

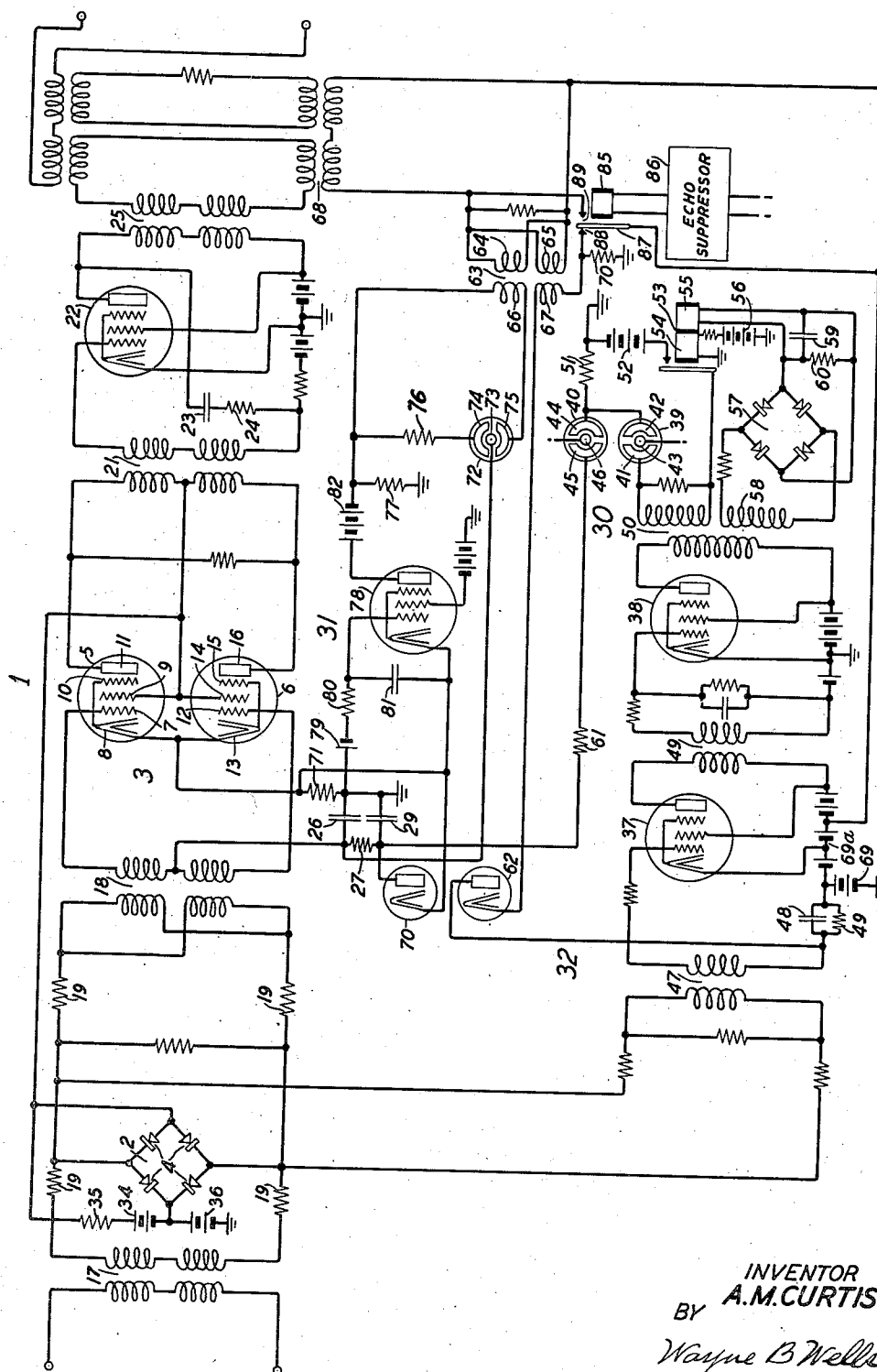
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TRANSMISSION SYSTEM

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TRANSMISSION SYSTEM

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10 Claims. (Cl. 178—44)

This invention relates to signal transmission systems and particularly to signal transmission systems having voice-operated circuits for maintaining constant volume.

5 One object of the invention is to provide a signal transmission system with voice-operated gain control circuits that shall prevent change of the gain by click impulses received during pauses in speech.

10 A further object of the invention is to provide a transmission line with voice-operated gain control circuits for governing the gain on the line to maintain the signals at constant volume that shall have a gain increaser circuit with a delay in the operation thereof to prevent change in gain on the line by click impulses.

15 In a radio system which is connected to a telephone system it is desirable to have the telephone currents supplied to the radio transmitter at constant volume in order to prevent overloading the apparatus in the radio transmitter. In a radio transmitter it is simpler to effect amplification and over-ride the noise level encountered in radio systems when constant volume signals are supplied to the transmitter.

20 In a telephone system voice currents controlled by different types of talkers are transmitted. In one extreme case may be the very loud talker and in the other extreme case may be the very weak talker. The volume range including a very loud talker and a very weak talker may be such as to cause overloading of the apparatus in a radio transmitter when the adjustments are such as to cause the weak talker to be properly transmitted. In order to prevent overloading the apparatus in the radio transmitter, the signal currents produced by the weak talker and the loud talker are controlled by voice-operated circuits so that constant volume is supplied to the radio transmitter. Voice-operated circuits for maintaining constant volume are disclosed in the application of S. Doba, Jr., Serial No. 174,948, filed November 17, 1937.

25 In voice-operated circuits for maintaining constant volume on a transmission line difficulty is sometimes experienced by reason of change in the gain by click impulses received during pauses in speech or when the speech currents are relatively weak. The click impulses may be caused by ringing currents by the operation of a receiver switchhook or by induction from lightning or power lines. According to the present invention a delay is provided in the operation of certain of the voice-operated circuits to insure against
55 change in the gain by the click impulses which

are frequently high in amplitude but generally of very brief duration.

In the system employed to describe the invention a varistor and a vario-repeater are included in the transmitting channel of a transmission line to maintain constant volume on the channel beyond the varistor and vario-repeater. Although only the transmitting channel is shown to describe the invention, it is to be understood that a receiving channel may also be controlled if so desired in the manner disclosed in the application of S. Doba, Jr., Serial No. 174,948, filed November 17, 1937. The varistor is in the form of a bridge composed of copper-oxide rectifier elements. Two opposite vertices of the bridge are connected across the transmitting channel. The vario-repeater is preferably in the form of two space discharge devices effectively connected in series with the channel. The two space discharge devices are controlled by impressing variable potential on the control grid from two control condensers. The bridge comprising the varistor is controlled according to the plate current supplied to the two space discharge devices in the vario-repeater.

25 The charge on the two control condensers is governed by a gain increaser circuit and a gain decreaser circuit. The gain increaser circuit is also controlled by a gain increase disabler circuit. The gain decreaser circuit impresses a negative charge on the control condensers to reduce the gain on the transmitting channel when the energy level of the signals beyond the varistor and the vario-repeater is above a predetermined maximum level. The gain increaser circuit impresses a charge in a positive direction on the control condensers when the energy level of the signal on the transmitting channel between the varistor and the vario-repeater is above a predetermined low level. The gain increase disabler circuit blocks the gain increaser circuit when the energy level of the signals on the transmitting channel beyond the varistor and the vario-repeater is above a predetermined minimum level.

30 The gain increaser circuit which impresses a charge on the control condensers in a positive direction to raise the gain on the transmitting channel is provided with two cold-cathode gas-filled space discharge devices which determine the signal level at which the increaser circuit operates. The first gas-filled tube in the gain increaser circuit is provided with a positive bias to insure operation of the tube on one polarity only. During pauses or weak speech, it has been

found that the gas-filled tube may be broken down by click impulses on the transmitting channel to raise the gain. A series of click impulses of reasonably high amplitude may cause the gain to increase as much as 10 to 20 decibels. In order to prevent operation of the gain increaser circuit by click impulses a delayed operating polar relay is provided for keeping the first gas-filled tube in the gain increaser circuit disconnected during silent intervals or during the normally brief duration of various click disturbances. The relay connects the first gas-filled tube into the circuit only when relatively continuous speech currents have been impressed on the input of the gain increaser circuit for a time of the order of .025 second long compared to the usual click duration. A rectifier, which is preferably in the form of a copper-oxide bridge, is provided for supplying current to operate the polar relay. The copper-oxide bridge is connected to the gain increaser circuit so as to be operated by the same currents which break down the gas-filled tubes. Between the connection of the coil of the polar relay and the bridge a condenser and a resistance element are inserted to make the relay slow operating.

In the operation of the gain increaser circuit two conditions must be filled before a gain increase can take place on the transmitting channel. First, the polar relay which normally opens the circuit of the first gas-filled tube must operate and, second, the energy supplied to the gas-filled tube must be great enough during the time the relay is operated to break down the gas-filled tube. The protection of the gain increaser circuit against operation by click impulses is due to the fact that most of the energy of the click impulses has passed before the polar relay is operated. After the polar relay is operated there is usually not enough energy received to break down the gas-filled tube.

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

Referring to the drawing, a transmitting channel 1 is shown having the gain thereon controlled by a varistor 2 in the form of a bridge and a vario-repeater 3 comprising two pentode space discharge devices. The bridge 2, preferably composed of copper-oxide rectifier elements 4, has two opposite vertices thereof connected across the channel 1. The vario-repeater 3 has the two space discharge devices 5 and 6 thereof effectively connected in series with the transmitting channel.

The space discharge device 5 comprises a control grid 7, a cathode 8, a screen grid 9, a compressor grid 10 and an anode 11. The space discharge device 6 comprises a control grid 12, a cathode 13, a screen grid 14, a compressor grid 15 and an anode 16. The bridge 2 is connected to the transmitting channel between transformers 17 and 18, and resistance elements 19 are positioned in the transmitting channel on opposite sides of the connections of the bridge thereto. The secondary winding of the transformer 18 is connected to the input circuits of the space discharge devices 5 and 6. The output circuits of the devices 5 and 6 are connected by a transformer 21 to the input circuit of an amplifier space discharge device 22. The device 22 is preferably a pentode and is provided with a negative feedback circuit comprising a condenser 23 and a resistance element 24. The output circuit of the amplifier device 22 connected to a transformer 25.

A relatively small condenser 26, which is shunted by a resistance element 27 and a relatively large condenser 29, impresses variable potential on the control grids 7 and 12 to control the gain on the transmitting channel. The charge on the control condensers 26 and 29 is controlled by a gain increaser circuit 30, a gain decreaser circuit 31 and a gain increase disabler circuit 32. The two space discharge devices 5 and 6 which are controlled according to the charge on condensers 26 and 29 in turn control the loss effected by the bridge 2 and provide compensation for the gain decreaser circuit 31, as will be described later.

A biasing battery 34 is connected in series with resistance element 35 across the two vertices of the bridge 2, which are not connected to the transmitting channel 1. The battery 34 impresses a bias on the bridge 2 in a positive direction to increase the loss effected by the bridge on the transmitting channel. A battery 36, which supplies plate potential to the anodes 11 and 16 of the space discharge devices 5 and 6, is connected in circuit with the resistance element 35 so that a potential drop is provided across the resistance element 35 according to the plate current drawn by the devices 5 and 6. The potential drop across the resistance element 35 opposes the potential of the battery 34.

The gain increaser circuit 30 comprises two pentode space discharge devices 37 and 38, and two cold-cathode gas-filled tubes 39 and 40. The tube 39 comprises two cathodes 41 and 42, and an anode 43. The tube 40 comprises two cathodes 44 and 45, and an anode 46. The input circuit of the amplifier device 37 is connected by a transformer 47 to the transmitting channel 1 between the bridge 2 and the two space discharge devices 5 and 6. A condenser 48 shunted by resistance element 49, which is included in the input circuit of the device 37, is controlled by the gain increase disabler circuit 32 to block the gain increaser circuit 30 when the energy level of the signals on the transmitting channel 1 beyond the varistor 2 and the vario-repeater 3 are above a predetermined minimum level. The output circuit of the amplifier device 37 is connected to the input circuit of the amplifier device 38 by means of a transformer 49. The output circuit of the amplifier device 38 is connected by transformer 50 to the breakdown circuit of the cold-cathode gas-filled device 39. The breakdown circuit for the gas-filled tube 39 includes a coupling resistance 51 and a biasing battery 52. The biasing battery 52 insures the breakdown of the tube 39 by one polarity only.

A polar relay 53, having a polarizing winding 54 and an operating winding 55, is provided for connecting the biasing battery 52 in circuit with the tube 39. The relay 53 is slow in operation in order to prevent connection of the biasing battery to the tube 39 until after a predetermined delay. The delay effective in the connection of the biasing battery to the tube insures against operation of the gain increaser circuit 30 by click impulses on the transmitting channel. The polarizing winding 54 is energized by a battery 56. The operating winding 35 is supplied with a rectified current by a copper-oxide bridge 57. Two opposite vertices of the bridge 57 are connected to a secondary winding 58 of the transformer 50. The other two vertices of the bridge are connected to the winding 55 of the relay 53. A condenser 59 and a resistance element 60 are connected in the energizing circuit for the winding 55 in order to insure a delay in the operation of

the relay. It is to be understood that any other well-known means may be provided for delaying the operation of the relay 53.

The cold cathode gas-filled tube 40 is operated by the potential drop across the coupling resistance 51. The breakdown circuit for the tube 40, which includes the control condensers, may be traced from ground through the coupling resistance 51, cathodes 44 and 45, resistance element 61 and condenser 29 shunted by the resistance element 27, and condenser 26 to ground.

The gain increase disabler circuit 32 is operated from the transmitting channel 1 at a point beyond the varistor 2 and the vario-repeater 3 for impressing a charge on the condenser 48 to block the gain increaser circuit 30. The gain increase disabler 32 is operated to block the gain increaser circuit 30 when the energy level of the signals on the transmitting channel 1 beyond the varistor and the vario-repeater is above a predetermined low level. The gain increase disabler circuit comprises a diode 62 which is connected to the transmitting channel 1 by means of transformers 63 and 68. The transformer 63 comprises two primary windings 64 and 65, and two secondary windings 66 and 67. The primary windings 64 and 65 are connected to the transmitting channel 1 by means of the transformer 68. The circuit for charging the condenser 48 to block the gain increaser circuit 30 may be traced from one terminal of the battery 69A through armature 87, contact member 88, secondary winding 67 of the transformer 63, diode 62 and condenser 48 shunted by the resistance 49 to the other terminal of the battery 69A. The battery 69A impresses a negative bias on the diode 62 of the order of 10.5 volts. The condenser 48 when charged impresses a negative blocking potential on the control grid of the amplifier space discharge device 37. A diode 70 is connected across the control condensers 26 and 29 in circuit with a resistance element 71 to insure against a positive charge being impressed on the control grids 7 and 12 of the space discharge devices 5 and 6.

The gain decrease circuit 31 comprises a cold cathode gas-filled space discharge device 72 having an anode 73 and two cathodes 74 and 75. The breakdown circuit for the device 72 includes the secondary winding 66 of the transformer 63, a resistance element 76 and the two cathodes 74 and 75 of the tube 72. The main discharge circuit of the tube 72 may be traced from ground through a compensating resistance 77, secondary winding 66 of the transformer 63, cathode 75, anode 73 and the control condensers 26 and 29 to ground. The breakdown circuit for the tube 72 is energized at approximately 70 volts and a main charging circuit is energized at approximately 75 volts. If a breakdown circuit were not provided for the tube 72, a potential of the order of 175 volts would be required to break down the main charging circuit. The resistance element 77 has a potential drop across it to maintain the sensitivity and the gain rate change by the gain decrease circuit constant.

The potential drop across the resistance element 77 is produced by a circuit including a pentode space discharge device 78. The input circuit for the device 78 is connected across a resistance element 71 included in the plate current circuit for the devices 5 and 6 in the transmitting channel. A battery 79 impresses a negative bias on the control grid of the device 78. A resistance element 80 and a condenser 81 provide a fil-

ter in the input circuit for the device 78. A battery 82 supplies anode potential for the device 78. Thus, the compensating resistance 77 has potential impressed across it in accordance with the plate current supplied to the space discharge devices 5 and 6 in the transmitting channel 1. It has been found by experiment, as set forth in the application of S. Doba, Jr., Serial No. 174,948, filed November 17, 1937, that the potential drop across the resistance element 77 must be twice the opposition of the charge on the control condensers 26 and 29 to maintain constant sensitivity and constant charging rate by the gain decrease circuit 31.

A relay 85, which is operated by echo suppressor circuits 86 connected to the receiving channel, (not shown) is provided for blocking the gain increaser circuit 30 by operating the gain increase disabler circuit 32 whenever the receiving channel is in operation. The armature 87 of the relay 85, when moved from engagement with the contact member 88 and into engagement with contact member 89, short-circuits the input to the gain decrease circuit 31. At the same time the gain increase disabler circuit is operated from the battery 69 through the resistance element 70. The operation of the gain increase disabler circuit blocks the gain increaser circuit.

Modifications in the circuits and in the arrangement in the 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. In combination, a signal transmission line, means for controlling the gain on the transmission line to maintain the signals at constant volume, a normally open circuited gain increaser circuit in said means for raising the gain on the transmission line, said gain increaser circuit being operated according to the energy level of the signals on the transmission line, means comprising a relay operated by the energy impressed on the gain increaser circuit for closing the normally open circuited gain increaser circuit, and means for delaying the operation of said relay to effect a predetermined delay in the operation of said circuit to prevent operation thereof by click impulses.
2. In combination, a signal transmission line, means for controlling the gain on the transmission line to maintain the signals at constant volume, said means including a gain increaser circuit operated by the signals on the transmission line, means comprising a relay for disabling said circuit when the relay is in released position, means for operating said relay when energy is impressed on the gain increaser circuit to complete said circuit, and means for effecting a predetermined delay in the operation of said relay to prevent operation of the gain increaser circuit by click impulses.
3. In combination, a signal transmission line, means for controlling the gain on the transmission line to transmit the signals at constant volume, said means including a gain increaser circuit operated according to the energy of the signals on the transmission line, means comprising a relay for breaking said circuit when the relay is in released position, means for operating said relay when energy is impressed on the gain increaser circuit to close said circuit, and means comprising a condenser and resistance network for effecting a predetermined delay in the operation of said relay.
4. In combination, a signal transmission line,

means for controlling the gain on the transmission line to maintain the signals at constant volume, said means including a gain increaser circuit operated by the signals on the transmission line, a cold-cathode gas-filled tube in said increaser circuit, means comprising a relay for impressing a bias on said tube to lower the breakdown point thereof, means for energizing said relay when energy is impressed on the gain increaser circuit, and means for effecting a predetermined delay in the operation of said relay to prevent operation of the increaser circuit by click impulses.

5. In combination, a transmission line for voice frequency signals, means comprising a space discharge device connected in series with the line for controlling the gain of the voice signals on the line, a control condenser for governing said device, means comprising a normally open circuited gain increaser circuit for controlling the charge on said condenser to maintain constant volume on the line beyond said device, means for controlling said gain increaser circuit by the voice signals on the line to raise the gain on said line when the voice signals on the line before said device are above a predetermined low level, and means for completing the normally open circuited gain increaser circuit only after signal energy has been impressed on the gain increaser circuit for a predetermined period of time to effect a predetermined delay in the operation of said circuit to prevent operation thereof by interfering currents of brief duration on the transmission line.

6. In combination, a transmission line for voice frequency signals, a space discharge device on said line, a control condenser for governing said device, means comprising a gain decreaser circuit, a normally open circuited gain increaser circuit and a gain increase disabler circuit each operated by the energy level of the voice signals on the line for controlling said condenser to maintain constant volume on the line beyond said device, and means for completing the normally open circuited gain increaser circuit only after signal energy has been impressed on the gain increaser circuit for a predetermined period of time to delay the operation of said gain increaser circuit and prevent change of the charge on said condenser by interfering impulses on the line between signal currents.

7. In combination, a signal transmission line, gain control means on said line, a control condenser for governing said control means according to the charge thereon, means comprising a gain increaser circuit operated by the signal energy on the transmission line for charging said condenser to maintain constant volume on the line beyond said control means, a cold-cathode gas-filled tube included in said gain increaser circuit having a positive bias impressed thereon, means comprising a relay for disabling said circuit when the relay is in released position, means for operating said relay when energy is impressed on the gain increaser circuit to complete the circuit, and means for effecting delay in the operation of said relay to prevent operation of the

gain increaser circuit by spurious currents of short duration.

8. In combination, a signal transmission line, means comprising a space discharge device on said line for controlling the signal gain, a condenser for controlling said device according to the charge on the condenser to maintain the signals on the line beyond said device at constant volume, a gain increaser circuit controlled by the energy level of the signals on the line before said device for charging said condenser to raise the gain on the line, a cold-cathode gas-filled tube included in said gain increaser circuit, means comprising a relay for controlling said tube to enable operation of the increaser circuit only when the signals on the line before said device are above a predetermined lower limit, means for rectifying a portion of the signal energy on the increaser circuit to operate said relay, and means for providing a delay in the operation of said relay.

9. In a signal transmission system, a transmission line having gain control means for effecting transmission of the signals at constant volume, a condenser for controlling said gain control means according to the charge thereon, a gain increaser circuit comprising a cold-cathode gas-filled tube for charging said condenser to raise the gain on said line when the energy level of the signals received for transmission over said line is above a predetermined low level, means comprising a relay for impressing a positive bias on said cold-cathode tube, means for operating said relay by said circuit, means for preventing operation of said relay until signals have been on the line for predetermined length of time, and means comprising a gain increase disabler circuit for blocking said gain increaser circuit when the signals on the line beyond said gain control means are above a predetermined lower limit.

10. In combination, a signal transmission line, a space discharge device on said line, a control condenser for governing said device, a gain decreaser circuit for impressing a potential on said condenser to lower the gain on the line when the energy level of the signals on the line beyond said device is above a predetermined upper level, a gain increaser circuit for impressing a potential on said condenser to increase the gain on the line when the energy level of the signals on the line before said device is above a predetermined lower level, a gain increase disabler circuit for blocking said gain increaser circuit when the energy level of the signals on the line beyond said device is above a predetermined lower level, said gain increaser circuit including a cold-cathode gas-filled tube for determining the signal level at which the circuit operates, and means controlled by the energy impressed on the gain increaser circuit from the line for effecting a delay in the operation of said tube to prevent operation of the increaser circuit by spurious currents of short duration.