

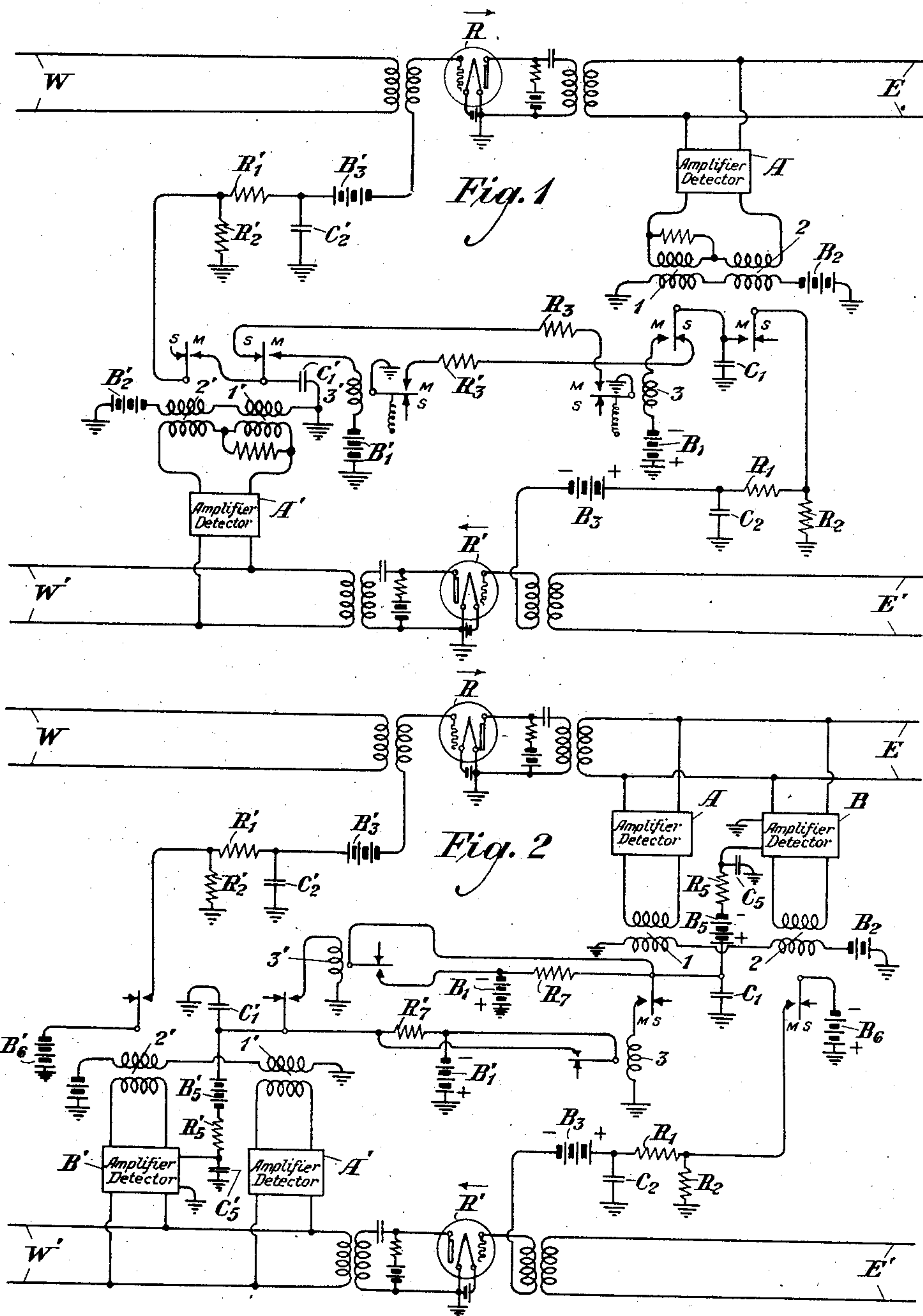
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ECHO SUPPRESSOR

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ECHO SUPPRESSOR

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This invention relates to improvements in voice operated devices, and more particularly to arrangements for automatically regulating the sensitivity of such devices.

6 An echo suppressor is such a voice operated device well known in the art and is utilized in connection with a two-way transmission system for disabling one of the one-way lines of such system, while transmission is taking place in the opposite direction over 10 another of the one-way lines of the system, thereby preventing echo effects or reflected currents from being transmitted back to the transmitting end of the system and disturbing the speaker. For purposes of illustration, the invention will be shown in connection with an echo suppressor device.

15 The voice operated echo suppressor must be so constructed that it will not be operated by noise currents existing on the system. Accordingly, it has been the practice to limit the sensitivity of the device by the greatest noise ever expected to be present on the line. As the line would not at all times include 25 this maximum noise current, it is obvious that during quiet periods, the voice operated echo suppressor would not be operating at maximum efficiency. In order to avoid interference from noise currents, the echo suppressor device of this invention is so constructed 30 as to be normally relatively insensitive until "primed" by speech currents which are stronger than the maximum noise current to be expected on the line. In other words, the 35 fundamental idea for securing protection against noise current consists in having the echo suppressor normally with low sensitivity so as to be unaffected by noise whenever voice currents are absent from the circuit, and to 40 automatically raise the sensitivity of the echo suppressor whenever voice currents appear on the circuit. This is accomplished by having the echo suppressor device "primed" by peaks of speech which rise above the noise 45 level. Other objects and features of the invention will appear more fully from the detailed description hereinafter given.

50 The invention may be more fully understood from the following description, together with the accompanying drawings, in

the Figures 1 and 2 of which is shown a circuit diagram embodying a preferred form of the invention and a modification thereof, respectively. Similar reference characters have been utilized to denote like parts in all of the figures of the drawings.

In Fig. 1, the echo suppressor arrangements of the invention are shown associated between the one-way sections WE and E'W' of the well known type of four-wire circuit. 60 Each of these one-way line sections will include repeater apparatus, such as the amplifier tubes R and R'. Bridged across the line WE on the output side of tube R is an amplifier-detector A. The output of this amplifier detector A will include an arrangement 65 of echo suppressor relays whereby the line section E'W' may be disabled. Bridged across the line E'W' on the output side of the tube R' will be a similar arrangement comprising 70 the amplifier-detector A' and the relay arrangement for disabling line WE. The general operating features and purposes of an echo suppressor device are well known in the art.

75 The "priming" by the speech currents of the echo suppressor to increase its sensitivity could, in accordance with the arrangements of this invention, have either one of two characteristics. The echo suppressor "priming" 80 could be maintained at maximum between peaks of speech and for an interval of time after speech ceases, or could be allowed to taper off gradually between the peaks of speech. Furthermore, the "priming" might 85 be applied to the amplifier-detector which controls the echo suppressing relay arrangement so as to increase its sensitivity to weak speech, or it could be applied to the echo suppressing relay arrangement, itself, so as to 90 change the degree of suppression accomplished by this relay arrangement.

In the arrangements of Fig. 1, the "priming" is allowed to taper off gradually between peaks of speech, and is applied to the suppressor relay arrangement. In the plate circuit of the amplifier-detector A are shown two polar relays 1 and 2, and a biasing circuit therefor including the battery B₂. The polar relay 1 is made less sensitive than the relay 2

by means of a resistance shunted across its operating winding, or by some other means. The object is to make the relay 1 sufficiently sensitive so as to operate fairly frequently on the peaks of voice or speech currents but not sensitive enough so as to operate on noise currents.

The polar relay 2 is made as sensitive as required for effective suppression of echoes in the case of weak speech and is therefore subject to operation by noise. A fundamental requirement for this relay is that it should not be held operated continuously by the steady noise on the circuit but should be operated and released frequently. Should the relay 2 be held operated, then the sensitivity of the echo suppressor would be only that of relay 1 and it would have a fairly long hangover.

The operation of relay 1 by speech currents charges the "priming" condenser C_1 from the negative battery B_1 through the winding of relay 3. The charge on this condenser is then utilized by relay 2 for suppressing echoes by applying it to the grid of the repeater tube R' . In other words, the negative potential on the grid of tube R' will be so increased by the charge on condenser C_1 together with the potential of battery B_3 , that the tube will not function. The values of R_1 and C_2 in the grid circuit of repeater R' determine the rate of building up of the grid voltage, and, therefore, to a large extent, the operating time of the suppressor. The rate of building up must of necessity be limited so as to avoid the transmission of "clicks" over the circuit whenever the grid voltage is applied. The hangover time is determined by the values of C_2 , R_1 and R_2 in series.

Relay 3 is operated momentarily whenever relay 1 operates. Its function is to dissipate any unused charge on condenser C'_1 , whenever the direction of the conversation changes from E'W' to WE. In this way, the echo suppressor relay associated with C'_1 is made ineffective in spite of operation by noise. The apparatus associated with the amplifier-detector A' is similar to that shown associated with the amplifier A and has been given similar reference characters with the added designation prime.

The manner in which the echo suppressor arrangements of Fig. 1 would function is as follows: At the beginning of the conversation, there will be no charge on either of the priming condensers C_1 and C'_1 , and both sides of the circuit will have their normal equivalents in spite of the operation of relays 2 and 2' by noise. Assume that speech currents are first transmitted over the WE side of the four-wire circuit. The first peak of the speech which rises above the noise level will operate relay 1 as well as relay 2 and connect the negative battery B_1 to the prim-

ing condenser C_1 and to the grid of the tube R' . This will render tube R' inoperative and echo suppression will begin. As long as speech continues in this direction over the circuit, relay 2 will suppress the echoes of both noise and speech currents which operate it, utilizing the charge on C_1 for disabling the repeater R' . The charge on C_1 is maintained at a sufficiently high level by occasional operations of relay 1 by the peaks of speech.

Should the talker pause for a while, and no reply is received in the meantime from the other end of the circuit, the suppressor will continue to suppress the echoes of noise currents. It will, however, become less and less effective in doing this since the charge on C_1 is being dissipated. If the pause is long enough, this charge will be entirely dissipated and the echo suppressor will be ineffective.

Should a reply be received over the E'W' side of the system, relay 1' will be operated by the first peak of speech and will charge the priming condenser C'_1 from battery B'_1 , and, in a manner similar to that heretofore described, disable the repeater R. The charging of C'_1 through the winding of relay 3' will cause a momentary operation of this relay and discharge the priming condenser C_1 on the other half of the echo suppressor. As a result of this, the speaker has complete control of the circuit in spite of noise currents on the opposite side and can maintain this control as well as suppress the echoes due to his speech until interrupted by voice currents from the first speaker.

In the modified form of the invention shown in Fig. 2, the "priming" is applied to the amplifier-detector which controls the echo suppressor relay. Accordingly, separate amplifier-detectors, such as A and B, are provided for each of the relays 1 and 2. Similar reference characters have been utilized to denote like parts with respect to Fig. 1.

The operation of the arrangements of Fig. 2 are substantially similar to those of Fig. 1 heretofore described. The following distinctions are pointed out. When the armature of relay 1 is on its s contact, the batteries B_1 and B_5 , which is the grid battery of amplifier-detector B, are in series. This gives a large grid voltage on the amplifier-detector B and hence low sensitivity. When peaks of speech operate relay 1, the large condenser C_1 , which has voltage of B_1 on it, is discharged through the winding of relay 3, thereby giving the amplifier-detector B only its normal grid voltage, namely, that of battery B_5 . When relay 1 goes back to its s contact, battery B_1 slowly charges condenser C_1 through the resistance R_7 , thereby gradually decreasing the sensitivity of the amplifier-detector B by increasing its grid voltage. Relay 3 has the same function as in the ar-

rangements previously described in connection with Fig. 1. When operated momentarily by the discharge of C_1 , it connects the battery B'_1 of the other side of the echo suppressor directly to the priming condenser C'_1 instead of through resistance R'_7 , thereby making the grid voltage of the amplifier-detector B' high at once, and the amplifier-detector insensitive at once. Relay 2 has the same function as in Fig. 2. However, instead of utilizing a priming condenser for its source of grid voltage to disable the repeater R' , it utilizes the battery B_6 in series with battery B_3 .

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the of the invention, as defined by the appended claims.

What is claimed is:

1. A transmission line, an echo suppressor device associated therewith, and means controlled by speech currents transmitted over said line for increasing the sensitivity of said device.

2. A transmission line comprising two one-way line sections for transmission in opposite directions, an echo suppressor device associated with said line sections comprising two relays associated with one of said line sections, one of said relays being operative by currents in said line section of any amplitude within a relatively wide range, the other of said relays being operative only by currents in said line section of amplitude equal to or in excess of a value considerably above the lower limit of said range, and means under the joint control of both of said relays for disabling the other of said line sections.

3. A transmission line comprising two one-way line sections for transmission in opposite directions, an echo suppressor device associated with said line sections comprising two relays associated with one of said line sections, one of said relays being operative by currents in said line section of any amplitude within a relatively wide range, the other of said relays being operatively only by currents in said line section of amplitude equal to or in excess of a value considerably above the lower limit of said range, and means for causing a gradual disabling of the other of said line sections, said means being controlled by the joint operation of both of said relays.

4. A transmission line comprising two one-way line sections for transmission in opposite directions, an echo suppressor device associated with said line sections comprising a relay operated by both noise and signaling currents on said line section, a relay operated only by signaling currents on said line section, and a circuit for disabling the other of said line sections, said relays being adapted

to complete said circuit upon their joint operation.

5. A transmission line comprising two one-way line sections for transmission in opposite directions, an echo suppressor device associated with said line sections comprising a relay operated by both noise and signaling currents on said line section, a relay operated only by signaling currents on said line section, a circuit for disabling the other of said line sections, said circuit being controlled jointly by both of said relays, and a condenser associated with said circuit for retarding the building up and dying down of the operating voltage applied to said circuit.

6. A transmission line comprising two one-way line sections for transmission in opposite directions, vacuum tube repeaters in each of said line sections, an echo suppressor device associated with said line sections comprising a relay operated by both noise and signaling currents on said line section, a relay operated only by signaling currents on said line section, a circuit for applying voltage to the grid of the repeater in the other of said line sections, and means controlled by both of said relays for increasing the voltage applied to said grid circuit.

In testimony whereof, I have signed my name to this specification this 9th day of August, 1928.

JOSEPH HERMAN.

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