

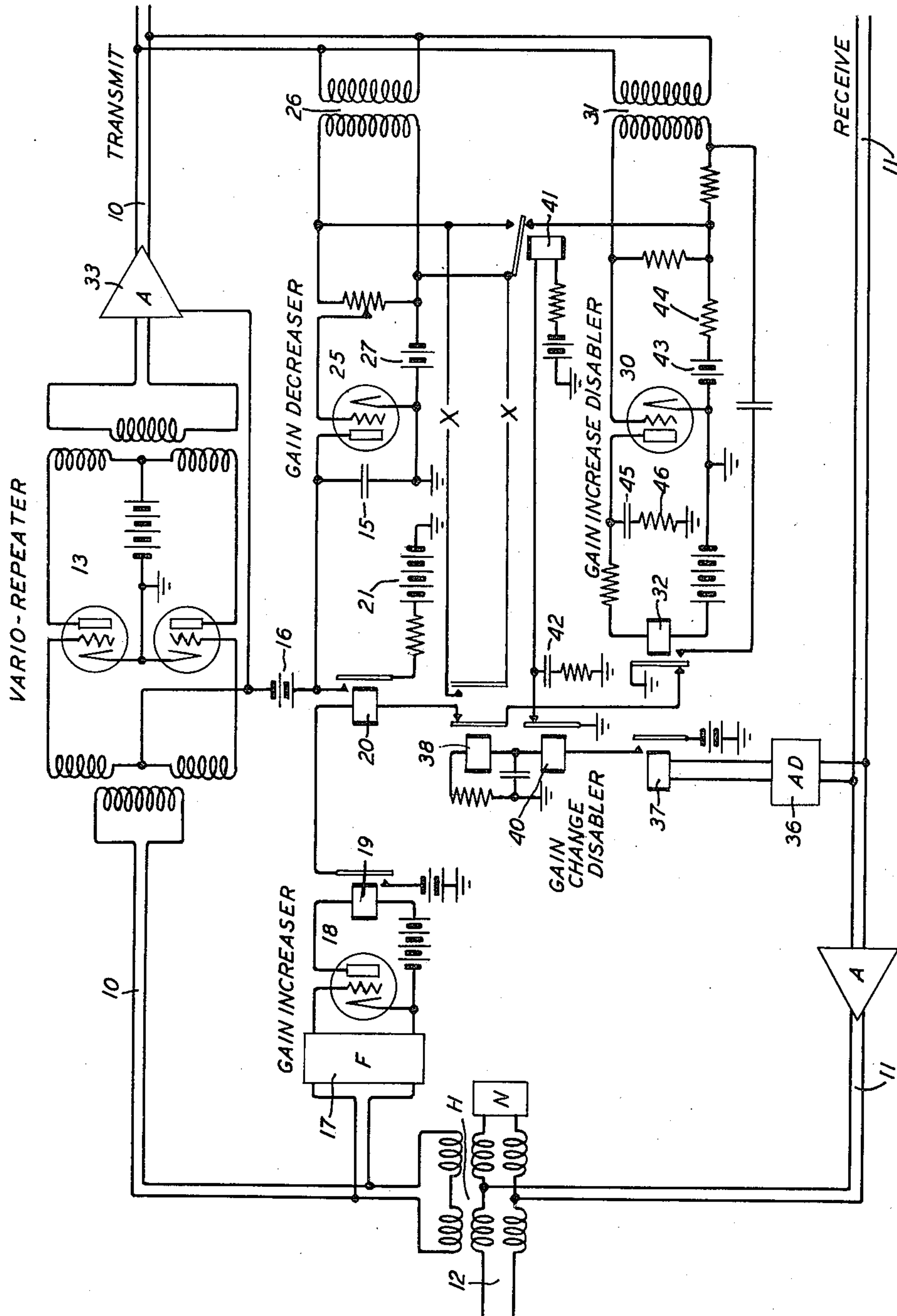
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SYSTEM OF VARIABLE AMPLIFICATION

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SYSTEM OF VARIABLE AMPLIFICATION

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The present invention relates to a four-wire transmission system with automatic variation of the gain in the transmitting branch of the system.

5 An object of the invention is an improved control of the variable gain mechanism to give improved overall operation of the system for talking or similar signaling.

10 In four-wire systems using a volume-operated gain adjusting device in the transmitting branch, difficulties arise in making the device respond to control by the transmitted speech so that it may make the necessary adjustments to insure proper volume under all conditions, while at the same 15 time preventing operation of the device by echoes or other currents that might adjust the device to a gain entirely unsuited to the speech that is in process of transmission.

20 It has been customary to disable the controls of the gain adjusting device when energy is present in the receiving side of the circuit in order to prevent the device from changing its gain during receiving times. This prevents the device from changing its gain under control of echoes.

25 A difficulty not obviated by this control is that produced when the talker on the transmitting side of the circuit, in which the gain adjusting device is located, makes short monosyllabic replies from time to time as he is listening to the 30 opposite talker. Experience shows that these are of much lower volume than his sustained talk and they consequently tend to set the transmitting gain to a value much higher than is required for his sustained speech. As a rule, these short 35 monosyllabic replies occur within brief pauses in the speech of the opposite talker.

40 In this invention there is a control which is relatively less responsive to sudden impulses of static than to speech and which, upon responding interrupts the gain increase control of the gain adjusting device for a considerable period. This prevents these monosyllabic replies from unnecessarily increasing the gain of the vario-re- 45 peater. By making this control less responsive to static than to speech, the gain adjusting circuits for the vario-repeater are able to take control quickly at all times except immediately following speech received from the opposite talker.

50 The nature of the invention and its various objects and features will be more fully understood from the following detailed description taken in connection with the accompanying drawing.

55 The single figure of the drawing shows, in simplified schematic form, one terminal of a four-wire circuit comprising transmitting line 10 and

receiving line 11. A two wire line 12 is shown connected to the lines 10 and 11 through the usual hybrid coil H and balancing network N. Transmitting line 10 contains a vario-repeater 13, the purpose of which is to maintain constant 5 volume on the line 10 on the output side of the repeater for speech of widely varying volume incoming from line 12. The difference in volume on line 12 may be caused by difference in length of line 12 leading eventually to the subscriber's 10 station or by difference in loudness of different talkers or of the same talker at different times or to other causes. This vario-repeater 13 may be of any suitable type but will be assumed to be of the type disclosed and claimed in United 15 States patent to Hogg and Doba, No. 1,853,974 granted April 12, 1932 to which reference may be made for a more detailed disclosure.

The gain setting of vario-repeater 13 is controlled by the speech that is being transmitted, 20 provision being made for increasing the gain if the speech is below its prescribed minimum volume and for decreasing the gain if the speech exceeds permissible volume, as described more fully in the patent referred to. The gain is a 25 function of the charge on condenser 15 which, in series with battery 16 is connected between the grids and cathodes of repeater 13. A gain increaser circuit is provided comprising filter 17 for passing the important frequency components 30 of speech but discriminating against noise, an amplifier-detector 18 and relay 19. Under certain circuit conditions to be described later, when relay 19 operates, relay 20 operates to connect the positive pole of grounded battery 21 across con- 35 denser 15 to increase its positive charge and raise the gain of amplifier 13.

A gain decreaser is shown comprising vacuum tube 25 having its grid circuit connected to line 10 on the output side of vario-repeater 13 through 40 input coil 26 and its anode-cathode circuit connected across condenser 15. The bias battery 27 makes the grid so far negative that, in the absence of impressed speech from 26, the cathode-anode impedance of tube 25 is substantially in- 45 finite and the tube does not shunt off the charge on condenser 15. Waves of sufficiently high amplitude in the grid circuit lower the cathode-anode impedance and cause a reduction in charge 50 on condenser 15.

If the gain of vario-repeater 13 is high enough and accordingly does not need to be increased, the gain increase disabler circuit comprising gas-filled tube 30 and relay 32 operates under control of waves impressed on the grid through 55

input coil 31. When relay 32 operates, it opens the energizing circuit for relay 20 to prevent that relay from operating under control of relay 19. At its front contact this relay shunts out a resistance in the input circuit to increase the sensitivity of the gain increase disabler circuit.

By means of the gain increaser, the gain decreaser and the gain increase disabler, the gain of the vario-repeater 13 is maintained under control of the transmitted speech to keep the volume on its output side substantially constant. Usually, the vario-repeater comprises more than a single stage and a second amplifier 33 is shown, the gain of which may be controlled concurrently with that of repeater 13 over a branch of the grid lead.

In a volume operated gain control system of the type described, it is important to prevent false settings of gain under control of waves other than the speech that is being transmitted out over line 10. An amplifier-detector 36 and relay 37 are provided to prevent the vario-repeater 13 from adjusting on echoes. Whenever there is speech energy in line 11, relay 37 is operated under control of amplifier-detector 36 to disable both the gain increaser and gain decreaser so that echoes from line 12 produced by the speech received over line 11 are unable to change the gain adjustment. This general provision against false setting on echoes is disclosed in application for United States Letters Patent filed April 30, 1932 by S. Doba, Serial No. 608,362. It is accomplished in the present disclosure by relay 38 which operates when relay 37 operates, opens the energizing circuit for relay 20 and, at its other armature, places a short circuit across the input of the gain decreaser 25.

It has been found that with so much of the system as has been thus far specifically described, a difficulty exists in that the vario-repeater is subject to a false gain adjustment by weak monosyllable replies by the talker on line 12. In an ordinary conversation, a train of words spoken by one party is frequently punctuated by short sounds from the other party indicating merely that such party is still on the line and is comprehending what is being said or, for example, is in a general way assenting. These short responses such as "yeah" or "uh-huh" are uttered in a much weaker voice than is used for sustained talking. Consequently, if the vario-repeater is allowed to adjust its gain to the volume of those weak sounds, it will be liable to be overloaded by the sustained talk when that occurs, until a new adjustment of the gain can be made.

The present invention solves that difficulty. Observations show that these short replies are interspersed in the speech of the opposite talker at slight pauses that admit of time to utter them. They occur mostly within less than two and a half seconds after a fragment of speech by the opposite talker. In accordance with the invention, a circuit is provided which disables the gain increaser circuit for a period of two and a half seconds after the cessation of a steady talking period by the opposite talker.

This is accomplished in the circuit of the drawing by providing relays 40 and 41, the operation of which will now be given. When relay 37 responds to receiving line energy, relay 40 energizes in series with relay 38. Relay 41 is normally energized through the back contact of relay 40 and upon energization of the latter, current for a time continues to flow through winding of relay 41 and into condenser 42, charging the latter.

After a time interval determined by the capacity of condenser 42 and the resistance of the circuit, relay 41 releases placing a short circuit across the input to the gain decreaser circuit 25 and opening at its lower contact the negative polarizing circuit for the grid of the gas-filled tube 30 to permit that tube to break down and energize relay 32. Previous to the release of relay 41, a circuit existed from negative battery 27, front contact of relay 41, resistance 44, positive battery 43 and ground, by which the bias on tube 30 was held negative by battery 27. When relay 41 was energized, as described, the battery 27 was cut off and battery 43 then made the grid of tube 30 positive. Resistance 44 is very large and may, for example, be of the order of a megohm.

Relay 32, in operating, opens the circuit for relay 20 making the gain increaser circuit ineffectual.

After relay 37 releases at the end of a talking period, relays 40 and 41 both restore to the condition shown in the drawing but relay 32 remains held up for a two and one-half second interval on account of the slow-release circuit comprising condenser 45 and resistance 46. If talking is resumed in circuit 11 during this interval, relays 37 and 40 energize and relay 41 releases and prevents the release of relay 32 with the qualification that relay 41 requires about one-tenth of a second to release, for a reason to be given presently. This relay operates in about one-fiftieth of a second.

Relay 38 is made slow to release by the condenser and resistance combination shown associated with its winding, the release time being about one-twentieth of a second. It will be observed that the gain can be quickly decreased after received speech ceases but cannot be increased until after the release time of relay 32.

Gain settings in response to weak echoes are prevented by relay 38 which, as stated, is quick to energize and has a hangover time of one-twentieth of a second, sufficient to allow for echo decay. The circuit from the back armature of relay 38 for disabling the gain decreaser can be used where there is a tendency for echoes to be stronger than the speech transmitted over circuit 10. In practice, it has been found sufficient, in some cases at least, to omit this connection and rely on relay 41 to disable the gain decreaser. This can be done by severing the connection at the points X—X.

If it were not for static energy operating the anti-singing (vodas) relays frequently on a circuit such as the transatlantic radio system, for example, relay 41 could be made quick to release. With frequent static impulses, if relay 41 were allowed to release quickly, the slow-release relay 32 might be held operated so much of the time on account of its long hangover time, that required gain increases could not be effected. Such gain increases might be needed, for example, to allow the talker on line 12 to get proper control of the voice-operated relays in the anti-singing circuit which may be assumed to follow the portion of the circuit shown in the drawing. By making relay 41 slow to release, it is made to discriminate against static in favor of sustained speech waves.

In a circuit not exposed to static, it will be seen from what has been said that a single control comprising relay 40 and relay 41 without its slow-release feature could be made to suffice, in which case relay 38 could be omitted.

What is claimed is:

1. In a four-wire telephone system comprising

a transmitting line and a receiving line, a vario-repeater in the transmitting line, means controlled by speech in the transmitting line for varying the gain of said repeater, and means to
5 reduce improper gain adjustments by said gain varying means comprising means controlled by sustained speech in the receiving line for preventing energy in the transmitting line from changing the gain of said repeater over pauses
10 long enough to exclude the effect of relatively weak substantially monosyllabic responses.

2. In a four-wire telephone system comprising a transmitting line, a receiving line, a vario-repeater in the transmitting line for maintaining
15 substantially constant output volume, means controlled by the speech energy being transmitted for varying the gain of said repeater to maintain such substantially constant volume, and a plurality of means responsive to energy in the re-
20 ceiving line for preventing changes in the gain of said vario-repeater, one of said last mentioned means comprising a quick response, slow-release circuit for preventing echoes from affecting the gain of said repeater and the other having a
25 much longer release time for preventing incidental weak responses occurring in the transmitting line from affecting the gain.

3. The system of claim 2, in which the said other of said last-mentioned means is relatively slow to operate whereby it is substantially unresponsive to static but responsive to speech.

4. In a four-wire telephone system having a
5 transmitting line and a receiving line, a vario-repeater in the transmitting line having a gain increaser controlled from its input and a gain decrease and gain increase disabler controlled
10 from its output, whereby substantially constant output volume of said vario-repeater is maintained under control of speech that is being transmitted, said gain increase disabler when
15 operated having a hangover time of the order of seconds, quick-operate means controlled by energy in the receiving line for disabling the gain increaser for preventing gain increase under control of echoes, and slow-operate means responsive
20 to sustained energy in the receiving line for operating the gain increase disabler, whereby quick short responses in the transmitting line are prevented from causing increase of gain of said
vario-repeater.

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