Nov. 7, 1944. N. BOTSFORD 2,362,348

TRANSMISSION MONITORING SYSTEM

Filed Jan. 28, 1941

FIG. 1

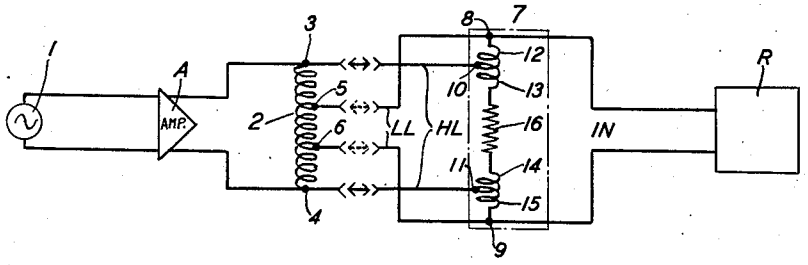
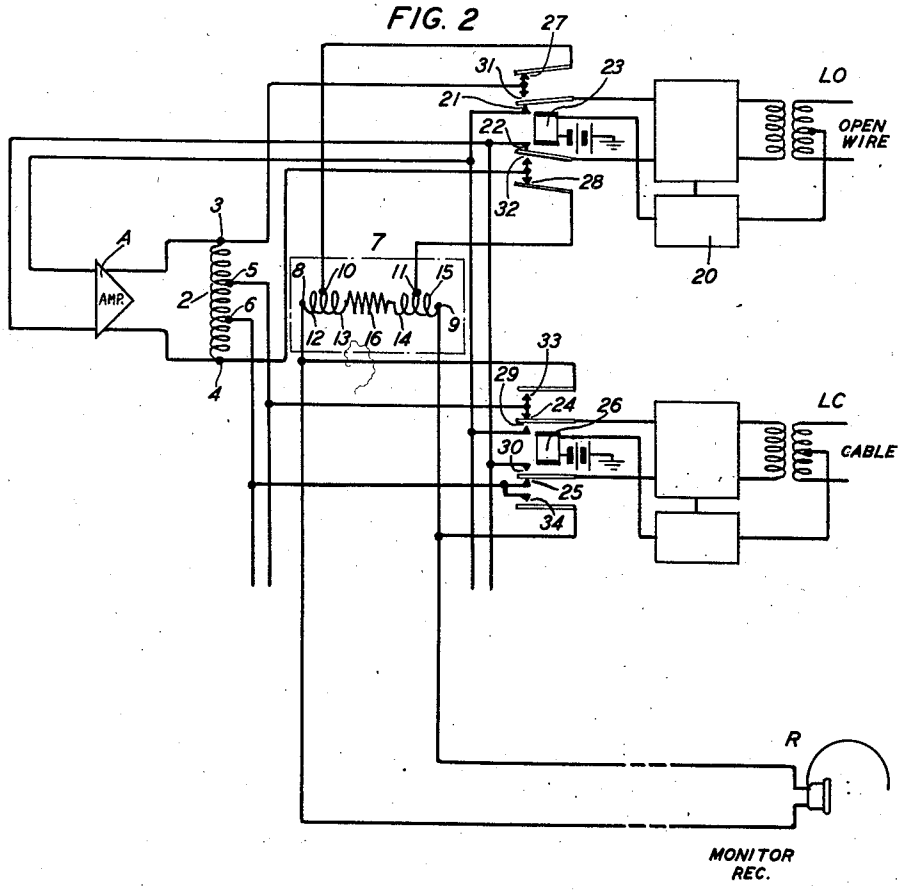


FIG. 2



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TRANSMISSION MONITORING SYSTEM

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9 Claims. (Cl. 179—175.3)

This invention relates to monitoring systems and more particularly to such systems for use at switching centers where broadcast program lines having different transmission characteristics are interconnected to form so-called networks which interconnections usually involve a voice frequency amplifier common to each of said networks, such for example as described in the patent to Bachelet 2,198,326, issued April 23, 1940, which shows (Fig. 5) a so-called bridging point comprising an amplifier **500** to which are connected an open-wire transmission line and two cable lines, one of said cable lines (**420**) being shown as connected to the input of the amplifier, over contacts of relay **507**, and the open-wire line **713**, and the other cable line **712**, are connected to the output of the amplifier over contacts of relays **503** and **501**, respectively.

In general, open-wire lines require a higher level of transmission than do cable lines of the type employed in this service, and therefore the lines receiving a program are connected to taps on an autotransformer (**517**), across the output circuit of the amplifier, which taps are so chosen as to provide the desired levels. In practice, the open-wire lines (**713** for example) are connected across the entire winding of the autotransformer whereas the cable lines (**712** for example) are connected to intermediate taps as discussed in the patent specification and shown in the drawing.

In systems of the character above described it is desirable for an attendant to monitor, i. e., listen to the program being repeated to the outgoing lines and this is accomplished, in practice, by automatically connecting the monitoring circuit to the high level output of the amplifier when an open-wire line is connected to its input and when a cable line is connected to the input of the amplifier, the monitoring circuit is connected to the lower level output. As it is desirable to maintain a substantially constant level of transmission energy in the monitoring receiver, regardless of the energy level supplied to the monitoring circuit, an object is to provide means whereby this result is accomplished in a simple and effective manner.

Briefly stated, therefore, an object of the invention is to provide a monitoring circuit which can be alternatively connected to either of two transmission lines having different energy levels which monitoring circuit will deliver to the receiver thereof a substantially constant level of transmission regardless of which transmission line the monitoring circuit is connected to.

A feature of the invention resides in a loss network comprising a plurality of inductive and non-inductive resistance elements, said network having two input terminals arranged to be connected to the high level of two energy sources, and having two output terminals permanently connected to a monitoring receiver, said output terminals being also adapted to be connected to the lower level of said two sources alternatively with the connection of the input terminals of the high level source, said network elements being so arranged and connected that when the higher level source is connected to the input terminals of the network a predetermined lower level of energy will be applied to the receiver and, alternatively, when the lower level source is connected directly to the receiver, and consequently to the output terminals of the network as well the energy supplied by the source to the receiver will not be substantially attenuated.

The invention will be understood from the following description and accompanying drawing, Fig. 1 of which is a schematic representation of the principles embodying the invention, and Fig. 2 shows a practical application of the invention to a program amplifying and switching system.

Referring to Fig. 1 of the drawing an amplifier A is shown supplied by a source of signaling current, which in practice may be a telephone line transmitting speech or other audible frequency. Connected across the output of the amplifier is an autotransformer **2** having outer terminals **3**, **4** and intermediate terminals **5**, **6** which sets of terminals **3**, **4** and **5**, **6** serve as separate sources of different energy level, the energy level across terminals **3**, **4** being higher than the level of energy across terminals **5**, **6**.

A monitoring receiver R is shown having an input circuit IN with which a transmission loss network, or pad, **7** is permanently connected, which loss pad has two sets of terminals **8**, **9** and **10**, **11** whereby the receiver input circuit IN can be alternatively connected either to the high level terminals **3**, **4** of the autotransformer **2** or to the low level terminals **5**, **6**.

The loss pad **7**, in practice, consists of a transformer having four windings **12**, **13**, **14** and **15** connected in series-aiding relation and having a non-inductive resistance **16**, connected between windings **13** and **14**. When the high level terminals **3**, **4** of the autotransformer **2** are connected to terminals **10**, **11** of the loss pad **7** the voltage impressed across the receiver R may be controlled by the proper proportioning of the turns of windings **12**, **15** and **13**, **14** and the value of resistance **16**, while at the same time the

impedance looking into terminals 10, 11 of the pad may be maintained equal to the impedance of the receiver R.

When the terminals 10, 11 of the loss pad are disconnected from the high level source and terminals 8, 9 are connected to the lower level terminals 5, 6 of transformer 2, current flows directly to the input circuit IN and thence to the receiver R with the combined inductance and resistance of the pad combination in shunt thereto. Under this condition the non-inductive resistance of the pad element is in series with the series-aiding inductance of the windings 12, 13, 14, 15 which, depending on the design of the transformer, may be so high that its shunting effect on the input circuit is negligible. For example, if the impedance looking into the receiver R is 600 ohms and it is desired to maintain approximately this same impedance when looking away from either the high or low level terminals 3, 4 or 5, 6 and at the same time introduce an attenuation of approximately 6 decibels between the high level terminals 3, 4 and the receiver R, the pad 7 may consist of a transformer having four substantially equal windings the combined non-inductive resistance of which is 70 ohms, the series-aiding inductance of the windings 120 henries and the non-inductive resistance connected in series at the mid-point of the pad may have a value of 1800 ohms. By changing the ratio of the windings and the value of the resistance, the 600-ohm impedance may be maintained and the high level current, when connected, attenuated by any reasonable amount without substantially altering the low level current when the receiver is switched to this source.

Fig. 2 shows a practical application of the loss pad in a program switching system arranged to amplify and connect a program incoming over one line to one or more other lines which may require either a low or high level of transmission energy, depending on the character of the individual line, for example, in the drawing LO represents a so-called open-wire line and LC a cable line which, as previously mentioned, require different levels of transmission energy for their satisfactory operation, i. e., open-wire lines when receiving a program from the network for transmission to a distant station require a higher level of transmission energy supplied thereto, due to line noise, etc., than do cable lines which are not subject to as much interference of this character.

For purposes of description the switching and amplifying arrangement of Fig. 2 is shown in the condition where the open-wire line LO is supplying the program, originating at some distant station, which line is connected, under control of a simplex switching circuit 20, to the input of amplifier A over contacts 21 and 22 of operated relay 23, and cable line LC is connected to low level terminals 5, 6 of an autotransformer 2 across the output of the amplifier over contacts 24, 25 of relay 26. Under this condition, the intermediate terminals or taps 10, 11 of the loss pad 7 are connected over contacts 27, 28 of relay 23 to the high level terminals 3, 4 of transformer 2 whereupon loss pad 7, as before described, introduces a desired loss in the monitoring circuit.

Now assuming the case in which the cable line LC is supplying the program for distribution to the network then relay 26 will be operated and all other corresponding relays including relay 23 will be released whereby cable line LC is connected over contacts 29, 30 of relay 26 to the input of amplifier A and open-wire line LO is connected over contacts 31, 32 of relay 23 to the high level terminals 3, 4 of autotransformer 2 across the output of the amplifier thus supplying the full output energy of the amplifier to the open-wire line. Under this condition with relay 26 operated, the circuit of the monitoring receiver R is connected over contacts 33, 34 directly to the low level terminals 5, 6 of transformer 2 and due to the high series-aiding inductance of the coil windings 12, 13, 14 and 15 of pad 7 plus the non-inductive resistance 16 the shunting effect of the pad on the low level energy applied to the receiver R is negligible.

What is claimed is:

1. In a monitoring system, two sources of signal frequency of different energy level, a receiver having an input circuit adapted to be connected to either source, means for maintaining a constant voltage level across said receiver regardless of which source the input circuit is connected to, said means comprising an impedance including a pair of mutually inductive transformer windings and a non-inductive resistance in series therebetween connected in shunt to said input circuit, and means for connecting said lower level source directly across said impedance and for connecting said higher level source between intermediate points of said pair of transformer windings.

2. In a monitoring system, two transmission lines operating at different energy levels, a monitoring receiver, means for connecting said receiver to the higher energy line, and other means for connecting the receiver to the lower energy line, said first means including an impedance in shunt to said receiver, effective to attenuate the energy of the higher level line by an amount equal to the difference in level between the two lines when a connection is established between said higher level line and two intermediate points in said impedance, said impedance having no substantial attenuating effect on the energy applied to the receiver when it is connected to the lower level line by said second means.

3. In a monitoring system in which a receiver is connected to either of two sources of different level signaling energy, means for equalizing the energy level applied to the receiver regardless of the source to which the receiver is connected, said means comprising an impedance network including inductive and non-inductive elements connected in shunt to said receiver, a circuit including certain of said elements in series therewith and other of said elements in shunt thereto for connecting said receiver to the higher energy source and a second circuit in parallel with said network and receiver for connecting to the lower energy source.

4. In a monitoring system, two sources of signaling frequency of different volume level, a monitoring receiver having an input circuit of impedance Zr, a network having two input terminals and two output terminals, said output terminals being connected to the input circuit of said receiver, means for alternatively connecting said high level source to said network input terminal or the lower level source directly to said receiver input circuit, said network comprising a plurality of impedance elements of such value and so arranged that energy transmitted from said higher level source to the input terminals of said network is attenuated a predetermined amount, the impedance viewed from the output terminals of the network is substantially that of the receiver impedance Zr, and the impedance of the network

viewed from its input terminals is also substantially that of the receiver Z_r.

5. In a wave transmission system, a network comprising a serially connected plurality of mutually inductive transformer windings and a non-inductive resistance, a load circuit having a known impedance in parallel with said network, a low energy input circuit connected in parallel with said network and load and a high energy input circuit connected to said network intermediate the points of connection of said load circuit thereto, the constants of said network being so chosen and said high energy input circuit so connected to said network that energy transmitted by way of said high energy input circuit to the network and load is attenuated a predetermined amount, the impedance of said network and load as seen from said high energy circuit is substantially equal to said load impedance and, alternatively, the impedance of said network and load, in parallel, as seen from said low energy circuit is also substantially equal to said load impedance and without substantial energy attenuation due to said network when energy is transmitted by way of said low energy circuit.

6. In a monitoring system, high and low level voice transmission lines, a monitoring receiver, two parallel input circuits therefor, an impedance network having a portion thereof in series and another portion in shunt to a first one of said input circuits and wholly in shunt to the second circuit, and means for alternatively connecting said receiver to the high level line by way of the first input circuit or to the low level line by way of the second input circuit, said network being so constructed and arranged that the level of transmission applied to the receiver is substantially the same regardless of which line the receiver is connected to.

7. In a monitoring system, high and low level voice transmission lines, a monitoring receiver, two parallel input circuits therefor, an impedance network comprising a plurality of serially connected mutually inductive elements and a non-inductive resistance having a portion of said inductive elements connected in series with a first one of said input circuits and the remainder of said inductive elements and said resistance serially connected in shunt thereto and said network being wholly connected in shunt to the second circuit and means for alternatively connecting said receiver to the high level line by way of the first input circuit or to the low level line by way of the second input circuit, said network being so constructed and its constants so chosen that the level of transmission applied to the receiver is substantially the same regardless of which line the receiver is connected to.

8. In a wave transmission system, a line, two inductors, one in series with each side of the line, a non-inductive resistance and two other inductors connected by said non-inductive resistance in shunt to said line, all inductors connected in series-aiding relationship, the values of said inductors and resistance being so chosen that the network formed by said inductors and resistance will have a high impedance to signal wave transmission applied to the line on one side of the network and a relatively lower impedance and a voltage attenuation through the network to transmission applied to the line on the other side of the network.

9. In a monitoring system, two sources of audible frequency of different power level, a monitoring receiver, an input circuit for said receiver, means for connecting said input circuit to either source and static means for maintaining a constant impedance and power level across said input circuit regardless of the source to which said input circuit is connected, said static means comprising an impedance including a pair of inductive elements and a non-inductive element connected in series across said input circuit, and said means for connecting the input circuit to the lower power level source comprising a connection in parallel with said impedance and the means for connecting the input circuit to the higher level source comprising a connection in shunt to a portion of said impedance including said non-inductive element and substantially half of each inductive element.

NELSON BOTSFORD.