

May 31, 1949.

E. FEENBERG

2,471,732

RESISTANCE ELEMENT FOR COAXIAL TRANSMISSION LINES

Filed March 13, 1947

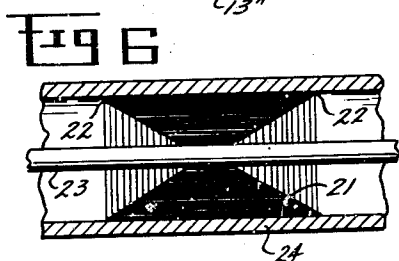
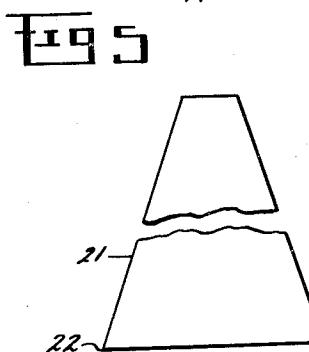
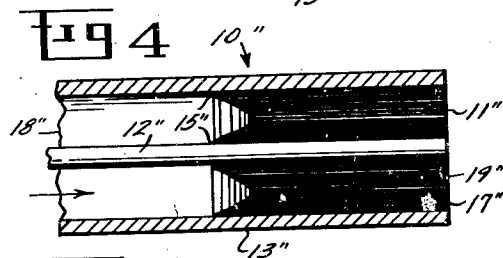
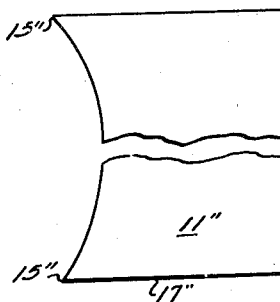
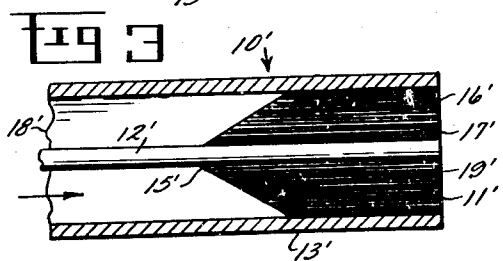
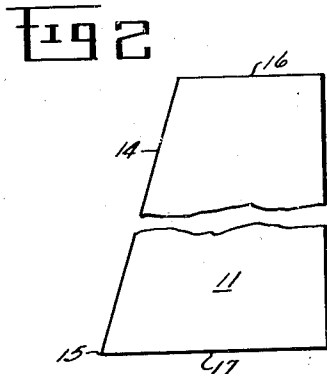
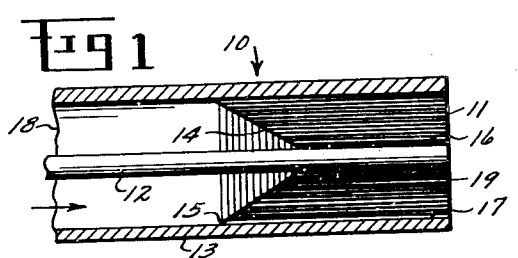
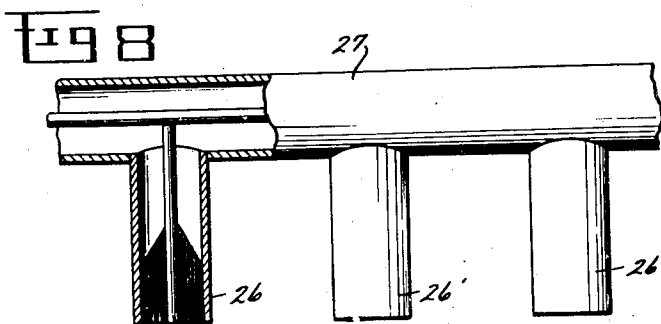


Fig 7



INVENTOR.
EUGENE FEENBERG
BY *Wade County and Daniel Stuker*
ATTORNEYS-

UNITED STATES PATENT OFFICE

2,471,732

RESISTANCE ELEMENT FOR COAXIAL TRANSMISSION LINES

Eugene Feenberg, St. Louis, Mo.

Application March 13, 1947, Serial No. 734,327

5 Claims. (Cl. 201-63)

1

The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a novel resistance element that is particularly suited for use as a terminating element for coaxial transmission lines or as an attenuating element for introducing losses into a coaxial transmission line.

One object of this invention is to provide a practical and inexpensive termination for a broad band coaxial transmission line.

Another object of the invention is to provide a practical and inexpensive attenuating element for use with coaxial transmission lines.

A more particular object of this invention is to provide a terminating or attenuating element for coaxial transmission lines in an inexpensive manner, and preferably doing this by utilizing sheet-like resistive material which is substantially trapezoidal, or irregularly shaped, or exponentially curved at one end in the case of a terminating element, and at both ends in the case of an attenuating element, and mounting the same in wrapped up form around the inner conductor of a coaxial transmission line.

These and various other objects and advantages are attained with this invention as will become apparent from the following description, taken in connection with the accompanying drawing wherein the invention is shown in a few of the preferred forms and manners of applying the same, it being evident that other arrangements and forms of construction may be resorted to for carrying out the objects and purposes of this invention.

In the drawing:

Fig. 1 is a view illustrating my invention in one of its forms, wherein the tapering resistive element consists of a rolled sheet of conductive material tapering at one end and having the short edge of the tapering sheet engaging the inner conductor.

Fig. 2 shows the sheet of flexible material which is trapezoidal in shape and tapering at one end, as used in the form shown in Fig. 1.

Fig. 3 shows the invention comprising such a rolled sheet tapering at one end but having its long edge engaging the inner conductor.

Fig. 4 shows the invention comprising the rolled sheet which at one end tapers from the middle toward both side edges, and the long edges and sides contacting the inner and also the outer conductor.

Fig. 5 shows the sheet having an irregular

2

perimeter and being dished at one end, as used in the form shown in Fig. 4.

Fig. 6 shows the resistance element tapering at both ends and mounted between the concentric conductors, so as to provide an attenuator.

Fig. 7 shows the sheet of flexible material which is trapezoidal but tapers at both ends, for use in the form of Fig. 6.

Fig. 8 illustrates an attenuator employing terminations of the type disclosed herein, providing a three-step attenuator.

Briefly, in carrying this invention into effect the terminations or attenuators are constructed out of sheet-like fibrous material, such as leaky cloth or paper, which is impregnated with a conducting material to make the same semiconducting. This sheet-like material, whether of one piece or of several pieces, is rolled up or wound into a substantially cylindrical form and is mounted in the annular space between the inner and the outer conductors of a coaxial transmission line, being positioned so that the inner end of the rolled sheet closely engages the exterior of the inner conductor while the outer end of the sheet engages the interior of the outer conductor. The sheet-like material used is cut or shaped to contain an irregular perimeter, being preferably trapezoidal in shape, as shown in Figs. 2 and 7 and is applied between the inner and outer conductor so that the rolled up section is tapered in the desired way. This taper may extend from one of the conductors forwardly toward the other conductor, or may be arranged to have the taper extending towards both the inner and the outer conductor, and also in such a manner that the taper is provided at one end in the case of a termination, and at both ends in the case of an attenuating element, when mounted in position for use.

In the form shown in Fig. 1 of the drawing the termination 10 has the tapering resistance element 11 mounted between the inner conductor 12 and the outer conductor 13 of the coaxial transmission line. Said element 11 is tapered at one end 14, and as shown herein has the projecting or longer edge 15 placed against the outer conductor 13.

The resistance element 11 is made of sheet-like resistive material, which may consist of one or more pieces so arranged as to have an irregular perimeter; and as illustrated in Fig. 2, the resistance element can be made conveniently of a piece of material which is cut or shaped to be substantially trapezoidal, having one end 14 tapered or slanting so as to produce a short side 16

and a long side 17. This short side 16 is herein placed against the inner conductor 12 and the long side 17 against the outer conductor 13. In this form the taper on the element 11 is provided at the input end 18 of the terminal, while the output end 19 of the terminal is shorted.

In Fig. 3 the termination 10' is shown as having the tapering resistance element 11' formed from a trapezoidal sheet of material like in the preceding form, but said sheet is rolled up and placed with its shorter side 16' against the outer conductor 13', and the longer side 17' placed upon the inner conductor 12'. The tapered end 14' herein also extends toward the input end 18' of the termination 10', as in the preceding form.

As shown in Figs. 4 and 5, the termination 10'' has the tapering resistance element 11'' mounted between the inner conductor 12'' and the outer conductor 13'', and herein the tapering end is arranged to be indented at the intermediate part of one end to form two projecting edges 15'', so that one long side 17'' with an edge or projection 15'' extends along the inner conductor and another one along the outer conductor. This element herein is conveniently formed from a piece of material containing an irregular perimeter and preferably having one end arranged or cut to be dished or indented at the middle so as to be longer or projecting at the two opposite sides 17'' at that end, substantially as indicated in Fig. 5. This is rolled in cylindrical form and mounted between the inner and outer conductors so as to provide the twin tapers 15'' at that end on element 11'', which tapers project alongside of both conductors, as shown in Fig. 4.

A nonresonant termination in a transmission line, in the manner as disclosed above, provides a means for producing a fixed resistance Z_0 , of magnitude determined by the ratio of the diameter of the inner and the outer conductors.

As shown in Fig. 6, attenuators can likewise be made by tapering the resistance element 21 at both ends 22, instead of only at one end as shown in the preceding forms, and mounting such element 21 between the inner conductor 23 and the outer conductor 24. Herein the sheet material used is also arranged to be substantially trapezoidal, as shown in Fig. 7, and it is rolled up so as to be tapering at both ends when mounted between the conductors, substantially as illustrated.

Terminations of the form disclosed herein are suitable for use in an attenuator of the Hansen three-step type, as shown in Fig. 8, adapted for use as a standard attenuator. The resistance elements 26, 26', and 26'' are used therein to terminate the three stub lines coupled to the transmission line 27, in the manner shown.

I claim:

1. A resistance element for insertion between the inner and outer conductors of a coaxial transmission line, comprising an electrical energy dissipating element having at least one tapered edge to provide one part more narrow than another part and composed of sheet-like resistive material spirally wound to provide a mass of uniform composition mountable between said conductors.

2. A resistance element for a coaxial transmission line, comprising a longitudinally tapering electrical energy dissipating element consisting of a sheet of electrically resistive material which is slanting at least along one lateral edge and is located in spirally wrapped-up formation around the inner conductor and in contact electrically with both the inner and the outer conductors of said line.

3. An electrical termination for a coaxial transmission line, comprising a longitudinally tapering electrical energy dissipating element consisting of a sheet of resistive material which is of varying lateral dimension from one end and is wound around the inner conductor and in contact electrically with both the inner and the outer conductors of said line.

4. A termination for a coaxial transmission line including an inner and an outer conductor, the improvement which comprises an electrical energy dissipating element consisting of a substantially trapezoidal sheet of resistive material located wrapped around the inner conductor and contacting electrically both the inner and the outer conductor and tapering physically toward the input end of said line.

5. An attenuator for a coaxial transmission line including an inner and an outer conductor, comprising a dissipating element tapering at both of its ends and consisting of a sheet of resistive material tapering from its two opposite ends and located wrapped up around the inner conductor and contacting the outer conductor.

EUGENE FEENBERG.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,340,813	Bernard	May 18, 1920
2,399,674	Harrison	May 7, 1946
2,405,515	Neyzi	Aug. 6, 1946
2,424,596	Webber	July 29, 1947
2,434,560	Gunter	Jan. 13, 1948