

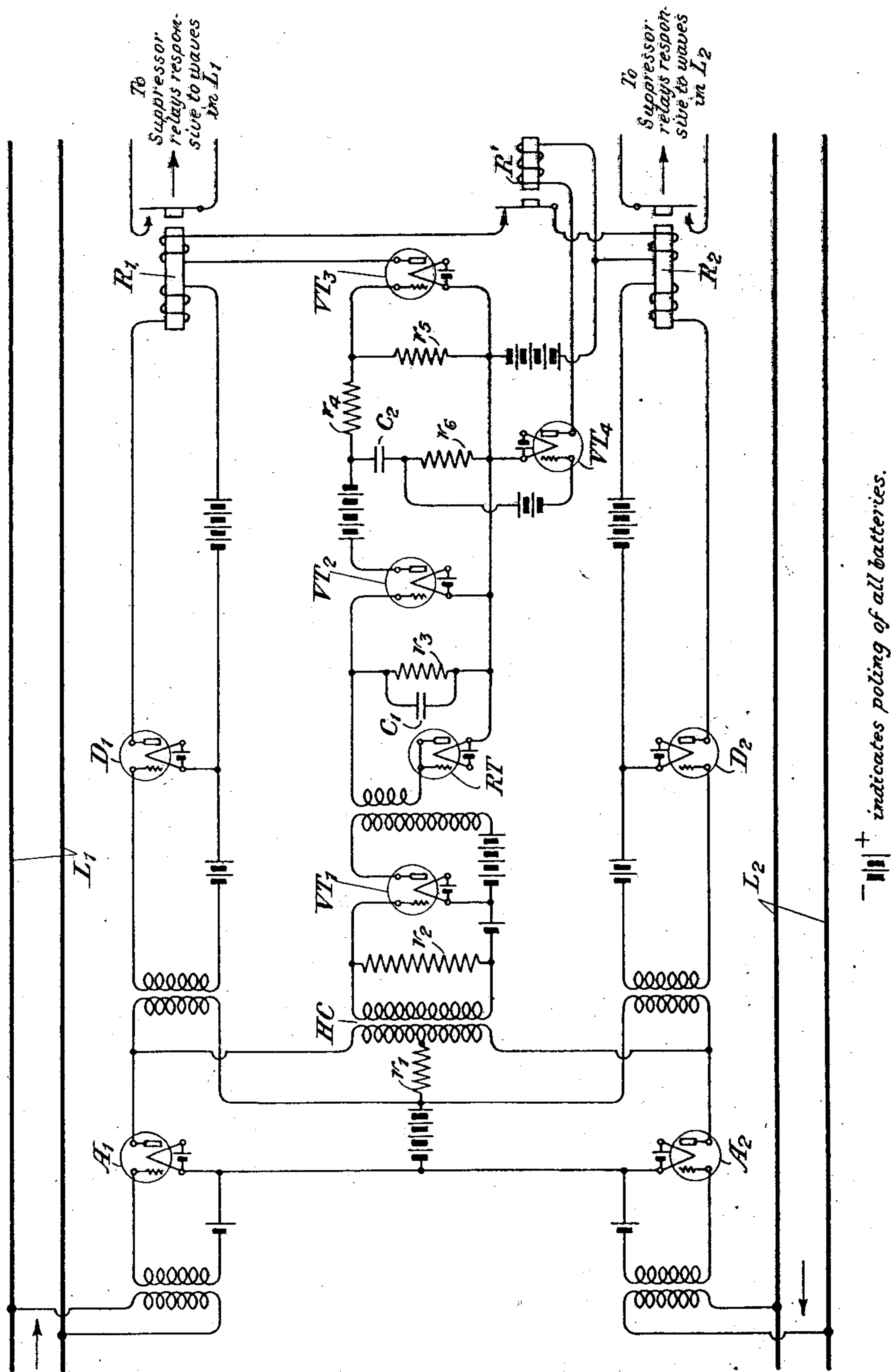
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ECHO SUPPRESSOR

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ECHO SUPPRESSOR

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This invention relates to two-way transmission circuits, and more particularly to four-wire circuits and the apparatus often associated therewith for suppressing echoes.

For a discussion of some of the fundamental problems connected with the presence of echoes in two-way transmission circuits, and for a description of echo-suppressing devices which are among those better known in the art, reference may be had to an article by A. B. Clark and R. C. Mathes, Journal of the American Institute of Electrical Engineers, June 1925, pages 618-626.

One object of the invention is to provide for reduction of the sensitivity of the echo-suppressor switches in such a manner as to prevent false operation of these devices by noise in the transmission paths.

A second object of the invention is to prevent the above-mentioned false operation without rendering the echo suppressor insufficiently sensitive to voice waves when no noise is present.

A further object of the invention is the reduction of the sensitivity of the echo-suppressor apparatus to noise currents without introducing improper interaction between the two sides of the echo-suppressor system.

In attaining the above stated objects, the applicants, in general, provide means responsive to noise in either side of the four-wire circuit for biasing the echo-suppressor relays, and means for preventing the biasing of the relays in response to voice waves, and arrange the circuits designed to accomplish the control of the echo-suppressor relays in such a manner that neither side of the system acts falsely upon the other side.

The invention will now be more clearly understood from the following detailed description of one desirable embodiment thereof. This description is to be read with reference to the accompanying drawing, showing diagrammatically the circuits and apparatus involved.

With reference to the details of the drawing, there is shown a section of a four-wire circuit having a path L_1 adapted for transmission from west to east, for instance, and a second path L_2 adapted for transmission

from east to west. Connected across the line L_1 is an amplifier A_1 which has its output connected to the input of a detector D_1 . The left hand winding of a relay R_1 is included in the plate circuit of detector D_1 and this relay controls other relays which directly accomplish the echo-suppressing function. Likewise there are associated with the line L_2 and amplifier A_2 , a detector D_2 , and a relay R_2 , the relay having its left-hand winding connected in the plate circuit of the detector. The relay R_2 controls other relays which directly accomplish the echo-suppressing function. The relays controlled by relays R_1 and R_2 are fully described in the above-identified article by Clark and Mathes; accordingly, the apparatus controlled by the two relays in the detector circuits of the applicants' arrangement are merely indicated in the drawing.

It is, of course, desirable that the echo-suppressor apparatus described above be as sensitive as possible to voice waves in the four-wire circuit. It is, however, equally desirable that the echo-suppressing apparatus be not operated in response to noise in the four-wire circuit.

The applicants add a right-hand winding to each of the relays R_1 and R_2 , these windings being so connected that current through them opposes the operating current from the detectors D_1 and D_2 , that is, current in the right-hand windings biases the relays against operation. To control the current through these right-hand windings of relays R_1 and R_2 , and consequently the sensitivity of the relays, the applicants employ the vacuum tubes VT_1 , RT , VT_2 , VT_3 , and VT_4 . A relay R' , condensers C_1 and C_2 , and resistances r_3 , r_4 , r_5 , and r_6 are connected as disclosed in the drawing. The input of tube VT_1 , which is an amplifier tube, is associated with amplifiers A_1 and A_2 through a hybrid coil arrangement HC . The resistances r_1 and r_2 , forming parts of the hybrid coil arrangement, are given such values that current passing from amplifier A_1 , for instance, to the tube VT_1 , will set up no false action in the side of the echo-suppressor system connected across line L_2 of the four-wire circuit. It is to be understood that any suitable arrangement known

in the art may be substituted for the hybrid coil arrangement described.

The operation of the applicants' circuits for controlling the sensitivity of relays R_1 and R_2 will now be considered. If voice waves act on tube VT_1 , the tube RT , which is a rectifier tube, is operated, and by reason of the connection shown and the action of condenser C_1 and resistance r_3 a negative potential is impressed on the grid of the vacuum tube VT_2 , which functions as a blocking tube. This negative potential serves to reduce the current in the plate circuit of the tube VT_2 and the condenser C_2 begins to discharge through resistances r_4 and r_5 . Since the voice wave is rapidly fluctuating, the discharge of condenser C_2 will usually be checked by a decrease of the amplitude of the input wave, which causes an increase of plate current in the blocking tube of VT_2 and a re-charging of condenser C_2 . However, as the condenser C_2 discharges through resistances r_4 and r_5 , the grid of tube VT_3 becomes less negative. It will be noted that the plate circuit of this tube VT_3 includes the biasing windings of relays R_1 and R_2 and the normally closed contact controlled by relay R' . With relay R' unoperated, it is evident that the driving of the grid of tube VT_3 less negative increases the plate current in the tube and tends to bias relays R_1 and R_2 against operation by detectors D_1 and D_2 , respectively. Accordingly, voice waves which represented somewhat sustained energy might, through the operation of the applicants' system, cause a slight reduction of sensitivity in relays R_1 and R_2 , which reduction is not desired in response to such waves.

In order to prevent the above-mentioned false reduction of sensitivity in relays R_1 and R_2 , the applicants employ the tube VT_4 associated with a resistance r_6 , the condenser C_2 , and the relay R' . The tube VT_4 is normally inoperative, due to the negative biasing voltage on the grid. Voice waves of considerable amplitude, however, will drive the grid of the tube considerably less negative and the tube will operate, causing the operation of relay R' . This relay operation breaks the circuit through the biasing windings of relays R_1 and R_2 , and plate current in tube VT_3 will have no effect on the sensitivity of relays R_1 and R_2 .

If, however, the waves coming in from the four-wire circuit are not fluctuating voice waves but relatively steady noise, the condenser C_2 will discharge slowly and fully through resistances r_4 and r_5 , and plate current will tend to flow in tube VT_3 not only while the circuit is broken at relay R' through operation of tube VT_4 but also after tube VT_4 has ceased to operate through restored negative biasing voltage on its grid and the circuit has been re-closed at relay R' . Thus it will be seen that while the fluctuating

voice waves have no effect whatsoever on the sensitivity of the echo-suppressor relays, noise which is sustained will, after a certain time, cause the full biasing of the echo-suppressor relays, and accordingly operation of the echo-suppressor apparatus in response to noise is substantially prevented.

It will be noted that the biasing windings of relays R_1 and R_2 are so connected in the system that noise on either side of the four-wire circuit causes reduction of sensitivity in both sides of the echo suppressor system, and accordingly false operation of the echo suppressor by noise is prevented.

While the invention has been described in one embodiment which is deemed desirable, it is to be understood that this description is merely for the purpose of illustration and does not limit the scope of the invention, which is determined by the appended claims.

What is claimed is:

1. In a system for suppressing echoes in a two-way circuit, a voice-operated device associated with each side of the circuit, a relay controlled thereby and adapted to block the opposite side of the circuit, and means responsive to noise in either side of the circuit for biasing both the relays to prevent operation thereof by the noise.
2. In a system for suppressing echoes in a two-way circuit, a voice-operated device associated with each side of the circuit, a relay controlled thereby and adapted to block the opposite side of the circuit, means responsive to noise in either side of the circuit for biasing both the relays to prevent operation thereof by the noise, and means for preventing the biasing of the relays in response to voice waves.
3. In a system for suppressing echoes in a two-way circuit, a voice-operated device associated with each side of the circuit, a relay controlled thereby and adapted to block the opposite side of the circuit, means responsive to noise in either side of the circuit for biasing both the relays to prevent operation thereof by the noise, means for preventing the biasing of the relays in response to voice waves, and means for preventing interaction between the two sides of the echo-suppressor system due to the association therewith of the biasing means.

In testimony whereof, I have signed my name to this specification this 18th day of February, 1929.

DOREN MITCHELL.

In testimony whereof, I have signed my name to this specification this 13th day of February, 1929.

HAROLD C. SILENT.