

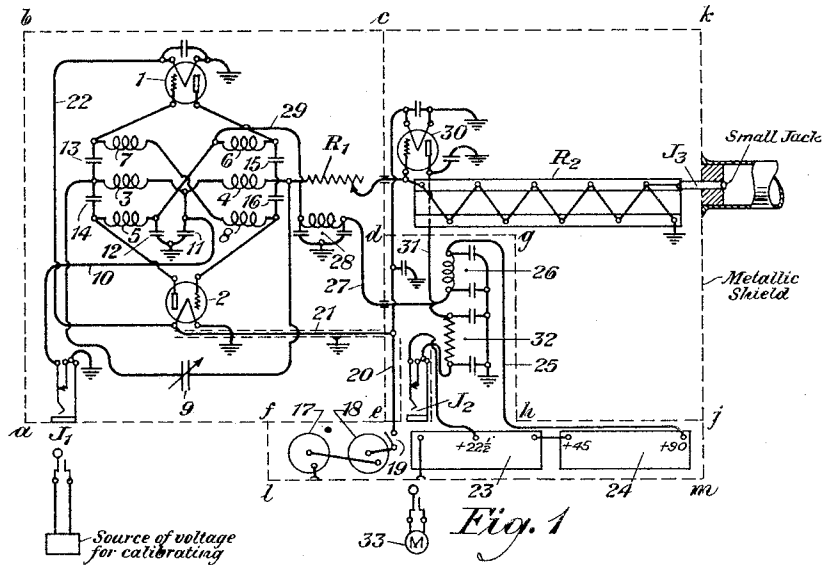
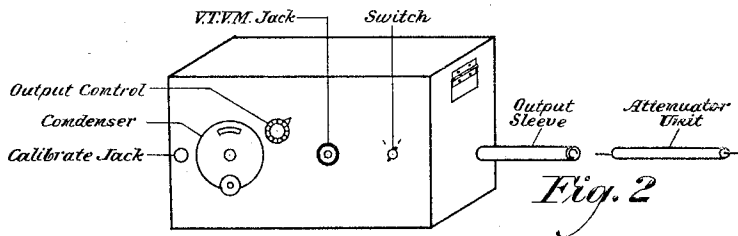
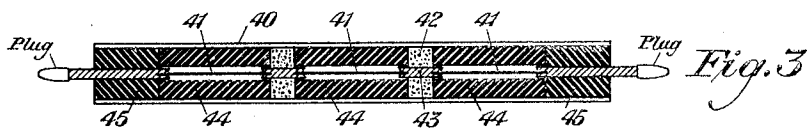
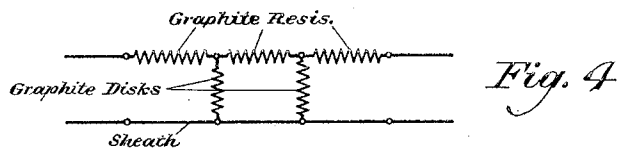
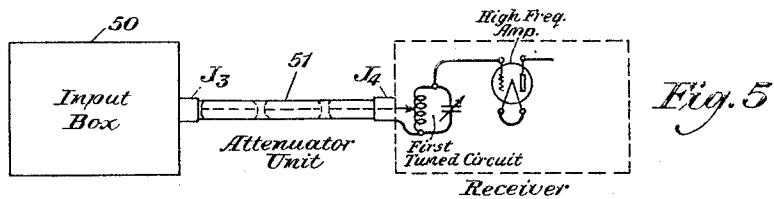
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ATTENUATION UNIT

Filed June 18, 1931



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ATTENUATION UNIT

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This invention relates to attenuation networks, and particularly to one adapted for use in connection with a concentric conductor transmission system.

In short wave receiving systems, particularly those employed in transoceanic signaling, it is customary to use concentric conductors for the transmission line connecting the antenna arrays to the receiving apparatus for the reception of signals. The concentric conductor transmission line consists of a copper pipe within which is a copper conductor held in concentric position by isolantite rings, or other suitable means, distributed about a foot apart along the inside of the pipe. The pipe is supported by metallic stakes driven into the earth, and the said pipe is connected to the stakes by flexible copper bonds. The concentric conductor transmission line is connected to the terminal apparatus at the antenna array by means of a jack and a sleeve into which the concentric conductor and the outer sheath properly fit; and the transmission line is connected to the circuit at the receiver in similar manner. In the making of tests and measurements upon the circuits of the receiving system, it is desirable to apply to them a voltage corresponding to that produced by the flow of current over a given length of the concentric conductor transmission line.

This invention resides in a concentric conductor attenuator unit having the characteristics of a concentric conductor transmission line of a predetermined length.

The invention will be clearly understood from the following description when read in connection with the attached drawing, of which Figure 1 shows schematically a type of oscillator that may be employed in the making of tests in which the attenuator unit is also employed; Fig. 2 shows a practical arrangement of the circuit of Fig. 1 with the control apparatus mounted thereon, which arrangement is referred to hereinafter as an input box; Fig. 3 is a cross-sectional view of the attenuator unit in which the invention is embodied; Fig. 4 is a schematic arrangement of the unit shown in

Fig. 3, and Fig. 5 shows the mode of using the attenuator unit in making tests upon the receiving system.

The input box, shown in Fig. 1, comprises a source of high frequency oscillations, a vacuum tube voltmeter, and a source of current and filters connected with the tubes of the oscillator and the voltmeter. The oscillator comprises those elements within the dotted lines *abcdef*, the said dotted lines representing the metallic shield of the oscillator; the vacuum tube voltmeter embraces the apparatus within the dotted line *cdghjk*; and the filters and the source of current and voltage are shown within the dotted lines *deflmjhg*. The oscillator comprises the vacuum tubes 1 and 2 of the three-electrode type, and a plurality of windings, connected with the electrodes, by which the necessary feed-back may be effected to produce oscillations. The windings 3 and 4 have their outer terminals connected with the variable condenser 9 and have their inner terminals joined together. That junction is connected by conductor 10 and the contacts of the jack *J₁* to the grounded shield of the oscillator. The junction point of 3—4 is also connected to ground through the condenser 11. The windings 5—6, which are coupled to the windings 3—4, have their junction point connected to ground through the condenser 12. The outer terminal of winding 5 is connected to the plate of the tube 2 and, similarly the outer terminal of winding 6 is connected to the plate of tube 1. The winding 7 has its outer terminal connected to the grid of tube 1, and in like manner the outer terminal of winding 8 is connected to the grid of tube 2, the junction of the said windings being connected to ground. The outer terminals of all of the said windings are connected together by a plurality of condensers 13, 14, 15 and 16. The filament heating current is supplied by the batteries 17 and 18 over a circuit that includes the switch 19, conductors 20—21 to the filament of tube 2, thence over conductor 22 to the filament of tube 1. The plate voltage is supplied from the positive terminal of the

90-volt battery 23—24 over a circuit that includes conductor 25, filter 26, conductor 27, filter 28 and conductor 29 to the midpoint of the windings 5—6 connected, respectively, with the plates of the tubes 2 and 1. The output of the oscillator is coupled to the resistance R_2 by the variable resistance R_1 .

In a preferred form of oscillator the windings 3—4 are formed of six turns of copper tubing, the said winding being about $2\frac{1}{2}$ inches in diameter and 6 inches in length. The number of turns, of course, may be greater or less than 6, and the diameter of the winding may also vary. That winding, formed of copper tubing, is tapped at its midpoint in the manner shown. The winding represented by 5—6 is formed by threading a wire through the coils of copper tubing 3—4, and in like manner the winding 7—8 is likewise formed by threading another conductor through the said tubing. The midpoint of each of those threaded conductors is connected in the manner shown in the circuit diagram. It is to be understood, however, that the invention is not limited to the particular type of oscillator shown in the drawing and described above. The type of oscillator shown is well adapted to supply the power required in making the tests herein-after described, but it is to be understood that other types of oscillators may be employed without departing from the scope of the invention.

The resistance R_2 is made up of pencil lead, and has in its preferred form a resistance of about 500 ohms. That resistance is connected to the resistance R_1 in the oscillator compartment. At the coupling between the resistances there is connected a vacuum voltmeter comprising the three-electrode vacuum tube 30. The plate of that tube is connected by conductor 31 to the $+22\frac{1}{2}$ -volt terminal of battery 23, the connection including the filter 32 and the contacts of jack J_2 . For the sake of clarity, conductor 31 is shown dotted where it passes under resistance R_2 . The filter 32 is provided to permit the use of an external meter 33 to be plugged into the jack J_2 , without causing appreciable effect upon the pick-up by the receiver for input voltages as low as 70 d.b. below one volt. The grid of the vacuum tube 30 is connected with the coupling between R_1 and R_2 and the filament is energized by current from the batteries 17—18, transmitted by conductor 20. The left-hand terminal of resistance R_2 is grounded and a point about 35 ohms above ground is connected to a small jack at the center of a copper sleeve projecting from the side of the metallic box that shields the testing apparatus. That sleeve, which is about 6 inches long, is adapted to receive

one end of the attenuator unit shown in detail in Fig. 3. The center conductor of that unit terminates in a plug that coacts with the jack J_3 and the sleeve makes contact with the tubing that forms the outer conductor of the attenuator unit shown in Fig. 3.

The attenuator unit comprises a tube 40, preferably of copper, that forms a shield about the concentric conductor. That conductor, as made in the form shown in Fig. 3, comprises sections of pencil leads designated 41, the tips of which are copper plated. Those pencil leads are spaced and supported by discs 42 made of graphite or a graphitic mixture formed under high pressure. Those discs, prior to being subjected to pressure, are fitted with small brass hubs 43 at their centers that are intended for supporting the pencil leads of the concentric conductor. Thin copper gauze is formed around the outer surface of the discs to provide good contact between the discs and the inner surface of the copper pipe. The discs are spaced apart from each other and from the end members 45 by means of spacers 44 made of hard rubber or other suitable material. The end members 45 are also made of hard rubber or other suitable material, and have therein a plug, one end of which is adapted to receive a pencil lead, and the other end is formed to coact with the jack of the terminal apparatus with which the concentric conductor transmission line normally coacts. As will be seen from Fig. 4, a unit of the type shown in Fig. 3 comprises a plurality of resistances in series, with a plurality of spaced resistances in shunt. Obviously, by suitably proportioning the materials employed in the attenuator unit, that is the pencil leads and the graphite discs, the resistance of the unit may be made to simulate any electrical network. To avoid variation of resistance, the ends of the pencil leads are copper plated and have a small spring contact connected thereto to provide, a tight fit at the point of connection with the hubs of the discs and of the terminal contact members. The resistance materials used for the longitudinal and sectional elements of the attenuator may, of course, be of any materials other than graphite that is suitable for use at high frequencies.

The manner in which the arrangement shown in Fig. 3 is used, will be apparent from the following description of the method of testing the gain of the high frequency amplifier of the receiving system, as shown in Fig. 5. In the latter figure, the input box 50 is connected to the first tuned circuit of the high frequency amplifier of the receiving system. The connection is effected by means of the attenuator unit 51 of the type shown in Fig. 3, which is inserted in the jack J_3 of the input box and in the jack J_4

of the receiving system. The condensor of the input box is adjusted to give the desired frequency, and the output control of the input box is adjusted to give a predetermined deflection of the ammeter in the plate circuit of the demodulator connected with the output of the amplifier. A reading is made simultaneously of the meter 33 connected with the vacuum tube voltmeter. Then, the output control dial, which operates the resistance R_1 , is turned so as to short-circuit the resistance. Readings similar to those just mentioned are taken. From those readings the gain of the high frequency amplifier is obtained, which gain includes that produced by the step-up coil in the input circuit. To obtain the gain of the amplifier itself, it is, of course, necessary to eliminate that produced by the step-up coil. This is obtained by connecting the input box directly to the grid of the first amplifier. In this case the attenuator unit employed would be smaller than that previously employed. The central conductor of the attenuator is connected to the grid, and the sheath of the concentric conductor is connected to ground. The input box is then adjusted to give the same frequency as in the previous measurement, and the oscillator is adjusted to give a suitable deflection in the plate circuit of the first demodulator. The readings of the meter 33 and of the ammeter in the demodulator plate circuit are then read. The output control is turned so as to short-circuit the resistance R_1 , and readings are then made upon the same meters. From those measurements the gain of the high frequency amplifier itself may be determined. The difference between that determination and the calculation of the gain for the amplifier and the high frequency step-up circuit, is the gain produced by the said step-up circuit.

It is to be understood that the invention is not limited as to use to a particular type of input box, nor is it limited to the making of measurements of the gain attainable by the step-up circuit of the high frequency receiving system. That apparatus and method of use have been described simply for the purpose of making clear the manner in which an attenuation unit of the type to which this invention belongs, may be employed.

It is to be understood furthermore, the invention is capable of embodiment in other forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. An attenuation network comprising a tube of electrically conductive material, a plurality of discs inserted therein said discs being composed of graphitic material, and a plurality of graphitic rods each having its ends supported by adjacent discs, the said

rods being concentrically located within the said metallic tube.

2. An attenuation network comprising a tube of electrically conductive material, a longitudinal resistance element concentrically located therein, and a resistance in shunt with the longitudinal resistance element and the said tube, the said longitudinal element terminating in a plug.

3. An attenuation network comprising a tube of electrically conductive material, a longitudinal resistance element concentrically located therein, and a resistance in shunt with the longitudinal resistance element and the said tube, the said longitudinal element terminating in a plurality of plugs, one at each end of said network.

4. In a high frequency testing system the combination with an input box comprising a shielded oscillator terminating in a jack and a sleeve in the wall of said box, of an attenuator network as defined by claim 2 adapted to coact with the said input box, the plug of said network being capable of insertion in the jack of said box, and the tube of said network and the sleeve of said box being of such diameters as to fit closely together.

5. In a high frequency testing system the combination with an input box comprising a shielded oscillator terminating in a jack and a sleeve in the wall of said box, of an attenuator network as defined by claim 2 adapted to coact with the said input box, the plug at one end of said network being capable of insertion in the jack of said box and the plug at the other end being capable of insertion in a jack of a concentric conductor transmission system, the tube of the said network being adapted to be conductively connected to said sleeve of said box and also the tube of the concentric conductor transmission system.

In testimony whereof, I have signed my name to this specification this 16th day of June 1931.

RALPH K. POTTER.