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COAXIAL CABLE ATTENUATOR

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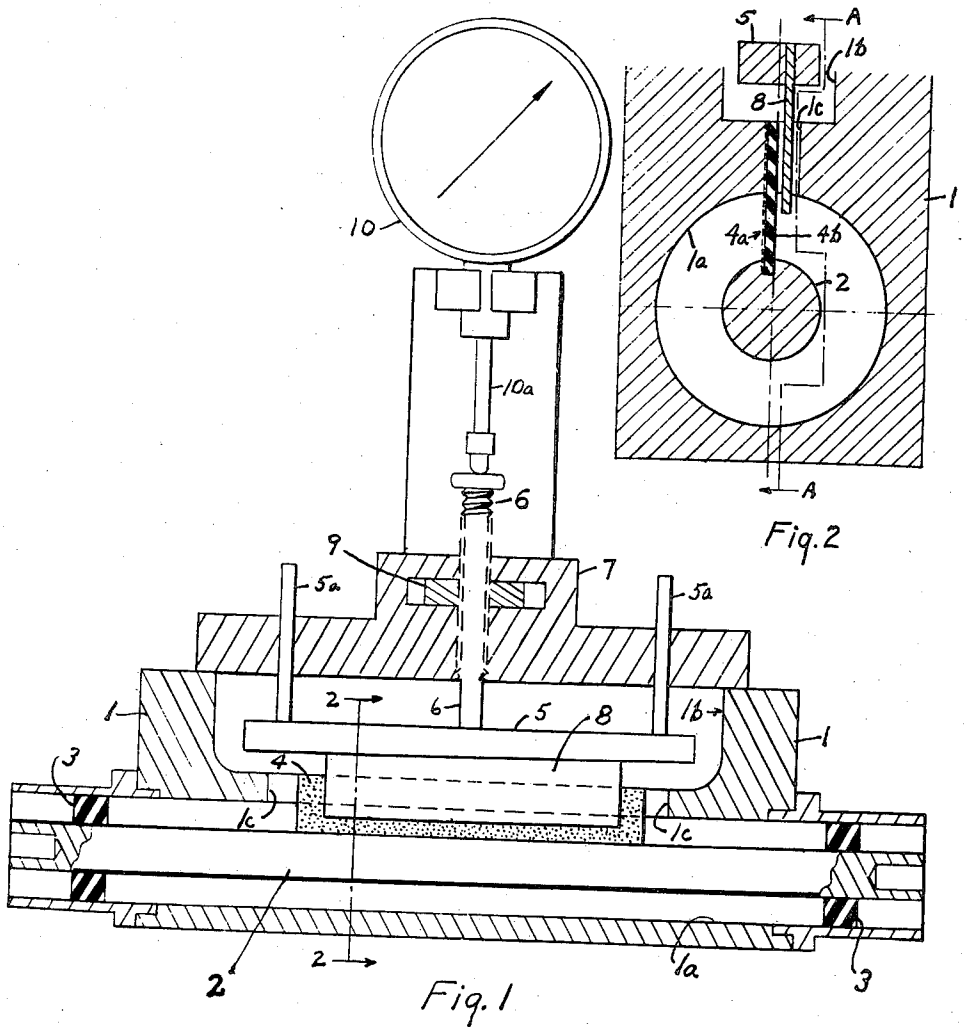


Fig. 1

Fig. 2

Inventor
Lucio M. Vallese
By Ralph B. Stewart
Attorney

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COAXIAL CABLE ATTENUATOR

Lucio M. Vallese, Brooklyn, N. Y., assignor to Polytechnic Institute of Brooklyn, Brooklyn, N. Y., a corporation of New York

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3 Claims. (Cl. 333—81)

This invention relates to attenuators for variably attenuating wave energy in coaxial cables.

An object of the invention is to produce an attenuator for use in a coaxial transmission line for attenuating the wave energy therein over a range of attenuation having definite and fixed limits, and by a smooth variation throughout the range.

My invention employs a shunt conductance connected across the two conductors of a coaxial cable section, together with means for producing a smooth and continuous variation of said shunt conductance.

One embodiment of my invention is illustrated in the accompanying drawing in which Figure 1 is a sectional view of the attenuator taken along a cutting plane indicated by the line A—A in Figure 2; and Figure 2 is an enlarged sectional view of Figure 1 taken along the cutting plane 2—2.

Referring to the drawing, the attenuator is incorporated in a section of coaxial cable, the outer conductor of which is formed by a metal block **1** having a longitudinal bore **1***a* formed therein, the inner conductor **2** of the cable section being supported within the bore **1***a* by suitable insulating beads **3**. The ends of the cable section are suitably formed for connection in a coaxial line.

The upper face of the block **1** is hollowed out to provide a cavity **1***b*, and this cavity is connected to the cable section through a slot **1***e* formed in the outer wall of the cable section. An attenuator plate **4** embodying a resistive sheet is arranged within the slot **1***c* and is conductively connected to one wall of the slot **1***c* along one edge of the plate and to the center conductor **2** along the other edge of the plate. Thus, the resistive plate **4** is connected directly across the conductors of the coaxial cable section and forms a shunt conductance.

Within the cavity **1***b* is located a horizontal bar **5** mounted for vertical movement within the cavity on a screw **6** passing freely through a vertical hole formed in a cover plate **7**. The bar **5** is guided in its vertical movement by means of a pair of vertical guide pins **5***a* secured to the bar and sliding in vertical bores formed in the cover **7**. Mounted upon the bar **5** and extending into the slot **1***c* in overlapping relation with the resistive plate **4** is a movable plate **8** formed of metal of good conductivity. As shown in Figure 2, the plate **8** is maintained in insulated relation with respect to the resistive attenuator plate. The attenuator plate may be formed in various ways, but a preferred arrangement is illustrated in Figure 2 where the plate is shown as being formed of a thin metallic film **4***a* applied to one face of a dielectric plate **4***b*, such as a glass plate, the film **4***a* being arranged to have contact with one wall of the slot **1***c* and with the center conductor **2**. The film **4***a* may be formed by known metallizing methods such as that disclosed in U. S. patent to Weber et al. 2,586,752.

The amount of insertion of the movable plate **8** into the coaxial cable section is controlled by means of a round nut **9** threaded on the screw **6** and located in a horizontal slot formed in cover piece **7**. The amount of insertion of the adjustable plate **8** is indicated by means of a suitable dial indicator **10** mounted above the screw **6** and having its plunger **10***a* engaging the upper end of the screw **6**. The dial of the indicator may be calibrated in terms of attenuation.

The plate **8** is connected to the outer conductor of the coaxial section through its mounting structure and it may have sliding contact with the adjacent wall of slot **1***c*. As the plate enters the bore **1***a* of block **1**, a portion of the plate is capacitively coupled to the resistive film **4***a* connected between the inner and outer conductors of the coaxial section. The plate **8** by-passes or shunts a substantial part of the energy from that part of film **4***a* which is overlapped by the plate and thereby effectively increases the shunt conductance or admittance between the coaxial conductors with a resulting increase in attenuation of energy transmitted to the output end of the coaxial section. The attenuation increases with the amount of insertion of plate **8**.

For maximum range of attenuation, it is desirable to have the plate **8** located as close to the film **4***a* as possible. Thus, the film may be located on the face of plate **4***b* facing plate **8** and covered with a thin coating of insulating material to prevent direct contact between the resistive film and the shunting plate.

The resistivity of the attenuator sheet or film may be selected between rather wide limits depending upon requirements with respect to insertion loss, range of attenuation, etc. In the case of a coaxial section having an inside diameter of 0.811" and a center conductor of 0.356" diameter and operating over frequencies of 3100 mc./s. to 4560 mc./s., I have obtained good results with an attenuator plate 9 inches long and having a resistivity of 2500 ohms/square. The insertion loss varies with frequency but was always less than 5 db. Maximum attenuation of 25 db is easily attainable at a VSWR of less than 1.3.

The end portions of the glass plate **4***b* may be left free of the film **4***a* to aid in reducing the standing wave ratio, and the shunting plate **8** may be made somewhat shorter than the resistive sheet or film **4***a* for the same purpose.

Other arrangements may be devised for mounting and moving the shunting plate **8** and for indicating the amount of insertion or attenuation.

In Figure 2 some of the dimensions are exaggerated; see, for example, the clearance between plate **8** and the attenuator plate. Plate **8** may have sliding contact with the attenuator plate but the film **4***a* should have a coating of insulation if it faces plate **8**.

I claim:

1. A variable attenuator comprising a coaxial cable section having a tubular outer conductor and a center conductor, a sheet of resistive material arranged longitudinally within the annular space between said conductors and being conductively connected along opposite longitudinal edges to said inner and outer conductors respectively, said outer conductor having a longitudinal slot formed therein adjacent said resistive sheet, a conductive sheet of a thickness to enter said slot, and means mounting said conductive sheet to move into said slot and into closely spaced parallel overlapping relation with said resistive sheet but out of conductive contact therewith.

2. A variable attenuator comprising a coaxial cable section having a tubular outer conductor and a center conductor, a sheet of resistive material arranged longitudinally within the annular space between said conductors and being conductively connected along opposite longitudinal edges of said inner and outer conductors respectively, and means including a conductive sheet mounted to move into closely spaced over-lapping rela-

tion with said resistive sheet but out of conductive contact therewith for shunting energy around a variable portion of said resistive sheet.

3. A variable attenuator comprising an elongated block of conducting material having a bore formed longitudinally therethrough, means insulating by mounting a conductor at the center of said bore, said bored block and conductor comprising the outer and inner conductors of a coaxial cable section, one outer face of said block being hollowed out to provide a cavity therein extending parallel with said bore, a conductive cover plate secured to said block and covering said cavity, said cavity being connected with said bore by a narrow slot formed longitudinally through the bottom wall of said cavity substantially radially of said bore, an adjusting rod extending through an opening in said cover plate and into said cavity, screw means for adjusting the amount of insertion of the end of said rod into said cavity, a bar carried on the inner end of said rod within said cavity and arranged parallel with said bore, guide means

carried by said bar and extending through guide openings in said cover plate for maintaining said bar parallel with said bore, a sheet of resistive material arranged longitudinally within the annular space between said conductors and being conductively connected along opposite longitudinal edges to said inner and outer conductors, respectively, said resistive sheet being arranged substantially radially of said inner conductor and adjacent one edge of said slot, and a sheet of highly conductive material carried by said bar and extending into said slot and being movable into closely spaced overlapping relation with the portion of said resistive sheet which is connected between said inner and outer conductors but out of conductive contact therewith.

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