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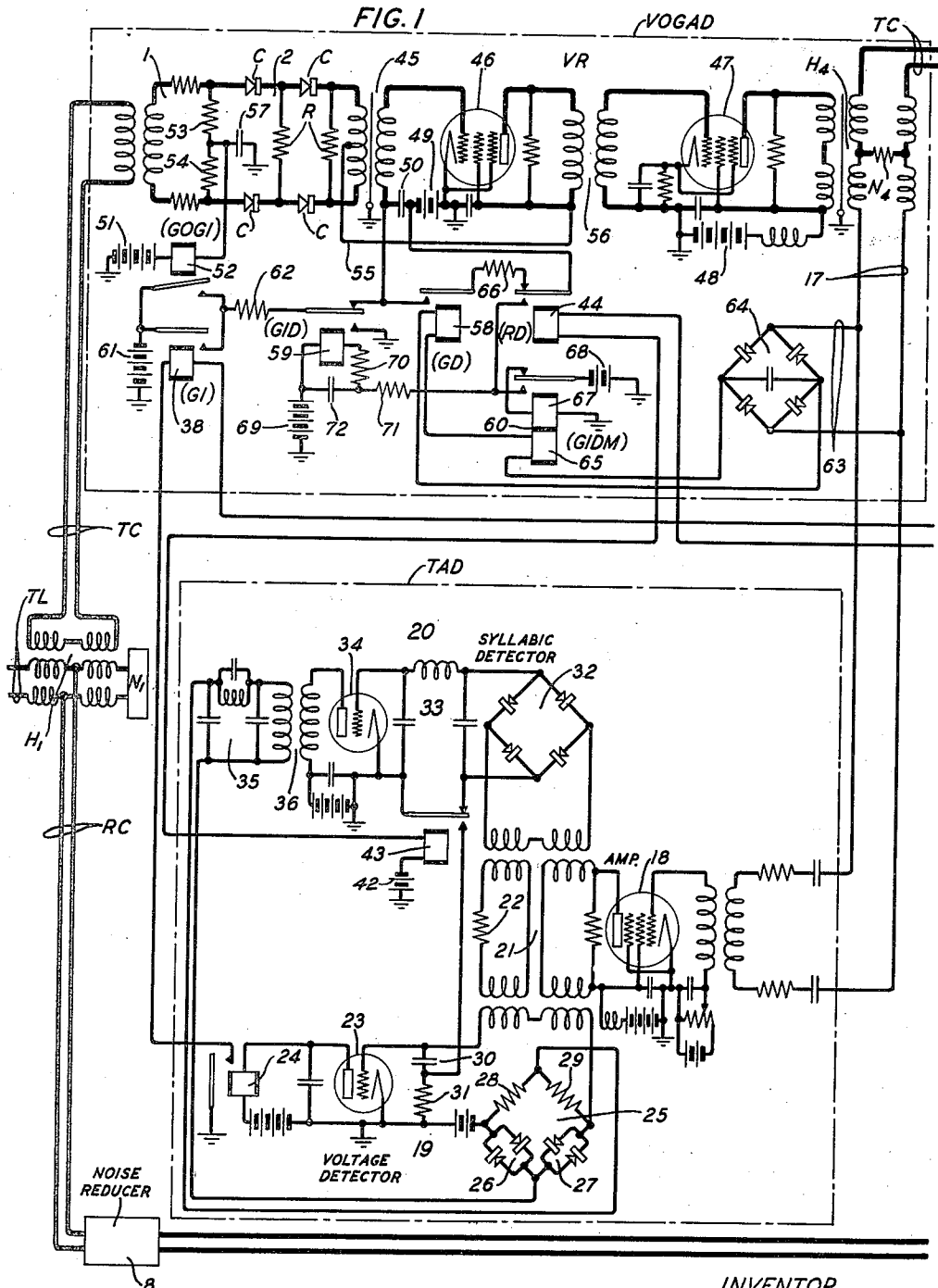
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2,101,246

TRANSMISSION CONTROL IN SIGNALING SYSTEMS

Filed March 28, 1936

3 Sheets-Sheet 1



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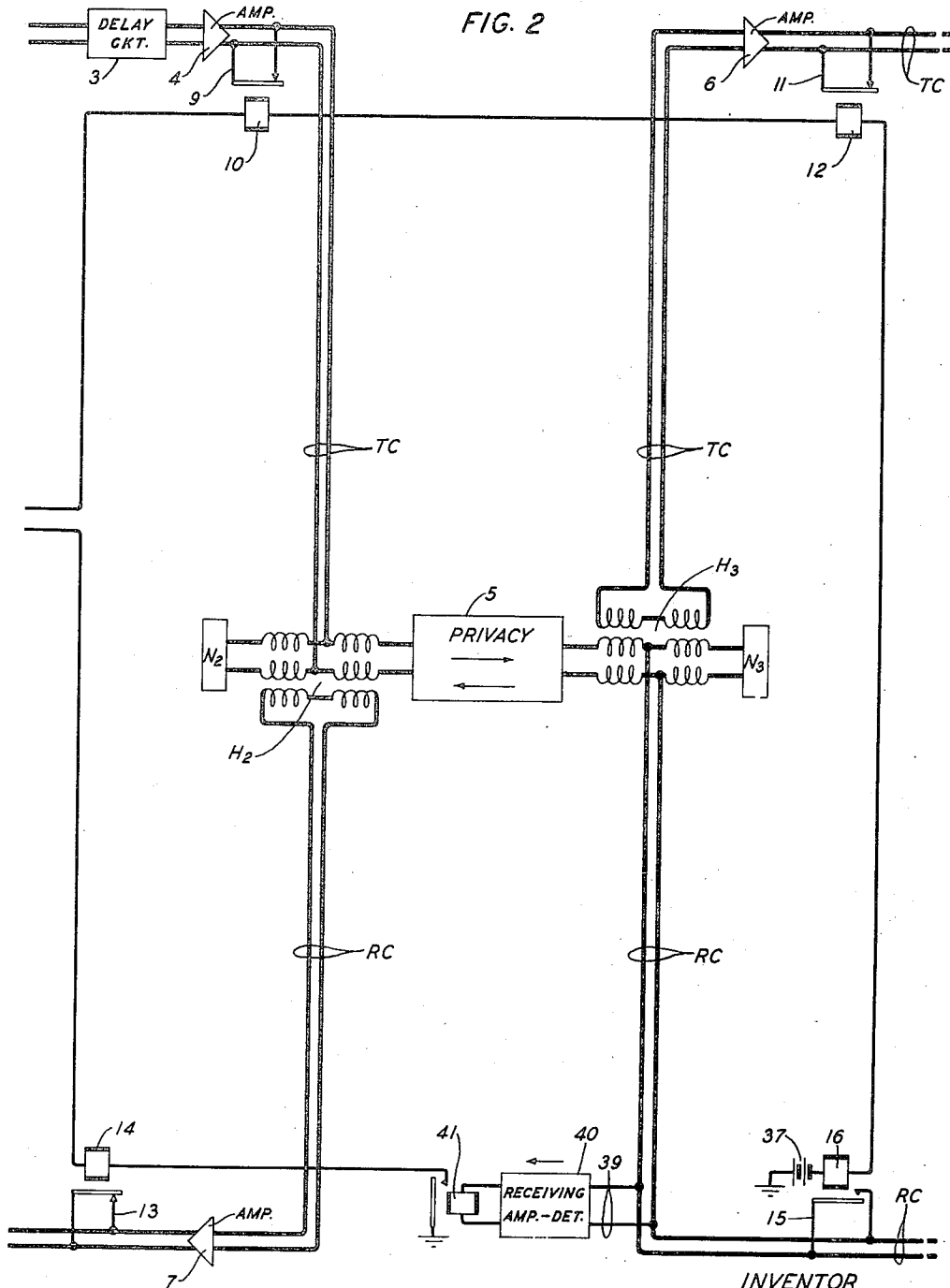
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3 Sheets-Sheet 2



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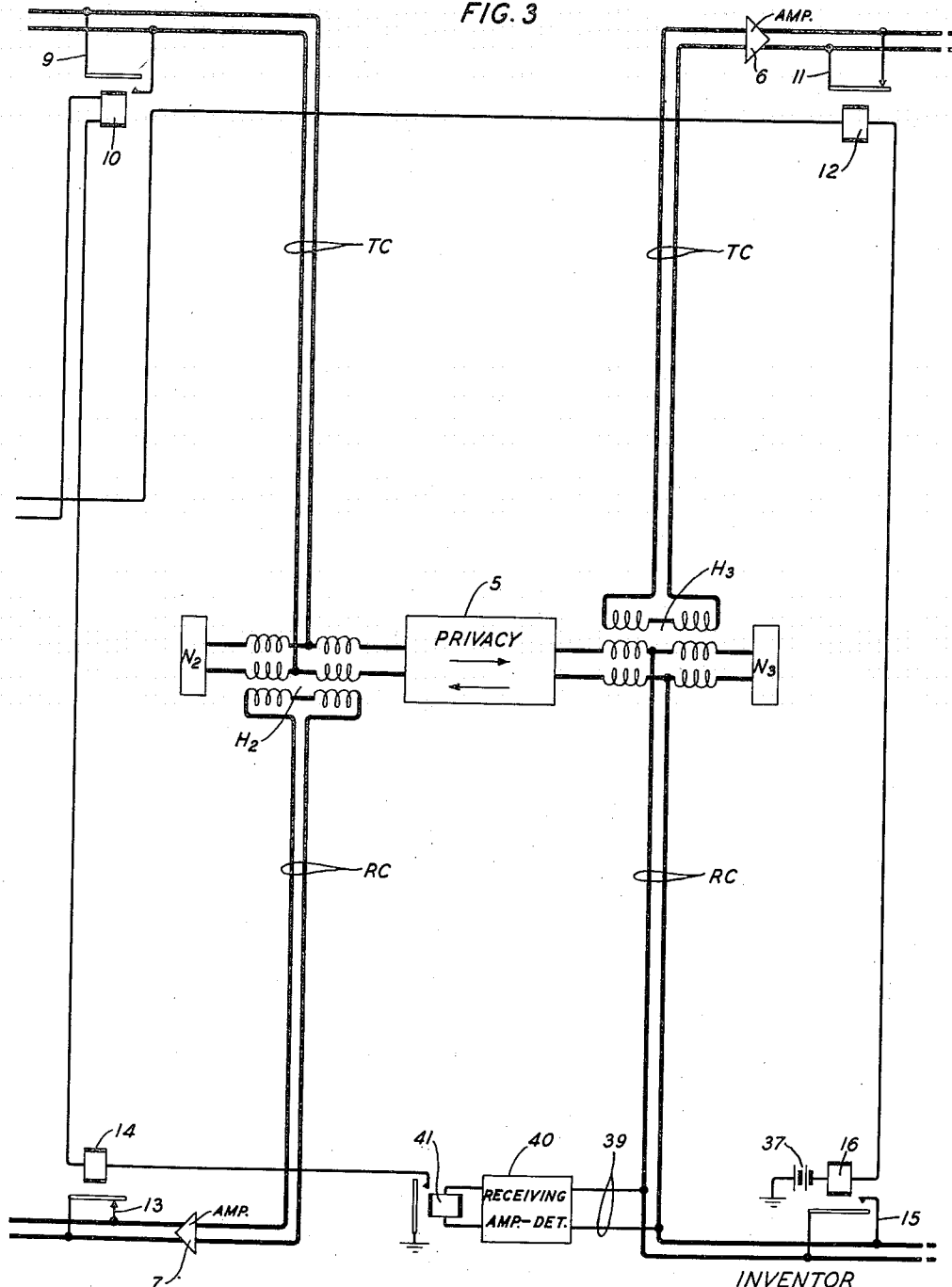
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TRANSMISSION CONTROL IN SIGNALING SYSTEMS

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3 Sheets-Sheet 3

FIG. 3



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TRANSMISSION CONTROL IN SIGNALING SYSTEMS

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13 Claims. (Cl. 179—170)

The invention relates to signaling systems and particularly to circuits for automatically controlling transmission in such systems.

An object of the invention is to combine and relatively arrange automatic devices for exercising different types of control on transmission in a two-way signaling system in such manner as to provide improved operation and economy of apparatus.

Another and a more specific object is to so relate the operation of signal-controlled switching devices for directionally controlling transmission and signal-controlled devices for automatically regulating transmission volume in a two-way signaling system, as to provide economy of apparatus without deleteriously affecting the operation of the different devices.

The invention is directed mainly to the simplification of and improvement in operation of automatic transmission control apparatus at a control terminal for a two-way signaling system, particularly a radio telephone system. One feature is the use of the transmitting detector of the signal-controlled device provided for directionally controlling transmission while preventing singing, to control also the gain increase action of the signal-controlled gain adjusting device at the control terminal.

Another feature is an improved signal-controlled gain adjusting device in which a variable loss network employing elements having non-linear voltage current characteristics is used in conjunction with a variable mu electric space discharge device to produce the desired gain variation.

Another feature is the relative positioning at the control terminal of a two-way device for providing secrecy in the transmission of messages, with respect to the signal-operated anti-singing device (Vodas) so that the former device besides performing its usual function also helps prevent signal clipping by both the transmitting and receiving anti-singing contacts of the latter device.

Other objects and features of the invention will be brought out in the following detailed description when read in connection with the drawings in which:

Figs. 1 and 2 when placed side by side with Fig. 1 at the left show schematically a portion of a control terminal for a two-way radio telephone system, embodying the invention; and

Fig. 3 shows an alternative arrangement of the anti-singing switching controls of the control terminal to that shown in Fig. 2.

Referring first to Figs. 1 and 2, the transmit-

ting circuit TC and the receiving circuit RC of the control terminal are coupled by the usual hybrid coil H_1 and balancing network N_1 in conjugate relation with each other and in energy transmitting relation with the east end of the telephone line TL.

The transmitting circuit TC includes the following elements reading from west to east: a portion of the voice-operated gain adjusting device (Vogad) shown within the dot-dash box so labeled, comprising in order the resistance loss pad 1 of fixed value, the variable loss pad 2 and the two-stage vacuum tube vario-repeater VR; the transmission delay circuit 3; the one-way amplifier 4; the two-way privacy device 5 and the one-way amplifying device 6. The transmitting circuit TC would be extended eastward from the output of the amplifier 6 to the radio transmitting apparatus including the transmitting antenna, (not shown).

The receiving circuit RC would extend westward from the radio receiving apparatus including the receiving antenna, (not shown) through the two-way privacy device 5, the one-way receiving amplifying device 7 and the noise reducer circuit 8 to the east end of the telephone line TL through hybrid coil H_1 .

The two-way privacy device 5 is coupled to the transmitting circuit TC and the receiving circuit RC by hybrid coils H_2 , H_3 and associated balancing networks N_2 , N_3 so as to allow the use of this same privacy device for both directions of transmission while maintaining a conjugate relation between the other portions of the circuits TC and RC. The two-way privacy device may be of any of the types well known in the art, but is preferably of the "scrambler" type such as is disclosed in Fletcher Patent No. 1,573,929, issued February 23, 1926.

The noise reducer 8 may be any device which will introduce an appreciable loss for low inputs and a very low loss for high inputs, thus discriminating between the usual line noise and speech waves of relatively high amplitudes. A device of this type is disclosed in the copending patent of N. C. Norman, No. 2,063,334, issued December 8, 1936.

The transmitting circuit TC is normally disabled on each side of the privacy device 5 by the short-circuiting connection 9 across that circuit between the amplifying device 4 and the hybrid coil H_2 , through the normally closed armature and contact of the transmitting circuit enabling relay 10, and by the short-circuiting connection 11 across that circuit in the output of the ampli-

fyng device 6 through the normally closed armature and contact of the transmitting circuit enabling relay 12, respectively.

Also, the receiving circuit RC is normally disabled by the short-circuiting connection 13 across that circuit in the output of the amplifying device 7, through the normally closed armature and contact of the receiving enabling relay 14. The receiving circuit RC is also adapted to be disabled at some point in front of the hybrid H₃ by the closing of the normally broken short-circuiting connection 15 across that circuit by operation of the normally unoperated receiving circuit disabling relay 16 to close its armature and contact.

The input of the transmitting control circuit 17 of the voice-operated anti-singing switching circuit (Vodas) is coupled by hybrid coil H₄ and associated balancing network N₄ in substantially conjugate relation with the outgoing portion of the transmitting circuit TC leading to the delay circuit 3, and in energy transmitting relation with the incoming portion of TC leading from the output of the vario-repeater VR.

The transmitting control circuit 17 includes the transmitting amplifier-detector, shown within the dot-dash box labeled TAD, the normal function of which is to more completely disable the receiving circuit RC and to simultaneously render the transmitting circuit TC completely operative in response to initiation of signal transmission in the latter circuit, so as to prevent the setting up of a singing condition between the circuits TC and RC when the control terminal is used for transmitting.

The transmitting amplifier-detector TAD is designed to be unoperated by the maximum noise which may be expected on the transmitting circuit TC but to be operated quickly by received speech signals of both low and high amplitudes. The amplifying portion of the amplifier-detector TAD comprises a single amplifying vacuum tube stage 18, preferably of the screen grid type as indicated, biased so as to provide high sensitivity. The detector portion comprises a voltage-detector circuit 19 and a syllabic detector circuit 20 having their input circuits coupled in substantially conjugate relation with each other and in energy transmission relation with the output of the common amplifier 18 by the hybrid coil transformer 21 and associated balancing network 22.

The voltage detector circuit 19 includes the three-electrode vacuum tube detector 23, and a mechanical relay 24 having its winding connected in series with the plate battery in the anode-cathode circuit of the detector tube. The grid-cathode circuit of the detector tube 23 includes in series with the biasing grid battery and the secondary winding of the input transformer forming a part of the hybrid coil transformer 21, a bridge circuit 25 having in each of two of its arms 26, 27 two equivalent oppositely-poled copper-oxide rectifier units in parallel and in the other two arms equal series resistances 28, 29. A circuit comprising a resistance 30 and a condenser 31 in series is connected directly between the cathode and control grid of tube 23 for a purpose which will be brought out later.

The syllabic detector circuit 20 comprises in its input the full-wave copper-oxide rectifier 32 followed by a section of low-pass filter 33, then a single vacuum tube stage 34 of direct current amplification, and another section 35 of low-pass filter coupled by transformer 36 to the output of amplifier 34. The alternating current output of filter 35 is applied across the shunt diagonal of

the bridge circuit 25 in the grid circuit of the detector 23 in the voltage detector circuit, between the junction of the two resistance arms 28, 29 and the junction of the copper-oxide rectifier arms 26, 27.

The relay 24 is operatively responsive to flow of current in the output of the detector tube 23 to apply energizing current from battery 37 in series to the windings of the receiving circuit disabling relay 16, the transmitting circuit enabling relays 10 and 12, and the (GI) "gain increaser" relay 38 in the Vogad.

Connected across the input of the receiving circuit RC between the point of connection of the normally broken short-circuiting connection 15 thereto and the hybrid coil H₃ is the input of the receiving control circuit 39 of the voice-operated anti-singing switching circuit (Vodas). It comprises the receiving amplifier-detector 40 and the mechanical relay 41 controlled from the output thereof. Its function is to render the receiving circuit RC completely operative when voice signal transmission is initiated thereon, in the absence of prior voice signal transmission in the transmitting circuit TC, and to simultaneously disable the transmitting amplifier-detector circuit TAD and the Vogad.

In the Vogad, the fixed resistance loss pad 1 (about 15 decibels) is utilized to screen the impedance variation of the variable loss pad 2 from the input terminals of the transmitting circuit TC. The variable loss pad 2 comprises the copper-oxide rectifier elements C in series in each side of the circuit TC and the linear resistance elements R in shunt with the circuit TC. The output of the pad 2 is coupled to the input of the vario-repeater VR by the transformer 45.

The vario-repeater VR comprises two transformer-coupled vacuum tube stages, a variable mu amplifying vacuum tube 46 being used in the first stage and a power amplifying vacuum tube 47 in the second stage. The tubes 46 and 47 are preferably of the screen grid type as indicated. Plate current is supplied to the plate of tube 47 from battery 48 through a retardation coil and the primary winding of the output transformer forming a part of the hybrid coil H₄. The cathode-control grid circuit of the variable mu-tube 46 includes in series the grid biasing battery 49, and the control or regulating condenser 50 which is used for applying a variable bias to the control grid through the secondary winding of transformer 45.

The copper-oxide rectifier loss pad 2 in conjunction with the variable mu-tube 46 is used for supplying the necessary gain variation to the vario-repeater VR. Plate current is normally supplied to the plate of tube 46 from battery 51 over a circuit extending from the positive terminal of that battery through the winding of the (GOGI) "gain operated gain increase" relay 52 to the junction point of shunt resistances 53 and 54 of loss pad 1, from that point through the two parallel paths comprising resistance 53, copper-oxide rectifier units C in the upper conductor of loss pad 2 and upper half of primary winding of transformer 45, and resistance 54, copper-oxide rectifier units C in lower conductor of pad 2 and lower half of the primary winding of transformer 45, respectively, to the mid-point of that primary winding, and from that point through conductor 55, primary winding of interstage transformer 56, plate to cathode space path of tube 46 and ground to the negative terminal of battery 51. The alternating current component 75

of the plate current of tube 46 is by-passed around the winding of relay 52 by condenser 57.

The plate current of tube 46 passes through the copper-oxide rectifier units C in loss pad 2 over the path previously traced in such manner that, as the grid bias on that tube is made more negative, corresponding to low plate current and low gain, the loss in the circuit TC due to the copper-oxide rectifiers C increases. By this means the gain change of tube 46 is made as large as 2.5 to 3.0 decibels per volt change in grid bias, so that a desired 45 decibel range in gain can be obtained without the use of floating grid batteries or telegraph batteries. The circuit constants of the power amplifying tube 47 are made such that the load on the variable stage 46 is low enough to prevent excessive modulation. The (GOGI) "gain operated gain increase" relay 52 and the associated circuits are designed so that, if the plate current of the variable mu-tube 46 falls below a value corresponding to a previously chosen gain (say 20 decibels) of the Vogad, the relay 52 releases to cause the increase of the gain of the Vogad in a manner which will be described later in connection with the description of operation of the complete system.

Also, in the manner which will be explained below, the gain of the vario-repeater VR will be adjusted in accordance with the amplitude level of the waves in the transmitting circuit TC, by the relay chain including the (GI) "gain increaser" relay 38, the "gain decreaser" relay 58, the (GID) "gain increase disabler" relay 59, the (GIDM) "gain increase disabler master" relay 60 and the (RD) "receiving disabler" relay 44.

The operation of the system of Figs. 1 and 2 is as follows:

When no one is talking in either direction the gain of the vario-repeater VR is fixed at the value previously set, unless that value is below 20 decibels, when the plate current flowing through the winding of the (GOGI) relay 52 is low enough to cause the release of that relay to close its armature and contact. Then +130 volts is supplied from battery 61 through the closed armature and contact of relay 52, the charging resistance 62, closed armature and back contact of the (GID) relay 59 to the regulating condenser 50 in the grid circuit of the variable mu-tube 46. This makes the grid of tube 46 more and more positive which raises the gain of the vario-repeater VR until it reaches 20 decibels. At that point the larger plate current of the tube 46 passing through the winding of the relay 52 is sufficient to cause that relay to operate to separate its armature and contact disconnecting charging resistance 62 from regulating condenser 50. The gain of the vario-repeater VR will remain fixed practically at the value determined by the charge then on the condenser 50.

Now, if speech waves to be radiated are received over the telephone line TL, these speech waves will be impressed by the hybrid coil H₁ upon the transmitting circuit TC and will pass through the fixed loss pad 1 and the variable loss pad 2 to the input of the vario-repeater VR. The impressed speech waves will be amplified in the amplifying tubes 46 and 47 of the repeater to a value dependent on the value to which the gain of the variable mu-tube 46 has been previously adjusted. The amplified waves in the output of the vario-repeater VR will be divided by the hybrid coil H₄ between the outgoing portion of the transmitting circuit TC and the input of the transmitting control circuit 17.

A portion of the speech waves in circuit 17 will be transmitted into the circuit 63 where it will be rectified by the full-wave copper-oxide rectifier 64 and will be supplied as energizing current to the operating winding 65 of the (GIDM) relay 60 and the winding of the (GD) relay 58 in series.

The remaining portion of the diverted speech waves in the transmitting control circuit 17 will be amplified by the common amplifier 18 in the transmitting amplifier-detector TAD, and the amplified waves divided between the inputs of the syllabic detector circuit 20 and the voltage detector circuit 19.

The resistance arms of the bridge circuit 25 in series in the grid circuit of the detector tube 23 of the voltage detector 19 are made of such value that in the initial condition, that is, with no current in the copper-oxide rectifier units in the bridge arms 26, 27, the loss introduced by the bridge 25 in the voltage detector circuit 19 is sufficient, say about 8-10 decibels, to effectively reduce the sensitivity of the latter circuit, so as to prevent false operation of the voltage detector circuit 19 by the maximum noise energy received from the circuit TC. The low sensitivity of the voltage detector circuit 19 in this condition will prevent the production of sufficient detected current in the windings of relay 24, in the case of the applied speech waves of low amplitude at least, to cause operation of that relay.

The portion of the amplified speech energy impressed on the highly sensitive, syllabic detector circuit 20, will be rectified by the copper-oxide rectifier bridge 32 therein and transmitted through the first section 33 of low-pass filter which suppresses all but the low frequencies and direct current. The transmitted low frequencies and direct current in the output of filter 33 will be amplified by the vacuum tube amplifying device 34, and the amplified waves will be impressed by transformer 36 on the second section of low-pass filter 35.

The syllabic frequencies in the output of the filter 35 are applied across the diagonal of the bridge circuit 25 in the input of the detector tube 23 in the voltage detector circuit 19, and are transmitted through the non-linear impedance, copper-oxide rectifier units in arms 26, 27 of the bridge in such direction as to reduce their impedances to a low value. The loss introduced by bridge 25 in the input of the detector circuit 23 is thus substantially reduced (say to about 2-3 decibels), effectively making the detector tube 23 very sensitive so that it will be immediately operated by the impressed speech energy received in the output of detector tube 20. The balanced connection of the copper-oxide rectifier units in the arms 26, 27 of bridge 25 prevents the syllabic frequencies from the output of the syllabic detector circuit 18 from being applied to the detector tube 23.

The output current of the detector tube 23 passing through the winding of relay 24 will be sufficient to cause the immediate operation of that relay to close an energizing circuit from battery 37 to the winding of relays 38, 19, 12 and 16 in series causing the operation of these relays.

Relay 16 will operate to close the short-circuiting connection 15 across the receiving circuit RC preventing energy received thereafter over that circuit from the radio receiving circuit from getting through to cause false operation of the receiving control circuit 39 to reverse control of the terminal. Relays 10 and 12 will simultane-

ously operate to remove the normal short circuits 9 and 11, respectively, from across the transmitting circuit TC, thus rendering that circuit completely operative. The speech waves, which meanwhile have been delayed in the delay circuit 3 in transmitting circuit TC, after amplification by amplifier 4 will be transmitted through the privacy device 5, and after being again amplified by the amplifier 6 will be transmitted out over the outgoing portion of the circuit TC to the radio transmitting apparatus and will be radiated thereby.

The contacts of the (GI) relay 38 are connected in parallel with the contacts of the (GOGI) relay 52, so operation of the former relay in response to operation of the transmitting detector relay 24, as in the case of the (GOGI) relay 52, will apply +130 volts from battery 61 through the charging resistance 62 and the closed armature and back contact of the (GID) relay 59 to the regulating condenser 50 in the grid circuit of the variable mu-tube 46, causing the gain of the latter tube to be increased.

The gain of tube 46 will continue to increase until the stronger speech sounds begin to operate the (GD) relay 58 and the (GIDM) relay 60 through the copper-oxide rectifier 64 in the circuit 63 connected across circuit 17 in the input of the transmitting amplifier-detector. The (GD) relay 58, which is designed to be fast operating and to have no hangover, operates to close its armature and contact connecting the rather low discharge resistance 66 across the regulating condenser 50 in the grid circuit of the variable mu-tube 46 causing the gain of the latter to start to decrease.

The (GIDM) relay, besides its operating winding 65 has a biasing winding 67 normally supplied with biasing current from battery 68 through the normally closed armature and back contact of the relay. The applied bias is such that the (GIDM) relay 60 has about the same operate sensitivity as the (GD) relay 58. However, operation of the (GIDM) relay 60 in response to the application of the rectified strong speech sounds to its operating winding 65 breaks the back contact to disconnect battery 68 from the biasing winding 67 thus making the relay 60 so sensitive that it will hold on an output on which the (GD) relay 58 will release.

When the (GIDM) relay 60 operates, its armature and front contact close causing the winding of the (GID) relay 59 to be energized by current from batteries 68 and 69 in series through the series resistances 70 and 71, and the closed armature and front contact of relay 60. Condenser 71, shunting the winding of the relay 59 and resistance 70 in series will be simultaneously charged by the batteries 68 and 69 to apply hangover (about 2.5 seconds) to relay 59.

The (GID) relay 59 operates in response to energization of its winding to shift its armature from the back to the front contact. The breaking of the back contact of the (GID) relay 59 opens the charging circuit for the regulating condenser 50 from battery 61 through the charging resistance 62 and thus prevents further increase of the gain of tube 46 by operation of the (GOGI) relay or the (GI) relay 38. On substantially continuous application of speech energy through the rectifier 64 to the operating winding 65 of the (GIDM) relay 60 and the winding of the (GD) relay 58, the (GID) relay 59 is held operated almost continuously, with only occasional adjustments of the gain up or down.

A given time interval after speech transmission ceases in the circuit TC, or after an appreciable pause therein, the relay 24 will return to the unoperated condition and subsequently the switching relays 10, 12 and 16 controlled thereby will release causing the switching circuits to be returned to the condition indicated in the drawings with the circuit TC disabled at two points and the circuit RC operative to transmit received signal energy to the receiving control circuit 39 and through the privacy device 5. The (GI) relay 38 controlled by relay 24 also will release, and the (GD) relay 58 and the (GIDM) relay 60 with cessation in the supply of controlling speech wave thereto will then also be in the unoperated condition, so that the Vogad gain is fixed at the value to which it previously had been adjusted.

With cessation in the supply of speech energy to the transmitting amplifier-detector circuit TAD there will be no alternating current supplied by the syllabic detector circuit 20 to the bridge circuit 25 in the input of the voltage-detector circuit 19. Therefore, the bridge circuit 25 will again be effective to insert a large loss in the input of the latter circuit sufficient to prevent false operation of the voltage-detector 23 by noise energy received from the circuit TC.

Now, if during this interval speech energy from the radio receiving circuit (not shown) is transmitted over the receiving circuit TC to the input of the receiving control circuit 39, the short-circuiting connection 15 across RC being then open, this energy will cause operation of the receiving amplifier-detector 40 to energize the winding of the receiving relay 41. The latter relay will then operate to close an energizing circuit from battery 42 to the windings of the receiving circuit enabling relay 14, the (RD) relay 44 and the relay 43 in series, causing the operation of these three relays.

Relay 14 will operate to open the normal short-circuiting connection 15 across the receiving circuit RC in the output of amplifier 7 so as to allow the received speech energy after transmission through the privacy device 5 and amplification by amplifier 7 to be transmitted over the circuit RC to the telephone line TL through the noise reducer 8 and hybrid coil H1.

Relay (RD) 44 will operate to shift its armature from the back to the front contact, thus opening the discharge circuit for the regulating condenser 30 in the grid circuit of tube 46 through the discharge resistance 66, and causing the energization of the winding of the (GID) relay 59 from batteries 68 and 69, and charging up the condenser 72 through resistance 71. The (GID) relay 59 will then operate to break the charging circuit for condenser 50 through resistance 62 in the same manner as accomplished by the (GIDM) relay 60 as previously described. This operation prevents the gain of the vario-repeater VR from being changed subsequently in response to operation of the (GOGI) relay 52, the (GI) relay 38 or the (GD) relay 58 during the interval during which speech energy is being received from the radio receiving circuit, and, due to the hangover on the (GID) relay 59 provided by the discharge of condenser 72 through the relay winding when the controlling (RD) relay 44 releases, prevents the gain from being increased for a desired time interval thereafter. By proper selection of the values of the elements in the hangover circuit this hangover is made sufficient (about 2.5 seconds), to pre-

vent monosyllabic replies from running the gain of the vario-repeater up unnecessarily.

The relay 43 operates to shift its armature from the back to the front contact. The breaking of the back contact disconnects the grid of the detector tube 34 in the syllabic detector circuit 20 from the rectifier 32, so that the grid of tube 34 has no discharge path except through leakage. Hence, any direct current potential applied to that tube due to steady noise from the circuit TC will be maintained, so that with cessation in the received speech energy and release of the receiving relay 41, and consequent release of relay 43, there will be no change in the grid potential of tube 34 when noise is again applied thereto (assuming that the noise level and Vogad gain have not changed).

The making of the front contact of relay 43 in response to operation of that relay applies ground to the junction point of condenser 31 and resistance 30 in the circuit shunting the grid and cathode of detector tube 23 in the voltage-detector circuit 19, thus effectively short-circuiting the grid of detector tube 23 and disabling the voltage-detector circuit 19.

The relays controlling the disabling of the syllabic detector circuit 20 and the voltage-detector circuit 19 are designed to have sufficient hangover in operation to prevent false operation thereof by echoes of received speech when the receiving amplifier-detector 40 releases with cessation in the supply of received speech thereto.

It will be noted that in the system of the invention illustrated in Figs. 1 and 2, the receiving amplifier-detector 40 is connected to the receiving circuit RC at a point in front of the privacy device 5; that the short-circuiting connection 13 normally blocking the receiving circuit RC is connected across that circuit on the output side of the privacy device 5; and that the short-circuiting connection 13 is broken to render the receiving circuit RC completely operative by operation of relay 14 in response to operation of the receiving amplifier-detector 40 by the received speech energy. Thus, the inherent delay of the privacy device 5 may be made use of to help prevent clipping of received speech energy by operation of the receiving suppressor relay 14 to open the short-circuiting connection 13. It does this by delaying the transmission of the received speech energy to the short-circuiting point (circuit 13) in the receiving circuit until after relay 14 has operated to remove the short circuit.

On the transmitting side, the normal short-circuiting connection 9 is connected across the circuit TC in front of the privacy device 5 and the normal short-circuiting connection 11 is connected across that circuit in the output of the privacy device 5, and the transmitting control circuit 17 controlling the two short-circuiting connections is connected across the circuit TC at a point in front of the short-circuiting connection 9. The inherent transmission delay of the privacy device 5, therefore, is not made use of to prevent clipping of the transmitted speech as clipping has already been introduced by the time the transmitted speech arrives at the input of the privacy device. This clipping is minimized by the use of the electrical delay circuit 3 in the transmitting circuit in front of the first disabling point (circuit 9).

Fig. 3 shows an arrangement of the switching controls alternative to that shown in Fig. 2, which

will enable the inherent delay of the privacy device 5 to be made use of to prevent speech clipping on both the transmitting and receiving sides of the terminal. In this case, the receiving amplifier-detector 40 is connected to the receiving circuit RC at a point in front of the privacy device 5 and the normal short-circuiting connection 13 is connected across the receiving circuit RC on the output side of the privacy device 5, and is broken in response to operation of the receiving amplifier-detector 40 by the received speech energy, as in the system of Figs. 1 and 2 so that the inherent delay of the device 5 prevents speech clipping on the receiving side. However, in the circuit of Fig. 3, in the transmitting circuit TC the short-circuiting connection 9 in front of the privacy device 5 is normally broken, the short-circuiting connection 11 on the output side of the privacy device 5 is normally operative to disable circuit TC, and the transmitting control circuit 17 is connected across the transmitting circuit TC in front of the broken short-circuiting connection 9. The transmitting enabling relay 12 is operated to open the short-circuiting connection 11 to render the circuit TC completely operative under control of the transmitting detector circuit 17 in response to transmitted speech energy. Because the transmitted speech energy must pass through the privacy device 5 before it arrives at the short-circuiting point (connection 11) in the circuit TC, the inherent delay in the device 5 prevents the speech arriving at that point before relay 12 has operated to remove effectively the short-circuiting connection 11. Thus, the inherent delay in the device 5 helps prevent speech clipping on the transmitting circuit TC also.

When speech is being transmitted over the receiving circuit RC, the short-circuiting connection 9 is closed by operation of relay 10 in response to operation of the receiving amplifier-detector 40 by receiving speech energy, to disable the transmitting circuit TC at a point on the output side of the point of connection of the transmitting detector circuit 17 thereto. Thus, subsequent speech transmission in the circuit TC, while received speech energy is still being received in the path RC, cannot get into the privacy device 5. This speech energy can get into the transmitting control circuit 17 but because this circuit is held disabled by relay 43, it will not reverse control of the circuit. This allows the transmitting side of the terminal to quickly get control when transmission in the receiving circuit RC ceases.

Many other modifications in 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. A control circuit for a two-way signal wave transmission system including at each terminal thereof a signal transmitting path and a signal receiving path each including a wave amplifier, comprising wave-operated switching means responsive to outgoing signals in the transmitting path at one terminal, in the absence of prior received signals in the receiving path at that terminal, to condition said one terminal for transmitting only, and means responsive to operation of said switching means to control the gain of the wave amplifier in the transmitting path at said one terminal.

2. The control circuit of claim 1, in which said gain control means operates to increase the gain of the wave amplifier in the transmitting path at said one terminal when the amplitude level of the

signal waves in said transmitting path is below a given value.

3. A control circuit for a two-way signaling system including at each terminal thereof a signal transmitting path and a signal receiving path each including a wave amplifier, comprising wave-operated switching means responsive to signal wave transmission in the transmitting path at one terminal, in the absence of prior signal transmission in the receiving path thereat, to condition the terminal for transmitting signals only, means responsive to variations in the amplitude level of the transmitted signals to control the gain of the amplifier in the transmitting path at said one terminal, and auxiliary means directly responsive to the gain setting of said amplifier to cause the gain thereof to be increased when below a given value.

4. A control circuit for a two-way signaling system including at each terminal thereof a signal transmitting path and a signal receiving path each including a wave amplifier, comprising wave-operated switching means responsive to outgoing signals in the transmitting path at one terminal, in the absence of prior received signals in the receiving path, to condition said one terminal for transmitting signals only, means responsive to operation of said switching means to control the gain of the wave amplifier in the transmitting path at said one terminal, and a second wave-operated switching means connected to the receiving path at said one terminal and responsive to received signals therein, in the absence of prior signal transmission in the transmitting path at the terminal, to condition the terminal for receiving signals only, and to disable said gain controlling means.

5. The control circuit of claim 3 in which the wave amplifier in the transmitting path at said one terminal includes an electron discharge device having a cathode, anode and control electrode, and circuits therefor, and said auxiliary means comprises a relay controlled by the cathode-anode current of said device and operatively responsive to a decrease in said cathode-anode current corresponding to a reduction in gain of said device below said given value, to regulate the biasing potential on said control electrode so as to increase the gain of said device.

6. A circuit for controlling the gain of a signal wave transmission path comprising an electron discharge amplifying device therein having a cathode, an anode and a control electrode, and circuits therefor, a variable loss pad including elements having a non-linear voltage current characteristic effective in said path, the cathode-anode current of said device being passed through said non-linear elements in such manner that as the potential on the control electrode of said device is made more negative, the loss in said path due to said non-linear elements changes, and means for controlling the potential on said control electrode of said device.

7. A circuit for controlling the gain of a signal wave transmission path comprising a variable mu electron discharge amplifying device therein having a cathode, an anode and a control electrode, and circuits therefor, and a variable loss pad including elements having a non-linear voltage current characteristic, effective in said path, the cathode-anode current of said device being passed through said non-linear elements in such manner that as the potential of the control electrode of said device is made more negative, the loss in said path due to said non-linear elements

changes and means responsive to a given change in said cathode-anode current to control the potential on said control electrode of said device.

8. The gain controlling circuit of claim 7, in which the last-mentioned means comprises a mechanical relay having a winding in the cathode-anode circuit of said device, said relay being operatively responsive to a current sent through its winding when below a certain value, a condenser in series in the control electrode cathode circuit of said device, and means responsive to operation of said relay to apply a charge on said condenser.

9. In a signal transmission system, a signal transmission path, a wave amplifier and a loss pad connected in tandem in said path, said amplifier comprising an electric discharge amplifying tube having a cathode, an anode and a control electrode, said loss pad comprising one or more loss elements having a non-linear voltage current characteristic, means responsive to variations in the amplitude level of the signal waves in said path to control the bias on the control electrode of said tube and thus the gain of said amplifier, and means passing the anode-cathode current of said tube through the loss elements in said loss pad in such manner that as the bias on the control electrode of said tube is made more negative, the loss provided by said pad in said path increases.

10. A control circuit for a two-way signal transmission system including near each terminal a transmitting signal transmission circuit and a receiving signal transmission circuit and a two-way privacy circuit common to the transmitting and the receiving circuits at one terminal, said control circuit comprising means normally disabling the transmitting circuit on the input and output side of said privacy device, means normally disabling said receiving circuit on the output side of said privacy device, switching means connected to said transmitting circuit in front of the disabling points therein, and responsive to outgoing signals, in the absence of prior received signals in the receiving circuit at that terminal, to render said transmitting circuit completely operative, and to disable said receiving circuit at a point in front of said privacy device, and a second switching means connected to said receiving circuit between said privacy device and the last-mentioned disabling point, and responsive to received signals, in the absence of prior signals in the transmitting circuit at the terminal, to render said receiving circuit operative on the output side of said privacy device and to disable the switching circuit connected to the transmitting circuit at the terminal.

11. A control circuit for a two-way signal transmission system including near each terminal a signal transmitting and a signal receiving circuit and a two-way privacy device common to the transmitting and receiving circuits at the terminal, said control circuit comprising means normally blocking the transmitting circuit at one terminal at a point beyond the output of the privacy device, means normally blocking the receiving circuit at said one terminal at a point beyond the output of the privacy device, switching means connected to the transmitting circuit of said one terminal at a point in front of the privacy device, and responsive to outgoing signals therein, in the absence of prior received signals in the receiving circuit at the terminal, to unblock the transmitting circuit and to block the receiving circuit on the input side of the privacy de-

vice, a second switching means connected to the receiving circuit between the input of the privacy device and the blocking point on the input side thereof, and responsive to received signals, in the absence of prior signal transmission in the transmitting circuit at the terminal, to unblock the receiving circuit and to block the transmitting circuit of the terminal at a point between the point of connection of the switching means thereto and the input of the privacy device.

12. A control circuit for a two-way signal wave transmission system including at each terminal signal transmitting and signal receiving circuits each including a wave amplifier, means normally blocking the transmitting circuit and the receiving circuit in their outputs at one terminal, wave-operated switching means connected to the transmitting circuit at said one terminal in front of the disabling point therein and responsive to initiation of signal transmission therein, in the absence of prior received signals in the receiving circuit at the terminal, to unlock the transmitting circuit at the terminal and to block the receiving circuit thereat in its input, means responsive to operation of said switching means to increase the gain of the amplifier in the transmitting circuit of the terminal when the amplitude level of the signal waves in the output of

said amplifier decreases below a given value, auxiliary means responsive to an increase in the level of the signal waves in the output of the amplifier above a certain other value to cause the gain of said amplifier to be decreased, and a second switching means connected to the receiving circuit at the terminal at a point between the blocking points in the input and output of said receiving circuit, and responsive to received signals, in the absence of prior signals in the transmitting circuit at the terminal, to unblock the output of said receiving circuit and to disable said amplifier gain increasing and decreasing means and said switching means connected to the transmitting circuit.

13. A control circuit for a two-way signaling system including at each terminal thereof a signal transmitting path and a signal receiving path each including a wave amplifier, comprising means responsive to variations in the amplitude level of the signals in one of the paths at said one terminal to control the gain of the amplifier therein, and auxiliary means directly responsive to the gain setting of said amplifier in said one path to cause the gain of said amplifier to be increased when below a given value.

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