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SUPPORTING DEVICE FOR HELIX IN TRAVELING WAVE TUBES

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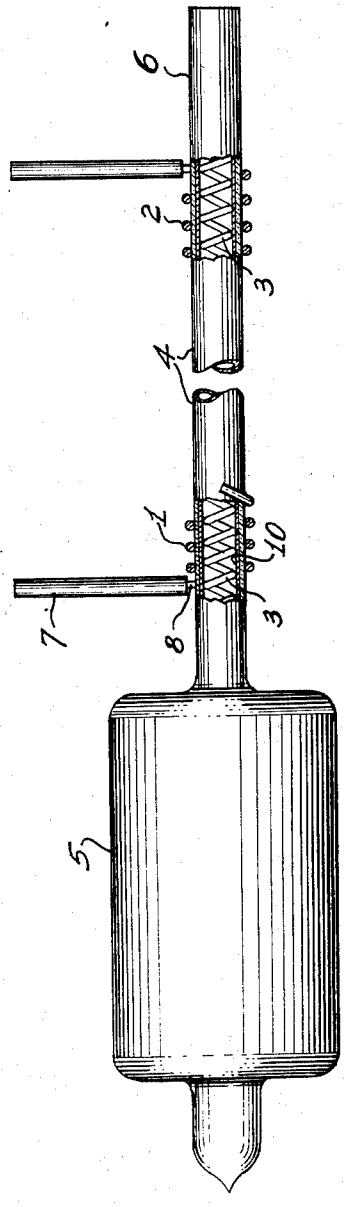


Fig. 1.

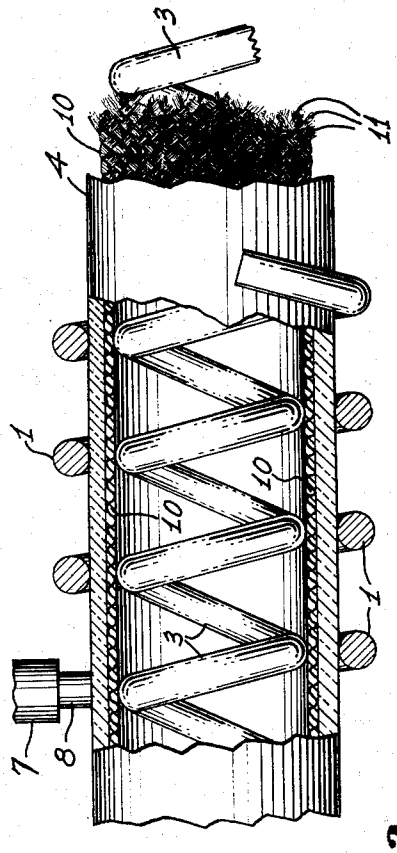


Fig. 2.

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SUPPORTING DEVICE FOR HELIX IN TRAVELING WAVE TUBES

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2 Claims. (Cl. 315—3.5)

My invention relates to traveling wave tubes. More specifically, it relates to a means for supporting a helix in a traveling wave tube.

Traveling wave power amplifier tubes have a long tubular glass envelope section which contains a wire helix. In order to be able to operate such a tube over wide frequency ranges, special couplings are used for input and output stages. In one type of construction, an external input helix is mounted on the tube near the electron-gun end of the tube for inducing a signal in the internal helix. An external output helix is mounted near the collector end of the tube for picking up the amplified signal from the internal helix. In order to get the required electromagnetic coupling between the internal and external helixes the ratio of their diameters should be as close to unity as possible. This rules out a standard mounting of the internal helix as used in other types of traveling wave tubes, i. e., supporting the helix with longitudinal ceramic rods placed between the helix and the wall of the evacuated envelope. If the helix is placed in the glass envelope so that it is in contact with the glass wall, thermal expansion of the helix during operation is likely to result in breakage of the envelope. It is the purpose of my invention to eliminate this likelihood of breakage.

My invention accomplishes this purpose by placing the internal helix within a woven or braided fiber glass sleeve. The helix with its sleeve is then mounted within the tubular portion of the glass envelope of the traveling wave tube. The fiber glass sleeve provides a resilient cushion between the wire of the internal helix and the glass wall of the tube. This means of mounting supports the internal helix in axial alignment with the tubular portion of the evacuated envelope. It permits the helix to expand within the tube, compressing the fiber glass, without danger of breaking the glass envelope. It also has the advantage of substantially eliminating the danger of breakage from vibration.

An example of a traveling wave tube made in accordance with my invention is shown in the drawing. Figure 1 shows the relative position of the input and output helixes 1 and 2 with respect to the internal helix 3 and the evacuated envelope 4. Figure 2 is an enlarged view of the input portion of the tube showing the details of how the internal helix 3 is supported within the envelope 4. My invention is not dependent upon any particular type of electron gun, accelerating means, focusing arrangement, and collector electrode, so these are not illustrated.

As is common in power amplifier tubes, an evacuated glass envelope comprises an electron gun enclosure 5, a long tubular portion 4 which contains a wire helix 3, and an end 6 of the envelope containing a metal electron collector. The signal input is fed to the tube by a coaxial cable 7, the center conductor end 8 of which is coiled into a helix 1 around the glass tubular portion 4 of the envelope near the electron gun enclosure 5 to form a close electromagnetic coupling with the input end of the internal helix 3. The output signal is removed from the

internal helix 3 near the collector end 6 in exactly the same manner. Both the input helix 1 and the output helix 2 are wound on the tube in a direction opposite to the direction of winding of the internal helix 3.

In accordance with my invention the internal helix 3 is supported within the tubular portion 4 of the traveling wave tube by a resilient support in the form of a woven or braided glass sleeve 10. A suitable glass sleeve 10 for supporting the internal helix 3 is constructed of multiple strands 11 each comprised of numerous individual fibers. Each individual fiber has a crinkled shape much like a single fiber of wool, which provides resilient compressibility. When numerous fibers are combined together to make up a single strand 11 this resilient compressibility is enhanced. In forming the fabric of the glass sleeve 10, the strands 11 are woven or braided together so that the thickness of the sleeve fabric between the internal helix 3 and the glass tubular portion 4 is essentially double the thickness of a single strand and this further enhances the compressibility of the fabric. The sleeve 10 of fiber glass is peculiarly suited for supporting the internal helix not only because of its mechanical properties but also because it is an excellent dielectric and is nonmagnetic. Therefore, the sleeve is transparent to electromagnetic fields between the internal helix 3 and the external helixes 1 and 2. At the same time it is well suited to incorporate in an envelope which must be kept at high vacuum, since even when hot it does not give off residual gas as some materials would.

In assembling the components of this embodiment of my invention the internal helix 3 is first mounted within the woven glass sleeve 10. Next, the assembled internal helix 3 and sleeve 10 are slipped into the long tubular portion 4 of the envelope. Finally, the remaining components of the tube are assembled and the tube is evacuated in the usual manner. During evacuation, heat is applied to the tube resulting in expansion of the internal helix 3. Since the fiber glass sleeve 10 is resilient, the thermal expansion of this helix will not result in breaking the envelope. The same holds true when the helix 3 becomes heated during operation of the tube. The danger of breakage as a result of shock or vibration is also lessened since the fiber glass sleeve will act as a buffer between the internal helix 3 and the glass of the envelope. Because of the resilient character of the fiber glass sleeve, the internal helix 3 will fit snugly in axial alignment with the tubular portion 4 of the envelope and the helix 3 will not distort when the tube is vibrated during operation; this prevents degradation in the tube's electrical characteristics. Since the helix 3 is supported evenly throughout its entire length and diameter, thermal expansion will take place in a uniform manner with each point on the circumference of each turn maintaining equal distance from the axis of the helix.

Also, during tube operation, the fiber glass sleeve 10 will cause the heat from the helix 3 to be distributed uniformly to the tubular portion 4 and prevent envelope breakage caused by non-uniform heating which could occur if the helix 3 were in direct contact with the glass of the tubular portion 4.

I claim:

1. In a traveling wave tube the combination of an evacuated glass envelope having an elongated tubular portion, a metallic helix contained within said glass tubular portion, a resilient tubular support between said helix and said tubular portion comprising a sleeve surrounding said helix and having an internal diameter substantially equal to the external diameter of said helix, said sleeve having an external diameter equal to the internal diameter of said tubular portion, said sleeve comprising a woven structure of fiber glass.

2. In a traveling wave tube having: an evacuated glass envelope including an elongated tubular portion, an internal wire helix within said tubular portion, an external input helix coupled to one end of said internal helix for inducing an electrical signal in said internal helix, and an external output helix coupled to other end of said internal helix for deriving an electrical signal from said internal helix; the combination with said internal helix and said tubular portion of a resilient tubular woven fiber glass support between said internal helix and said tubular portion, said support extending along substantially the entire length of said internal helix, said support having an external diameter equal to the internal diameter of said tubular portion and having an internal

diameter substantially equal to the external diameter of said internal helix whereby said internal helix is resiliently supported, in axial alignment, within said tubular portion and has a close electromagnetic coupling with both said external helixes.

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