

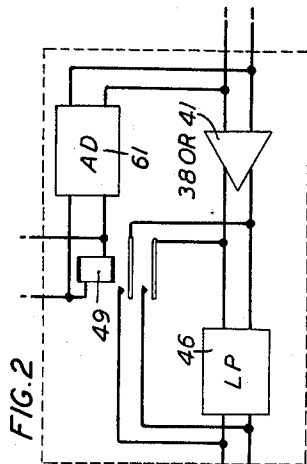
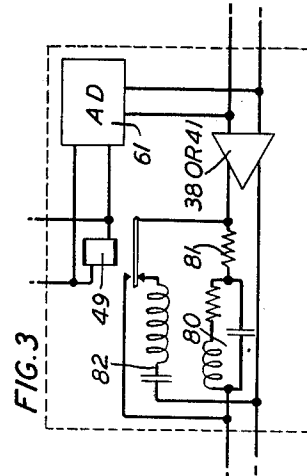
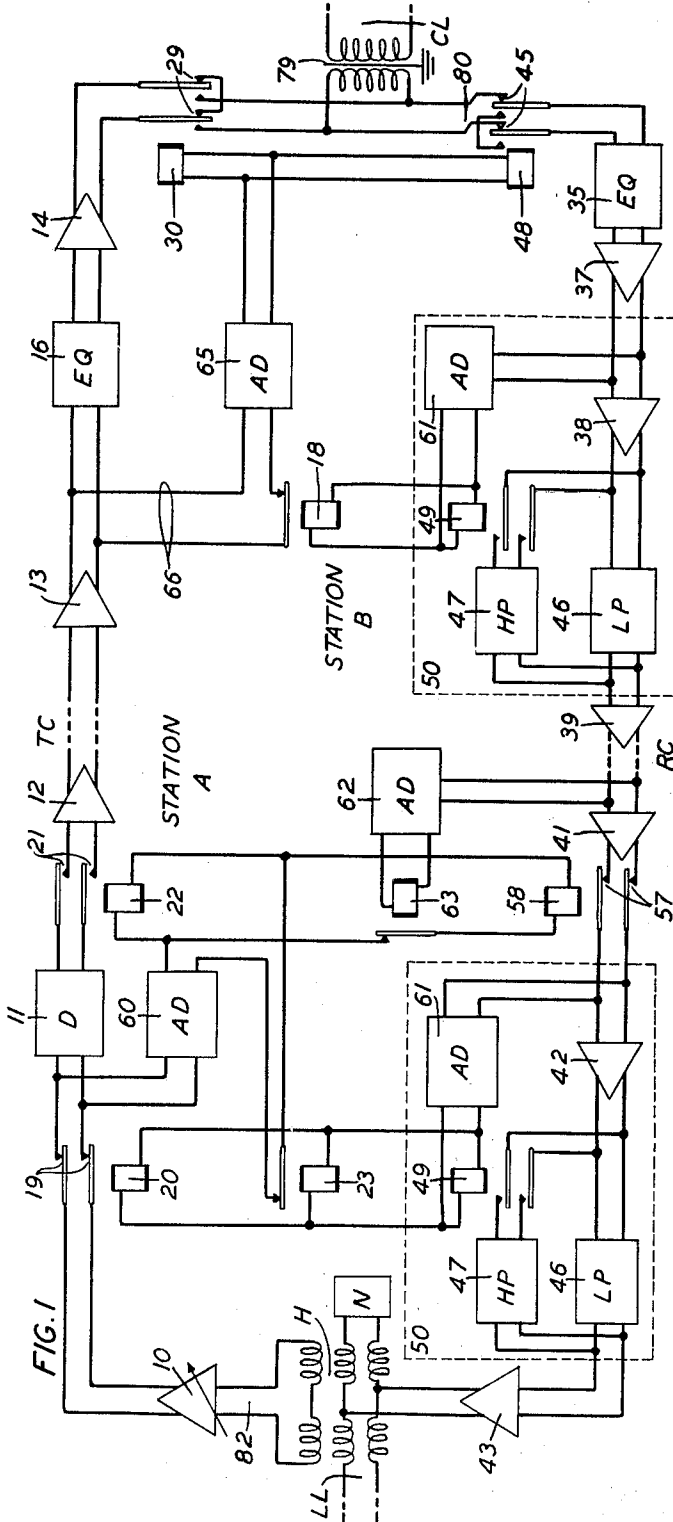
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LONG DISTANCE TELEPHONE SYSTEM

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LONG DISTANCE TELEPHONE SYSTEM

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6 Claims. (Cl. 178-44)

This invention relates to signal transmission systems employing directional switching mechanisms, or the equivalent, for enabling a circuit to be either dissociated from or associated with a transmission path under control of transmitted signals, as for example in a two way telephone system.

In such systems, where a receiving circuit is connected to and disconnected from a long transmission path such as a submarine cable, a problem arises due to the resistance noise which is heard when the receiving circuit is connected to the cable but is not heard at other times. This noise coming on and off during the conversation is liable to be disconcerting to a talker.

Methods of reducing the disturbing effects of such noise energy are disclosed in A. W. Horton Jr., application, Serial No. 501,275 filed December 10, 1930 and Serial No. 514,917, filed February 11, 1931.

The present invention relates to a still further means of reducing the noise effects in such a system and is in the nature of an improvement upon the system disclosed, particularly, in the latter one of the two Horton applications mentioned.

According to the present invention the receiving circuit is normally conditioned to pass currents of only certain frequencies which are in a different frequency range from the principal noise currents. Thus at all times except when speech is in process of being transmitted, the receiving circuit is in condition to receive currents of a limited frequency range but the noise is reduced to a negligible level since the noise currents lie mostly in the excluded frequency range. This system, therefore, is one in which so-called "full neutral" operation is approached but is only partially realized since the receiver is only partially disabled at the time that the transmitter is disabled.

The various objects and features of the invention will appear more fully from the following detailed description taken in connection with the attached drawing in which Fig. 1 is a simplified schematic diagram of a terminal circuit for a transoceanic cable, and Figs. 2 and 3 show modifications of the frequency-selective equipment of the invention.

Fig. 1 shows a schematic circuit including two distantly separated stations A and B, the former being the connecting station to a land line telephone system indicated by the single line terminal LL, and the latter being the terminal station for a transoceanic cable CL. In practice station A may be at New York and station B at New-

foundland. It will be assumed that the cable CL has another terminal in, say, Irish Free State similar to that in the drawing in station B, connected in similar manner to a land line switching terminal similar to A at, say, London.

Stations A and B are connected by a four-wire circuit comprising transmitting circuit TC and receiving circuit RC for respectively transmitting from A to B and receiving at A from B.

The directional switching and other apparatus at stations A and B is for the most part known in the art, and only such disclosure of it is made as is necessary or helpful to an understanding of the present invention.

The circuit RC is normally set in an operative condition to receive from the cable. The circuit TC is, however, normally disabled at both stations A and B and before transmission over it is allowed to take place, it is necessary to remove the disabling means and also to disable the path RC so that the transmitting energy is kept out of the receiving branch. Directional switching means controlled by the speech waves are therefore provided at both stations A and B.

The apparatus disclosed in branch TC comprises, at station A, a volume control 10, delay circuit 11, and suitable amplifiers one of which is indicated at 12; and at station B, amplifiers 13 and 14 and sending end equalizer 16. At station A, there is a disabling point, normally ineffective, at contacts 19 of relay 20, and another disabling point, normally effective, at contacts 21 of relay 22. Throughout the drawing where a relay is indicated as having two or more armatures, it will be understood that in practice a plurality of relays may be used each with but one armature, this being especially preferred where high speed of operation is to be had since it is difficult to use two armatures for a high speed relay.

At station B, amplifier 14 would in practice be normally disabled by the application to it of high negative grid bias derived from the signals as disclosed in my prior application Serial No. 459,663, filed June 7, 1930, but since this specific provision forms no part of the present invention it has been omitted from the drawing. There is a further disabling point at contacts 29 of relay 30.

Volume control 10 may be of the type shown in Hogg-Doba application Serial No. 445,543, filed April 19, 1930 or in U. S. patent to R. C. Mathes No. 1,844,423, granted February 9, 1932 or any other suitable type, its purpose being mainly to keep the input into path TC substantially con-

stant notwithstanding variable volume levels received over line LL due to different talkers, different length of connected land lines or other causes.

5 Delay device 11 may be electrical, mechanical or acoustical and of any suitable type for delaying speech transmission until contacts 21 have had time to operate.

10 Equalizer 16 is similar to the sending-end equalizer disclosed in U. S. patent to Mathes and Horton No. 1,844,422, granted February 9, 1932 and has a rising loss characteristic for low frequencies in order to enable the higher and weaker components of speech to be brought up to the
15 proper level to traverse the cable and to override noise. It may be placed ahead of or following amplifier 13 or 14 or divided up into sections located at different points along the circuit.

20 The receiving branch RC is shown equipped at station B with equalizer 35, which may be of the type disclosed in the Mathes-Horton patent, supra, and amplifiers 37, 38 and 39; and at station A with amplifiers 41, 42 and 43. Disabling points, normally ineffective are provided in the
25 contacts 45 of relay 48. Also amplifier 38 would in practice be arranged to be disabled during transmission over circuit TC by the application to it of a large negative grid bias in the manner disclosed in my prior application supra. Other
30 disabling points along RC may be provided as in that application disclosure.

At station A, there is a further disabling point in branch RC, in contacts 57 of relay 58, these contacts being, however, normally closed to permit reception over branch RC.

35 At station A, an amplifier-detector 60 causes operation of relays 22 and 58 when speech is impressed on its input circuit. Similarly amplifier-detector 61 controls actuation of relays 20 and 23, and amplifier-detector 62 controls actuation
40 of relay 63 for removing relay 58 from control by amplifier-detector 60. Amplifier-detector 61 also controls a relay 49 the function of which will be described later on.

45 At station B, amplifier-detector 65 is coupled to branch 66 leading from circuit TC, and renders speech waves from branch 66 capable of actuating relays 30 and 48.

The foregoing disclosure in and of itself forms
50 no part of the present invention but is helpful to an understanding of the invention.

In accordance with this invention, there is provided in the circuit RC, at either or both of stations A and B, a frequency selective circuit,
55 (low pass filter 46 in Fig. 1) which is normally in circuit and restricts transmission in the circuit to its pass range. Upon receipt of speech waves this element is supplemented or may be removed so that a wider frequency range is transmitted.

60 The purpose of these provisions will be clear from the following considerations. Resistance noise produced in the cable CL passes into the receiving circuit during the non-transmitting periods, and encounters equalizer 35 and amplifier 37. The equalizer has a loss-frequency characteristic such that it, in conjunction with the
65 amplifier, causes the higher frequency components in the speech range to be amplified to a much greater extent than the low frequency components. This is for the purpose of compensating, at least in part, for the relatively greater
70 attenuation of the cable at the higher frequencies. As a result of this greater amplification at higher frequencies, the higher frequencies of the resistance noise are greatly emphasized. The
75 noise as heard on the output side of amplifier 37

of Fig. 1 will therefore consist principally of high frequency components. The principal noise components are prevented from reaching the subscriber, in the idle condition of the circuit, by the low pass filter 46 which suppresses the high
80 frequency components and transmits only the lower frequency components. In practice the pass range of the filter 46 may be from zero to the order of 2300 cycles where the total band used for speech transmission extends up to 3000 cycles,
85 most of the resistance noise in this case being in the 2300 to 3000 cycle band on the output side of amplifier 37. When speech is received over the cable, as will be made clear in the description of the operation in detail, to follow, the high pass
90 filter 47 is connected in the circuit in parallel with the low pass filter 46 so that the entire speech band is accommodated. The high pass filter may have a pass range from infinity down to a frequency below the cut off of filter 46.
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The operation of the system will now be described. Assuming the subscriber connected to the telephone system associated with line LL is not talking, speech incoming over the cable CL will find receiving circuit RC in readiness to
100 receive. The speech passes through shielded transformer 79 into circuit 80 leading through normally closed contacts 45 to equalizer 35, amplifiers 37, 38 and 39, low pass filter 46 and out over circuit RC to the distant station A. Filter
105 46, as above pointed out, transmits only the lower part of the speech band.

The speech in the output of amplifier 37 passes in part into amplifier-detector 61 and causes disabling of the singing prevention control circuit
110 by operating relay 18 which opens the circuit 66 leading to amplifier 65. This prevents speech or noise in circuit TC from reaching amplifier-detector 65 and operating the switching relays and cutting off the receiver circuit. Relay 49 also
115 operates as will be described later.

The speech in circuit RC arriving at station A operates relay 63 removing relay 58 from control by energy that may be present in branch TC. The speech continues along path RC, through
120 closed contacts 57, filter 46 amplifiers 42 and 43 and is impressed on line LL through terminals of hybrid coil H. By means of amplifier-detector 61 the speech also causes relay 20 to disable circuit TC at points 19 and causes relay 23
125 to remove relay 22 from control of amplifier-detector 60.

It will be noted that if the subscriber connected to line LL starts to talk at a time such that his speech has progressed to any point on
130 circuit TC between stations A and B after speech arriving over branch RC has disabled amplifier 65, the speech in circuit RC will obtain control of the circuit even though relay 58 may have been operated and opened contacts 57. This is accomplished by providing anti-lockout relay 63
135 which allows relay 58 to be released if it has already been operated, or prevents its operation, under control of speech waves in circuit RC.

The speech received at station B as described
140 causes operation of relay 49 in the same manner as described of relay 18, and at station A similarly causes operation of relay 49 thereat. Relay 49 in each case in attracting its armatures connects filter 47 in parallel with filter 46 thus permitting
145 the entire speech band to pass through the circuit RC and into the line LL.

Due to the provision of filters 46 and 47 and their associated circuits as described, the subscriber on line LL is unaware of the fact that
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the resistance noise comes on and off the circuit RC at the point where it is connected to the cable. The only time that noise over the full speech range is permitted to pass is when speech is also being received, and the noise is less noticeable at such time.

Filters 46 and 47, as already stated, need not be provided at both stations A and B, but may be used at either station alone. It will be observed that the use of frequency selective circuits as described offers an advantage over use of loss elements in which the loss is the same for all frequencies. With the frequency selective circuits of the invention, clipping is reduced since the circuit RC is at all non-talking times in condition to transmit the major portion of the received speech energy. Failure of relay 49 to be actuated by initial speech elements means a reduction in frequency band but not a loss of these elements as would be the case in a circuit-disabling type of suppressor. The filter 46 permits fairly understandable speech to be received at all times but effectively suppresses the noise.

Continuing the description of the operation, upon cessation of speech in branch RC the circuits restore to the condition shown in the drawing.

Speech incoming on line LL and reaching hybrid coil H, passes into circuit 82. It will be assumed that no speech is present in circuit RC. Contacts 19 are therefore closed and the speech passes through the volume control circuit 10 and into delay 11. A part of the speech is diverted into amplifier-detector 60 and is rendered capable of actuating relays 22 and 58. Relay 22 closes contacts 21 and enables the speech to pass from delay device 11, through amplifier 12 and out over circuit TC to station B.

The speech in circuit TC upon arriving at station B passes in part into branch 66, into amplifier-detector 65 and causes actuation of relays 30 and 48. Relay 48 in operating opens contacts 45, cutting branch RC off from the cable. Relay 30 closes contacts 29, connecting the circuit TC through to the cable so that the speech may be transmitted. Relay 30 when energized and relay 48 when deenergized close short-circuiting shunts across TC and RC respectively.

Upon cessation of speech waves in circuit TC the circuits restore to the condition shown in the drawing.

The circuit elements within either dotted line rectangle 50 of Fig. 1 may be replaced by the circuit elements shown either in Fig. 2 or in Fig. 3.

According to the modification in Fig. 2, when relay 49 operates in response to received speech, the filter 46 is simply shunted out so that speech components of all frequencies may pass along circuit RC.

According to the modification of Fig. 3, there is normally connected to the circuit RC a series circuit comprising anti-resonant loop 80 and resistance 81, and a shunt circuit comprising series resonant elements 82. Either resonant combination may be used alone without the other and may have any requisite amount of damping. Circuit 80 impedes currents of frequencies in the neighborhood of 3000 cycles or whatever frequencies correspond to those receiving the greatest amplification by the combination of 35 and 37 (Fig. 1). Shunt circuit 82 is made resonant at these same frequencies. Currents of these frequencies are, therefore, very effectively suppressed. Upon actuation of relay 49 by received speech, both

resonant combinations are removed from the circuit.

Still other modifications within the scope and spirit of the invention will occur to those skilled in the art, and the invention is therefore not to be construed as limited to the features specifically disclosed but its scope is defined in the appended claims.

What is claimed is:

1. In a transmission system including a transmission path for speech and noise currents, and a circuit for receiving waves therefrom, means in said receiving circuit tending to make noise currents of certain frequencies disturbing in the absence of received speech, means in said receiving circuit normally restricting its pass range to a narrow band of frequencies excluding the range at which said noise frequencies are most disturbing, and means operating in response to speech waves in said path for increasing the frequency transmission range of said receiving circuit to include the range of said noise current.

2. In a wave transmission system, a wave propagating path, a circuit adapted for connection thereto to receive energy therefrom, said circuit normally receiving noise from said path when connected thereto, and being normally subject to a higher level of said noise at certain frequencies than at others, means in said receiving circuit normally transmitting only waves of those frequencies at which the noise level in the circuit is low, and means operating in response to wave energy in said path for enabling said receiving circuit to transmit waves of frequencies corresponding to said higher level noise.

3. In a speech receiving system for a path having unequal attenuation at different frequencies, means to amplify waves of different frequencies unequally to compensate for such unequal attenuation, a selective circuit in said receiving system normally transmitting only waves of frequencies at which the amplification is relatively small, and means for enabling said system to transmit waves of the frequencies at which the amplification is higher when waves of such frequencies are received from said path.

4. In a telephone system, a line of high attenuation for the transmission of speech currents, a receiving circuit adapted for connection to said line, means in said circuit for amplifying received waves, said means producing greater amplification at certain speech frequencies than at others, means in said circuit normally restricting transmission therein to a range of frequencies at which the amplification is relatively low and means actuated by received waves for rendering the receiving circuit capable of transmitting waves outside said range.

5. In a telephone system, a line for transmitting speech, said line having an appreciable noise level, a receiving circuit receiving speech and noise from said line, means producing higher amplification of high frequency speech components and corresponding noise frequencies in said receiving circuit than of low frequency speech components and corresponding noise frequencies, means restricting transmission in said receiving circuit to low frequencies in the absence of speech whereby the noise is normally amplified by a relatively small amount, and means actuated by received speech waves for enabling said receiving circuit to transmit both the low and the high frequency components of speech.

6. In a transoceanic telephone cable system, a cable terminating in a four-wire land-line circuit

comprising a transmitting branch and a receiving branch, speech-controlled directional circuits for operatively associating the receiving branch with the cable in the absence of transmitting speech and for associating the transmitting branch with the cable and dissociating the receiving branch when speech is to be transmitted, said receiving branch being normally responsive only to low speech-frequency components of energy received from the cable, means in said receiving circuit for amplifying high frequency components of speech and noise more than those of low frequencies, and means controlled by waves received from the cable for rendering the receiving branch responsive to said high frequency components in addition to said low frequency components, whereby the effect of received noise in the absence of speech is minimized.

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