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ECHO SUPPRESSOR

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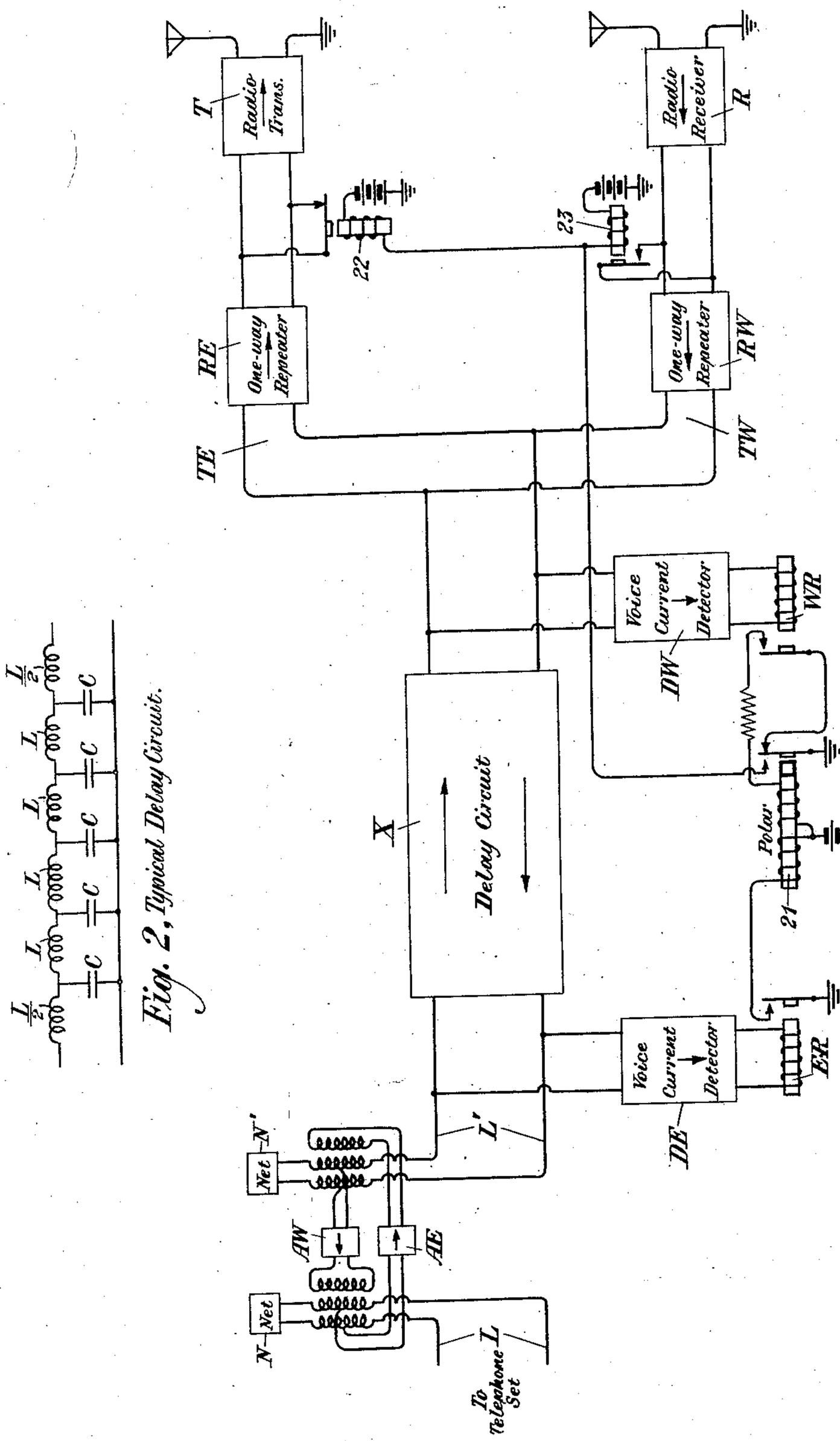

Fig. 1

Fig. 2, Typical Delay Circuit.

INVENTOR
S. B. Wright

BY

ATTORNEY

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SUMNER B. WRIGHT, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ECHO SUPPRESSOR.

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This invention relates to voice operated devices for suppressing echoes and singing in two-way transmission systems, and more particularly to arrangements whereby the voice-operated devices may be located in the two-wire part of such a system.

Two-way transmission systems are usually so arranged that certain portions of the circuit are operated on a two-wire basis, while other parts of the circuit, more particularly where repeaters are located, are operated on a four-wire basis. In the four-wire parts of the system, there will be a tendency to sing if the total amplification of the four-wire loop exceeds the total loss. Furthermore, when transmission takes place in one direction over such a system, echo currents may be transmitted back from the terminals or from other reflection points in the system.

It has therefore been proposed to associate echo suppressors with the four-wire parts of the systems, these echo suppressors functioning to prevent transmission in one direction while transmission is taking place in the other directions. In accordance with the present invention, however, it is proposed to so arrange the echo suppressors that they may be connected to and operated from the two-wire part of the system. More specifically, it is proposed by the present invention to provide two echo suppressors in the two-wire part of the system, with a delay circuit interposed between the echo suppressors having such a circuit control that the suppressor which is operated first will be effective, and the suppressor which is operated later will be unable to perform its usual function. In this manner, the echo suppressors may exercise different controls over the circuit, depending upon the direction of transmission.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing, Figure 1 of which is a circuit diagram illustrating the preferred embodiment of the invention, and Fig. 2 is a diagram showing a typical delay circuit.

Referring to Fig. 1, the invention is shown applied to a radio system of communication, but it will be understood that it is equally applicable to other types of systems. The circuit as illustrated comprises a schematically shown radio transmitter T, and a schematically shown radio receiver R, each of which may be of any well-known type or construction. A trunk TE including a one-way repeater RE serves to connect the radio transmitter T to a two-wire line L′. Similarly, a trunk TW including a one-way repeater RW serves to connect the radio receiver R to the two-wire line L′. The two-wire line L′ may be connected to a terminal line L leading to a telephone subscriber's set in any well-known manner, as, for example, through a 22-type repeater comprising amplifiers AE and AW, balancing networks N and N′, etc., all arranged in a manner well understood in the art.

A delay network X may be interposed in the two-wire line L′. This delay network may be of any known type. For example, it may assume the form of a low-pass filter such as is illustrated in Fig. 2. At one side of the delay circuit X, an echo suppressor unit comprising a voice current detector or rectifier DE and its controlled relay ER is bridged across the line L′. The detector or rectifier is indicated conventionally and may be of any type well-known in the art, preferably including suitable amplifying means for amplifying the voice currents which are to be rectified in order to operate the relay. A similar echo suppressor unit comprising a voice current detector or rectifier DW and its associated relay WR is bridged across the line L′ on the opposite side of the delay circuit X. The relays ER and WR exercise a joint control over a switching relay 21 which in turn controls the circuits of relays 22 and 23. The trunk TE is normally short circuited over the back contact of relay 22, thereby preventing singing from the transmitting antenna to the receiving antenna and thence through the trunks TW and TE in tandem. Relay 23, when energized, is adapted to short circuit the trunk TW to prevent transmission from east to west.

The relays used are such that while relays 22 and 23 operate promptly in response to the effect of voice currents, they do not return to their normal condition until a period has elapsed after the cessation of the voice currents which is long enough to insure that all echoes have died out.

It will, of course, be understood that the transmission loss introduced by the delay network X may be made up by the 22 repeater interposed between line sections L and L′.

The operation is as follows: Normally, the trunk TE is short circuited so that transmis-

sion can not take place from west to east. The trunk TW is normally operative, however, and signals radiated from the distant transmitting station will be received. If a subscriber talks over the line L, the transmission passes through the 22 repeater to the line section L′ and thence through the delay network X. In the meantime, part of the energy passes into the voice current detector DE and is rectified to operate the relay ER. This relay closes the circuit through the left-hand winding of the relay 21. Relay 21 pulls up its armature, thereby opening the circuit of its right-hand winding which is controlled by the relay WR, and at the same time it closes the circuit of relays 22 and 23. Relay 22 removes the short circuit from the trunk TE of the four-wire part of the system, while at the same time the relay 23 short-circuits the trunk TW of the four-wire part of the system. As a result, the system is now in a condition to transmit from west to east. Furthermore, any energy radiated by the transmitter T and received locally by the receiver R will be ineffective due to the short circuit across the trunk TW. When the voice signals have passed through the delay network X, a part of the energy is transmitted into the trunk TE and through the repeater RE to be radiated by the radio transmitter T. Another part of the energy enters the voice current detector DW and is rectified to operate the relay WR. The operation of this relay produces no effect, however, as the relay 21 has already been energized, so that the right-hand circuit of the relay 21 is opened. The delay circuit X therefore performs a dual function in that it delays the operation of the relay WR until after the relay ER has seized control of the circuit. It also delays the transmission of the voice currents to the trunk TE until such time as the relay 22 has operated to remove the short circuit from the trunk.

With the circuit in the condition above described, it is not possible for a subscriber at a distant station to talk from east to west, since the trunk TW associated with the radio receiver R is disabled. When, however, the subscriber associated with the line L ceases to talk, the echo suppressor relay ER is deenergized, and, a moment later, the echo suppressor WR is also deenergized. Relay 21, which may be somewhat slow to release, will release its armature after an interval, thereby opening the circuits of relays 22 and 23. This again restores the short circuit to the trunk TE and removes the short circuit from the trunk TW, a sufficient interval having elapsed to insure that all echoes have died out. The circuit is now in condition to transmit from east to west.

If a subscriber associated with the distant intercommunicating set talks, the energy so radiated will be received by the radio receiver R, and the voice signal detected therefrom in the usual manner. The detected voice currents pass through the repeater RW and over the trunk TW to the line section L′. The energy is prevented from passing over the trunk TE to the radio transmitter T by the short circuit controlled by the relay 22. As the voice energy enters the delay circuit X, a portion of said energy is diverted into the voice current detector DW, and upon being rectified, operates the relay WR. This relay at once closes the circuit through the right-hand winding of relay 21. As relay 21 is a polar relay, the current flowing through its right-hand winding is in such a direction as not to cause it to pull up its armature. After the voice energy passes through the delay circuit X, a part of it is diverted to operate the relay ER of the other echo suppressor unit. This closes the circuit through the left-hand winding of the relay 21. The relay 21 is differentially wound so that its windings oppose each other, with the result that the current flowing through the left-hand winding is ineffective to actuate the relay. Accordingly, relays 22 and 23 remain deenergized during the time the transmission is taking place from east to west. When the subscriber at the distant station ceases talking, relay WR and relay ER release, and the circuit is restored to normal. Relay WR should, of course, hang on until relay ER releases as otherwise relay 21 might operate.

It will be clear that the operation of the circuit above described depends upon which of the two echo suppressor units is operated first, and this in turn is determined by the direction from which the voice currents arrive. It will also be clear that as the circuit is only operative in one direction at a time, it is unnecessary to provide balancing arrangements between the two-wire and four-wire parts of the system.

It will also be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention, as defined in the following claims.

What is claimed is:

1. In a transmission system comprising a two-wire section and a four-wire section, echo suppressor units so associated with the two-wire section as to be both operable by transmission in one direction thereover, means in said section to delay transmission from one of said units to the other, means operative to determine which branch of the four-wire section of the system shall be operated, and means whereby the determination exercised by said last mentioned means will be dependent upon which echo suppressor unit is first operated.

2. In a signaling system having a two-wire section and a four-wire section, a pair of echo

suppressor units associated with said two-wire section, means in said section to delay transmission from one unit to the other, means responsive when one of said units is actuated before the other to render one branch of the four-wire section operative and the other branch inoperative, and means operating when the other unit is operated first to render said first branch of the four-wire section inoperative and said last branch operative.

3. In a signaling system comprising a two-wire section and a four-wire section, a relay normally operative to disable one branch of the four-wire section while permitting the second branch of said section to remain operative, a pair of echo suppressor units associated with said two-wire branch, a delay circuit interposed between said units, and means whereby when one of said units is operated before the other, said relay will be actuated to render said first mentioned branch operative and to disable said second branch, and whereby when the other unit is operated first, said relay will cause said first branch of the four-wire section to be disabled and said second branch to be operated.

4. In a signaling system having a radio transmitter and a radio receiver, separate branches extending from said transmitter and receiver, respectively, to a two-wire line, a pair of echo suppressor units connected to said two-wire line, a delay circuit interposed between the said units, relay means normally functioning to disable the branch leading to said transmitter, means operative when one of said units is actuated before the other to cause said relay means to render the branch leading to said transmitter operative while disabling the branch leading to the receiver, and whereby when the other of said units is actuated first, said relay means will disable the branch leading to the transmitter, and render the branch leading to the receiver operative.

In testimony whereof, I have signed my name to this specification this 22nd day of April, 1926.

SUMNER B. WRIGHT.