

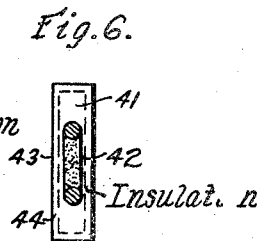
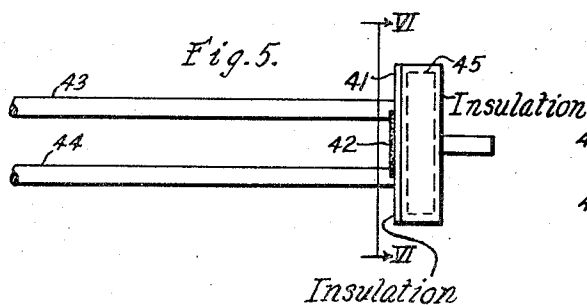
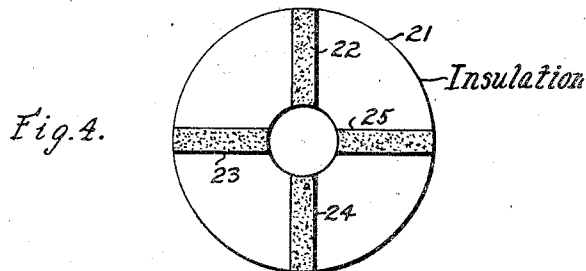
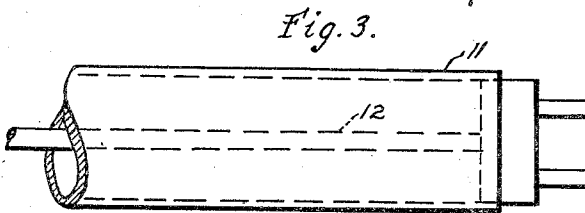
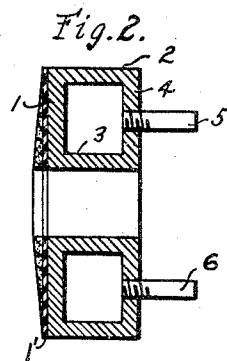
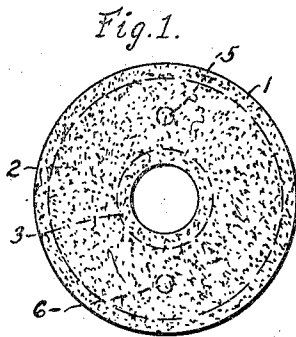
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F. B. GUNTER

2,434,560

TERMINATION FOR TRANSMISSION LINES

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WITNESSES:

Alice R. Howell
Mr. L. Groome

INVENTOR

Frank B. Gunter.

BY

F. W. Lytle
ATTORNEY

UNITED STATES PATENT OFFICE

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TERMINATION FOR TRANSMISSION LINES

Frank B. Gunter, Baltimore, Md., assignor to
Westinghouse Electric Corporation, East Pitts-
burgh, Pa., a corporation of Pennsylvania

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My invention relates to electrical transmission lines and, in particular, to arrangements for terminating high-frequency transmission lines with substantially non-reactive impedances.

It can be shown that where alternating-electric currents are transmitted over transmission lines having distributed capacity and inductance, reflection of traveling waves at points such as the terminus of the line, where the value of the capacitance and inductance per unit length of line undergo sudden changes, produces standing electric waves on the line except under certain load conditions. It is frequently desirable to minimize such wave reflections and their consequent standing waves, and it can be shown that the reflection is avoided at the terminus of a line if its two conductors are interconnected there by an impedance which is equal to the characteristic impedance of the line, this latter quantity being equal to

$$\sqrt{\frac{r+j\omega L}{g+j\omega C}}$$

where r equals the resistance per unit length of the line

L equals the inductance per unit length,
 g the leakance per unit length,
 C the capacitance per unit length, and
 ω equals 2π times the frequency.

For most purposes, it is sufficient if the terminating impedance be a substantially pure resistance equal to the scalar value of this characteristic impedance. It is also frequently desirable for other reasons to supply dummy loads for transmission lines, particularly in the case of very high frequency transmission lines. In both the instances so far mentioned, there arises a problem, particularly at ultra high frequency, of producing an impedance which shall have substantially pure resistance, and shall be thus devoid of reactance over a relatively wide band of frequencies.

One object of my invention is to provide loading impedance for transmission lines which shall approximate very closely to a pure resistance.

Another object of my invention is to provide loading impedance for transmission lines which shall be substantially devoid of reactance over a wide band of frequencies.

Still another object of my invention is to provide a convenient loading impedance which shall approximate the pure resistance for transmission lines of the concentric-line type.

Other objects of my invention will become ap-

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parent upon reading the following description, taken in connection with the drawing in which:

Figure 1 shows an elevational view of a terminating impedance for a concentric line embodying the principles of my invention;

Figure 2 shows a view of the same element taken at right angles to Fig. 1;

Figure 3 is an elevational view illustrating how the impedance element of Figs. 1 and 2 may be used in conjunction with a transmission line of the concentric type;

Figure 4 shows an elevational view, taken in the same direction as Fig. 1, of an alternative type of line loading impedance embodying the principles of my invention;

Figure 5 shows a diagrammatic view in plan of an impedance embodying the principles of my invention as applied to a line comprising separate spaced conductors; and

Figure 6 shows a view, partly in elevation and partly in section, along the lines VI—VI of Fig. 5.

Referring in detail to Figs. 1 and 2 of the drawing, a structure 1 which may be operated with a facing-layer 1' of insulating or other resistance material has a plane face in the form of an annular ring having a central hole. The face 1 is coated, for example, by spraying, with a high resistance material in the form of a very thin layer. The particular material to be used for this purpose will vary with the impedance which it is desired to produce, but it may, for example, be a mixture of finely divided graphite and clay suspended in water. Such a coating would, of course, be allowed to dry and might afterward be baked in accordance with procedures well known in the resistor-manufacturing art. To take another example, the coating might be of silver, gold, tungsten or other metal deposited by placing the element 1 in an evacuated container in proximity to a sample of the metal in question which was elevated to a high temperature by electric heating. Such thin films of the metals can be produced having high resistance by numerous methods well known in the arts today.

It will often be desirable that the voltage gradient due to current flow through the coating should be maintained nearly uniform between the inner and outer edges of this coating; and to do this, the thickness of the coating may be made inversely proportional to the radial distance from the center of the inner circle.

In order that it shall be possible to send currents of considerable magnitude through the resistor thus produced without destructive overheating, it will frequently be desirable to pro-

vide for effectively cooling the resistance film. In order to do this, the insulating plate 1 is provided with a backing comprising cylindrical walls 2 and 3 and a closure plate 4 which will form an annular chamber on the reverse side of the plate. Inlet pipes 5 and 6 may be provided to circulate cooling fluids from any suitable source through this annular chamber.

The structure shown in Fig. 1 is particularly adapted for use with transmission lines of the concentric type illustrated in Fig. 3 and comprising an outer conductor or sheath 11 and central conductor or core 12. The external diameter of the plate 1 of Fig. 1 is made just right so that the outer periphery of the above-described resistive coating is in contact with the inner face of the sheath 11 and the central hole in the plate 1 is made of such a diameter that the inner periphery of the resistive film makes contact with the core 12.

Instead of employing the expedient of varying the thickness of the film with the radial distance as described in Fig. 1, a uniform voltage gradient between the inner periphery and outer periphery of the resistor may be produced in the manner illustrated in Fig. 4 where the insulating plate 21, otherwise similar to that described in Fig. 1, is coated, not over its entire surface, but on a plurality of paths 22, 23, 24, 25 of uniform width throughout their length, the coating being of uniform thickness.

The method of applying the principles of my invention to a transmission line of the type comprising two spaced parallel conductors is shown in Fig. 5. A plate 41 of insulating material of substantially rectangular shape is provided with a coating 42 of insulating material, preferably of substantially uniform width and thickness and having a length sufficient so that it can contact the two conductors 43 and 44 of the transmission line. The plate 41 may be provided with a hollow chamber 45 through which a cooling fluid may be circulated in a manner analogous to that already described in connection with Fig. 2.

While I have described a particular embodiment to illustrate the principles of my invention, these principles are of broader applicability in ways which will be evident to those skilled in the art.

I claim as my invention:

1. In combination with an ultra high frequency transmission line of the concentric core and sheath type, a loading element comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, the resistance per unit length in a radial direction of said resistance layer being substantially independent of the radial distance from the center of said core.

2. In combination with an ultra high frequency transmission line of the concentric core and

sheath type, a loading element comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, and means for cooling the side of said member of insulating material opposite to said resistance layer.

3. In combination with an ultra high frequency transmission line of the concentric core and sheath type, a loading element comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, the thickness of said resistance layer varying inversely with the radial distance from the center of said core.

4. A loading element for a transmission line of the core and sheath type comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, the resistance per unit length in a radial direction of said resistance layer being substantially independent of the radial distance from the center of said core.

5. A loading element for a transmission line of the core and sheath type comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, and means for cooling the side of said member of insulating material opposite to said resistance layer.

6. A loading element for a transmission line of the core and sheath type comprising a member of resistance material having on its surface an annular high resistance layer extending from said core to said sheath and conductively interconnecting them, the thickness of said resistance layer varying inversely with the radial distance from the center of said core.

FRANK B. GUNTER.

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