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2 Sheets-Sheet 1

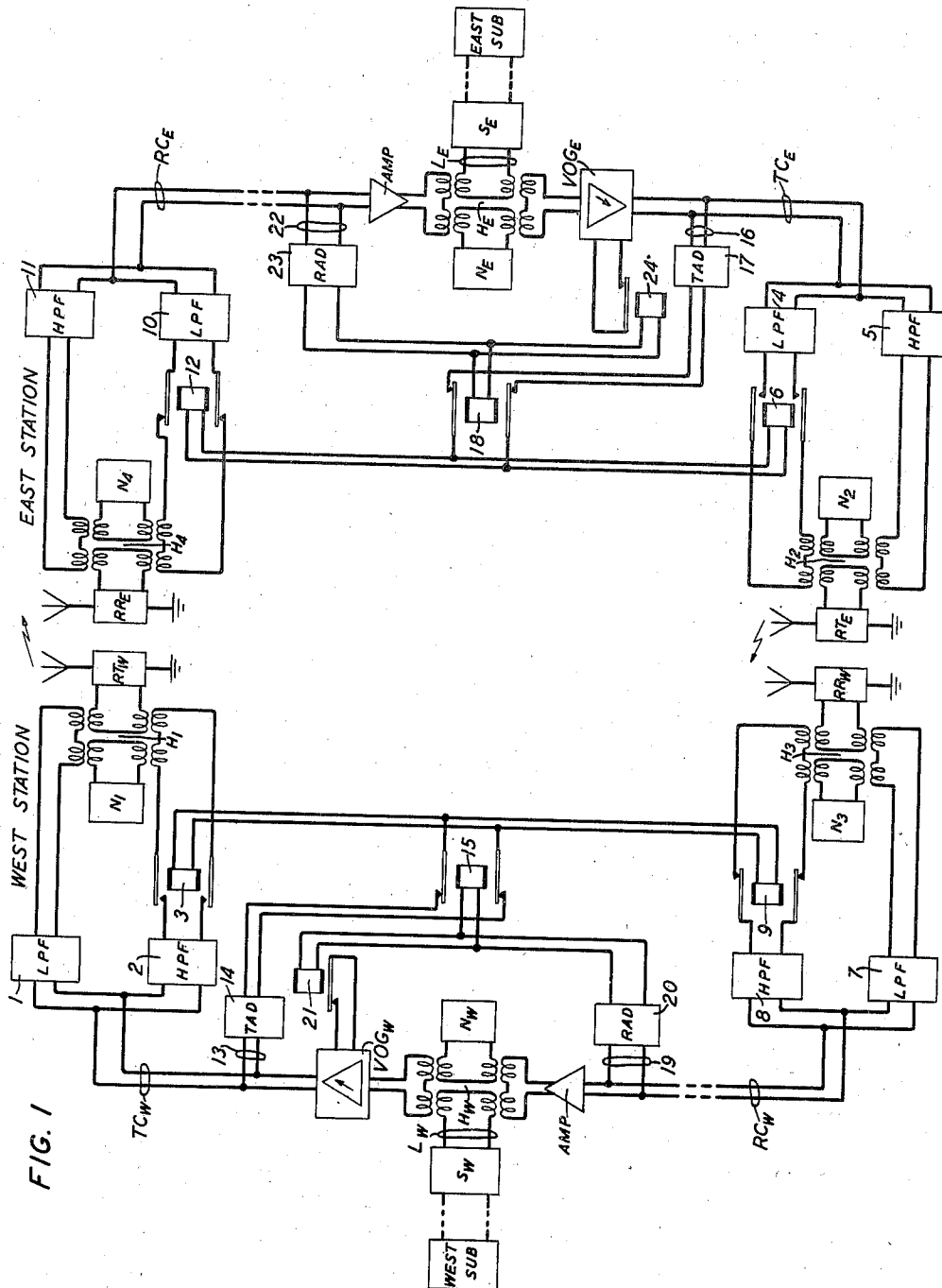


FIG. 1

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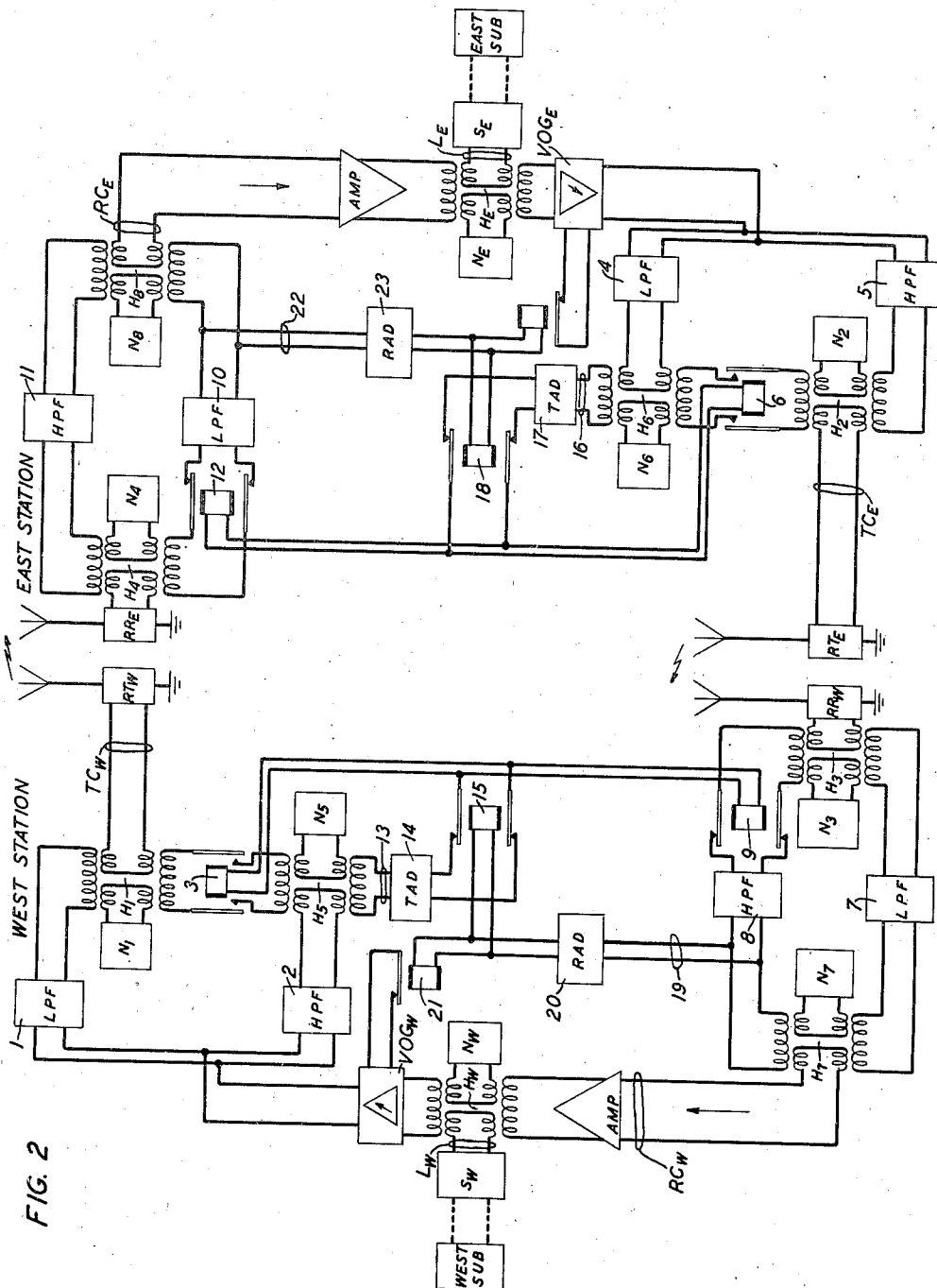


FIG. 2

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CIRCUITS FOR DIRECTIONALLY CONTROLLING SIGNAL TRANSMISSION IN TWO-WAY SIGNAL TRANSMISSION SYSTEMS

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13 Claims. (Cl. 178-44)

This invention relates to two-way signal transmission systems and particularly to circuits for directionally controlling signal transmission in such systems.

An object of the invention is to improve the operation of such circuits.

A more specific object is to directionally control telephone transmission in a two-way telephone system, such as a two-way radio or wire telephone circuit, in such manner as to minimize signal transmission lock-outs and clipping, and to facilitate break-ins by a listening subscriber.

These objects are attained in accordance with the invention by circuits at the terminals of the systems, which, in the idle condition of the system and when the subscribers associated with the two terminals start talking simultaneously, limit the transmission frequency range in both directions to only a portion, say, one-half, of the signal frequency band, and when one subscriber starts talking a definite time in advance of the other, gives the former complete control with full-frequency band transmission of his signal currents over the system while allowing partial-frequency band transmission of the speech currents of the latter to the distant terminal to facilitate break-in during a pause by the former.

In a preferred embodiment, this is accomplished by parallel-connected high-pass and low-pass filters which are cut in and out of the transmitting and receiving circuits at each terminal to properly vary their transmission frequency range under control of voice-operated switching circuits.

The various objects and features of the invention will be better understood from the following detailed description read in conjunction with the accompanying drawings of which:

Figs. 1 and 2 show schematically different modifications of the invention embodied in a two-way radio telephone system.

The two-way radio system, of Fig. 1 comprises a west terminal station and an east terminal station connected by a radio link which preferably employs different radio frequencies for the opposite directions of transmission to reduce the possibility of singing difficulties.

Each station includes a four-wire circuit connecting a two-way telephone line to a radio transmitter and radio receiver. The four-wire circuit at the west station comprises, as shown, a transmitting circuit TC_w including a vogad (volume-operated gain-adjusting device) VOG_w for automatically regulating the signal volume trans-

mitted to the radio transmitter to load the transmitter to an optimum amount, leading to the radio transmitter RT_w, and a receiving circuit RC_w leading from the radio receiver RR_w. The input of circuit TC_w and the output of circuit RC_w are coupled by the usual hybrid coil H_w and associated balancing network N_w to the two-wire line section L_w which may be connected through the switchboard S_w to a two-way telephone line leading to a west telephone subscriber. The east station comprises similar signal transmission circuits and apparatus as indicated by the use of similar identification characters applied to corresponding elements but followed by the subscript E.

At the west station, the transmitting circuit TC_w includes at some point between the output of the vogad VOG_w and the radio transmitter RT_w, two parallel filtering circuit branches respectively including a low-pass filter 1 and a high-pass filter 2, having their inputs connected directly in parallel to the input portion of TC_w and their outputs coupled by the hybrid coil H₁ and the associated balancing network N₁ to the output portion of the circuit TC_w. The low-pass filter branch is normally operative to transmit to the radio transmitter RT_w, but the high-pass filtering branch is normally disabled through the normally open contacts of switching relay 3, in series in the output leads of high-pass filter 2. Similarly at the east station the transmitting circuit TC_E includes between the output of vogad VOG_E and the radio transmitter RT_E two parallel filtering circuit branches respectively including a low-pass filter 4 and a high-pass filter 5, having their inputs connected directly in parallel to the input portion of circuit TC_E and their outputs coupled through hybrid coil H₂ and associated balancing network N₂ to the output portion of the circuit TC_E. However, the high-pass filtering circuit branch in the circuit TC_E is normally operative to transmit to the radio transmitter RT_E, and the low-pass filtering circuit branch is normally disabled through the normally open contacts of switching relay 6, in series with the output leads of low-pass filter 4.

At the west station the receiving circuit RC_w includes two normally enabled parallel filtering branches respectively including the low-pass filter 7 and the high-pass filter 8, having their outputs connected directly in parallel to the output portion of circuit RC_w and their inputs coupled by hybrid coil H₃ and associated balancing network N₃ to the input portion of the circuit RC_w. The normally closed relay contacts of switching

relay 9 are connected in series in the high-pass filtering branch in front of high-pass filter 8. Similarly, at the east station the receiving circuit RC_E includes two parallel normally enabled filtering circuit branches respectively including the low-pass filter 10 and the high-pass filter 11, having their outputs connected directly in parallel to the output portion of the circuit RC_E and their inputs coupled through hybrid coil H_4 and associated balancing network N_4 to the input portion of circuit RC_E , but the normally closed relay contacts of switching relay 12 are included in series in the low-pass filtering branch in the input of low-pass filter 10.

Connected across the transmitting circuit TC_W of the west station, at a point between the output of vogad VOG_W and the inputs of filters 1 and 2, is the input of a transmitting voice-operated switching circuit 13 including amplifier-detector 14 and the windings of switching relays 3 and 9 connected in parallel to its output. The normally closed relay contacts of the switching relay 15 are included in series in the switching circuit 13 between the output of amplifier-detector 14 and the windings of switching relays 3 and 9. Similarly, at the east station, connected across the transmitting circuit TC_E at a point between the vogad VOG_E and the inputs to filters 4 and 5 is the input of a voice-operated transmitting switching circuit 16 including the amplifier-detector 17 and the windings of switching relays 6 and 12 connected in parallel to the output of the latter. The switching circuit 16 includes in series between the output of amplifier-detector 17 and the windings of switching relays 6 and 12, the normally closed relay contacts of switching relay 18.

At the west station, connected across the output of the receiving circuit RC_W at a point between the outputs of filters 7 and 8 and hybrid coil H_W is the input of a receiving voice-operated switching circuit 19 including the amplifier-detector 20 and the windings of switching relays 15 and 21 connected in parallel to the output of the latter. Similarly, at the east station connected across the receiving circuit RC_E at a point between the output of filters 10 and 11 and hybrid coil H_E is the input of a voice-operated receiving switching circuit 22 including the amplifier-detector 23 and the windings of switching relays 18 and 24 connected in parallel to the output of the latter.

The low-pass filters 1, 4, 7 and 10 and the high-pass filters 2, 5, 8 and 11 are respectively designed to have frequency transmission characteristics such that the former will pass the lower frequencies in the voice frequency range and the latter the higher frequencies in that range. Preferably, the cut-off points of these filters are set so that each passes half of the voice frequency band.

The circuits which have been described accomplish the objects of the invention in a manner which will be brought out in the following complete description of the operation of the system of Fig. 1.

In the absence of signal transmission over the system in either direction, the connection of the filters in the transmitting and receiving circuits at each terminal, as indicated in Fig. 1, is such that the transmitting circuit at the west terminal station is conditioned to pass to the associated radio transmitter only the lower half of the signal frequency band, and the transmitting circuit at the east terminal station is conditioned to pass to the associated radio transmitter only the upper

half of the signal frequency band; and the receiving circuits at both terminal stations are conditioned to pass the entire signal frequency band. Thus, for the idle condition of the system, it will pass freely half of the signal frequency band in both directions between the subscribers at each end of the system.

Now, let it be assumed that speech signals from a west telephone subscriber are received at the west station over the associated two-way telephone line and are impressed by the hybrid coil H_W on the input of the transmitting circuit TC_W , and at that time no speech signals are being received at the east station over the associated two-way telephone line from the east subscriber.

The west subscriber's speech currents will pass through the vogad VOG_W in which they will be regulated to the desired constant volume. Speech currents in the output of the vogad will be divided between the input of the parallel filters 1 and 2 in the signal transmitting circuit TC_W , and the input of the transmitting switching circuit 13.

The speech currents diverted in the switching circuit 13 will be amplified and detected in amplifier-detector 14 and will cause operation of the transmitting switching relays 3 and 9. The operation of relay 3 will remove the normal disability in the output of high-pass filter 2 so as to make that filter effective to increase the transmission frequency range of the transmitting circuit TC_W so that it will include both halves of the signal frequency band. The operation of relay 9 will disconnect the output of high-pass filter 3 from the receiving circuit RC_W thus reducing the transmission frequency range of the latter circuit so that it includes only the lower half of the signal frequency band. West has now obtained directional control of the west station.

In the transmitting circuit TC_W , the lower and upper portions of the frequency band of west's speech currents are respectively passed by filters 1 and 2 and, the output portion of the high-pass filter 2 now being enabled, the whole frequency band of west's signals will be transmitted through the hybrid coil H_1 to the radio transmitter RT_W and will be radiated thereby to the east station.

At the east station, west's speech signals will be picked up and detected by the radio receiver RR_E , and the detected signals will pass through the hybrid coil H_4 . If the transmitting switching relay 12 at the east station is in the unoperated condition, indicating that the east subscriber has not started to talk after west within a time interval equal to the over-all one-way transmission time between the terminal stations, both filters 10 and 11 will be effective each to pass half of the frequency band of west's speech currents. The full frequency band of west's speech currents will then pass out over the outgoing portion of the receiving circuit RC_E through hybrid coil H_E and switchboard S_E to the two-way telephone line leading to the east subscriber's telephone set.

A portion of west's speech current will be diverted from the output of RC_E into the receiving switching circuit 22 and will cause operation of the amplifier-detector 23 to operatively energize the windings of receiving switching relays 18 and 24. Relay 24 will operate to disable the control circuit for the transmitting vogad VOG_E so that its gain will remain fixed at the last regulated value. Relay 18 will simultaneously operate to disable the energizing circuit of the receiving switching relays 6 and 12. This will give west

directional control of the east station of the system, and he will maintain directional control of both stations as long as he continues to talk without an appreciable pause.

Now, let it be assumed that the east subscriber starts to talk about the same time as the west subscriber or within a time interval thereafter within the over-all one-way transmission time between the terminal stations.

East's speech currents when they reach the east station will be impressed by the hybrid coil H_E on the input of the transmitting circuit TC_E and after regulation to constant volume by the vogad VOG_E , still in its normal operative condition because west's currents have not reached the east station, will be divided between the input of the low-pass filter 4 and the high-pass filter 5 in the main signal transmission circuit, and the input of the associated transmitting switching circuit 16.

The portion of east's speech currents diverted into switching circuit 16 will be amplified and detected by amplifier-detector 17 and, relay 18 being in its normally unoperated condition, will operatively energize the windings of transmitting switching relays 6 and 12. Switching relay 6 will operate to connect the low-pass filter 4 in parallel with the high-pass filter 5 in the transmitting circuit TC_E , thereby rendering the latter circuit operative to transmit the full frequency band of east's speech currents through hybrid coil H_2 to the radio transmitter RT_E .

Relay 12 will simultaneously operate to effectively disconnect the low-pass filter 10 from the receiving circuit RC_E thereby changing the transmission frequency range of that circuit so that it is subsequently effective to transmit to the two-way telephone line leading to the east subscriber only the upper half, transmitted by high-pass filter 11, of the frequency band of west's speech currents when they are subsequently received at the east terminal station.

When the half-frequency band (higher speech frequencies) of west's speech currents reaches the input of the receiving switching circuit 22, the portion diverted therein will cause operation of amplifier-detector 23 to operatively energize the receiving switching relays 13 and 24. Relay 24 will operate to disable the control for the transmitting vogad VOG_E so that the gain of the latter is maintained at the last regulated value. Relay 13 will operate to open the energizing circuit for receiving switching relays 12 and 6 causing the release of these relays to respectively reconnect the low-pass filter 10 in the receiving circuit RC_E and to disconnect the low-pass filter 4 from the transmitting circuit TC_E so that the former circuit thereafter passes the whole frequency band of west's speech currents and the latter circuit thereafter only transmits the high frequency half of east's speech currents.

The initial portion of east's speech currents reaching the west station and picked up and detected in the radio receiver RR_W will include the entire speech frequency band. These detected speech currents will be passed through hybrid coil H_3 . As switching relay 9 is held operated by west's outgoing speech currents at the west station, the high-pass filter 8 at that time is disconnected from the receiving circuit RC_W . However, the low-pass filter 7 is effective in that circuit and will pass the lower frequency band of the initial portion of east's speech currents. The main portion of these currents will be transmitted out over the outgoing portion of circuit

RC_W through hybrid coil H_W , switchboard SW , and the connected telephone line to the west subscriber and will be heard by him. Another portion will pass into the receiving switching circuit 19 and operate the receiving amplifier-detector 20 to operatively energize the switching relays 21 and 15. Relay 21 will disable the control circuit for the transmitting vogad VOG_W to maintain its gain at the last regulated value, and relay 15 will operate to break the energizing circuit for the transmitting switching relays 9 and 3. Transmitting switching relay 3 will then release to effectively remove high-pass filter 2 from the transmitting circuit TC_W so as to reduce the transmission frequency range of that circuit to the lower half of the signal frequency band, and relay 9 will simultaneously release to reconnect high-pass filter 8 in the receiving circuit RC_W , thereby increasing the transmission frequency range of the latter circuit to include the entire signal frequency band.

After the initial period, east's voice currents received at the west station comprise the upper half of the voice frequency range only due to the disconnection of low-pass filter 4 from the transmitting circuit at the east station by release of relay 6. These speech currents are picked up and detected at the west station by the radio receiver RR_W and pass through hybrid coil H_3 . The portion of these voice currents passing into the low-pass filter branch will be suppressed by low-pass filter 7 therein, but the portion passing into the high-pass filter branch, the input of which is now operated due to the release of relay 9 caused by operation of relay 15 in the manner described, will pass through high-pass filter 8 over the outgoing portion of RC_W and through hybrid coil H_W and switchboard SW to the telephone line leading to the west subscriber. A portion of this upper half of the frequency band of the east speech current diverted into switching circuit 19 will be amplified and detected by amplifier-detector 20 and will be impressed on relays 15 and 14 to maintain them in the operated condition initiated by the preceding lower half of the voice frequency band. Thus, for this condition of operation, that is, with both subscribers starting to talk simultaneously within the over-all one-way transmission time between the terminal stations, both subscribers will hear each other, although not necessarily understand each other, so that probably one or both, realizing what has happened, will stop talking as in a face-to-face conversation.

Now, let it be assumed that the west subscriber starts to talk first and obtains directional control of both terminal stations in the manner first described above, and at some later time after west has started to talk, but not within a time interval equal to the one-way over-all transmission time of the system between terminal stations, east starts to talk.

East's speech currents arriving at the east terminal will be impressed by the hybrid coil H_E on the input of the transmitting circuit TC_E and will pass through the vogad VOG_E , the control of which has previously been disabled in response to west's speech currents in the manner previously described so that its gain is maintained at the last regulated value prior to west getting control. The speech currents in the output of the device VOG_E will be divided between the inputs of the filters 4 and 5 in the main signal transmission circuit, and the input of the transmitting switching circuit 16. The

portion diverted into switching circuit 16 will be amplified and detected by amplifier-detector 17 but, because of the previous operation of the receiving switching relay 18 under control of west's speech currents to disable the energizing circuit for the transmitting switching relays 6 and 12, there will be no operation of the latter relays in response to east's speech currents. The receiving circuit RC_E, therefore, will be maintained in its normal condition in which the low-pass filter 10 and the high-pass filter 11 are together effective to transmit the complete frequency range of west's speech currents to the east subscriber, and the transmitting circuit TC_E will be maintained in its normal transmission condition in which the low-pass filter 4 is disconnected and only the high-pass filter 5 is effective to transmit the upper half band of east's speech currents to the radio transmitter RT_E through hybrid coil H₂.

When east's radiated speech currents (upper half band) arrive at the west terminal station, they will be picked up and detected by the radio receiver RR_W and transmitted through the hybrid coil H₃. As the high-pass filter 8 is maintained disconnected from the receiving circuit RC_W by relay 9 under control of west's speech currents at the station, and the low-pass filter 7 will not pass the upper signal frequency band, none of east's speech currents will get through to the west subscriber or to the input of the receiving switching circuit 19 as long as west talks continuously without appreciable pause.

However, as long as east continues to talk his speech energy, or rather the upper half of the frequency band of his speech currents, will be continued to be received at the east station so that when west ceases talking or pauses for an appreciable time interval sufficient to allow his transmitting switching relay 9 to release to reconnect the high-pass filter 8 in the receiving circuit RC_W, the upper half of the frequency band of east's currents will be transmitted through the high-pass filter 8 over the outgoing portion of the circuit RC_W and through hybrid coil H_W and switchboard Sw to the west subscriber and into the receiving switching circuit 18. The portion diverted into switching circuit 19 controls receiving switching relays 21 and 15 to render the transmitting vogad VOG_W operative and to disable the transmitting switching circuit 13. High-pass filter 2 will then be disconnected from the transmitting switching circuit TC_W and high-pass filter 8 will be effective in the receiving circuit RC_W to increase its transmission frequency range to the entire signal frequency band. Then east has directional control of the west terminal stations.

Prior to this, east will have regained directional control of the east station, for with cessation in the transmission of west's speech currents to the east station, the receiving switching circuit 22 at that station will release to allow the transmitting switching relays 6 and 12 at that station to be operated by east's speech currents to render the transmitting circuit at the east terminal station effective to transmit the complete signal frequency band of east's speech currents and to decrease the transmission frequency range of the receiving circuit RC_E at the station to include only the higher half of the speech frequency range.

It will be apparent from the above description that the circuits of the invention as shown in Fig. 1 differ from the usual vodas switching

circuits which require both a receiving switching relay to release and a transmitting switching relay to operate at the receiving station before a listening subscriber can break in. Thus, the present arrangement increases the facility of break-in by a listening subscriber and as well prevents complete transmission lock-out. Also, as the signal transmission paths in both directions are maintained operative to transmit half of the signal frequency band during the idle condition of the system, it is apparent that the circuits as described will reduce signal clipping.

Fig. 2 shows a two-way radio telephone system embodying a modification of the invention providing a somewhat different break-in action.

The system of Fig. 2 differs from that of Fig. 1 essentially in the following respects.

In Fig. 2, at the west station, the transmitting voice-operated switching circuit 13 operating in response to outgoing speech signals at the terminal to insert the high-pass filter 2 in parallel with the low-pass filter 1 in the transmitting circuit TC_W, and to effectively remove the high-pass filter 8 from the receiving circuit RC_W, has its input connected to the high-pass filtering branch of transmitter circuit TC_W between the output of the high-pass filter 2 and the normally open switching contacts of transmitting switching relay 3, through hybrid coil H₅ and associated balancing network N₅, instead of directly to the transmitting circuit TC_W at a point between the output of vogad VOG_W and the inputs of low-pass filter 1 and high-pass filter 2 as in the system of Fig. 1. In Fig. 2, at the east station, the transmitting voice-operated switching circuit 16 operating in response to outgoing voice signals to insert the low-pass filter 4 in parallel with the high-pass filter 5 in the transmitting circuit TC_E and to effectively remove the low-pass filter 10 from receiving circuit RC_E, has its input connected by hybrid coil H₆ and associated balancing network N₆ to the low-pass filtering branch of circuit TC_E at a point between the output of low-pass filter 4 and the normally open switching contacts of transmitting switching relay 6, instead of directly to the transmitting circuit TC_E at a point between the output of vogad VOG_E and the inputs of low-pass filter 4 and high-pass filter 5 as in the system of Fig. 1.

Also in Fig. 2, at the west station the outputs of low-pass filter 7 and high-pass filter 8 are coupled to the output portion of the receiving circuit RC_W leading to hybrid coil H_W by a hybrid coil H₇ and associated balancing network N₇, instead of directly in parallel to that portion of RC_W as in the system of Fig. 1; and the input of the receiving switching circuit 19 operating in response to received voice signals to disable the transmitting switching circuit 13 in its output and to disable the control for the vogad VOG_W, has its input connected to the high-pass filtering branch of receiving circuit RC_W at a point between the output of high-pass filter 8 and the hybrid coil H₇, instead of to the receiving circuit RC_W in the output of both the low-pass filter 7 and the high-pass filter 8 as in the system of Fig. 1. In Fig. 2, at the east station the outputs of the low-pass filter 10 and the high-pass filter 11 are coupled to the output portion of the receiving circuit RC_E leading to hybrid coil H_E by a hybrid coil H₈ and associated balancing network N₈, instead of directly to that portion of RC_E as in the system of Fig. 1; and the receiving switching circuit 22 responsive to

received voice signals to disable the transmitting switching circuit 16 in its output and to disable the control for the vogad VOG_E, has its input connected to the low-pass filtering branch of the receiving circuit RC_E at a point between the output of low-pass filter 10 and hybrid coil H_E, instead of directly to the receiving circuit RC_E at a point in the outputs of both the low-pass filter 10 and high-pass filter 11 as in the system of Fig. 1.

The result of these changes in the system of Fig. 2 as compared to Fig. 1 is that the addition of two hybrid coils and associated balancing networks, has the effect that in the case when both subscribers start talking simultaneously each will obtain control of the local transmitting amplifier-detector (14 and 17) but not of the distant receiving amplifier-detector (23 or 20). In that case, transmission east to west will be through the filters 4, 5 and 7, but not through filter 8 and transmission west to east will be through filters 1, 2 and 11, but not through filter 10. Thus, both subscribers will receive half-band transmission as obtained with Fig. 1. In Fig. 1 each subscriber under the condition of both starting to talk simultaneously first obtains control of the local transmitting amplifier-detector and then of the distant receiving amplifier-detector. When the distant receiving amplifier-detector is controlled it disables the distant transmitting amplifier-detector. Thus initially east-to-west transmission is through filters 4, 5 and 7, but not through filter 8 and west-to-east transmission is through filters 1, 2 and 11, but not through filter 10. After the speech waves reach the distant terminal the east-to-west transmission is through filters 5, 7 and 8, but not through 4 and transmission west to east is through filters 1, 10 and 11, but not through filter 2.

It will be apparent from the above description of operation that the control circuits of the invention applied to two-way radio or wire telephone systems will provide reduced clipping on all calls, prevent complete "lock-out" on terminal calls and make "break-in" easier, at the expense of some band width reduction.

Various modifications of the circuits illustrated and described which are within the spirit and scope of the invention will occur to persons skilled in the art. For example, mutually exclusive band-pass filters transmitting any desired portions of the voice frequency range may be substituted for the low-pass and high-pass filters at the terminal stations, in the systems as illustrated and described.

What is claimed is:

1. A two-way signaling system comprising terminals connected by a two-way transmission medium, means to condition the system to transmit between terminals in both directions only a limited portion of the signal frequency range, at substantially all times except when signal transmission over the system in one direction is initiated a given time before signal transmission in the opposite direction, and means operating for the latter condition of transmission to automatically increase the transmission frequency range over the system for said one direction only to include a substantially greater portion of the signal frequency range.

2. A two-way signal transmission system comprising terminals connected by a two-way transmission medium, and means to minimize signal

lock-out and clipping and to facilitate break-in comprising means conditioning the system for transmitting between terminals in both directions a limited portion only of the signal frequency range when signal transmission in both directions is started simultaneously or within a time interval substantially equal to the one-way transmission time between the terminals of the system, and means for extending the frequency transmission range of the system only in the direction in which signal transmission is first started to include substantially the entire signal frequency range if signal transmission in the opposite direction does not start within said limited time interval.

3. A two-way signal transmission system including at least at the terminals thereof oppositely directed one-way transmission paths for the signals transmitted in opposite directions, means for controlling the transmission efficiency of said paths so that in the idle condition of the system and when signal transmission in both directions is initiated within a limited time interval the system is conditioned to transmit in both directions between said terminals a limited portion of the signal frequency range different for each direction of transmission and means effective when signal transmission for one direction is initiated before signal transmission in the other direction a given time greater than said limited time interval for controlling the transmission efficiency of said paths so that the system is conditioned to transmit between said terminals in said one direction substantially the entire signal frequency band, and to transmit a limited portion of said signal frequency range in the other direction to the distant terminal.

4. In combination with a two-way signal transmission system, means for limiting the transmission frequency range over the system for each direction to only a portion of the signal frequency range in the case of no signal transmission in either direction and the case of signal transmission in both directions initiated within a certain limited time interval, and means for giving directional control of the system and substantially complete frequency band transmission to the signals in the direction in which first initiated if signal transmission in the opposite direction is not initiated within said limited time interval, and for allowing limited frequency band transmission in said opposite direction for the signals last initiated to the distant terminal to facilitate the seizure of directional control by the latter signals at a pause in the transmission in said one direction.

5. A control circuit for a two-way telephone system comprising means for limiting the transmission frequency range over the system in both directions, when the system is idle and when talking is initiated in both directions within a limited time interval, to a limited portion of the signal frequency band, and means to increase the transmission frequency range over the system in the direction in which talking is first initiated, if initiated a given time greater than said limited time interval before talking in the other direction starts, to include substantially the complete signal frequency band, and to maintain the transmission frequency range over the system for the later initiated signals in the other direction to a limited portion of the signal frequency band until talking in said one direction ceases or is interrupted for a given time interval.

6. A two-way telephone system comprising terminals connected by a two-way transmission medium, means effective when the system is in the idle condition and when the subscribers associated with the terminals thereof start talking about the same time to allow transmission between the terminals in both directions of a limited portion of the telephone signal frequency range, and means effective when the subscriber associated with one terminal starts talking at a predetermined time before the subscriber associated with the other terminal to give complete directional control to the former subscriber and to allow full-frequency band transmission of his speech signals to the latter subscriber and partial frequency band transmission of the latter's speech signals to the distant terminal, whereby signal clipping and lock-out are minimized and break-in facilitated.

7. In a two-way telephone transmission system including at each terminal oppositely directed one-way transmission paths for the telephone signals transmitted in opposite directions, means for minimizing transmission lock-out and signal clipping while facilitating break-in by a listening subscriber comprising at each terminal transmission apparatus normally allowing the transmitting path to transmit only frequencies in a limited portion of the voice frequency band, different for each terminal, and the receiving path to transmit substantially all frequencies in the voice frequency band, a switching circuit responsive to outgoing signals in the transmitting path, in the absence of received signals in the receiving path, to control said transmission apparatus so that the transmission frequency range of the transmitting path is increased to include substantially all frequencies in the voice frequency band and the transmission frequency range of the receiving path is substantially simultaneously reduced to include only the frequencies in the limited portion of the voice frequency band to which the transmitting path at the terminal is normally limited and a second switching circuit responsive to incoming signals in the receiving path within the frequency transmission range of that path at that time, to disable the first switching circuit.

8. The system of claim 7, in which said transmission apparatus includes in the transmitting path at one terminal a normally operative filtering branch adapted to transmit the lower range of frequencies in the voice frequency band and a parallel-connected normally disabled filtering branch which, when operative, is adapted to transmit the higher range of frequencies in the voice frequency band and in the transmitting path at the other terminal a normally operative filtering branch adapted to transmit said higher range of frequencies and a parallel-connected normally disabled filtering branch which, when operative, is adapted to transmit said lower range of frequencies, and includes in the receiving path at each terminal a normally operative filtering branch adapted to transmit said lower range of frequencies and a parallel-connected normally operative filtering branch adapted to transmit said higher range of frequencies, said first switching circuit at each terminal, when operative, is responsive to outgoing signals in the transmitting path thereat to render the normally disabled filtering branch therein operative, and to disable the filtering branch adapted to transmit the same frequency range in the receiving path at the terminal, and said second switching

circuit at each terminal is responsive to incoming signals in said receiving path, when it is operative to transmit the frequencies of said received signals, to disable said first switching circuit.

9. The system of claim 7, in which said transmission apparatus includes in the transmitting path of the respective terminals a normally operative filtering branch adapted respectively to transmit the lower and higher range of frequencies in the voice frequency band and a parallel-connected normally disabled filtering branch which, when operative, is adapted to transmit the other range of frequencies in the voice frequency band, and includes in said receiving path at each terminal a normally operative filtering branch adapted to transmit said lower range of frequencies and a parallel-connected normally operative filtering branch adapted to transmit said higher range of frequencies, said first switching circuit at each terminal is responsive to outgoing signals in the transmitting path thereof to render the normally disabled filtering branch therein operative, and to disable the filtering branch adapted to transmit the same frequency range, in the receiving path of the terminal, said second switching circuit at each terminal is responsive to incoming signals in the receiving path within the transmission frequency range thereof at that time, to disable said first switching circuit, said first switching circuit at each terminal has its input connected to said transmitting path at a point in front of the two filtering branches therein and said second switching circuit at each terminal has its input connected to said receiving circuit at a point in the output of the two filtering branches therein.

10. The system of claim 7, in which said transmission apparatus includes in the transmitting path of the respective terminals a normally operative filtering branch adapted respectively to transmit the lower and upper range of frequencies in the voice frequency band and a parallel-connected normally disabled filtering branch which, when operative, is adapted to transmit the other range of frequencies in the voice frequency band, and includes in the receiving path at each terminal a normally operative filtering branch adapted to transmit said lower range of frequencies and a parallel-connected normally operative filtering branch adapted to transmit said higher range of frequencies, said first switching circuit at each terminal, when operative, is responsive to outgoing signals in the transmitting path to render the normally disabled filtering branch therein operative, and to disable the filtering branch adapted to transmit the same frequency range, in said receiving path, said second switching circuit at each terminal is responsive to incoming signals in said receiving circuit within its transmission frequency range at that time to disable said first switching circuit, said first switching circuit at each terminal has its input connected to the normally disabled filtering branch in front of the disabling point therein and said second switching circuit at each terminal has its input connected to the filtering branch in said receiving circuit, adapted to be disabled by said first switching circuit at the terminal, at a point beyond the disabling point therein.

11. The system of claim 7, in which said transmission apparatus includes in the transmitting path of each terminal a low-pass filter and a parallel high-pass filter, having cut-offs at inter-

mediate points in the signal frequency range, a different one of said filters at the two terminals being normally disabled in its output and being rendered operative by operation of said first switching circuit at the terminal, and includes in the receiving path of each terminal a low-pass filter and a parallel high-pass filter, having cut-offs at intermediate points in the signal frequency range, the one of the latter filters having the same transmission frequency range as the normally disabled filter in the transmitting path at the same terminal, being adapted to be disabled in its input by operation of said first switching circuit at the same terminal.

12. The combination of claim 7 in which said system is a two-way radio telephone system transmitting different radio frequencies in opposite directions between terminals, said transmitting path at each terminal leading to a radio transmitter and said receiving path at each terminal leading from a radio receiver.

13. A control terminal for a radio telephone system comprising a voice frequency transmitting path leading to a radio transmitter, a voice

frequency receiving path leading from a radio receiver, said transmitting path being normally operative to transmit to said radio transmitter for radiation therefrom to a distant terminal a limited portion of the voice frequency band, said receiving path being normally operative to transmit from said radio receiver to a telephone receiver substantially all frequencies in the voice frequency band, a transmitting switching circuit responsive to outgoing telephone signals in said transmitting path, in the absence of telephone signals in the output of said receiving path, to increase the frequency transmission range of said transmitting path to include the other frequencies in the voice frequency band, and simultaneously to reduce the frequency transmission range of said receiving path to include only those frequencies in said limited portion of the voice frequency band, and a receiving switching circuit responsive to received voice signals in said receiving path within its transmission frequency range at that time, to disable said transmitting switching circuit in its output.

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