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TRANSMISSION SYSTEM

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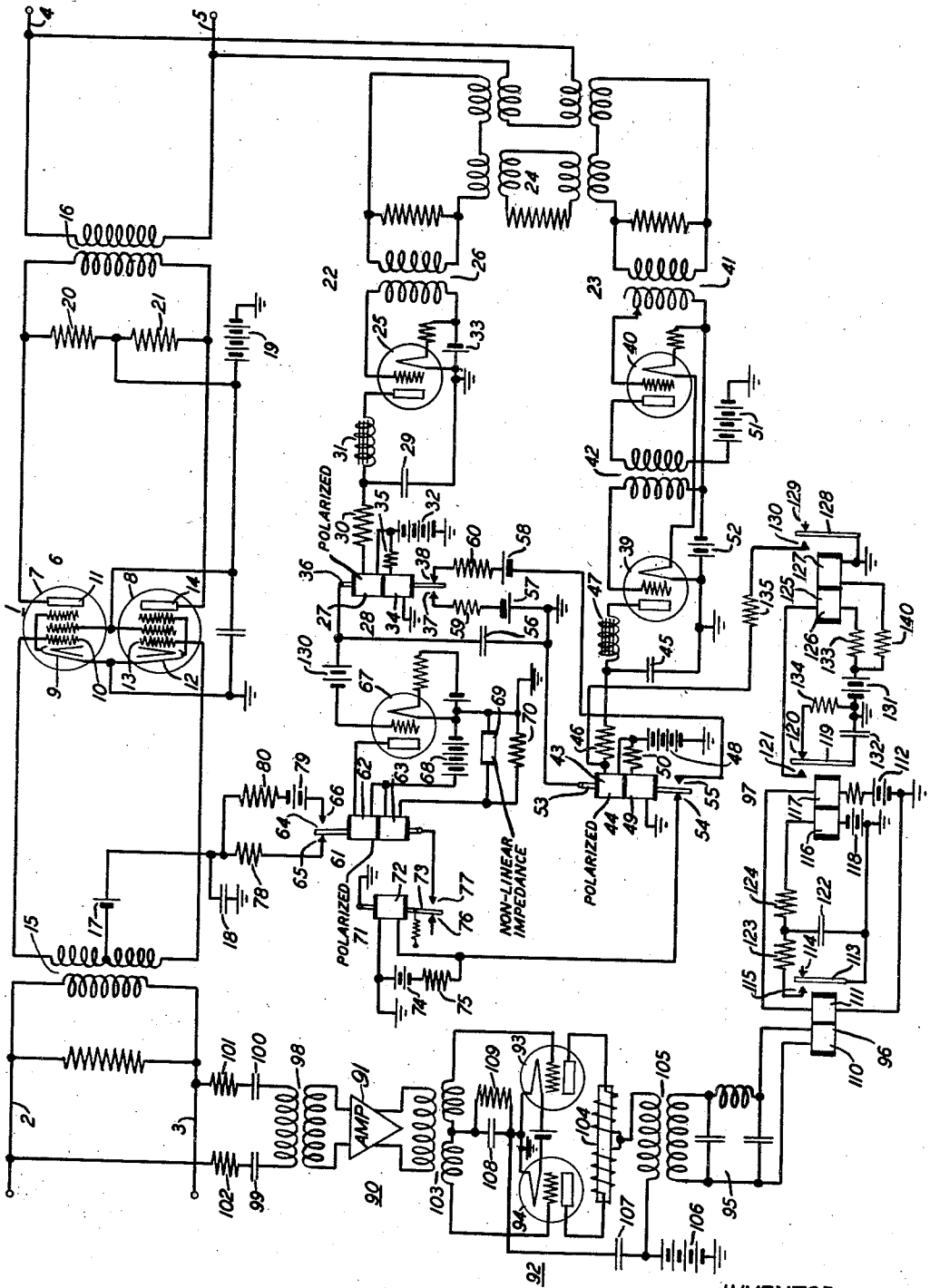

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TRANSMISSION SYSTEM

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Application August 10, 1938, Serial No. 224,088

10 Claims. (Cl. 178—44)

This invention relates to signal transmission systems and particularly to volume control circuits for signal transmission systems.

One object of the invention is to provide a transmission line with control circuits for governing the volume of the signals on the line to maintain the volume substantially constant that shall have a syllable detector circuit for increasing the range of operation of the control circuits without undue operation by noise.

Another object of the invention is to provide a transmission line with control circuits for raising and lowering the volume of the signals on the line to maintain the signal volume constant that shall have a circuit operated by syllables of speech to increase the gain when the volume of the signals is below the operating level of the control circuits.

Another object of the invention is to provide a transmission line with control circuits having sensitivity less than the noise on the transmission line for varying the gain of the signals on the line to maintain the volume constant and a syllable controlled circuit having higher sensitivity for raising the gain on the line when weak signals are on the line.

A further object of the invention is to provide a transmission line with control circuits and a syllable control circuit of the above indicated character that shall control the gain on the transmission line at very low volumes by means of the syllabic circuit and that shall govern the gain on the transmission line at close to normal volume by the control circuits.

In volume control circuits, for example, the volume control circuit disclosed in the application of B. G. Bjornson Serial No. 224,086 filed August 10, 1938, a large sudden decrease in the input volume to the volume control apparatus may interfere with the normal operation of the volume control apparatus. If the volume control apparatus is operating at low gain and there is a sudden decrease in the input volume to the volume control apparatus then it is possible that no operation of the volume control apparatus will take place.

In accordance with the present invention a syllabic control circuit is provided for effecting gain on the transmission line when the input volume to the volume control apparatus is very low. The syllabic control circuit is more sensitive for weak input volume than the volume control apparatus which serves to maintain substantially constant volume on the transmission line. The sensitivity of the volume control apparatus cannot be made high because operation by noise may then take place. The sensitivity of the syllabic control circuit may be made high without danger of operation by noise by reason of the noise discriminating feature thereof.

The volume control circuits employed to describe the invention are disclosed in the above-mentioned application of B. G. Bjornson Serial No. 224,086 filed August 10, 1938. A signal transmission line is provided with a variable gain device to control the gain so that two energy levels in speech E_1 and E_2 are exceeded only t_1 and t_2 per cent of the time. A balancing condenser is charged by potentials of opposite polarity under control of two detector circuits which are connected to the transmission line beyond the gain control device therein in any suitable manner, as by means of a hybrid coil. Each detector circuit comprises a marginal space discharge device which may be in the form of a three-element gas-filled tube. One of the marginal devices is set to operate or trigger off when the energy level E_1 and the other marginal device is set to operate when an energy level E_2 is on the transmission line. Two relays are respectively operated by the two marginal devices. One of the relays, which is operated by a detector device when an energy level of E_1 obtains on the transmission line, completes a circuit for charging the balancing condenser by potential of one polarity from a suitable source. The other relay which is operated by the other detector device when an energy level of E_2 obtains on the transmission line completes a circuit by charging the balancing condenser by potential of opposite polarity from a suitable source.

When the charge on the balancing condenser is raised above a predetermined value by a charge of either polarity a transfer relay is operated to change the charge on a control condenser. The control condenser governs the gain control device in the transmission line. If the balancing condenser is charged with one polarity under control of the relay operated by the high voltage V_1 then the transfer relay will be operated to impress a negative charge on the control condenser to increase the loss effect by the gain control devices. If the balancing condenser is charged above the predetermined value with opposite polarity under control of the relay operated by the lower voltage V_2 then the transfer relay will be operated to discharge a portion of the negative charge on the control condenser to decrease the loss effected by the gain control device.

Conditions may obtain on the transmission line

so that the signals beyond the gain control device do not even have the lower voltage V_2. The two detector circuits are backward-acting and are connected to the transmission line at a point beyond the gain control device. Low signal voltage may be on the transmission line beyond the gain control device if a very weak talker follows a strong talker who has produced a very low gain.

According to the present invention a forward-acting syllabic frequency circuit is provided for raising the gain when the energy of the signals is too low to successfully operate the normal volume control circuits. The syllabic detector circuit comprises an amplifier connected to the transmission line ahead of the gain control device, a detector connected to the amplifier and a filter or a tuned circuit which is connected to the detector for selecting impulses of syllabic frequency. A relay having the operating coil thereof connected to the output of the filter is operated by the syllabic frequency impulses. The syllabic frequency relay controls a second relay which has a predetermined hangover. The second relay controls the relay operated by the V_2 voltage on the transmission line and effects charging of the balancing condenser to increase the gain on the transmission line.

The syllabic frequency circuit is relatively insensitive to noise and therefore may have a higher sensitivity than the control circuits which normally control the gain control device to maintain constant volume on the transmission line. The syllabic frequency circuit, however, is slower-acting and once the volume is raised within 5 decibels, for example, of a normal volume, the normal control circuits will take control and maintain the volume substantially constant.

The single figure in the accompanying drawing is a diagrammatic view of control circuits constructed in accordance with the invention.

Referring to the drawing, a signal transmission line 1 having input conductors 2 and 3 and output conductors 4 and 5 is provided with a variorepeater 6 in the form of two space discharge devices 7 and 8. The device 7 is shown in the form of a pentode and is provided with a cathode 9, a control grid 10 and an anode 11. The device 8 is in the form of a pentode having a cathode 12, a control grid 13 and an anode 14. The variorepeater 6 is effectively connected in series with the transmission line 1 and is connected to the input conductors 2 and 3 by a transformer 15. The variorepeater is connected to the output conductors 4 and 5 by means of a transformer 16. A fixed biasing potential for the grids 10 and 13 of the pentodes 7 and 8 is supplied by a battery 17. A variable biasing potential for the control grids of the pentodes 7 and 8 is supplied by a control condenser 18. The charge on the control condenser 18 is governed in a manner to be hereinafter set forth for controlling the variorepeater 6 to govern the volume of the signals on the transmission line. A battery 19 is connected to the anodes of the devices 7 and 8 through resistance elements 20 and 21.

Two detector circuits 22 and 23 are connected to the output conductors 4 and 5 of the transmission line by means of a hybrid coil 24. The detector circuit 22 comprises a three-element gas-filled tube 25. The input circuit of the tube 25 is connected to the hybrid coil 24 by means of a transformer 26. The output circuit of the tube 25 is connected in series with a coil 27 of a polarized relay 28. A condenser 29 associated with a resistance element 30 and an inductance element 31 is provided to insure a hangover in the operation of the relay 28 by the tube 25. The hangover effected by the condenser resistance arrangement is preferably of the order .02 of a second. A battery 32 is provided for supplying plate potential to the anode of the tube 25. A battery 33 is provided for supplying filament heating current and grid bias to the tube 25.

The relay 28 is provided with a biasing winding 34 which is connected through a resistance 35 to the battery 32. An armature 36 of the relay 28 which is operated by the coil 27 engages contact members 37 and 38. In the release position when the coil 27 of the polar relay is not energized, the armature 36 is held in engagement with the contact member 38.

The detector circuit 23 comprises a three-element gas-filled tube 39 which is marginal in operation and an amplifier tube 40 of any suitable type. The input circuit of the amplifier 40 is connected by a transformer 41 to the hybrid coil 24. The output circuit of the tube 40 is connected by a transformer 42 to the input circuit of the detector tube 39. The output circuit of the detector tube 39 is connected in series with the operating winding 43 of a polarized relay 44. A condenser 45 associated with a resistance element 46 and an inductance element 47 is provided for insuring a hangover in the operation of the relay 44 by the detector tube 39. The hangover time is of the order of .02 of a second. A battery 48 is provided for supplying anode potential to the detector tube 39 and for energizing a biasing winding 49 of the relay 44. The biasing winding 49 is connected to the battery 48 in series with a resistance element 50. A battery 51 supplies anode potential to the amplifier tube 40. A battery 52 supplies filament heat current and grid biasing to the detector tube 39 and the amplifier tube 40.

The relay 44 is provided with an armature 53 which is adapted to engage contact members 54 and 55. When the operating coil 43 of the relay 44 is deenergized the armature 53 is held in engagement with the contact member 54. The relay 44 in combination with the relay 28 controls the charge impressed on a balancing condenser 56. Charges of opposite polarity are impressed on the balancing condenser 56 from batteries 57 and 58 through resistance elements 59 and 60. The batteries 57 and 58 are preferably of the same voltage and are of the order of 1½ volts. The resistance elements 59 and 60 may be of the order of 50,000 ohms and 130,000 ohms, respectively. With the relay 28 in release position and the relay 44 in operative position, the balancing condenser 56 will be charged with potential from the battery 58 in circuit with the relatively large resistance 60. When the relay 28 is in operative position the balancing condenser 56 is charged from the battery 57 in circuit with the relatively small resistance 59.

The detector circuits 22 and 23 are operated when different energy levels of speech current are on the transmission line. The detector circuit 23 is assumed to be operated at a lower level, for example minus 12½ decibels, and the detector 22 is assumed to be operated at a higher level, for example, plus 10 decibels. The difference in sensitivity, therefore, between the two detector circuits is 22.5 decibels.

A transfer relay 61 which is controlled by the balancing condenser 56 serves to control the direction in which the charge on the control condenser 18 is changed. The transfer relay 61 com-

prises an operating winding 62, a biasing winding 63 and an armature 64 which is adapted to engage contact members 65 and 66. The operating winding 62 of the relay 61 is connected in the output circuit of an amplifier 67. The amplifier 67 is preferably in the form of a three-element space discharge device. Biasing potential for the grid of the amplifier 67 is supplied by the battery 139 and the balancing condenser 56. A battery 68 is provided for supplying anode potential to the amplifier 67 and for energizing the biasing winding 63 of the relay 61. The circuit for the winding 63 extends from one terminal of the battery 68 through the winding 63 and two resistance elements 69 and 70 in parallel to the other terminal of the battery 68. The resistance element 69 has a non-linear coefficient of resistance and preferably is composed of silicon carbide crystals and a binder material. Resistance elements of this type are disclosed in the patent to K. B. McEachron, 1,822,742, September 8, 1931.

Normally with no charge of either polarity on the balancing condenser 56 the effects of the operating winding 62 and the neutralizing winding 63 for the relay 61 are neutralized and the armature 64 is held mid-way between the contact members 65 and 66. When the relay 28 is operated by the detector circuit 22 the condenser 56 is charged with potential of negative polarity from the battery 57. When the negative charge on the balancing condenser 56 is raised to a predetermined point the negative bias of the grid of the amplifier tube 67 reduces the plate current flow through the winding 62 of the relay 61 to move the armature 64 into engagement with the contact member 66. When the relay 44 is operated by the detector circuit 23 and the relay 28 is in released position, the balancing condenser 56 is charged with potential of positive polarity from the battery 58. Upon charging of the condenser 56 to a predetermined point by the battery 58 the positive potential bias on the grid of the amplifier device 67 increases the plate current flow through the winding 62 of the relay 61 to move the armature 64 into engagement with the contact member 65. If the charge on the balancing condenser 56 is initially zero the armature 36 of the relay 28 will have to be left on the contact member 37 a definite length of time, for example .06 of a second, to allow the transfer relay 61 to move the armature 64 into engagement with the contact member 66. When the armature 64 engages the contact member 66 the gain on the transmission line is reduced, as will be explained hereinafter. If the charge on the balancing condenser 56 is zero and the armature 53 of the relay 44 is moved into engagement with the contact member 55, it will take a definite length of time, for example .15 second, before the transfer relay armature 64 can be moved into engagement with contact member 65. When the armature 64 of the transfer relay 61 is moved into engagement with the contact member 65 the gain on the transmission line 1 is raised, as will be explained later.

A relay 71 comprising an operating coil 72 and an armature 73 is provided for insuring against change in the charge of the control condenser 18 except when speech currents are on the transmission line 1. The coil 72 of the relay 71 is normally short-circuited by the armature 53 of relay 44 and the armature 73 is held in engagement with the back contact member 76. Upon operation of relay 44 the coil 72 of relay 71 is energized from battery 74 and the armature 73 is moved to engage a contact member 77 for placing a ground on the armature 64 of the transfer relay 61. Normally a shunt circuit is maintained around the battery 74 and the resistance element 75 to insure the release of the relay 71. The shunt circuit around the battery 74 and the resistance element 75 may be traced from one terminal of the resistance element 75 through contact member 54, armature 53 and ground to a terminal of the battery 74. Upon operation of the relay 44 the shunt connection around the battery 74 is opened so that the relay 71 is operated whenever the relay 44 is operated. The relay 44 is operated by the detector circuit 23 of higher sensitivity.

When the armature 64 of the transfer relay 61 is moved into engagement with contact member 65, the control condenser is discharged through a resistance 78. The circuit may be traced from one terminal of the control condenser 18 through the resistance element 78, contact member 65, armature 64, contact member 77, armature 73 and ground return to the other terminal of the control condenser. When the armature 64 is moved into engagement with the contact member 66 the control condenser 18 is charged with potential of negative polarity from a battery 79. The charging circuit for the control condenser may be traced from one terminal of the condenser 18 through a resistance element 80, battery 79, contact member 66, armature 64, contact member 77, armature 73 and ground return to the other terminal of the condenser 18. The size of the resistance elements 78 and 80 may be varied as desired. The rate of gain increase depends upon the value of the condenser 18 and the resistance 78. The rate of gain decrease depends upon the condenser 18, resistance element 80 and the battery 79.

Assume that a weak talker transmits speech current over the transmission line 1 with a low gain. Under this circumstance the relay 44 will be operated by the detector circuit 23 and the relay 28 will not be operated. After two or more syllables, depending upon the previous condition of the system and the input amplitude, the relay 61 will move the armature 64 into engagement with the contact member 65. When the relay 44 is operated the balancing condenser 56 is charged with potential of positive polarity from the battery 58. The circuit for charging the balancing condenser 56 may be traced from one terminal of the condenser through the armature 36 of the relay 28, contact member 38, resistance 60, battery 58, contact member 55 and armature 53 of the relay 44 to the other terminal of the condenser 56. The charge on the balancing condenser 56 impresses positive potential on the grid of the device 67 to increase the current flow through the device. This effects operation of the transfer relay 61 to move the armature 64 into engagement with the contact member 65. The negative charge on the control condenser 18 is reduced by a circuit including the resistance element 78. The relay 71 is operated at this time inasmuch as this relay is operated whenever the relay 44 is operated. A reduction in the negative bias upon the control grids 10 and 13 of the pentodes 7 and 8 increases the gain upon the transmission line 1. It may be noted that the relay 71 which is operated only when the relay 44 is operated insures that change in the charge upon the control condenser 18 can only take place

when speech currents are on the transmission line.

The circuits controlled by the relays 28 and 44 are timed so that when operated the balancing condenser 56 is charged with potential of opposite polarity and inversely proportional to the times of operation of the relays. The gain on the transmission line will be increased gradually until the relay 28 is operated. The relay 28 is operated when the energy level on the detector circuit 22 is raised above the higher predetermined energy level. Upon operation of the relay 28 the charging circuit of the balancing condenser 56 from the battery 58 is broken and a circuit is completed from battery 57 for reducing the positive charge on the condenser 56. When the condenser 56 is charged with potential of negative polarity to the critical point, negative bias is impressed on the grid of the device 67 to reduce the current flow through the winding 62 of the relay 61 sufficient to move the armature 64 into engagement with the contact member 66. At this time the relay 71 is in operation because the relay 44 is in operation. The relay 44 is always in operation when the relay 28 is operated. The control condenser 18 is charged with potential of negative polarity from the battery 79 through the resistance element 80. Increase in the negative charge on the control condenser 18 increases the negative bias on the grids 10 and 13 of the pentode tubes 7 and 8 to lower the gain on the transmission line 1.

If the talker is talking at substantially constant volume it is possible to select the time constants of the circuits so that the critical charge on the balancing condenser 56 is never exceeded. If a critical charge of positive or negative polarity is never exceeded on the balancing condenser 56 the transfer relay 61 will not be operated and no change will take place in the gain of the transmission line.

A syllabic frequency detector circuit 90 is provided for controlling the relay 44 to raise the gain in case the voltage of the signals on the transmission line falls to a very low level. In case a strong talker is on the line the detector circuits 22 and 23 will set the variorepeater 6 for very low gain. If a very low talker is then put on the line the signals beyond the device 6 may not be able to operate the relay 44 by means of the detector circuit 23. The detector circuit 23 cannot be made with high sensitivity because of the danger of operation by noise when the variorepeater gain is high. The syllabic frequency detector circuit 90 has higher sensitivity than the detector circuit 23 except at high gain and is relatively insensitive to operation by noise on the transmission line.

The syllabic frequency detector circuit 90 comprises an amplifier 91, of any suitable type, a detector 92 comprising space discharge devices 93 and 94, a filter 95 for selecting the impulses of syllabic frequency and three polar relays 96, 97 and 125. The amplifier 91 is connected to the input conductors 2 and 3 of the transmission line 1 by means of a transformer 98, two condensers 99 and 100 and resistance elements 101 and 102. The resistance elements 101 and 102 and the condensers 99 and 100 in combination with the transformer 98 form a high impedance frequency selective network in the audio frequency portion of the detector circuit. A transformer 103 is provided for connecting the output circuit of the amplifier 91 to the input circuits of the space discharge devices 93 and 94. The anodes of the two devices 93 and 94 are connected together by means of an inductance coil 104. A midpoint of the inductance coil 104 is connected to one terminal of the primary winding of the transformer 105. A grounded battery 106 is connected to the other terminal of the primary winding for the transformer 105 to supply anode potential to the devices 93 and 94. A by-pass condenser 107 is connected between the filaments of the devices 93 and 94 and the primary winding of the transformer 105. A condenser 108 shunted by resistance element 109 serves as a grid leak for the devices 93 and 94.

The relay 96 is provided with two windings 110 and 111. The winding 110 is connected to the output circuit of the filter 95 which selects impulses of syllabic frequency. The winding 111 is energized from a battery 112 to normally hold the armature 113 in engagement with a back contact member 114. Upon energization of the winding 110 the armature 113 is moved into engagement with the front contact member 115. The relay 97 comprises an operating winding 116 and a biasing winding 117. The winding 116 is energized from a battery 118 upon operation of the relay 96. The winding 117 is energized by the battery 112 and opposes the action of the winding 116. Normally the winding 117 holds the armature 119 of the relay in engagement with contact member 120. Upon energization of the winding 116 the armature 119 is moved into engagement with a contact member 121. A condenser 122 and two resistance elements 123 and 124 are included in the energizing circuit for the winding 116 in order to provide a predetermined hangover in the release of the relay 97.

The relay 125 comprises an operating winding 126, a biasing winding 127 and an armature 128 which operates between contact members 129 and 130. The biasing winding 127 is energized by a battery 131 in circuit with a resistance element 140 to hold the armature 128 in release position and in engagement with the contact member 129.

The relay 96 when operated by energization of the winding 110 moves the armature 113 into engagement with the contact member 115. A circuit is then completed from the battery 118 through the armature 113, contact member 115, resistance elements 123 and 124 and the coil 116 for operating the relay 97. Upon release of the armature 113 the relay 97 is held in operative position for a predetermined time depending upon the time taken to charge the condenser 122 from the battery 118. The condenser 122 is discharged whenever the armature 113 engages the contact member 115. The biasing winding 111 which is energized from the battery 112 holds the armature 113 in engagement with the contact member 114 whenever the winding 110 is deenergized. Whenever strong syllable impulses operate the relay 96 the relay 97 may be held over between impulses. Thus the relay 96 may be operated by each impulse but the relay 97 may not be operated by each impulse.

The relay 97 when operated moves the armature 119 into engagement with the contact member 121 for completing a circuit to energize the operating winding 126 of the pulsing relay 125. The circuit for energizing the winding 126 of the pulsing relay 125 may be traced from one terminal of the battery 131 through a condenser 132, armature 119, contact member 121, winding 126 and resistance element 133 to the other terminal of the battery 131. The pulsing relay 125 is operated for a predetermined length of time which is the time taken to charge the condenser 132 up to a

certain value. Thus the relay 125 is operated a predetermined length of time for each operation of the relay 97 and irrespective of the strength of the syllable impulse on the transmitting channel 1. Upon release of the armature 119 the condenser 132 is discharged rapidly through a resistance element 134. The biasing winding 127 of the pulsing relay 125 normally holds the armature 128 in engagement with contact member 129. Upon energization of the operating winding 126 the armature 128 is moved into engagement with the contact member 130 for completing a circuit to energize the winding 43 of the relay 44. The circuit for energizing the winding 43 may be traced from grounded battery 48 through winding 43, resistance element 135, contact member 130, armature 128 and ground return to the battery 48. The relay 44 as above set forth controls the impressing of a positive charge on the balancing condenser 56 to effect operation of the transfer relay 61. The transfer relay 61 reduces the negative charge on the control condenser 18. Reducing the negative charge on the control condenser 18 serves to increase the gain on the transmission line 1.

Upon a sudden decrease in the input volume supplied to the variorepeater 6, the speech amplitudes supplied to the detector circuit 23 may be decreased to such an extent as to be unable to effect operation of the relay 44. However, at this time the syllabic frequency of the speech currents supplied to the syllabic frequency detector 90 will effect operation of the relay 96 which is connected to the filter 95. The relay 96 upon operation effects operation of the relay 97 and the relay 97 is held in operation for a predetermined time by reason of a hangover provided by the condenser 122 and the associated resistance elements. The relay 97 upon operation effects operation of the pulsing relay 125. The pulsing relay which is operated for a predetermined time effects operation of the relay 44. Upon operation of the relay 44 a predetermined number of times the balancing condenser 56 is charged sufficiently to effect operation of the transfer relay 61. The transfer relay in turn controls the variorepeater to increase the gain on the transmission line. When the output volume of the transmission line is substantially correct the operation of the relay 44 is effectively controlled from the detector circuit 23.

The circuit completed by the relay 97 for operating the relay 125 a predetermined length of time serves to insure that the pulsing relay is operated by a weak syllable impulse the same as for a strong syllable impulse. The syllabic frequency detector circuit 90 is not an essential circuit for the strong talker, but is a desirable circuit for the weak talker who produces weak syllable impulses. The hangover in the operation of the relay 97 is to reduce the number of operations of the pulsing relay 125 for the strong talker who produces strong syllabic frequency impulses. When the volume on the transmission line 1 increases the number of operations of the relay 96 increases until a certain maximum operation is effected and then it operates on practically every syllable. When syllable operation of the relay 96 takes place two operations of the relay 96 may follow each other very closely so that the hangover of the relay 97 will prevent a separate operation of the relay 97 for each operation of the relay 96. Accordingly two syllables which cause two operations of the relay 96 may only cause one operation of the relay 97 and one operation of the pulsing relay 125. When a weak talker is on the transmission line the syllables will not be so close together and the pulsing relay 125 will operate for each syllable which operates relay 96. The result of the above operation is that the pulsing relay operates at a rate which is uniform over a wide range of input volumes. However, if the pulsing rate were not restricted for the stronger talker it would be difficult to prevent the pulsing relay 125 from influencing the gain setting by the detector circuit 23 after adjustment near to constant volume had been effected. The operations of the relay 44 by the detector circuit 23 are so frequent that the relay 44 is usually operated before the syllabic frequency circuit 90 can take control. The syllabic frequency detector circuit usually loses control of the relay 44 when the gain on the transmission line is within 5 decibels of the correct value.

Modifications in the circuits and in the arrangement and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered by the appended claims.

What is claimed is:

1. A signal transmission line having a gain varying device therein, control means governed by the signal amplitude variations on said line beyond said device for controlling the device by signal amplitude variations of predetermined value to maintain the signal volume substantially constant, auxiliary means controlled by signal variations of syllable frequency on the line before said device and having higher sensitivity than said control means for governing said device to raise the gain on said line and means for reducing the speed of gain change by said auxiliary means when a strong talker is on the line to effect gain changes by said control means.

2. A signal transmission line having a gain varying device therein, control means governed by the signals on said line beyond said device for controlling the device according to amplitude variations of predetermined value to maintain the signal volume substantially constant, and auxiliary means controlled by signal variations of syllable frequency before said device for governing said device to raise the gain on said line, said auxiliary means being operated by amplitude variations of lower amplitude than the amplitudes of the variations required to operate said control means and effecting faster gain change by said device for a weak talker than for a strong talker.

3. A signal transmission line having a gain varying device therein, control means comprising two detector circuits of predetermined sensitivity governed by the signals on said line beyond said device for governing the device to maintain the signal volume substantially constant, and an auxiliary circuit connected to said line before said device and comprising detecting means, a filter selecting syllable frequency variations, and means having a higher sensitivity with respect to the signals on said line than said control means and governed according to the detected syllable frequency variations of said auxiliary circuit for governing said device to raise the gain on said line.

4. A signal transmission line having a gain varying device therein, control means governed by the signals on said line beyond said device for controlling the device according to amplitude variations of predetermined value to maintain the signal volume substantially constant, an

auxiliary circuit connected to said line before said device and comprising detecting means, a filter connected to said detecting means for selecting syllable frequency variations, and auxiliary means governed by said circuit for operating said device to raise the gain on said line when the amplitude of the signals is below the operating range of said control means, said auxiliary means effecting faster gain changes for a weak talker than for a strong talker.

5. A signal transmission line having a gain varying device therein, control means governed by voice currents on the line within a predetermined range for controlling said device to govern the volume of the voice currents on the line and a circuit connected to said line comprising detecting means, a filter selecting syllable frequency variations from the output of said detecting means, relay means operated by the output from said filter, said relay means being operated separately by each speech syllable when voice currents on said line are below the operating range of said control means, means for reducing the number of operations of said relay means when the volume of the signals on the line is raised to the range of said control means, and means controlled by said relay means for operating said device to raise the gain on the transmission line.

6. A signal transmission line having a gain varying device therein, control means governed by voice currents on the line beyond said device for controlling said device to maintain constant volume on the line beyond said device, detecting means operated by the voice currents on said line before said device, a filter for selecting the syllable frequency variation from the output of said detecting means, and auxiliary means operated by the output from said filter for operating said device to raise the gain on the line, said auxiliary means being operated when the volume of the voice currents on the line is below the range of operation of said control means.

7. A signal transmission line having a gain varying device therein, two detector circuits connected to the line beyond said device and respectively operated by two different amplitude levels on the transmission line, control means governed by said detector circuits for governing said device to maintain the volume of the signals on the line substantially constant, and auxiliary means governed by volume variations of syllable frequency on the line before said device when the signals have potentials lower than the volume variation amplitudes necessary to operate said detector circuits for governing said device to raise the gain on said line.

8. A signal transmission line having a gain varying device therein, two detector circuits connected to the line beyond said device and respectively operated by two different energy levels on the transmission line, gain increaser means controlled by one of said detector circuits for governing said device to increase the gain on said line, gain decreaser means controlled by the other one of said detector circuits for governing said device to decrease the gain on said line, and means comprising a syllabic amplifier detector circuit connected to said line before the device therein for controlling said gain increaser means to increase the gain on the line under control of the signal syllables when the signals on the line have potentials below that necessary to operate the two detector circuits.

9. A signal transmission line having a gain varying device therein, a balancing condenser, control means for charging said condenser by potentials of different polarity according to the durations of two different energy levels in the signals on said line, means controlled according to the polarity of the charge on said condenser when charged above a predetermined level for governing said device to maintain the signals on the line at substantially constant volume and means controlled by syllable variations on the line when the signals have potentials below that necessary to operate said control means for charging said balancing condenser to effect raising of the gain on the line.

10. A signal transmission line having a gain varying device therein, control means governed by voice currents on the line for controlling said device to govern the volume of the voice currents on the line and a circuit connected to said line comprising detecting means, a filter selecting syllable frequency variations from the output of said detecting means, a syllable relay operated according to the syllable variations in the filter output, a control relay operated by said syllable relay with a predetermined hangover, a pulsing relay operated by said control relay and having a fixed time of operation, and means controlled by said pulsing relay for operating said device to raise the gain on said line.

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