Jan. 17, 1950 S. ROSEN 2,494,722

RESISTIVE TERMINATION

Filed March 10, 1945

FIG. 1

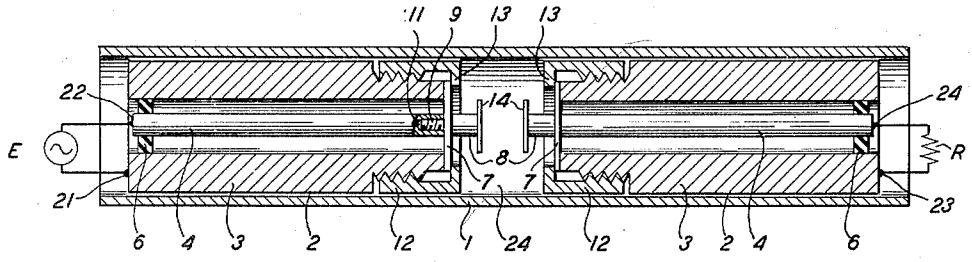
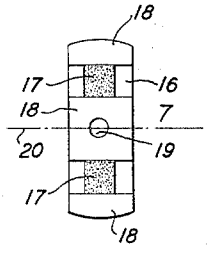


FIG. 2



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RESISTIVE TERMINATION

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3 Claims. (Cl. 178—44)

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This invention relates to coaxial transmission lines and more particularly to a resistive termination for such lines.

The object of the invention is to reduce the reactance inherently associated with a resistive termination for a coaxial transmission line.

There is often required for a coaxial transmission line a resistive termination which will have the least possible amount of associated reactance. However, the resistive material forming the termination must, in general, be associated with a mechanical supporting member. The presence of the supporting member, due to its dielectric properties, introduces an undesired capacitance effectively in shunt with the resistance.

In accordance with the present invention this unwanted capacitance is reduced to a minimum by making the supporting member in the form of a strip of insulating material which is diametrically connected between the outer conductor and the inner conductor of the line. The resistance is provided by coating the strip with resistive material. Means are provided for clamping the termination at its center to the inner conductor and at its ends to the outer conductor. To insure good electrical connections at these points the termination may be metalized at the center and at the ends.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawings, in which like reference characters refer to similar or corresponding parts and in which:

Fig. 1 shows a longitudinal cross-section of an attenuator comprising sections of coaxial transmission line with resistive terminations in accordance with the invention; and

Fig. 2 is a view of the termination alone.

The attenuator of Fig. 1 comprises a tube 1 in which are two sections of coaxial transmission line 2. Each section 2 is made up of a tubular outer conductor 3 and a concentric inner conductor 4, held in position at the outer end by the insulating spacer 6. At the inner end each section 2 is terminated by a resistor 7 which is connected diametrically between the ends of the conductors 3 and 4. The resistor 7 is clamped in place at its center by means of a stud 8 having a threaded end 9 of smaller diameter which passes through a hole in the resistor 7 and screws into a tapped hole 11 in the end of the central conductor 4. The ends of the resistor 7 are clamped against the end of the outer conductor 3 by means of the collar 12 which screws onto the reduced end of the conductor 3 and has an inwardly extending radial

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flange 13 which grips the ends of the resistor 7. Mounted on the end of each stud 8 is a metal disc 14.

As shown more clearly in the larger scale view of Fig. 2, the resistor 7 consists of a strip of insulating material 16 coated with resistive material 17. The insulating material 16 should have high mechanical strength so that its cross-section may be made small, and a low dielectric constant, to minimize the capacitance introduced. A satisfactory material for this purpose is a suitable glass or an infusible organic synthetic resin such as a cured phenol-formaldehyde condensation product, for example, "Bakelite." The resistive material 17 may, for example, be carbon or Nichrome. Contact surfaces 18 are provided at the ends and the center by applying a coat of silver or other metal paste over the resistive material 17. The resistance of the resistor 7 may be adjusted to the required value by gradually removing the material 17, as for example, by scraping. A central hole 19 is provided for the threaded end 9 of the stud 8 to pass through, as explained above.

In order to avoid setting up an undesired transverse electric field in the space between the two line sections 2, the resistor 7 should have both physical and electrical symmetry about the transverse center line 20. Under these circumstances the transverse electric field produced by current flowing between the outer conductor 3 and the inner conductor 4 through one-half of the resistor 7 is cancelled by that produced by the current through the other half.

By making the resistor 7 in the form of a strip, a minimum amount of supporting insulating material 16 is required, and, consequently, the inherent shunt capacitance associated with the resistor is reduced to a minimum. Therefore, when the resistor 7 is used as a termination for a coaxial transmission line, less reflection is introduced and, furthermore, the phase angle of the termination remains more nearly constant over a range of frequencies.

In operating the attenuator of Fig. 1, a source of alternating electromotive force E is connected to the outer end of one of the coaxial sections 2, say between a point 21 on the outer conductor 3 and a point 22 on the inner conductor 4. A load R is similarly connected to the outer end of the other coaxial section 2, as at the points 23 and 24. The diameter of the tube 1 is so small that waves of the frequency of the source E will not be transmitted directly through the section of wave guide 24 between the two coaxial sections 2. However, the left-hand disc 14 will act as a radiator

to establish the desired transverse magnetic field in the space between the two discs 14, and the right-hand disc 14 serves as a target for picking up the energy. The attenuation introduced depends upon the distance between the two discs 14 and is approximately proportional to this distance. The attenuation may be varied, as desired, by sliding one or both of the line sections 2 within the tube 1.

What is claimed is:

1. In combination, means for establishing a magnetic field, an energy pick-up device positioned within said field, a coaxial transmission line, and a substantially purely resistive termination, said line comprising a tubular outer conductor and an inner conductor concentric therewith, said pick-up device being connected to an end of said inner conductor, said termination comprising a strip of insulating material coated with resistive material, said strip being connected diametrically between said outer conductor and said inner conductor in proximity to said pick-up device, said insulating material being of minimum cross-section consistent with mechanical strength and having a low dielectric constant to minimize the capacitance introduced thereby, and said termination having physical and electrical symmetry about its transverse center line to minimize the inductive effects associated therewith, whereby wave reflection and the frequency-dependence of the phase angle of said termination are minimized.

2. An attenuator comprising a conducting tube, means for establishing a transverse magnetic field therein, an inner conductor concentric with said tube, an electrode connected to an

end of said inner conductor, and a substantially purely resistive termination comprising a strip of insulating material coated with resistive material, said strip being connected diametrically between said tube and said inner conductor in proximity to said electrode, said tube having a diameter so small that waves of the frequency of said field will not be directly transmitted, said insulating material being of minimum cross-section consistent with mechanical strength and having a low dielectric constant to minimize the capacitance introduced thereby, and said termination having physical and electrical symmetry about its transverse center line to minimize the inductive effects associated therewith.

3. An attenuator in accordance with claim 2 in which the position of said electrode within said tube is adjustable longitudinally to vary the attenuation.

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