

Dec. 31, 1935.

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2,026,305

TRANSMISSION CONTROL IN SIGNALING SYSTEMS.

Filed Oct. 6, 1934

FIG. 1

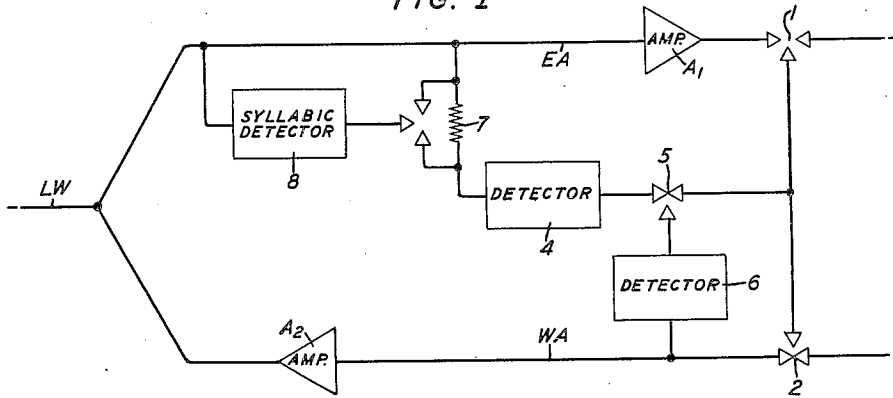
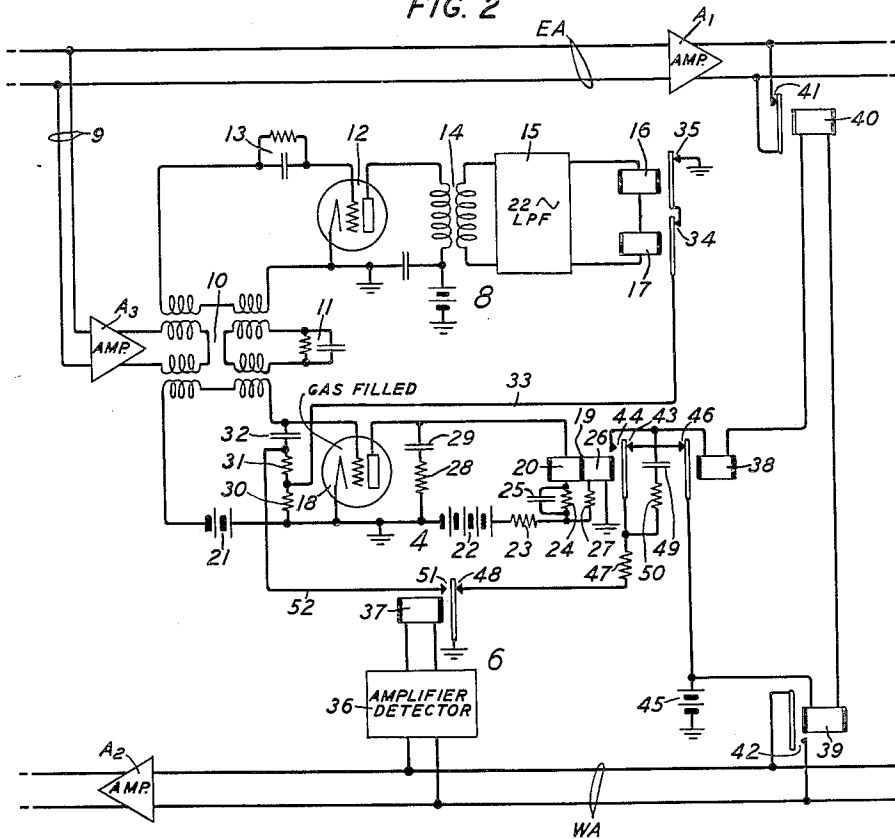


FIG. 2



UNITED STATES PATENT OFFICE

2,026,305

TRANSMISSION CONTROL IN SIGNALING SYSTEMS

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Application October 6, 1934, Serial No. 747,116

6 Claims. (Cl. 179—170)

The invention relates to transmission control in signaling systems, and particularly to circuits for reducing the effects of interfering waves in such systems.

5 An object of the invention is to discriminate between electrical waves of different characteristics, for example, between useful signal waves and interfering noise waves.

10 Another and a more specific object of the invention is to improve the operation of voice-operated devices for controlling signal transmission in a two-way telephone transmission system subject to interfering waves such as line noise.

15 Voice-operated switching devices, for example, echo suppressors or anti-singing devices, are often used in connection with two-way telephone systems subject to a considerable amount of noise varying in amplitude, such as the usual line noise or static. Such noise may seriously interfere with proper operation of the switching devices on voice energy. Noise waves of high amplitude may either cause false operation of the switching devices or necessitate reducing the sensitivity of the latter to such a degree as to prevent proper operation on speech waves of low amplitude. In certain circuits of the prior art, these difficulties have been minimized by the use of circuits which discriminate between speech and noise on the basis of differences in energy distribution with time. An example of such a circuit is the so-called "syllabic" detector which operates on the syllabic variations in speech but is unresponsive to the comparatively continuous noise energy.

25 The present invention is in the nature of an improvement upon voice-operated switching circuits of this type.

According to one embodiment of the invention to be described more fully hereinafter, in an echo and singing suppressor circuit located near a terminal of a two-way radio or wire telephone system, the usual voice-operated detectors associated with the transmitting and receiving circuits are responsive to outgoing speech energy to disable the receiving circuit and render the transmitting circuit operative, and to incoming speech energy to disable the transmitting detector. A loss pad normally inserted in the input of the transmitting detector is used to reduce the sensitivity of the latter. The sensitivity of the receiving detector and that of the transmitting detector without the loss pad are made approximately the same with respect to incoming energy. A syllabic detector connected to the input of the transmitting circuit is responsive to outgoing

speech energy to remove effectively the loss pad from the input of the transmitting detector and thus increase the sensitivity of the latter so as to improve its operation in response to the transmitted signals of low amplitude. As the syllabic detector must be made of quite high sensitivity in order to prevent clipping, on receiving, it will be operated by echoes of the received speech and static. This merely increases the sensitivity of the transmitting detector allowing it to be operated by the echoes which does no harm as the transmitting detector has been previously disabled by the receiving detector in response to the received speech signals.

The invention will be more clearly understood from the following detailed description thereof when read in connection with the accompanying drawing in which:

Fig. 1 shows diagrammatically the invention embodied in a singing and echo suppressor circuit for a two-way telephone system; and

Fig. 2 shows in greater detail a preferred construction of the suppressor circuit diagrammatically illustrated in Fig. 1.

The diagram of Fig. 1 is not an actual circuit diagram but rather a single line-layout, each line indicating a transmission path. In this layout, a normal break in a path is indicated by separated arrowheads and a normal make by contacting arrowheads. To show that a transmission element is to be controlled by a device, an arrow points from the device towards the element. An arrow directed at a make point indicates that the path will be disabled at that point by operation of the control device, and an arrow directed at a break point indicates that the break in the path will be eliminated by operation of the control device. A resistance element in a path indicates a finite loss in the path.

In Fig. 1 the suppressor circuits of the invention are shown incorporated in a four-wire circuit forming a part of a two-way radio or wire telephone system. As shown, the four-wire circuit comprises a one-way transmission circuit EA including the one-way amplifying device A₁, for repeating telephonic signals received from the two-way circuit LW in the direction from west to east and a one-way transmission circuit WA including the one-way amplifying device A₂, for repeating telephonic signals received from a distant station into the two-way circuit LW. The two one-way circuits EA and WA may be connected in substantially conjugate relation with each other and in energy transmitting relation with the two-way circuit LW and a correspond-

ing two-way circuit at the east station by any suitable means (not shown), for example, by hybrid coil transformers and associated balancing networks in the manner well-known in the art.

The two-way circuit LW may be assumed to extend towards the left eventually to a subscriber's set, and the circuits WA and EA toward the right to a two-way radio or wire transmission channel. For example, the circuit EA may extend to a radio transmitter and the circuit WA to a radio receiver, or both circuits may extend to a long distance telephone terminal such as an ocean cable telephone terminal.

The transmitting circuit EA is normally disabled, for example, by an open-circuit or a short circuit at the point 1, as indicated by the separated arrowheads, and the receiving circuit WA is normally operative as indicated by the contacting arrowheads at point 2. The circuit EA is rendered operative by removing the open or short circuit at point 1 and the circuit WA is disabled as by producing an open-circuit or short circuit at the point 2 in response to operation of a voice-operated device 4, such as an electric discharge detecting device and mechanical switching relays controlled from its output, connected to the transmitting circuit EA in front of the point 1. The voice-operated device 4 is arranged to be disabled at a point 5 in its output in response to operation of a second voice-operated device 6, similar to the device 4, connected to the receiving circuit WA at a point west of the point 2, in response to received speech signals.

A loss 7 of optimum value, say of about eight decibels, is normally inserted in the input of the transmitting voice-operated device 4. The sensitivity of the receiving voice-operated device 6 and that of the transmitting voice-operated device 4 without the loss in its input, are made approximately the same with respect to incoming energy. The sensitivity of the receiving voice-operating device 6 is set so that it will not be falsely operated by incoming static or line noise in the absence of speech transmission. A syllabic detector circuit 8 is connected to the transmitting circuit EA preferably at a point west of the point of connection of the voice-operated device thereto. The syllabic detector circuit 8 is responsive to the outgoing speech waves in EA when the circuit is transmitting to effectively remove the loss 7 from the input of the transmitting detector 4, for example, by short-circuiting the loss 7 as indicated.

When speech signal waves are being received over the circuit WA from the distant station, the syllabic detector 8, of course, may be operated by echoes of the received speech signals transmitted into the path EA at the junction with the circuit LW, so as to remove the loss 7 from the input of the transmitting detector 4 and thus effectively increase the sensitivity of the latter so that it will be operated by the echoes in EA. However, false switching will not be caused by this because the receiving detector 6 has been previously operated by the received speech to disable the detector 4 in its output at the point 5. Thus, it will be seen that the echoes of received speech or static will not cause false switching whether the loss pad 7 is in or out. The use of the normal loss in the input of the transmitting detector and of the syllabic detector for removing the normal loss improves the operation of the switching circuit in that it effectively

makes the transmitting detector more sensitive to speech signals than to steady noise by the amount of the inserted loss.

In the circuits of the prior art in which a syllabic detector circuit alone is employed to cause operation of the transmitting switching relays, a difficulty is encountered due to the fact that operation of that detector is dependent on the shape of the operating wave as well as its amplitude, whereas the operation of the receiving detector, of the type commonly used, depends principally upon the amplitude of the operating wave. Thus the relative sensitivity of the two detectors to speech or to interfering waves, or the margin against false operation of the transmitting relays, varies continually between positive and negative values, the average value being determined by the absolute sensitivities as adjusted by the control operator to keep the amount of false operation within tolerable limits. The above-mentioned difficulty is obviated by the arrangement of the invention as described above because similar detectors are used in the transmitting and receiving branches permitting the circuit to be operated with a constant zero echo margin, that is, so that the two detectors have equal sensitivities as seen from the point in the receiving branch where the receiving detector is bridged. On the other hand, the protection against noise afforded by the use of the syllabic detector in the prior art circuits is retained inasmuch as the sensitivity of the transmitting detector to noise waves is normally reduced by the loss circuit in its input under control of the syllabic detector.

A preferred embodiment of the switching circuit of the invention is illustrated in Fig. 2. As indicated, the syllabic detector circuit 8 and the transmitting detector circuit 4 have a common input circuit 9 including the one-way amplifying device A₃, connected across the transmitting path EA near its input. The input of the syllabic detector circuit 8 and the input of the transmitting detector circuit 4 are coupled in substantially conjugate relation with each other and in energy transmitting relation with the common input circuit 9 by the hybrid coil transformer 10 and associated balancing network 11 in well-known manner.

The syllabic detector circuit 8 includes a single three-electrode, high vacuum detector tube 12. The grid-cathode circuit of the detector tube 12, which includes the usual leak resistance-condenser combination 13 for determining the operation characteristics of the detector, is connected to a winding of the hybrid coil transformer 10. The plate-cathode circuit of the detector tube 12 is coupled by the transformer 14 to the input of the low-pass filter 15 having a cut-off at approximately 22 cycles per second. The output circuit of the filter 15 includes in series the windings of two mechanical relays 16 and 17 connected in respectively reverse order.

The transmitting detector circuit 4 comprises the three-electrode, gas-filled "trigger" detector tube 18 the input electrodes of which are coupled to the input circuit 9 by the windings of the hybrid coil 10, and the marginal relay 19 the operating winding 20 of which is connected across the output electrodes of the detector tube 18. The grid of the detector tube 18 is negatively biased by the grid battery 21, and space current is supplied to the plate of tube 18 by the plate battery 22 through the high resistance 75

24 shunted by the condenser 25, and the operating winding 20 of relay 19.

The biasing winding 26 of the marginal relay 20 is biased by current from the plate battery 22 through the large resistances 23 and 27 in series so that the marginal relay 19 will not operate until the current through its operating winding 20 exceeds a predetermined amplitude.

One purpose of the resistance 23 in parallel with resistances 24 and 27 in the plate circuit of the gas-filled tube 18 is to limit the plate current of the tube to a safe value. The parallel combination of resistance 24 and condenser 25 in the plate circuit, allows the operating current of relay 19. The circuit comprising resistance 28 and condenser 29 in series, connected across the plate and cathode of detector tube 18, acts in conjunction with resistances 23 and 24 to restore the gas-filled tube 18 to the unoperated condition after the signal voltage at the input ceases and also provides the hang-over time for relay 19.

Connected directly across the grid and cathode of the detector tube 18 is a loss circuit or pad comprising the resistances 30 and 31 and the condenser 32 in series. The resistance 30 in this circuit is normally short-circuited over a circuit extending from the grounded cathode of tube 18 through resistance 30, conductor 33 and the normally closed contacts 34 and 35 of the relays 17 and 16, respectively, to ground.

Connected across the receiving path WA preferably near its output is the input of the receiving control circuit 5 comprising the amplifier-detector circuit 36, which preferably includes a gas-filled "trigger" detector tube so that it will operate quickly in response to voice signals received over the path WA, which controls the operation of the receiving relay 37 connected to its output.

The marginal relay 19 operates in response to operation of the gas-filled detector tube 18 to control the operation of the hold-over relay 38 and the switching relays 39 and 40. The latter relays control the transmission efficiency of the circuits WA and EA in the manner which will be described later in connection with the description of the operation of the whole system. Also, as will be described later, the operation of the relays 16 and 17 in the syllabic detector circuit 8 causes the sensitivity of the transmitting detector circuit to be increased, and the operation of the relay 37 in the receiving detector circuit disables the transmitting switching relays 38, 39 and 40 and disables the transmitting detector circuit by grounding the input of tube 18 through condenser 32.

The operation of the system of Fig. 2 is as follows:

In the absence of speech signal transmission in the system, the transmitting path EA is disabled in the output of amplifier A₁, by the short circuit through the normally closed switch contacts 41 of the switching relay 40, and the receiving path WA is operative due to the normal open condition of the switch contacts 42 of the switch relay 39 in the short-circuiting connection across the path WA at a point in front of the connection thereto of the receiving detector circuit. The sensitivity of the receiving detector circuit including the amplifier-detector 36 and the relay 37 is initially adjusted so that the relay 37 will not be operated by the static or line noise incoming over the path WA. In the idle condition

of the switching circuit, that is, when no speech signals are being transmitted or received, the input electrodes of detector tube 18 are shunted by a circuit extending from the grid of the tube through condenser 32, resistance 31, conductor 33, normally closed contacts 34 of relay 17, normally closed contacts 35 of relay 16 and ground to the grounded cathode of the tube. The values of the circuit elements in this normal shunt circuit are so selected that a predetermined amount of loss is effectively inserted in the path of the waves impressed on the input circuit of the tube 18. The effect of this normal loss is to reduce the sensitivity of the transmitting detector circuit 18 to the desired degree below the sensitivity desired when speech signals are being transmitted over the path EA. The reduction in sensitivity is made at least sufficient to prevent operation of the marginal relay 19 in response to the normal amount of line noise impressed on the circuit from the path EA. The sensitivity of the transmitting detector circuit 4 with a portion of this normal loss removed by the action of the syllabic detector circuit 8 in the manner which will be described, is approximately the same as that of the receiving detector circuit comprising the amplifier-detector 36 and the receiving relay 37. The elements in the syllabic detector circuit 8 are initially adjusted so that that circuit has a high operating sensitivity in order to prevent clipping.

With the circuit in the idle condition as just described, let it be assumed that speech signals from a west subscriber are being received at the input of the four-wire circuit and are impressed upon the path EA. A portion of these speech signals will be diverted from the path EA into the common input circuit 9 of the switching circuit, and, after amplification by the amplifying device A₃ therein will be impressed by the hybrid coil transformer 10 on the input of the syllabic detector circuit 8 and on the input of the transmitting detector circuit 4.

The portion of the amplified speech signals impressed on the detector circuit 8 will cause operation of the detector tube 12 therein. The detected speech waves will be transmitted to the low-pass filter which will effectively suppress the frequencies above 22 cycles per second and transmit the frequencies below 22 cycles to the windings of relays 16 and 17.

The speech waves impressed on the syllabic detector circuit 8 and the transmitting detector circuit 4 do not represent a long continuous wave train, but occur as short trains of waves of syllable duration. The syllables of vocal intervals occur at the rate of about two to twenty cycles per second. Therefore, in the output of the low-pass filter 15 there will be produced a current impulse of one sign at the beginning of each speech syllable and another current impulse of opposite polarity at the end of the syllable.

As stated above, the windings of the relays 16 and 17 in the output of the filter 15 are reversely wound so that one relay, say relay 16, will be operated by the current impulse at the beginning of the syllable and the other relay 17 will be operated on the final impulse of the syllable. A succession of short syllables therefore will keep the armatures of the relays 16 and 17 in a state of vibration. The effect therefore will be that while speech waves are being substantially continuously transmitted over the path EA, the relays 16 and 17 will be operated in such manner that either the armature contact 35 or the armature

contact 34 will be open. Thus, the short circuit around the resistance 30 in the loss pad in the input of the detector tube 18 will be maintained broken during the continuous transmission of the west subscriber's speech currents in response to operation of the syllabic detector circuit 2. With the short circuit removed, the loss pad in shunt of the input electrodes of the detector tube 18 will comprise the condenser 32, the resistance 31 and the resistance 30 in series. The effect of adding the additional series resistance 30 in the shunt circuit across the tube electrodes is to decrease the shunt loss so as to make the detector tube 18 more sensitive to the impressed speech currents, while the west subscriber's speech signals are being continuously transmitted over the path EA. Thus, the impressed speech signals of low amplitude as well as those of high amplitude impressed upon the input of the transmitting detector circuit 4 will cause ionization to take place in the gas-filled detector tube 18 and cause the marginal relay 19 to be operated in the following manner.

The ionization of the gas in the detector tube 18 will cause the space path of the tube to become conductive to transmit space current from the plate battery 22 substantially instantaneously. The resulting output current of tube 18 will flow through the series resistances 23 and 24 and the operating winding of the marginal relay 19 and will cause operation of the latter relay to shift its armature from the back contact 43 to the front contact 44.

As soon as the armature of the marginal relay 19 leaves the back contact 43, the normal short circuit around battery 45 through the normally closed contacts 46 of the hold-over relay 38, the normally closed back contact 43, relay 19 and armature of the series resistance 47 and the normally closed back contact 48 and armature of the receiving relay 37, is broken. This causes a surge of charging current to flow from battery 45 through the relays 39, 40 and 38 to the condenser 49 and resistances 50 and 47 to the closed contact 43 and armature of relay 37 to ground. This surge of current causes relays 38, 39 and 40 to operate positively to attract their armatures whenever the armature and back contact 43 of relay 19 is broken. When the armature of the marginal relay 19 reaches its front contact 44, current is supplied to the windings of the switching relays 39 and 40 and the hold-over relay 38 from battery 45 over a circuit extending from ground through battery 45, the windings of relays 39, 40 and 38 in series, armature and front contact 44 of relay 19, series resistance 47 and the back contact 43 and armature of relay 37 to ground which holds the relays 38, 39 and 40 operated and discharges condenser 49 through the armature and contact 44 of relay 19 and resistance 50. Relay 39 will operate to close its normally open switch contacts 42 applying a short circuit across the path WA which will prevent signal energy subsequently received over the path WA from the east subscriber or echoes of the west subscriber's speech from reaching the receiving amplifier-detector 36 or the west subscriber. Simultaneously, relay 40 will operate to open switch contacts 41 removing the short circuit from the path EA and allowing the main portion of the speech currents of the west subscriber after amplification by the amplifying device A₁ to be transmitted out over the path EA to the distant station. Simultaneously, the hold-over relay 38 will operate to open its normally

closed switch contacts 46 to produce another break in the normal short circuit around the battery 45 and relays 39, 40 and 38.

Now, when the west subscriber pauses for an appreciable interval of time, the amplifier signaling voltages supplied to the input circuit of the syllabic amplifier detector circuit 3 and the input circuit of the transmitting detector circuit 4 through the hybrid coil transformer 10, will be removed. This will cause the detector tube 12 to return to the idle condition and thus cause the energizing current applied therefrom through the low pass filter 15 to the windings of the mechanical relays 16 and 17 to be removed. The armatures of these relays will then fall back to their normal condition so as to reapply the short circuit around the resistance 30 in the loss circuit in the input of the gas-filled detector tube 18, thus increasing the loss in the input of the latter tube and effectively reducing the sensitivity of the tube to the normal value.

Simultaneously the signal voltage is removed from the input electrodes of the gas-filled tube 18 in the transmitting detector circuit 4. The gas-filled tube 18 will be extinguished and its space current will cease to flow. However, the marginal relay 19 will remain operated for an additional hang-over interval due to the flow of charging current over the circuit extending from battery 22 through resistances 23 and 24, the operating winding 20 of relay 19, to condenser 29 and resistance 28 to ground. When condenser 29 has been charged to the proper voltage the flow of current through the operating winding 20 of relay 19 will cease and the relay will release causing the armature of the relay to shift from the front contact 44 to the back contact 43. As soon as the armature of relay 19 leaves the front contact 44, the energizing circuit for the switching relays 39 and 40 and the hold-over relay 38 from battery 45 will be broken. However, the relays 39, 40 and 38 will not immediately release because their windings will be maintained energized for an additional hang-over interval while the condenser 49, which in series with the resistance 50 formed a shunt around the closed armature and front contact 44 of relay 19 when the latter relay was operated, is being charged by current from battery 45 through the relay windings.

When condenser 49 has been charged to the full value of the battery 45, the flow of energizing current to the winding of relays 39, 40 and 38 will cease and the relay armatures will fall back to their normal positions. The release of relay 40 will cause the normal short circuit to be reapplied across path EA. The release of relay 39 will remove the short circuit from the path WA. The release of the hold-over relay 38 will return its contacts 46 to the normal closed condition and the battery 45 will again be short-circuited through the armature and closed contact 46 of relay 38, the back contact 43 and armature of marginal relay 19, the resistance 47 and the back contact 43 and armature of the receiving relay 37 to ground. Condenser 49 will then discharge through the series resistance 50 and the back contact 43 and armature of relay 19 and through armature and contacts 46 of relay 38 to battery 45 to ground. The hold-over relay 38 in this way controls the hang-over time of the switching relays 39 and 40. By suitable choice of the values of the elements in the hang-over circuit, the relay 40 may be maintained operated for a sufficiently

long time interval after the west subscriber ceases talking to insure that the outgoing speech currents in the path EA have passed the short-circuiting point in that path before the short circuit is reapplied through the closing of switch contacts 41. Also, by this means the switching relay 39 may be maintained operated for a sufficiently long time after the supply of signaling voltage to the transmitting detector circuit ceases to insure that the short circuit across the path WA through the closed contacts 42 of relay 39 will be maintained long enough to prevent all echoes of the outgoing speech currents from reaching the input of the receiving detector circuit 6 and causing false operation thereof.

Now, let it be assumed that speech currents of an east subscriber at the distant station are being received over path WA, and, at the time of their arrival at the point of connection of the receiving control circuit 6 to the path WA, the west subscriber has not yet started to talk.

A portion of the east subscriber's speech currents will be diverted into the receiving control circuit 6 and will cause operation of the amplifier-detector circuit 36 therein to energize the winding of the receiving relay 37 causing the operation of that relay to shift its armature from its back contact 48 to its front contact 51. As soon as the armature leaves the back contact 48, an additional break in the energizing circuit for the transmitting relays 38, 39 and 40 will be produced, so that subsequent operation of the marginal relay 19 cannot possibly result in operation of the transmitting relays. As soon as the armature of relay 37 reaches its front contact 51 the resistances 31 and 33 in the loss pad in the input of the transmitting detector tube 18 will be short-circuited over a path extending from ground through the armature and front contact 51 of relay 37, conductor 52 and the resistances 31 and 33 in series to the grounded cathode of detector tube 18. The circuit shunted between the grid and cathode of the detector tube 18 now comprises only the condenser 32, and the sensitivity of the detector tube 18 is so reduced that it is effectively disabled.

Meanwhile, the main portion of the east subscriber's speech currents will be amplified by the amplifying device A₂ in the output of the path WA and the amplifying currents will be transmitted thereover to the input of the four-wire circuit and from thence over the two-wire path (not shown) to the receiving circuits of the west subscriber. The portion of any echoes of the east subscriber's speech currents which may be transmitted into the input of the path EA through the coupling at the west end of the four-wire circuit, will, of course, be impressed on the input of the syllabic detector circuit 8 and the input of the transmitting detector circuit 4 over the circuit 9.

Because of the high sensitivity of the syllabic detector circuit 8 that circuit will occasionally be operated by the echo currents, in the same manner as previously described for the outgoing speech currents. This will cause operations of the relays 16 and 17 which tend to increase the sensitivity of the transmitting detector circuit 4 by removing the short circuit around resistance 30, which ordinarily would permit operation of detector 4 and the relays 38, 39 and 40 by echoes impressed upon the input of the transmitting detector circuit 4. However, such false operations of the detector 4 and the re-

lays 38, 39 and 40 cannot occur as the previous operation of the receiving relay 37, in response to the east subscriber's speech currents, has disabled the energizing circuit for relays 38, 39 and 40 and short-circuited the grid-cathode circuit of gas-filled tube 18 in the manner described above. The receiving detector circuit 6 is arranged to have sufficiently long hang-over time to hold the relay 37 operated for a short period after transmission of speech current in the path WA has ceased, so as to permit the echoes which may be stored in the two-wire connecting circuit to be thoroughly dissipated before enabling the transmitting branch.

When the east subscriber ceases talking the receiving relay 37 releases and the elements of the switching circuit will return to their normal condition as indicated in Fig. 2. It may be desirable to produce a suitable hang-over in the operation of the receiving relay, for example, by making it slow to release by proper mechanical design, to prevent interruption of the received speech by false operation of the transmitting relays.

Many other changes which may be made in the circuits illustrated and described which would be within the scope of the invention will occur to persons skilled in the art. The invention is only to be limited in accordance with the appended claims.

What is claimed is:

1. In combination, a source of speech waves subject to relatively steady noise waves of lower amplitude than said speech waves, a wave-operated control device connected to said source so as to be supplied with waves therefrom, switching apparatus responsive to operation of said control device, the operating sensitivity of said control device being normally reduced at least to such a degree that said device will be unoperated by impressed waves of said lower amplitude received from said source, a second control device connected to said source so as to be supplied with waves therefrom, said second device being unresponsive to the comparatively steady noise waves from said source but operatively responsive to the syllabic variations of impressed speech waves of substantially all amplitudes, and means responsive to operation of said second device to effectively increase the operating sensitivity of the first-mentioned control device to permit quick operation of the latter device by impressed speech waves.

2. The combination of claim 1 in which the operating sensitivity of said first-mentioned control device is reduced by means of a loss normally inserted in the input thereof, and in which said means responsive to operation of said second device increases the operating sensitivity of said first-mentioned device by effectively removing said loss from the input thereof.

3. In a voice-operated circuit, a source of voice waves subject to comparatively steady noise waves of lower amplitude than said voice waves, a wave-operated detector circuit connected to said source so as to be supplied with waves therefrom, a switching device responsive to operation of said detector circuit, means normally inserting a loss in the input of said detector circuit at least sufficient to prevent operation thereof by impressed waves of said lower amplitude, a second detector circuit also connected to said source so as to be supplied with waves therefrom, said second detector circuit being arranged to be operatively responsive to the syllabic variations in speech but

to be unresponsive to comparatively steady noise waves, and means responsive to operation of said second detector circuit by impressed speech waves to remove effectively said loss from the input of the first-mentioned detector circuit.

4. In a two-way telephone system, a four-wire circuit comprising two oppositely directed one-way paths for repeating telephonic signals in opposite directions between two two-way circuits, a wave-operated control device connected to one one-way path and responsive to signal transmission therein to control the transmission efficiency of said one-way paths, the sensitivity of said device being normally adjusted at least so that it will be unoperated by impressed noise waves of amplitude below a certain value, a second wave-operated control device connected to the other path and responsive to signal transmission therein to disable the first device in its output, a third control device connected to said one path, which is responsive to transmitted speech waves of substantially all amplitudes in said one path but unresponsive to the comparatively steady noise waves, to increase the sensitivity of said first control device so as to permit quick operation of the latter device by impressed speech waves.

5. The system of claim 4 in which the sensitivity of said first control device is normally adjusted by a loss of suitable value inserted in the path of the impressed waves in the input of said first device, and the sensitivity of said first device is in-

creased by removing effectively said loss from the input of said first device.

6. In a two-way telephone system, a four-wire circuit comprising two oppositely directed one-way paths for repeating telephonic signals in opposite directions between two two-way lines, a wave-operated control device connected to one of said paths near its input and responsive to outgoing telephonic signals therein to disable the other one-way path near its output, a loss in the input of said device at least sufficient to prevent false operation thereof by line noise in said one path, a second wave-operated control device, connected to said other path beyond the disabling point therein and responsive to received telephonic signals to disable the first-mentioned device in its output, the sensitivity of said second device being normally adjusted so that it will be unoperated by noise below a given amplitude in said other one-way path, a third control device connected to said one one-way path near its input so as to be supplied with waves therefrom, said third control device being unresponsive to the comparatively steady noise waves in said one path but being operatively responsive to the syllabic variations in the impressed telephonic waves, and means responsive to operation of said third control device to remove the loss in the input of said first-mentioned device and thus effectively increase the sensitivity of the latter device.

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