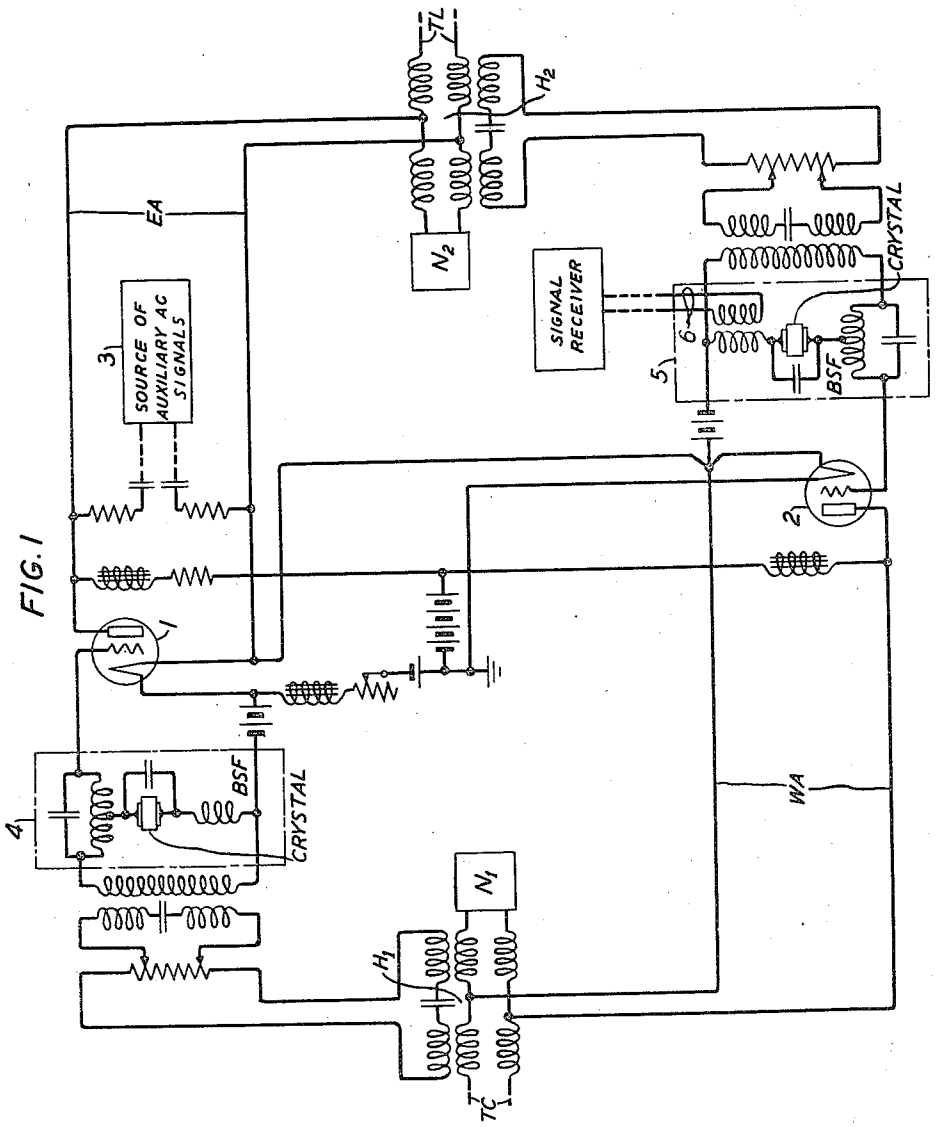
Feb. 5, 1935. N. D. NEWBY ET AL 1,990,414

CIRCUIT FOR CONTROLLING TRANSMISSION IN SIGNALING SYSTEMS

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FIG. 1



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FIG. 4.

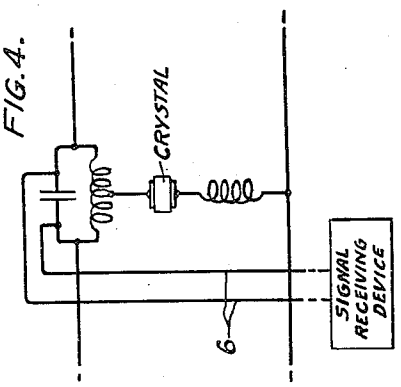


FIG. 3.

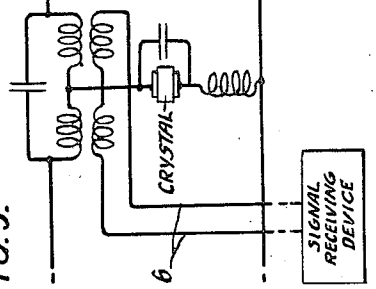


FIG. 8.

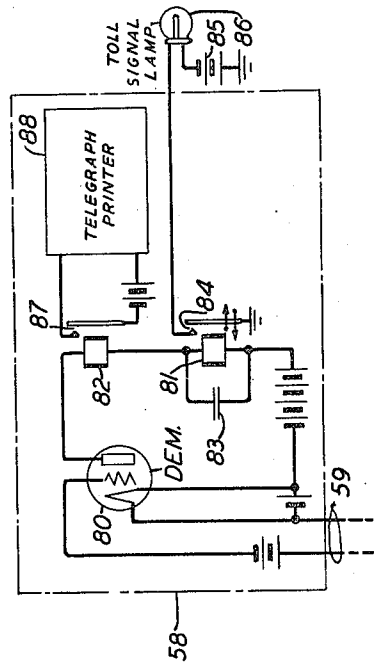


FIG. 2.

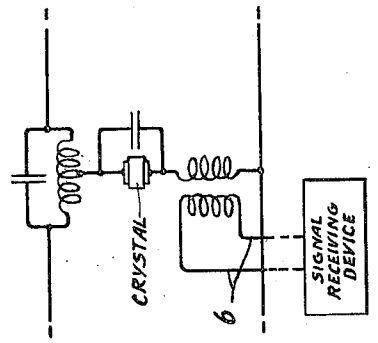
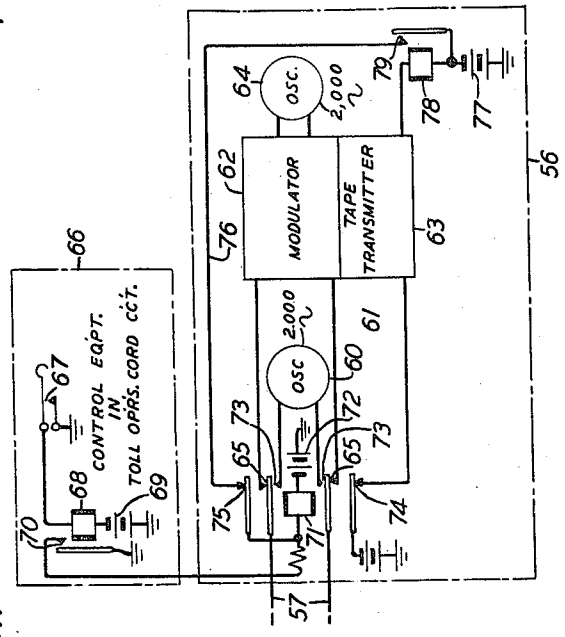


FIG. 7.



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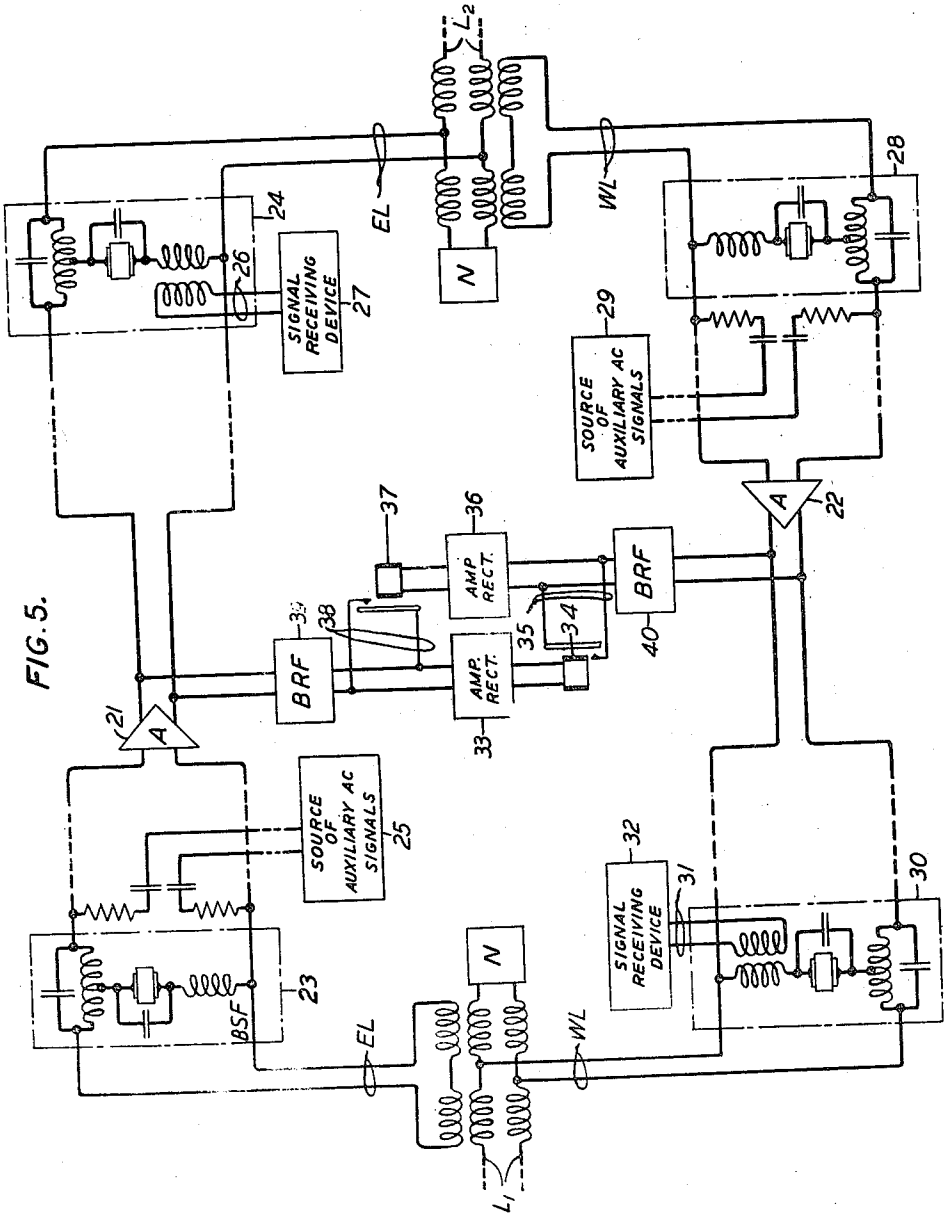
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CIRCUIT FOR CONTROLLING TRANSMISSION IN SIGNALING SYSTEMS

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FIG. 5.



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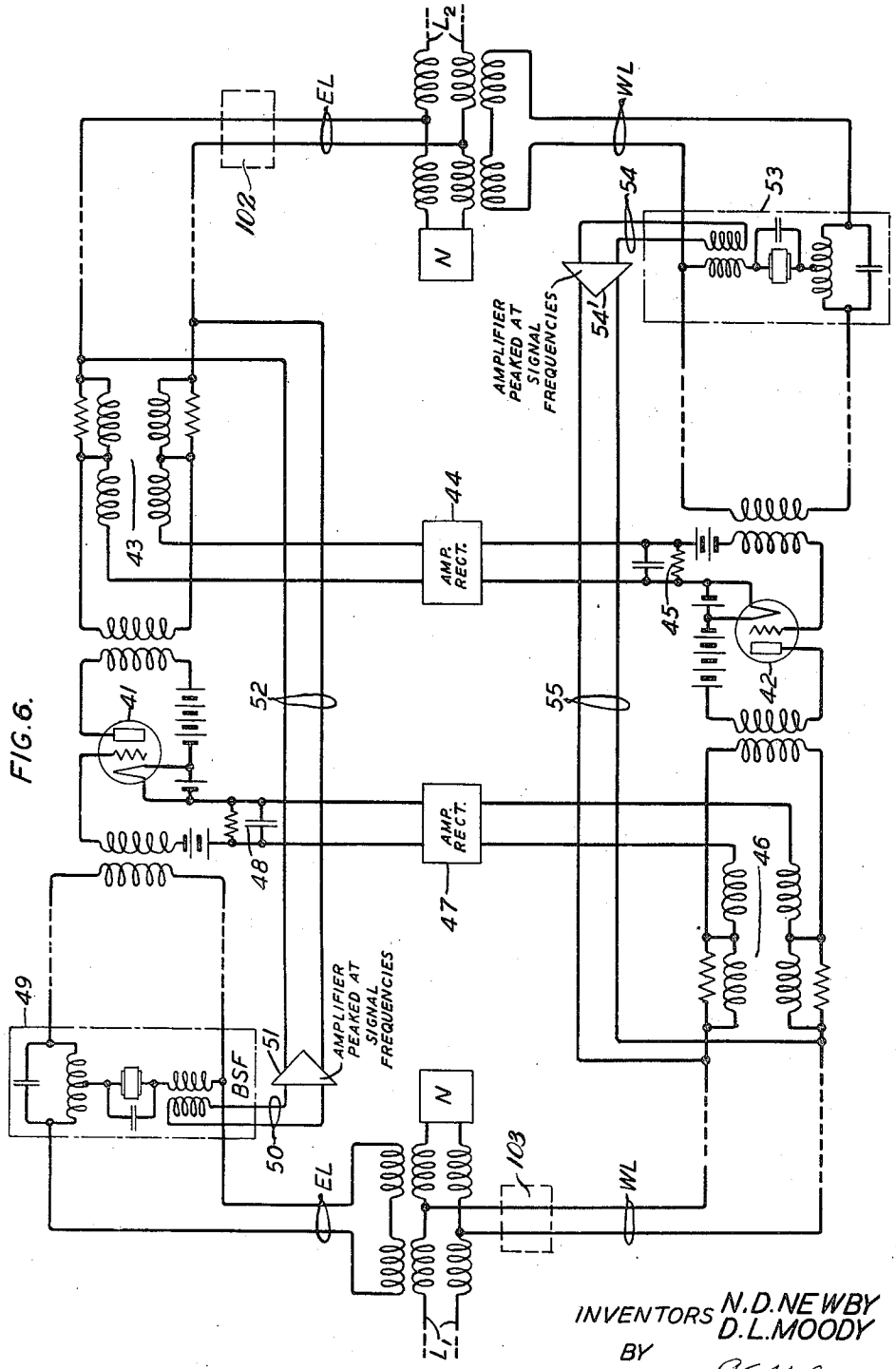


FIG. 6.

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UNITED STATES PATENT OFFICE

1,990,414

CIRCUIT FOR CONTROLLING TRANSMISSION IN SIGNALING SYSTEMS

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Application August 19, 1932, Serial No. 629,536

5 Claims. (Cl. 179—15)

The invention relates to signaling systems and particularly to composite signaling systems.

An object of the invention is to improve the operation of systems for simultaneously transmitting over the same circuits a plurality of signals utilized for different purposes.

The invention is particularly directed to such systems in which it is desired to transmit simultaneously signals comprising a comparatively wide band of frequencies and other signals comprising a single frequency or a narrow band of frequencies within the frequency range of the former signals, for example, a two-way telephone system employing auxiliary alternating current signals within the voice frequency range for ringing, pulsing and supervisory purposes.

Improved operation of systems of the above mentioned type is attained in accordance with the invention by the use of specially designed circuits for confining the transmission of the auxiliary signals to a particular portion of the main signaling circuit so as to prevent interference between the different signals at a receiving station and false operation of receiving and switching apparatus. This is accomplished in one embodiment of the invention in a two-way telephone system by suppressing from the transmitted voice waves at the input of the voice channel, a narrow band of frequencies, utilizing for the auxiliary signals transmitted over the voice channel along with the voice waves, the suppressed waves or other waves of frequencies within the frequency range of the suppressed band, and diverting the auxiliary signals from the voice channel at any desired point between the suppressing means at the input and the voice receiving apparatus at the other end of the system.

In a modification of the invention applied to a two-way toll telephone system employing voice-controlled echo suppressors, false operation of the latter by the auxiliary signals is prevented by means for excluding said auxiliary signals from the echo suppressor circuits.

The various features of the invention and their advantages will be better understood from the following detailed description thereof when read in connection with the accompanying drawings in which:

Figure 1 shows schematically one terminal station of a two-wire toll telephone line embodying the invention;

Figs. 2, 3 and 4 show alternative types of networks which may be used for separating the auxiliary signals from the voice signals in the circuits of the invention shown in Fig. 1 and the other figures;

Figs. 5 and 6 show schematically four-wire toll telephone circuits equipped with echo suppressors of different types and embodying different modifications of the invention; and

Figs. 7 and 8, respectively, show diagrammatically signal sending and receiving circuits adapted for use with the systems of the invention shown in Figs. 1 or 5 when it is desired to transmit either toll line signals or telegraph signals in addition to the telephonic signals.

Fig. 1 shows the invention applied to a two-wire toll telephone line equipped with terminal repeaters, only one terminal repeater being shown. It will be assumed for the purpose of simplifying the description of the invention that the apparatus in the terminal repeater at the other end of the telephone line is identical with that at the west repeater shown and that the frequencies of the auxiliary signals transmitted from the two terminal stations are the same.

The terminal repeater circuit shown comprises the one-way path EA including the one-way amplifying device 1 for repeating in amplified form telephonic signals in the direction from west to east between the circuit TC leading to the telephone transmitting and receiving terminal equipment, and the two-wire toll telephone line TL, and the one-way path WA including the one-way amplifying device 2 for repeating in amplified form telephonic signals in the direction from east to west between the toll telephone line TL and the circuit TC. The input of the amplifying path EA and the output of the amplifying path WA are connected in substantially conjugate relation with each other and in energy transmitting relation with the circuit TC by means of the three winding transformer or hybrid coil H_1 and associated balancing network N_1 in the manner well known in the art. Similarly, the output of the amplifying path EA and the input of the amplifying path WA are connected in substantially conjugate relation with each other and in energy transmitting relation with the toll line TL by means of the hybrid coil H_2 and associated balancing network N_2.

A source of auxiliary signals 3, for example, ringing or supervisory signals, is arranged to be connected by any suitable means to the path EA in the output of the amplifying device 1 therein, so as to cause these auxiliary signals to be transmitted to the toll line TL through the hybrid coil H_2. The signals supplied from the source 3 may be of a single frequency within the telephonic fre-

quency range or a narrow band of frequencies within that range.

Connected in the path EA between the input of the amplifying device 1 therein and the hybrid coil H_1 is a band filter 4 designed to suppress from the transmitted speech waves the frequencies corresponding to those of the auxiliary signals supplied from the source 3 while passing the speech waves of other frequencies received from the circuit TC to the input of the amplifying device 1. Connected in the path WA between the hybrid coil H_2 and the input of the amplifying device 2 is a band-suppression filter 5, similar to the filter 4, which is designed to suppress from the waves received from the toll line TL through the hybrid coil H_2 waves of frequencies corresponding to those of the auxiliary signals supplied from a source at the east terminal repeater station corresponding to the source 3 at the west terminal repeater station, which, in the special case being considered, comprise the same frequencies as the auxiliary signals supplied from the source 3.

A circuit 6 leading to signal receiving apparatus is coupled to the filter 5 in any suitable manner so as to pick off therefrom the signal frequencies suppressed by that filter.

Any network or filter adapted to suppress from transmission the single frequency or narrow band of frequencies which may be used for the auxiliary signals while transmitting efficiently voice waves of other frequencies may be used for the filters 4 and 5. For example, special filters utilizing a piezo-electric crystal, coils and condensers, such as illustrated within the dot-dash boxes, which will suppress from transmission a very narrow band of frequencies within the voice frequency range while transmitting other frequencies in the voice frequency range, are suitable for the purpose. Filters of this type are disclosed, for example, in the copending application, Serial No. 653,622, filed January 26, 1933, by W. P. Mason.

Figs. 2, 3 and 4 show various circuit arrangements which may be used for picking off the suppressed auxiliary signals from the filter 5 in the path WA when the piezo-electric type filter illustrated is used. In the arrangement shown in Fig. 2 the signal receiving circuit 6 is coupled to a coil in the shunt branch of the filter; in the arrangement of Fig. 3 the receiving circuit 6 is coupled to the coil in the series branch of the filter; and in the arrangement of Fig. 4 the signal receiving circuit 6 is connected across the condenser in the series branch of the filter. In each case, the band of signal frequencies effectively suppressed from the voice channel will be diverted into the signal receiving circuit.

The operation of the system of Fig. 1 will now be described. It will be assumed that a telephone subscriber associated with the circuit TC starts talking. His speech waves will be received over the circuit TC and will be impressed by the hybrid coil H_1 upon the input of the east to west transmission path EA. These waves will be transmitted through the filter 4 which will effectively suppress therefrom a band of frequencies corresponding to those of the source of signals 3, and will transmit the remaining voice frequencies to the input of the amplifying device 1. The amplified speech waves in the output of the amplifying device 1 will be impressed by the hybrid coil H_2 upon the toll line TL and will be transmitted thereover to the terminal repeater station at the other end of the line.

The auxiliary signals from the source 3 are impressed on the output of the path EA. If speech currents are being transmitted over the path EA at the time when the auxiliary signals from the source 3 are applied thereto, the latter signals will not be interfered with by the voice signals inasmuch as they occupy the portion of the voice frequency range in which the voice currents have been suppressed by the band filter 4 in the input of the amplifying device 1. The auxiliary signaling currents from the source 3 are impressed by the hybrid coil H_2 upon the toll line TL and will be transmitted thereover along with the voice signals to the receiving station (not shown).

The operation of the receiving circuit at the east terminal station (not shown) will now be described by reference to the similar receiving apparatus at the west terminal station shown in Fig. 1. That the apparatus to be referred to is that of the east terminal station will be indicated by designating the apparatus thereat with the same characters which designate the corresponding apparatus at the west terminal station but followed by a prime (') mark.

At the east terminal station the voice currents and auxiliary signals received over the toll line TL will be impressed by the hybrid coil H'_2 upon the west-to-east repeating path WA', and will be transmitted thereover to the band suppression filter 5'. The band-suppression filter 5' will operate to suppress effectively from the transmitted waves those frequencies which it is designed to suppress, that is, the auxiliary signal frequencies, and will transmit the remaining voice frequencies to the input of the receiving amplifying device 2'. The amplified voice currents in the output of the amplifying device 2' will be impressed by the hybrid coil H'_1 on the circuit TC' over which it will be transmitted to the listening subscriber.

The auxiliary signals suppressed by the filter 5' will be diverted into the circuit 6' and transmitted to the signal receiving apparatus.

From the above description, it will be seen that the transmission of the auxiliary signals is confined to the portion of the voice channel extending from the output of the amplifying device in the transmitting path at one terminal repeater station to the suppression filter in the input of the receiving path of the repeater at the other terminal of the toll line. Thus, it is possible in the system of the invention to transmit auxiliary signals in either direction during voice transmission over the system without these signals being heard by the telephone subscribers or interfering with the operation of the repeaters, for the suppression filters prevent the auxiliary signals from reaching the amplifying devices or the voice receiving apparatus. If the frequency band assigned to the auxiliary signals is made sufficiently narrow, the suppression of the corresponding voice frequencies from the speech waves will not appreciably affect the quality of voice transmission.

Although the system of Fig. 1 has been described for the case where the auxiliary signals transmitted from opposite terminal stations comprise the same frequencies, in some cases it may be desirable to use different frequency bands for the auxiliary signals generated at the two stations, in which case the band-suppression filters in the transmitting and receiving paths at each station would be designed to suppress the proper band.

The signaling system of the invention illustrated in connection with a two-wire toll telephone line

equipped with terminal repeaters in Fig. 1 is applicable as well to a four-wire toll telephone system equipped with terminal repeaters. In the latter case, the terminal repeater circuits would be the same as illustrated in Fig. 1 except that the transmitting and receiving amplifying paths at each terminal would be extended to form four-wire connections between the terminals instead of being coupled to opposite ends of the two-wire toll line TL through hybrid coils as shown in Fig. 1.

Fig. 5 shows schematically a modification of the invention applied to a four-wire toll telephone circuit employing mid-point echo suppressors of the mechanical relay type. The four-wire circuit comprises a two-wire circuit EL including the one-way amplifying device 21 for repeating in amplified form telephonic signals in the direction from west to east between a west telephone subscriber associated with the two-wire, two-way circuit L_1 and an east subscriber associated with the two-wire two-way circuit L_2, and a two-wire circuit WL including the one-way amplifying device 22 for repeating in amplified form telephonic signals in the direction from east to west between the east circuit L_2 and the west circuit L_1. The circuits EL and WL are connected in substantially conjugate relation with each other and in energy transmitting relation with the line sections L_1 and L_2 by the usual three-winding transformers or hybrid coils and associated balancing networks in well-known manner.

The circuit EL comprises near the west terminal a band suppression filter 23 similar to the band suppression filter 4 in the system of Fig. 1, and near the east terminal a band suppression filter 24 similar to the band suppression filter 5 in the receiving path WA in the system of Fig. 1. A source 25 of auxiliary signals similar to the source 3 in the path EA in the system of Fig. 1, is adapted to be connected across the circuit EL in the output of the band suppression filter 23 at the west terminal. The receiving circuit 26, similar to the circuit 6 in the path WA in the system of Fig. 1, is coupled to the filter 24 in circuit EL in such manner as to pick off from the filter 24 the signal frequencies suppressed thereby, the picked off signals being used to operate the signal receiving device 27.

The auxiliary signals supplied by the source 25 to the circuit EL may comprise a single frequency or a narrow band of frequencies within the voice frequency range. The band suppression filters 23 and 24 are designed to suppress substantially from the waves impressed thereon the frequencies corresponding to those supplied from the source 25 while transmitting efficiently waves of other frequencies.

The east to west two-wire circuit WL comprises in its input a band suppression filter 28, similar to the filter 23 in the circuit EL, adapted to suppress from the voice waves received from the circuit L_2 frequencies corresponding to those of the auxiliary signals supplied to the circuit WL in the output of filter 28 by the source 29 which is similar to the source 25 associated with the circuit EL.

In the circuit WL near the west terminal is a band suppression filter 30, similar to the filter 24 in the output of circuit EL, designed to suppress substantially from the waves received over the circuit WL the frequency or band of frequencies corresponding to those of the auxiliary signals supplied by the source 29 at the east terminal while transmitting efficiently waves of other frequencies, that is, the voice waves of other frequencies, so that they may be transmitted from the output of the circuit WL to the listening telephone subscriber associated with the line section L_1 through the hybrid coil connection at the west terminal. A receiving circuit 31, similar to the circuit 26 associated with the circuit EL, is coupled to an element of the band suppression filter 30 in such manner as to pick off therefrom the suppressed band of auxiliary signals which signal band is transmitted to the signal receiving device 32.

The operation of the apparatus in the portion of the system of Fig. 5 which has just been described enabling transmission of auxiliary signals within the voice frequency range over the system in either direction and during simultaneous transmission of the telephonic signals without interference therebetween or causing the auxiliary signals to be heard by the telephone subscribers associated with the line sections L_1 and L_2 is similar to that of the similar apparatus in the system of Fig. 1 and therefore there is no necessity for repeating this description here.

In addition to the apparatus which has just been described, the system of Fig. 5 includes echo suppression apparatus of the mechanical relay type. The E—W echo suppressor comprises a wave-controlled, relay-controlling device 33, such as a vacuum tube amplifier-rectifier circuit of the type well known in the art, having its input connected across the circuit EL near the mid-point thereof and responsive to transmission of telephonic signals therein to cause the operation of a mechanical relay 34 to disable the W—E echo suppressor by closing short-circuiting connection 35 thereacross. The W—E echo suppressor comprises a wave-controlled relay-controlling device 36, similar to the device 33, having its input connected across the circuit WL near the mid-point thereof and responsive to transmission of telephonic signals therein to cause operation of the mechanical relay 37 to disable the E—W echo suppressor by closing the short-circuiting connection 38 thereacross.

In accordance with the invention, false operation of the echo suppression apparatus by the auxiliary signals transmitted over the circuit EL or WL is prevented by the use of band rejection filters 39 and 40 in the inputs of the control devices 33 and 36, respectively, designed to suppress from transmission to said devices, and thus to prevent their false operation thereby, waves of frequencies corresponding to those of the auxiliary signals transmitted over the associated two-wire amplifying circuit while allowing transmission thereto of the telephone waves of other frequencies. The band rejection filters 39 and 40 may be of the piezo-electric crystal type similar to those illustrated in the dot-dash boxes 23, 24, 28 and 30, or they may be of any other suitable type. The short-circuiting connections 38 and 35 are applied inside the band rejection filters so that the short circuits will not affect transmission of the auxiliary signals. It is not necessary to supply echo protection for these frequencies because they are suppressed at the end of the circuit before reaching a return path.

Fig. 6 shows schematically another modification of the invention applied to a four-wire toll telephone circuit employing mid-point echo suppressors of the so-called "vacuum tube" type. The four-wire circuit of Fig. 6 comprises a two-wire circuit EL including the normally operative

one-way vacuum tube amplifying device 41 for repeating in amplified form in the direction from west to east telephonic signals between a west telephone subscriber associated with the circuit L_1 and an east telephone subscriber associated with the circuit L_2, and a two-wire circuit WL including the normally operative one-way vacuum tube amplifying device 42 for repeating in amplified form in the direction from east to west telephonic signals between the east subscriber associated with the circuit L_2 and the west subscriber associated with the circuit L_1.

Connected across the circuit EL in the output of the amplifying device 41 near the mid-point of the circuit through a directional selection circuit 43 is the input of an echo suppressor of the type commonly known in the art as the "vacuum tube type". It comprises an amplifier-rectifier circuit 44 of such design as to be responsive to waves from the circuit EL impressed thereon to apply to the grid of the amplifying device 42 in the circuit WL through the parallel condenser-resistance combination 45 a biasing voltage of such value as to render the amplifying device 42 inoperative, and therefore, effectively to disable the circuit WL so as to prevent echoes or reflected currents due to the waves transmitted over the circuit EL from being transmitted back over the circuit WL to the west terminal of the system and causing a disturbance thereat or singing. The purpose of the directional selection circuit 43 is to prevent the signals impressed on the circuit EL from circuit 52 from entering the input of amplifier-rectifier 44 in the echo suppressor. As indicated, it may take the form of a special bridge transformer similar to that disclosed in Crisson Patent No. 1,755,243, issued April 22, 1930, for a similar purpose. Similarly, connected across the circuit WL in the output of the amplifying device 42 therein and through the directional selection circuit 46 is connected the input of another vacuum tube type echo suppressor comprising the amplifier-rectifier circuit 47, similar to the device 44, which is designed to be responsive to waves impressed thereon from the circuit WL to apply through the resistance-condenser combination 48, a biasing voltage to the grid of the vacuum tube amplifying device 41 in the circuit EL of such value as to render that device inoperative and thus effectively to disable the circuit EL for the desired interval of time to prevent echoes from being transmitted back over that circuit to the east terminal of the system and causing a disturbance or singing. The vacuum tube type echo suppressors have been illustrated only diagrammatically and have been described in only general terms, as any of the well-known types of vacuum tube echo suppressors may be used to produce the required operation. For example, one type of vacuum tube echo suppressor which would be suitable is disclosed in the Marriage-Thomas Patent No. 1,960,019, issued May 22, 1934.

Connected in the input of the circuit EL in the system of Fig. 6 is a band suppression filter 49, similar to the band suppression filters employed in the systems of the preceding figures, which is designed to suppress from the voice waves received from the west subscriber over the circuit L_1a single frequency or a narrow band of frequencies within the voice frequency range corresponding to the frequencies which it is desired to employ for auxiliary signals to be transmitted over the system simultaneously with the voice waves for a desired purpose, for example, to operate calling or supervisory apparatus at a certain point in the system. The suppressed frequency or frequency band is picked off from the filter 49 by any suitable means, for example, as indicated for the piezo-electric type filler illustrated, through a circuit 50 coupled to an inductive element in the shunt arm of the filter. The voice frequencies thus suppressed from the transmitted speech waves and diverted into the circuit 50 are utilized for the auxiliary signals to be transmitted over the system simultaneously with the speech waves. They are then impressed on a special amplifier 51 peaked at the signal frequencies which brings their amplitude level up to the value required for satisfactory transmission to the signal receiving equipment at some distant point. The amplified auxiliary signal waves in the output of the amplifying signal device 51 are then by-passed by the circuit 52 around the amplifying device 41 and that portion of the circuit EL to which the input of the associated echo suppressor is connected, to the outgoing portion of the circuit EL. The amplified auxiliary signals are then transmitted over the output of the circuit EL along with the voice waves in the output of the amplifying device 41, both being impressed by the hybrid coil bridge circuit on the circuit L_2 over which they are transmitted to the associated voice receiving and signal receiving apparatus.

The directional selection circuit 43 used for associating the echo suppressor with the circuit EL serves to prevent the amplified auxiliary signals received from the by-pass circuit 52 from entering the echo suppressor and causing false operation. A band suppression filter, similar to the filter 49, inserted in the circuit EL between the point of connection of the input of the echo suppressor thereto and the point of connection of the output of the by-pass circuit 52 thereto could be used in place of the directional selection circuit 43 for the same purpose.

Similarly, a band suppression filter 53, similar to the band suppression filter 49 in the circuit EL, is inserted in the input of the east to west two-wire circuit WL and is designed to suppress from the voice waves received by the circuit WL from the circuit L_2, the single frequency or the narrow band of frequencies which it is desired to use for the auxiliary signals to be transmitted over the circuit WL simultaneously with the voice signals, while transmitting the remaining voice frequencies to the amplifying device 42. The suppressed band to be utilized for the auxiliary signals is picked off from the filter 53 by the circuit 54 and, after amplification by the special amplifying device 54', which is peaked at signal frequencies, is by-passed by the circuit 55 around the amplifying device 42 and the input of the echo suppressor associated with the circuit WL by the directional selection circuit 46, to the outgoing portion of the circuit WL. The directional selection circuit 46 prevents the amplified auxiliary signals from the by-pass circuit 55 from entering the input of the echo suppressor and causing false operation thereof.

The amplified auxiliary signals are then transmitted with the amplified voice currents in the output of the amplifying device 42 out over the outgoing portion of the circuit WL and are impressed upon the circuit L_1 by the hybrid coil connection.

At any desired point in the system between the point of application of the auxiliary signals to the circuit EL and the telephone receiving apparatus

(not shown) associated with the circuit L_2, and between the point of application of the auxiliary signals to the circuit WL and the telephone receiving apparatus associated with the circuit L_1, band suppression filters and associated band rejection circuits, similar to the filter 5 and associated rejection circuit 6 in the path WA in the system of Fig. 1, may be inserted to separate the eastwardly directed auxiliary signals from the eastwardly directed voice currents and the westwardly directed auxiliary signals from the westwardly directed voice currents, respectively, and to divert them to the signal receiving apparatus, so as to prevent the auxiliary signals from being heard by the listening telephone subscribers. For example, such a filter and associated band rejection circuit may be inserted in the output of the path EL and in the output of the path WL, as indicated by the dotted boxes 102 and 103 in Fig. 6.

Figs. 5 and 6 have shown different circuit arrangements which may be used in connection with four-wire circuits for preventing false operation of mid-point echo suppressors when the voice frequency signaling systems of the invention are used. The auxiliary apparatus described in connection with these figures for preventing the voice frequency auxiliary signals from getting into the echo suppressors and causing false operation thereof may be dispensed with in systems employing terminal type echo suppressors. In the latter systems, which may be long four-wire toll telephone systems, two-way radio telephone systems, or two-way telephone systems employing a long intermediate two-wire link, such as a submarine telephone cable system, to prevent false operation of the echo suppressors it is only necessary to associate the auxiliary signaling equipment with the repeating path on the line side of the echo suppressors.

In the above described systems, it is apparent that the auxiliary alternating current signals transmitted over the same circuit with the telephonic currents may be voice frequency telegraph signals. Figs. 7 and 8 show diagrammatically signal transmitting and receiving circuits, respectively, which may be associated with any of the above described systems to permit of using the voice channels for both printer telegraph and toll line signals. If used with the system of Fig. 1 the signal transmitting equipment shown within the dot-dash box 56 in Fig. 7 by means of its output leads 57 would be connected across the path EA in the output of the amplifying device therein in place of the source of auxiliary signals 3. Similarly, the signal receiving equipment within the dot-dash box 58 shown in Fig. 8, by its input leads 59 would be coupled to the filter 5 in the path WA in the system of Fig. 1 in place of the signal receiving equipment which is shown in the latter figure. If used in connection with the system of Fig. 5, the signal transmitting equipment of Fig. 7 would be substituted for the source of auxiliary signals 25 or 29 in the former figure, and the signal receiving equipment of Fig. 8 would be substituted for the receiving equipment 27 or 32 in Fig. 5.

The signal transmitting equipment within the dot-dash box 56 in Fig. 7 comprises a source 60 of steady toll line signals comprising any frequency within the voice frequency range, for example, 2000 cycles, as indicated in the figure, the printing telegraph transmitting equipment 61, which may be of any of the well known types, indicated by the box 62 labeled "Modulator", the associated box 63 labeled "Tape Transmitter" and the associated oscillator 64, which is indicated as generating a frequency of 2000 cycles, but which may generate any other frequency within the voice frequency range. The output of the printing telegraph transmitting apparatus is normally connected by means of the normally closed switch contacts 65 to the output leads 57 and thus to the outgoing toll telephone line (not shown). The source 60 of toll line signals is normally disconnected from the output leads 57 so that it is not connected to the toll telephone line.

The connection of the source of toll line signals to the telephone line may be controlled by control equipment 66 located in the toll operator's cord circuit. As indicated, the control equipment may comprise a switch 67 which when operated causes a relay 68 to be energized by current from a battery 69 so as to operate to close switch contacts 70, completing an energizing circuit for the electromagnetic relay 71 from the battery 72. If the printing telegraph transmitter is not in operation, the resultant operation of relay 71 will cause switch contacts 73 to be closed to connect the source 60 of toll line signals to the toll telephone line through the output leads 57, the normally closed switch contacts 65 to be opened to disconnect the printing telegraph transmitting apparatus 61 from the toll line and the normally closed switch contacts 74 in the energizing circuit for the tape transmitter 63 and the normally closed switch contacts 75 in the relay disabling circuit 76 to be opened.

The direct current battery 77 serves in the manner which will be explained below as a means for disabling the electromagnetic relay 71. If the relay 71 has not been previously operated under control of the switch 67 to open switch contacts 65, 74 and 75, the tape transmitter 63 will be energized from battery supplied through closed contacts 74. The tape transmitter 63 while operating supplies ground to the windings of electromagnetic relay 78 during the sending of each character causing its energization by current from battery 77. Alternating current impulses representing telegraph signals produced by modulation of the 2000 cycle alternating current from the oscillator 64 by the tape transmitter 63 will then be transmitted from the output of the modulator through the closed switch contacts 65 to the output leads 57, and thence over the toll telephone line to the signal receiving apparatus at the receiving station.

The energization of the mechanical relay 78 by current from the battery 77 through the windings of relay 78 to ground supplied by the tape transmitter during the sending of each character will cause the operation of that relay to close the normally open switch contacts 79 in the relay disabling circuit 76 closing a circuit extending from ground, through battery 77, closed switch contacts 79, closed switch contacts 75, winding of mechanical relay 71 and battery 72 to ground. The battery 77 is poled so as to oppose battery 72 and is of such value that the resultant current through the winding of the relay 71 is insufficient to cause its operation if switch 67 is subsequently operated. Thus, operation of switch 67 to send toll line signals from source 60 during operation of the printing telegraph transmitting apparatus 63 will cause the telegraph transmitting apparatus to be stopped at the end of the character then being sent out, and then the toll signals will be applied to the toll telephone

line. The opening of switch contacts 74 and 75 by relay 71 under control of switch 67 before the telegraph transmitting apparatus is put into operation, or, if it is in operation, during the interval between the sending of characters, produces a break in the relay disabling circuit 76 and in the energizing circuit for the tape transmitter 63, respectively. Thus, the tape transmitter cannot regain control of the relay 71 during substantially continuous transmission of the toll line signals.

The operation of the signal receiving apparatus shown within the dot-dash box 58 in Fig. 8, in response to the toll line signals or the printing telegraph signals received over the toll telephone line from the signal transmitting apparatus shown in Fig. 7 will now be described.

The toll line signals or printing telegraph signals will be diverted from the telephone channel by the input leads 59 of the signal receiving equipment and will be detected by the vacuum tube demodulator 80. The detected currents will flow through the windings of the mechanical relays 81 and 82 in the output circuit of the demodulator. The relay 81 by means of the shunt condenser 83 is made to have such a long response time as to be unaffected by the printing telegraph signals, whereas the comparatively steady toll line signals will cause its operation to close the normally open switch contacts 84 causing energizing current to be supplied from the battery 85 to the toll signal lamp 86 or other signaling device.

Relay 82, on the other hand, is designed to be unresponsive to the comparatively steady toll line signals, but to be responsive to the short pulses of current representing the printing telegraph signals to control switch contacts 87 in proper manner to reproduce the telegraph signals in the telegraph printer device 88.

Various applications other than those described above and illustrated in the drawings, are within the scope of the invention. For example, signaling channels as described above may be used as control channels for automatic gain regulation. For telephone lines it may be used to replace the pilot wire by sending out a constant level signal which will be rectified at the incoming end and the rectified signal passed to a group of marginal relays to control the gain setting for one or more repeaters. Another application would be in connectiton with a telemetering system, that is, a system for transmitting time measures, meter readings, circuit designations, number of calls waiting for a particular operator, groups of operators or circuits, circuit groups, etc., and any other indication required between distant points over lines simultaneously used for telephone messages or the like.

Many modifications of the circuits of the invention and other applications thereof within the spirit and scope of the invention as defined by the appended claims will occur to persons skilled in the art.

What is claimed is:

1. A two-way signal transmission system comprising two oppositely directed one-way signal transmission paths connecting stations, means at one station for impressing on the outgoing of said one-way paths signal waves comprising a wide band of frequencies, a wave filter in said outgoing path near said one station designed to suppress from the impressed signal waves a narrow band of frequencies while transmitting other signal frequencies, means for impressing on said outgoing path in the output of said filter auxiliary waves of frequencies within the band suppressed by said filter, means at the receiving station of said system for separating and utilizing the received signal waves and auxiliary waves, wave controlled means connected to said outgoing path, which when operated effectively disables the other of said one-way paths for transmission of signals, and means for excluding from said wave-controlled means, said auxiliary waves while allowing transmission thereto of the signal waves of said other frequencies.

2. A two-way composite signaling system comprising two oppositely directed one-way transmission paths, means near each terminal of the system for impressing on the outgoing path thereat principal signals comprising a wide band of frequencies, a wave filter in the outgoing path near each terminal, designed to suppress from the impressed signals a narrow band of freqencies while transmitting other signal frequencies, means for impressing on each one-way path at a point in the output of the filter therein auxiliary signals of frequencies within the band suppressed by that filter, means at a receiving point for separating and utilizing the principal and auxiliary signals transmitted over each one-way path, switching means connected to each one-way path and selectively responsive to the signal waves of the frequencies passed by the filter in that path to disable effectively the other one-way path for transmission of signals of the frequencies passed by the filter in said other path while allowing transmission thereover of the auxiliary signals impressed on that path, and to disable the switching means connected to said other path.

3. The system of claim 2 and in which the switching means connected to each one-way path comprises a second wave filter connected in shunt therewith, designed to suppress the same band of frequencies as the first-mentioned filter in that path and to transmit impressed signals of other frequencies, and means responsive to the signal waves transmitted by said second filter to apply a short circuit across the output of the corresponding wave filter in the switching means connected to the other one-way path.

4. A two-way signal transmision system comprising two oppositely directed one-way signal transmission paths connecting terminal stations, means at one station for impressing on one uath for transmission to the other station signal waves comprising a wide band of frequencies, wave-controlled means connected to said one path and responsive to signal transmission therein to disable the other path, a wave filter in said one path near said one station and designed to suppress from the impressed signals a narrow band of frequencies while freely transmitting other frequencies of said signals, a source of auxiliary waves of frequencies within the band suppressed by said filter, means for impressing said auxiliary waves on said one path at a point therein in the output of said wave filter, signal receiving means connected to said one path at said other station, auxiliary wave receiving means at said other station, a second wave filter in said one path near said other station and designed to suppress from the received waves, the same frequency band suppressed by the first-mentioned wave filter while freely transmitting other frequencies to said signal receiving means, means for picking off from said second wave filter, and transmitting to said auxiliary wave receiving means, the frequencies suppressed by said second filter, and means for excluding said auxiliary waves from said wave-controlled means while allowing

transmission of the signal waves of said other frequencies thereto.

5. The system of claim 4 and in which said auxiliary waves impressed on said one path are derived from the signals suppressed by said first-mentioned wave filter, and said means for excluding the auxiliary waves from said wave-controlled means includes means for impressing said auxiliary waves on said one path beyond the point of connectiton of said wave-controlled means thereto.

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