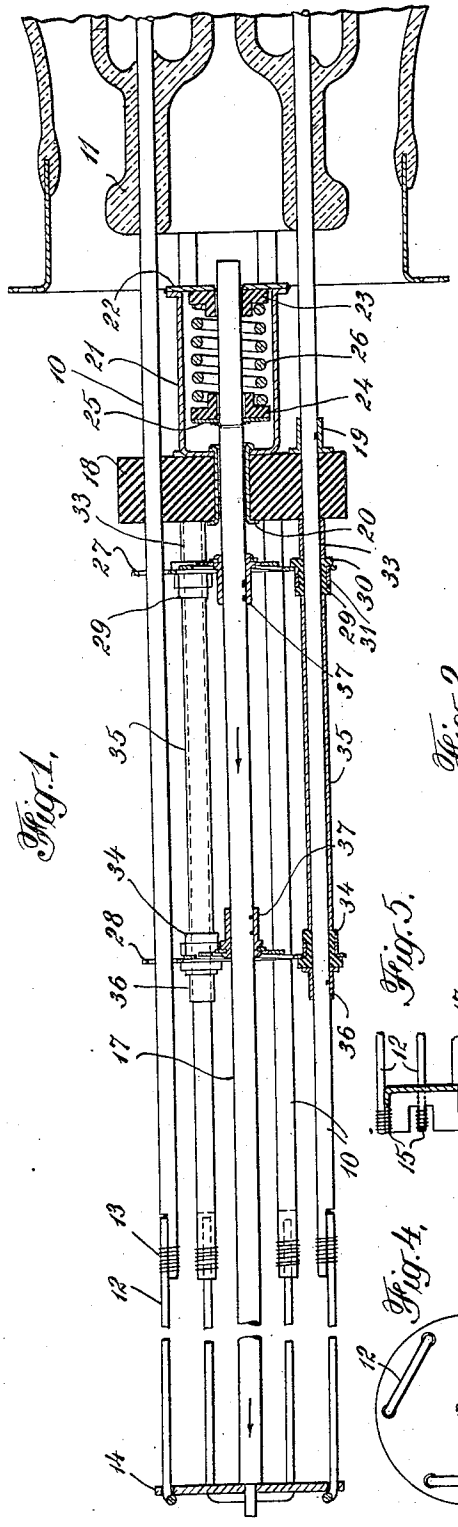


Fig. 1.

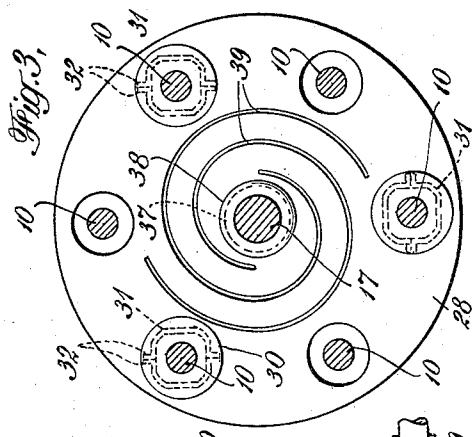


Fig. 3.

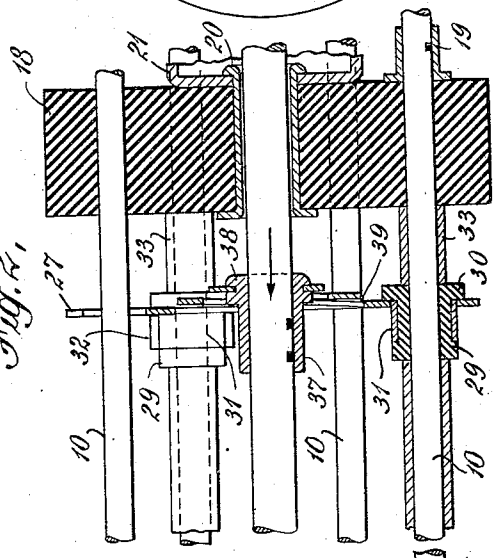


Fig. 2.

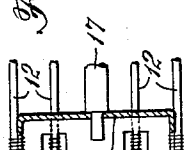


Fig. 5.

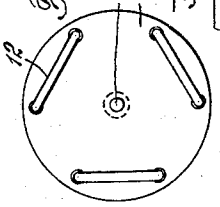


Fig. 4.

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FILAMENT ASSEMBLY STRUCTURE

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11 Claims. (Cl. 250—27.5)

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This invention relates to filament structures, such as are employed, for example, in high powered radio transmitting tubes, and include a plurality of filaments lying side by side and means for maintaining the filaments under tension to prevent them from sagging, when they increase in length upon being heated. The present invention is concerned with a filament structure of the type referred to containing novel filament tensioning means, which are superior in performance to those heretofore used, and less likely to emit gases and thus impair the operation of the tube.

In prior filament structures for heavy duty use, it has been the usual practice to attach each filament at one end to a support, the filaments extending in the same general direction and lying side by side in a closed series. The free ends of the filaments are connected together by suitable means and pressure is continuously applied to the connecting means to maintain the filaments under tension. For this purpose, a tensioning rod extends lengthwise within the series of filaments and bears at one end against the connecting means. Near its other end, the tensioning rod is supported in openings in a pair of ceramic blocks mounted in fixed position. One or more springs encircling the tensioning rod between the blocks bear at one end against one block and act at the other end on the rod to force it outwardly. With this construction, difficulties are encountered, because the openings in the blocks, through which the tensioning rod extends, must be sufficiently larger than the diameter of the rod to prevent the rod from seizing in the blocks and the rod, accordingly, has more lateral motion than is desirable. Also, in the production of the tube, it is difficult to de-gasify the blocks completely and, when the blocks become heated in the operation of the tube, they are likely to emit gasses which may impair the operation of the tube.

The new filament structure overcomes the difficulties encountered in the use of the prior structure above described and includes only a single ceramic block for guiding the tensioning rod, the block being mounted at such a distance from the filaments that there is little likelihood of gas evolution from the block during the operation of the tube. The tensioning rod is supported and guided between the block and the filaments by at least one guide member fixed in position and having an opening through which the rod extends. The rod is connected to the member adjacent the opening and the member

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is unyielding in a direction transverse to the axis of the rod and flexible in a direction lengthwise of the rod. The member, accordingly, holds the rod rigidly in position against lateral displacement and, at the same time, permits such lengthwise movement of the rod as is necessary to maintain the filaments under continuous tension.

For a better understanding of the invention, reference may be had to the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view through one form of the new filament structure;

Fig. 2 is a longitudinal sectional view, on an enlarged scale, of a part of the new structure;

Fig. 3 is a sectional view on the line 3—3 of Fig. 2;

Fig. 4 is an end view of the structure as seen from the left in Fig. 1; and

Fig. 5 is a sectional view of a modified feature of construction.

The new filament structure in the form illustrated includes a plurality of supporting rods 10 mounted to extend through a re-entrant end portion 11 of the envelope of the tube, in which the structure is employed. In the form shown, there are six rods 10, and they are arranged in a circular series at equal spacings. A filament 12 is attached to the free end of each rod 10 by welding and a wrapping of fine wire 13, in accordance with the usual practice. Each filament 12 extends beyond the end of its supporting rod in the general direction of the latter, and the free ends of the filaments are connected together in any suitable manner. In the construction illustrated in Fig. 1, the filaments are of the loop type with the ends of each filament loop connected to adjacent rods 10. Each filament then extends from the end of one rod 10 through an opening in a plate 14 at the desired distance from the ends of the rods, passes over the outer face of the plate, and returns through another opening in the plate to the other rod 10. If desired, however, single straight filaments may be used, in which case, the free ends of the filaments may be connected to tongues 15 formed in the rim of a cup 16 (Fig. 5).

In order to maintain the filaments under tension at all times and thus prevent them from sagging when they become expanded upon heating, a tensioning rod 17 is mounted within the group of filaments and supporting rods and bears at one end against the means connecting the free ends of the filaments. The rod is movable endwise and it is supported for such movement in a

central opening through a ceramic block 18. The block has openings, through which the supporting rods 10 pass, and it is held against movement in a direction away from the filaments by one or more flanged sleeves 19 mounted on the supporting rods and secured thereto in any convenient manner. An eyelet 20 is mounted in the central opening through the block and a casing 21 is held in position against the face of block 18 remote from the filaments by a flange on the eyelet. The casing is closed at its rear end by a plate 22 and the tensioning rod extends through the casing and projects through the plate. An insulating bushing 23 lies within the casing against the inner face of plate 22 and another insulating bushing 24 encircles the tensioning rod within the casing and lies at a distance from the first bushing. Bushing 24 abuts a disc 25 anchored on the tensioning rod and a coil spring 26 encircles the rod and bears at opposite ends against the bushings. The spring is normally under compression and urges the tensioning rod against disc 14 to maintain the filaments taut at all times.

The tensioning rod is supported between block 18 and the filaments by a pair of discs 27, 28. Disc 27 is mounted on three insulating bushings 29 carried by alternate supporting rods 10, the intervening rods passing freely through openings in the disc. Each bushing has an end flange 30 against the inner face of which the disc is held by a metal bushing 31, which encircles the insulating bushing and has a portion extending through the opening in disc 27 to abut flange 30. Bushing 31 is in two halves having radial lateral flanges 32 secured together by welding after the halves of the bushing are mounted in place. The bushings 29 are spaced from the block 18 by sleeves 33 encircling the supporting rods 10, on which the bushings are mounted. Disc 28 is mounted, in the same manner as disc 27, on a plurality of insulating bushings 34 similar to bushings 29. Bushings 29 and 34 on the same rod 10 are separated by a spacing sleeve 35 enclosing the rod. The displacement of bushings 34 in a direction toward the filaments is prevented by flanged sleeves 36 mounted on the respective supporting rods 10 and secured thereto in any convenient manner, as by spot welding.

The discs 27, 28 have openings aligned with one another and with the opening through block 18, for the passage of tensioning rod 17. The tensioning rod is connected to each disc around the opening therethrough by means of a bushing 37 secured in place on the rod, as by welding, and having a flange 38 at one end formed with a circumferential channel, in which the edge of the disc around the opening is received. The discs are unyielding in a direction transverse to the tensioning rod and flexible in a direction lengthwise of the rod. In order that the discs may have the desired flexibility, each disc is formed with a pair of spiral cuts 39 in the central portion around the opening, through which the tensioning rod extends.

With the construction described, it will be evident that, although the tensioning rod fits somewhat loosely in the bushing 20 through the opening in block 18, the rod is held firmly against lateral displacement by the discs 27, 28, which are rigid in their plane and transverse to the rod. At the same time, the flexibility of the central portions of the discs permits spring 26 to urge the rod to maintain the filaments taut, when they expand upon heating. With the tensioning rod supported by discs 27, 28, the ceramic block 18 may be well back from the filaments and thus not exposed to heat, which would produce gas evolution therefrom. The spring 26 lies on the side of the block remote from the filaments and is protected from heat by both the block and the casing, which encloses the spring.

I claim:

1. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide for the rod fixed in position remote from the filaments and beyond the rigidly attached ends thereof, a member fixed in position between the guide and the filaments and having an opening, through which the rod extends, and means connecting the rod and member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

2. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide block fixed in position remote from the filaments and beyond the rigidly attached ends thereof, the block having an opening through which the rod is movable, spring means remote from the filaments pressing on the block and rod and tending to move the rod and element to apply tension to the filaments, a member fixed in position between the guide block and the filaments and having an opening, through which the rod extends, and means connecting the rod and member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

3. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide block fixed in position remote from the filaments and beyond the rigidly attached ends thereof, the block having an opening through which the rod is movable, spring means on the side of the block remote from the filaments and pressing on the rod and block, said means tending to move the rod and element to apply tension to the filaments, a member fixed in position between the guide block and the filaments and having an opening, through which the rod

extends, and means connecting the rod and member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

4. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide block fixed in position remote from the filaments and beyond the rigidly attached ends thereof, the block having an opening through which the rod is movable, a casing attached to the block on the side remote from the filaments, a portion of the rod extending through the casing, spring means within the casing pressing on the casing and rod and tending to move the rod and element to tension the filaments, a member fixed in position between the block and the filaments and having an opening, through which the rod extends, and means connecting the rod and member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

5. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide for the rod fixed in position remote from the filaments and beyond the rigidly attached ends thereof, a disc fixed in position between the guide and the filaments and having an opening through which the rod extends, and means connecting the rod to the disc near the opening, the portion of the disc around the opening being unyielding in the plane of the disc and flexible in a direction lengthwise of the rod.

6. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide for the rod fixed in position remote from the filaments and beyond the rigidly attached ends thereof, a disc fixed in position between the guide and the filaments and having an opening through which the rod extends, and means connecting the rod to the disc near the opening, the portion of the disc around the opening being unyielding in the plane of the disc and having a cut-out rendering said portion flexible in a direction lengthwise of the rod.

7. A filament structure which comprises a plurality of stationary supporting rods lying

parallel and in a closed series, a plurality of filaments attached rigidly at one end to the respective rods, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod extending within the group of filaments lengthwise thereof and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide mounted on the supporting rods remote from the filaments and beyond the rigidly attached ends thereof, the guide having an opening through which the rod is movable endwise, a member fixed on the supporting rods between the guide and filaments and having an opening, through which the rod extends, and means connecting the rod to the member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

8. A filament structure which comprises a plurality of stationary supporting rods lying parallel and in a closed series, a plurality of filaments attached rigidly at one end to the respective rods, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod extending within the group of filaments lengthwise thereof and engaging the element, a guide mounted on the supporting rods remote from the filaments and beyond the rigidly attached ends thereof, the guide having an opening through which the rod is movable endwise, a spring on the side of the guide remote from the filaments and pressing on the guide and rod to urge the rod and element to apply tension to the filaments, a member fixed in position between the guide and filaments and having an opening, through which the rod extends, and means connecting the rod to the member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

9. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a ceramic block mounted remote from the filaments and beyond the rigidly attached ends thereof, the block having an opening through which the rod is endwise movable, a member fixed in position between the block and the filaments and having an opening, through which the rod extends, and means connecting the rod to the member near the opening, the portion of the member around the opening being unyieldingly in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

10. In a filament structure which comprises a plurality of stationary filament supports arranged in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are con-

nected, a rod lying within the group of filaments and engaging the element, a ceramic block mounted remote from the filaments beyond the rigidly attached ends thereof and having an opening, through which the rod is movable endwise, spring means on the side of the block remote from the filaments and pressing on the rod and block to urge the rod and element to tension the filaments, a member fixed in position between the block and the filaments and having an opening, through which the rod extends, and means connecting the rod to the member near the opening, the portion of the member around the opening being unyielding in a direction transverse to the rod and flexible in a direction lengthwise of the rod.

11. A filament structure which comprises a plurality of stationary filament supports disposed in a closed series, a plurality of filaments attached rigidly at one end to the respective supports, the filaments lying side by side and extending in the same general direction, an element, to which the other ends of the filaments are connected, a rod lying within the group of filaments and engaging

the element, spring means remote from the filaments pressing on the rod and tending to move the rod and element to apply tension to the filaments, a guide for the rod fixed in position remote from the filaments and beyond the rigidly attached ends thereof, a metallic disc fixed in position between the guide and the filaments and having an opening through which the rod extends, and means connecting the rod to the disc near the opening, the portion of the disc around the opening being unyielding in a direction transverse to the rod and being cut spirally to render it flexible in a direction lengthwise of the rod.

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