

Oct. 10, 1950

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ATTENUATOR FOR HIGH-FREQUENCY
ELECTRIC SIGNALING SYSTEMS
Filed Dec. 22, 1944

2,525,554

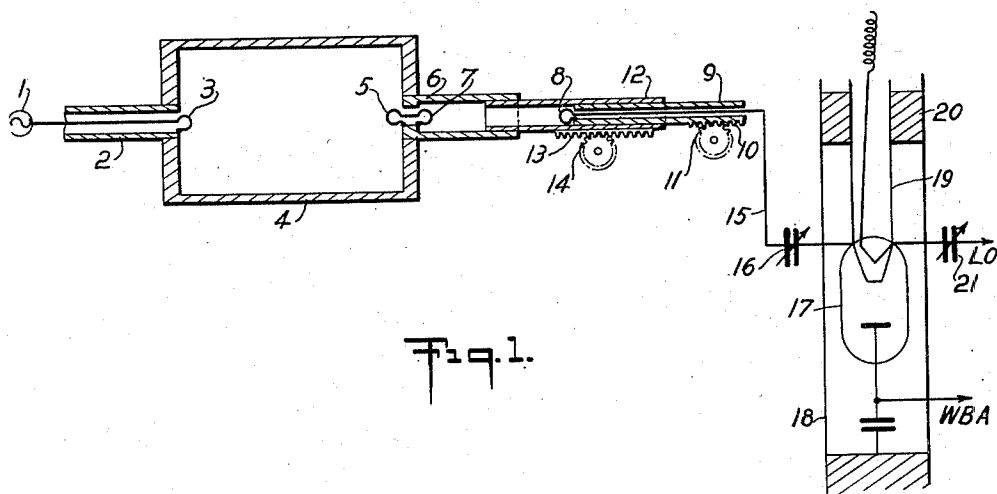


Fig. 1.

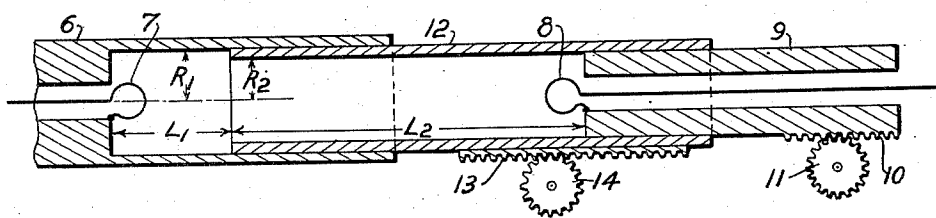


Fig. 2.

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2,525,554

ATTENUATOR FOR HIGH-FREQUENCY
ELECTRIC SIGNALING SYSTEMSKenneth Eric Latimer, London, England, assignor
to The Hartford National Bank and Trust Com-
pany, Hartford, Conn., as trusteeApplication December 22, 1944, Serial No. 569,412
In Great Britain August 26, 1943

7 Claims. (Cl. 178-44)

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This invention relates to so-called piston attenuators which consist fundamentally of a sending element and a receiving element disposed within a tube, at least one of the elements being moveable lengthwise of the tube so as to alter the distance between the sending and receiving elements with corresponding alteration in the attenuation. The coupling between the elements may be capacitative or inductive.

According to the present invention the tube between the sending and the receiving elements consists of at least two portions of different diameter, which portions are relatively displaceable, so that the effective lengths of the respective tubes can be varied without varying the total length between the sending and receiving elements. In addition, the sending element or the receiving element or both may be moveable axially of the tubes as in known piston attenuators so as to give the usual variation in attenuation by varying the separation in addition to the fine adjustment which is obtained by altering the relative lengths of the tubes of different diameter.

A preferred embodiment of the invention in which the sending and receiving elements consist of loops, so that the coupling is inductive, will now be described with reference to the accompanying drawings, in which:

Fig. 1 shows a typical circuit arrangement incorporating a piston attenuator constructed in accordance with the present invention.

Fig. 2 shows in greater detail the piston attenuator incorporated in Fig. 1.

The circuit arrangement of Fig. 1 can be utilised for example for determining the "Q" of a cavity resonator 4 comprising an input loop 3 and an output loop 5. The loop 3 is connected to a generator 1 by means of a cable 2 the loss of which can be varied as required. The output loop 5 is connected to the input element 7 of the piston attenuator which in the construction shown consists of a fixed cylinder 6 surrounding the input element 7, an auxiliary cylinder 12 sliding within the fixed cylinder 6, and a piston 9 carrying the output element 8 of the attenuator and slidable within the cylinder 12. The piston 9 is provided with a rack bar 10 engaging with a pinion 11 whereby the separation between the elements 7 and 8 can be adjusted; this piston 9 is preferably locked with a clamp after rough adjustment to avoid backlash. Similarly the cylinder 12 is provided with a rack bar 13 which is engaged by the pinion 14 whereby the cylinder 12 can be adjusted relatively to the cylinder 6

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and the piston 9. The output element 8 of the attenuator is connected by way of a very small variable condenser 16 to a tuned diode 17 which is disposed within an enclosure 18. The line 19 connected to the cathode of the diode 17 is tuned to resonance by means of a piston 20. The cathode end of the line 19 is connected to a local oscillator LO through a very small variable condenser 21. The output of the diode mixer 17 is passed to a wide-band amplifier WBA and an indicator. With this arrangement, for example, it is possible to determine readily when the amplitude of the field in the cavity has dropped to any given fraction of its value at resonance even if the relationship connecting the input to the mixer valve 17 with the output indication from wide-band amplifier is not known.

As best seen from Fig. 2, the attenuator illustrated can be regarded as built-up from a cylinder of length L_1 and radius R_1 , and a cylinder of length L_2 and radius R_2 , the total length being $L_1 + L_2$. The attenuation varies with the length and also inversely with the radius. For a given total length $L_1 + L_2$, fine adjustment of the attenuation is achieved by varying L_1 and L_2 equally and oppositely by turning the pinion 14 to cause the cylinder 12 to slide into or out of the cylinder 6. In this way it is possible even with the use of cylinders of small diameter to achieve an open scale enabling small differences of attenuation to be measured. The reading of an attenuation scale associated with the cylinder 12 is in fact

$$\frac{R_1 - R_2}{R_2}$$

times the reading of an attenuation scale associated with the piston 9. Conveniently the scales can be associated directly with the pinions 14 and 11 respectively.

I claim:

1. A piston attenuator for an electric signaling system comprising a loop fixed at one end of a cylindrical tube open at the other end, an open ended cylindrical tube slidable within the first tube, a piston member slidable within the second tube, a loop fixed at the inner end of the piston member, and separate means for axially moving the second tube and the piston.

2. An attenuator for an electric signalling system comprising a sending element and a receiving element, a tube consisting of at least two portions of different diameter, one of said portions surrounding said sending element and the other of said portions surrounding said receiving

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element, and a piston member slidable within one of said portions and carrying the element contained therein, said portions being relatively displaceable so that the effective lengths of the tube portions can be varied without varying the total length between said sending and receiving elements.

3. An ultra-high frequency attenuator comprising first and second ultra-high frequency coupling elements, a wave guide constituted by two telescoping sections having different cross-sectional areas, one of said sections surrounding said first element and the other of said sections surrounding said second element, and a piston member slidable within one of said sections and carrying the element contained therein, said sections being relatively displaceable so that the effective lengths of the sections can be varied without varying the total distance between the first and second elements.

4. An ultra-high frequency attenuator comprising a loop fixed at one end of a circular wave guide open at the other end, an open ended circular wave guide slidable within the first guide, a piston member slidable within the second guide, a loop fixed at the inner end of the piston member, and separate means for axially moving the second guide and the piston.

5. An ultra-high frequency attenuator comprising a first tubular wave guide open at one end, a first ultra-high frequency coupling element fixedly disposed within said first guide, a second tubular wave guide open at both ends and slidably arranged within said first guide, a second ultra-high frequency coupling element freely disposed within said second guide, means for axially moving said second guide, and means for moving said second element longitudinally within said second guide.

6. In combination, a hollow pipe wave guide, a conductive tubular sleeve telescopically fitted within said wave guide and arranged for movement therewithin, and a coaxial transmission

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line having an outer conductor and an inner conductor extending along said sleeve, said outer conductor being telescopically fitted within said sleeve to permit relative movement between said sleeve and said outer conductor, and said inner conductor being connected to said outer conductor at the end of said coaxial transmission line adjacent said hollow pipe wave guide.

7. Attenuating apparatus for electromagnetic energy of at least a predetermined wavelength, comprising a hollow pipe wave guide for conducting electromagnetic energy of at least said predetermined wavelength, said wave guide being so dimensioned as to provide substantially constant attenuation per unit length for electromagnetic energy of wavelength longer than said predetermined wavelength, a movable sleeve telescopically fitted within one end of said hollow pipe wave guide, a section of coaxial transmission line having an inner conductor and an outer conductor extending along said movable sleeve, said inner conductor being connected to said outer conductor at the end thereof adjacent said hollow pipe wave guide for providing energy-interchanging relation between said coaxial line section and said hollow pipe wave guide, and coupling means engaging said hollow pipe wave guide in energy-interchanging relation therewith, whereby said hollow pipe wave guide conducts energy between said section of coaxial transmission line and said coupling means.

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