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TWO-WAY SIGNALING SYSTEM

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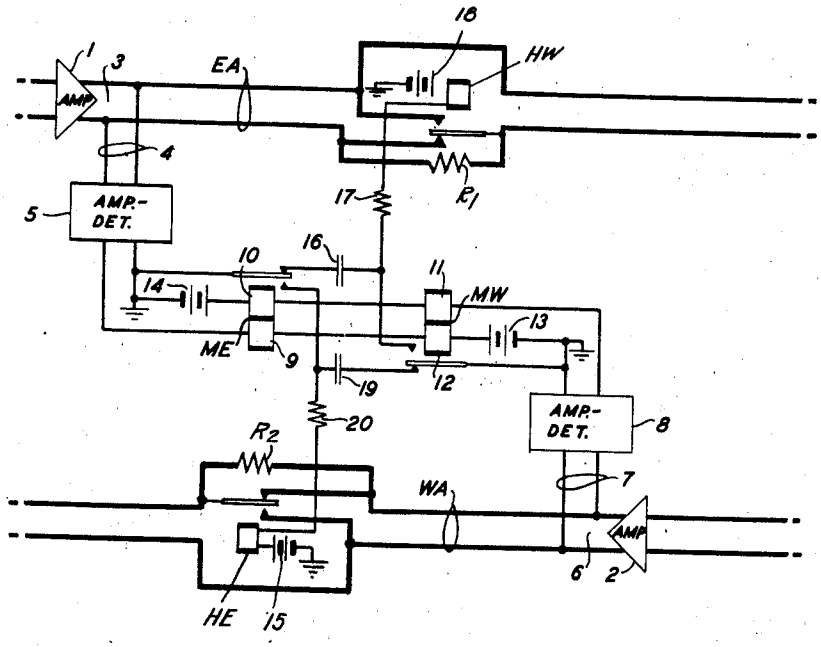

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TWO-WAY SIGNALING SYSTEM

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3 Claims. (Cl. 178—44)

The invention relates to two-way signal transmission systems, such as two-way telephone systems, and particularly to the signal-controlled switching circuits used with such systems to directionally control signal transmission while suppressing echoes and preventing singing.

Such signal-controlled switching circuits, commonly called echo suppressors, usually employ two switching branches respectively connected to each of the two oppositely directed one-way signal transmission paths at a terminal or intermediate point of the two-way system, each including an amplifier and a detector for amplifying and detecting the applied signal waves, and electromagnetic relays or other switching devices operated by the detected signals to apply or remove short-circuiting connections across the signal transmission paths, or otherwise suitably control their transmitting efficiencies, and to disable the other switching branch, so as to provide the desired directional control with suppression of echoes and singing. Each switching branch also usually includes auxiliary hang-over means, such as a resistance-condenser arrangement with an associated direct current source, operating to prolong the operation of the switching branch for a given hang-over time interval after the controlling signal energy ceases, to insure suppression of delayed echoes.

An object of the invention is to improve the operation of such echo suppressors particularly from the standpoint of facilitating "breaking" by one party to a conversation when the other has obtained control of the system.

A more specific object is to so improve such echo suppressors as to enable one party to a conversation to break in quickly on a party who has been talking.

These objects are attained in accordance with the invention by arranging the echo suppressor switching branch connected to each of the two oppositely directed signal transmission paths, so that when it is operated by applied signals it disables the other transmission path, desensitizes rather than short-circuits the input to the echo suppressor switching branch connected to the latter path, and effectively cancels the hang-over of the other switching branch. Thus, the party who is attempting to break in, by merely talking loudly enough to overcome the desensitization of his own echo suppressor branch may obtain complete control of the echo suppressor circuits substantially immediately.

The various objects and features of the invention will be better understood from the following detailed description when read in conjunction with the accompanying drawing the single figure of which shows schematically part of a two-way telephone system equipped with echo suppressors embodying the invention.

In the single figure of the drawing are shown a one-way transmission circuit EA including the one-way amplifying device 1, for repeating telephone signals transmitted in the direction from west to east, and a one-way transmission circuit WA including the one-way amplifying device 2, for repeating signals transmitted in the direction from east to west. These two circuits may be, for example, part of a two-way telephone repeater, or of a four-wire telephone circuit, in which case they would be connected at their terminals to two-way line sections leading to subscribers' telephone transmitting and receiving apparatus, by the usual hybrid coils and associated balancing networks, or other suitable means so that the one-way circuits are connected in transmitting relation with the line sections but in conjugate relation with each other.

Connected across the circuit EA at a point 3 beyond the output of the amplifying device 1 is the input of a switching circuit 4 comprising the amplifier-detector 5, which may be of the vacuum tube type, and a chain of relays comprising the master relay ME and the switching relay HE with an associated hang-over circuit, controlled by operation of the amplifier-detector 5. Similarly, connected across the circuit WA at a point 6 beyond the output of the amplifying device 2 is the input of the switching circuit 7 including a similar amplifier-detector 8 and a chain of relays comprising the master relay MW and the switching relay HW with an associated hang-over circuit, controlled by operation of the amplifier-detector 8.

The master relay ME has an operating winding 9 and an opposing biasing winding 10, and the master relay MW has an operating winding 11 and an opposing biasing winding 12. The operating winding 9 of the master relay ME and the biasing winding 12 of the master relay MW are connected in series with the detector energizing battery 13 across the output of amplifier-detector 5, and the operating winding 11 of the master relay MW and the biasing winding 10 of master relay ME are connected in series with the detector energizing battery 14 across the output of the amplifier-detector 8.

With no signal input to the amplifier-detector 5 of switching circuit 4 from transmission circuit EA, the master relay ME and switching relay HE

are in their normally unoperated condition illustrated, with the energizing circuit for the winding of switching relay HE from battery 15 broken at the open front contact of relay ME, and the hang-over circuit for relay HW, including condenser 16, resistance 17 and battery 18 connected in series across the winding of the latter relay through the closed armature and back contact of relay ME. Similarly, with no signal input to the amplifier-detector 8 of the switching circuit 7 from the transmission circuit WA, the relays MW and HW are in their normally unoperated condition illustrated, with the energizing circuit for the winding of the switching relay HW broken at the open front contact of the relay MW, and the hang-over circuit for the switching relay HE, including condenser 19, resistance 20 and battery 15 connected in series across the winding of relay HE through the normally closed back contact and armature of the relay MW.

With relay HW unoperated, the signal transmission circuit EA is operative at maximum efficiency due to the short-circuiting of the resistance R_1 in series with one side of the circuit beyond the point 3 to which the switching circuit 4 is connected, through the normally closed back contact and armature of that relay, and the break in the short-circuiting connection across the circuit EA at the open front contact of relay HW. Similarly, with relay HE unoperated, the transmission circuit WA is operative with maximum efficiency due to the short-circuiting of the resistance R_2 in series with one side of that circuit beyond the point 6 of connection of the switching circuit 7 thereto, through the normally closed back contact and armature of relay HE, and the break in the short-circuiting connection across the circuit WA at the open front contact of relay HE.

Let it be assumed that a west telephone subscriber associated with the west end of the transmission circuit EA starts to speak, and at that time the east subscriber associated with the east end of the transmission circuit WA is silent. The speech waves of the west subscriber transmitted over EA will be amplified in the amplifier 1 and, the relay HW being in its normal unoperated condition, will pass out over the path EA with little attenuation towards the east subscriber. A portion of West's speech waves diverted into the switching circuit 4 at the point 3 in the output of amplifier 1, will be amplified and detected in the amplifier-detector 5 and will be applied as energizing current to the operating winding 9 of the master relay ME, and to the biasing winding 12 of the master relay MW to bias the latter relay against operation in an amount dependent on the amplitude level of the voice currents in the circuit EA.

The energizing current applied to the operating winding 9 of master relay ME, if of sufficient level, will cause the operation of that relay to shift its armature from the back to the front contact. The breaking of the back contact will disconnect ground from the condenser 16 of the hang-over circuit associated with the winding of switching relay HW to immediately cancel the hang-over of that relay. The closing of the front contact of relay ME will complete an energizing circuit for the winding of the switching relay HE from battery 15 through the resistance 20 and the closed front contact and armature of relay ME. The consequent operation of the switching relay HE to shift its armature from its back to its front contact, will remove the short-circuit from the resistance R_2 in one side of the circuit WA, and will close a short-circuit across the circuit WA to block the path WA. The blocking of the circuit WA will suppress echoes of West's signals reflected from the east terminal of the four-wire circuit.

Because of the manner in which the contacts of the switching relay HE and the resistance R_2 are interconnected in the transmission circuit, however, the input to the amplifier-detector 8 of the switching circuit 7 will not be shorted but will be only shunted by the resistance R_2, so as to further desensitize that switching circuit by a fixed amount substantially equal to the loss value of that resistance.

When West ceases talking and the output current of the amplifier-rectifier 5 falls off sufficiently, the master relay ME will immediately release to return its armature from the front contact to the back contact, thereby putting a break in the normal energizing circuit for the winding of relay HE from battery 15, and reconnecting the hang-over circuit 16—17—18 across the winding of the switching relay HW. The relay HE, however, will not immediately release but will be maintained operated for a suitable hang-over time interval until the condenser 19 of the hang-over circuit for relay HE charges up to the potential of battery 15 through the winding of relay HE, resistance 20 and the back contact and armature of unoperated relay MW. Relay HE therefore for that hang-over time interval will maintain the circuit WA blocked and the switching circuit 7 desensitized by the amount of the value of resistance R_2 in series with its input circuit.

Now, suppose that while West is still talking and retains the relays ME and HE operated to block the transmission circuit WA and to disable the hang-over circuit for relay HW in the manner described, the east subscriber wishes to break in. He can do this by talking loudly enough so that the level of his speech currents in the output of amplifier 2 is sufficiently high to overcome the desensitizing loss inserted into the input of the switching circuit 7 by resistance R_2. The consequent operation of the amplifier-detector 8 to supply energizing current to the operating winding 11 of master relay MW and the biasing winding 10 of master relay ME will cause the operation of the master relay MW and the desensitization of the relay ME. The relay MW will then operate to break its back contact to disconnect the condenser 19 from ground which will immediately cancel the hang-over for relay HE, and to make its front contact to complete an energizing circuit for relay HW from battery 18, operating that relay.

The master relay ME will immediately release because of the high bias applied to its biasing winding 10 in response to East's high level voice currents, which is sufficient to overcome the operating bias applied to the operating winding 9 in response to West's normal level voice currents. The release of relay ME will cause the immediate release of relay HE because of the breaking of the energizing circuit of the latter at the front contact of relay ME and the previous cancellation of the hang-over of relay HE, and will reconnect the hang-over circuit 16—17—18 across the winding of relay HW. The release of relay HE will remove the short circuit from path WA allowing East's speech currents to be transmitted out over that path to the west subscriber, and will reconnect the short around resistance R_2 to

effectively remove the desensitizing loss from the input of switching circuit 7 so that the latter circuit may be maintained operated by East when he drops his voice to normal loudness.

The operation of relay HW will cause a short circuit to be connected across the path EA to block that path to suppress echoes of East's signals, and will remove the short around resistance R_1 to insert a desensitizing loss of substantially its value in the input of the switching circuit 4. When East ceases talking, relay MW will release immediately but the relay HW will be maintained operated to block path EA and reduce the sensitivity of the switching circuit 4, by the charging current to condenser 16 in the hang-over circuit from battery 18 through the relay operating winding, for a sufficient time interval to insure suppression of delayed echoes of East's speech waves.

As speech is not a continuous power function, it is not necessary that the level of the breaking subscriber's speech currents be greater than the level of the talking subscriber's speech currents for the former to break in. For example, if the breaking subscriber is talking loudly enough to overcome the desensitizing loss in the input of his suppressor device and the average level of the voice current of the other subscriber who has obtained control is about the same, the strong intervals of the former's speech may break in during the weak intervals of the latter's.

As the echo suppressor circuits for the two sides of the four-wire circuit are symmetrical, the operation for the case where the East subscriber is talking and the West subscriber is attempting to break will be similar to that already described for the opposite case.

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.

What is claimed is:

1. In combination in a two-way signal transmission system including oppositely directed one-way paths for the signals transmitted in opposite directions, a switching device connected to each path, responsive to signal transmission in that path, in the absence of prior signal transmission in the other path, to disable said other path beyond the point of connection of the other switching device thereto, to reduce the sensitivity of said other switching device by a given amount, and to set up a hang-over circuit for the first switching device operating to prolong the disabling of said other path for a desired time interval after the supply of controlling signals to said first switching circuits ceases, and means responsive to subsequent signal transmission in said other path while said first switching device is operated, of sufficient level to overcome the desensitization of said other switching device, to immediately disable the hang-over circuit for said first switching device thereby allowing said subsequent signal transmission by means of said other switching device to immediately reverse the directional control of the system.

2. In combination in a two-way telephone system including oppositely directed one-way paths for respectively transmitting the oppositely directed signals of the subscribers at the two terminals of the system, an echo suppressor device connected to each path, responsive to signal transmission in that path, if initiated before signal transmission in the other path, to disable said other path beyond the point of connection of the other suppressor device thereto, and to set up a hang-over circuit for the first suppressor device to prolong the disabling of said other path for a desired hang-over time interval after cessation in the supply of controlling signals to said first suppressor device, and means to enable break-in by one subscriber after another has operated the suppressor device connected to the path transmitting his signals to seize directional control of the system, comprising means responsive to operation of the latter suppressor device to insert a fixed amount of desensitizing loss in the input of the other suppressor device connected to the other path, and means responsive to the transmission by said one subscriber of signals in said other path of a level sufficient to overcome the desensitization of said other suppressor device, to immediately disable the hang-over circuit of said latter suppressor device and by operation of said other device to immediately reverse control of the system.

3. The combination of claim 2, in which the echo suppressor device connected to each path includes a wave rectifier for rectifying the signals applied thereto from the connected path, a master relay having an operating winding energized by the rectified signal output of that rectifier and an opposing biasing winding energized by the rectified signal output of the wave rectifier of the other suppressor device, said master relay operating when the energy supplied to its operating winding exceeds that supplied to its biasing winding, and a switching relay having an operating winding, operating in response to operation of said master relay to disable said other path, said hang-over circuit for said switching device includes a charged condenser which discharges when said master relay operates and recharges through said operating winding of said switching relay to maintain the latter relay operated for said desired hang-over interval when said master relay releases, and the said break-in enabling means includes a loss element in series with said other path, normally short-circuited through certain contacts of said switching relay when it is unoperated and effectively connected into the input of said other suppressor device by operation of the latter relay and means responsive to operation of the master relay of said other suppressor device in response to said other subscriber's signals of said sufficient level to prevent the condenser in the hang-over circuit of said latter switching device from recharging through the operating winding of the switching relay of said latter device when the master relay of that device releases.

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