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SIGNALING SYSTEM

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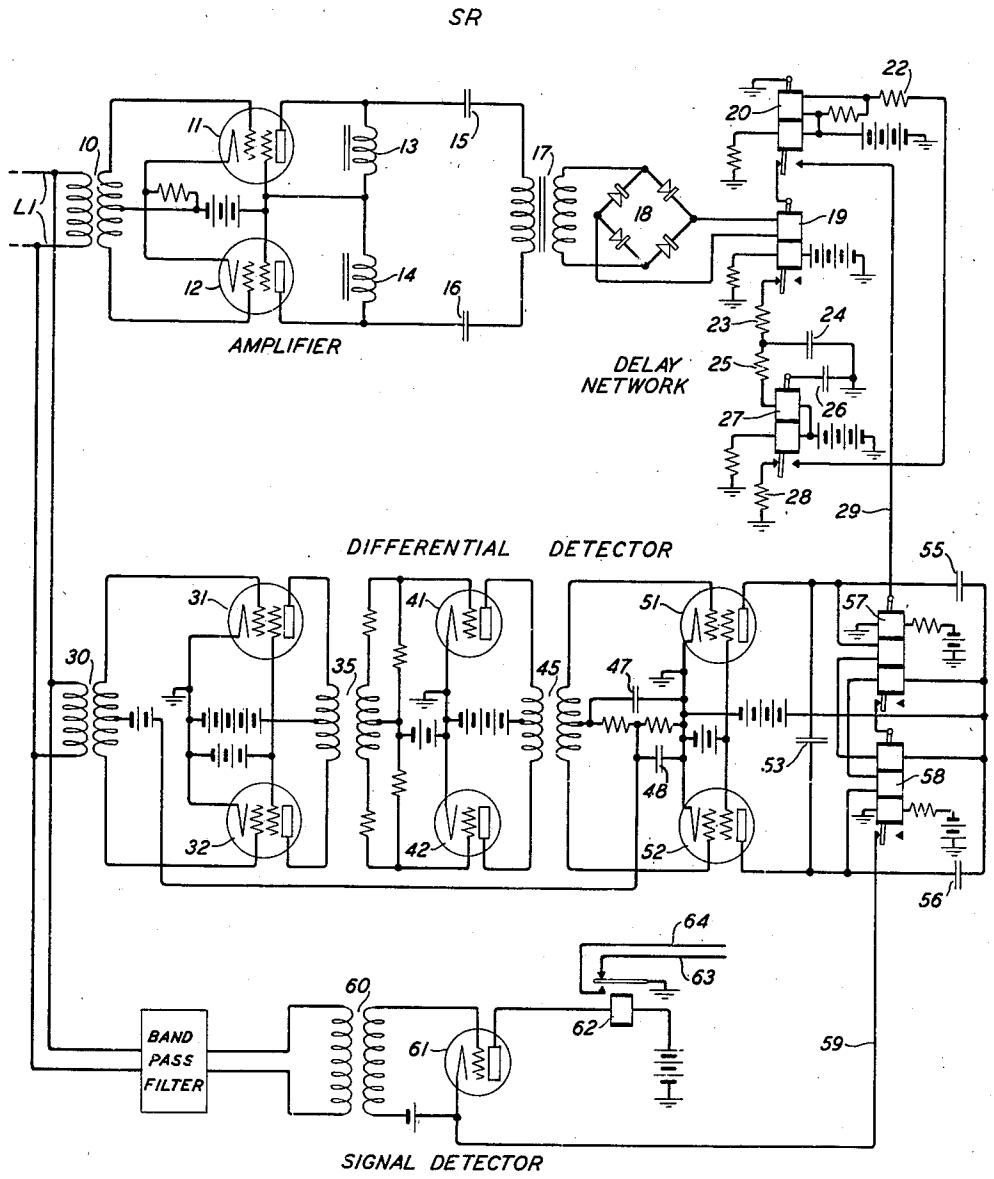

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SIGNALING SYSTEM

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7 Claims. (Cl. 179—4)

This invention relates to signaling systems and particularly to systems in which alternating currents within the voice frequency range are used to transmit signals.

Objects of the invention are an increase in the reliability of signal response and a decrease in the likelihood of false signal operation in systems in which signals consisting of current of voice frequency are transmitted over lines used for the transmission of voice currents.

It is known that voice currents, that is currents generated in telephone transmitter circuits and transmitted over the associated line, are not symmetrical in wave form, the amplitude of the negative half cycles of current being greater than the amplitude of the positive half cycles of current or vice versa depending upon the particular circuit arrangement at the station. Since signaling currents are usually symmetrical in this respect and the signal transmitting means can be designed so that alternating signaling currents are symmetrical in this respect, this asymmetry characteristic of voice currents may be utilized to prevent false signal operation when voice currents are being transmitted over a line.

This invention is a signaling system in which signals of symmetrical voice frequency current effect a signal response and in which the asymmetry of voice currents is utilized to prevent a signal operation in response to voice currents or other non-symmetrical currents of signaling frequency.

According to a feature of the invention the current in a line over which both voice currents and signal currents are transmitted is connected to a signal receiver comprising an asymmetry or differential detector and a signal detector, the differential detector being effective to prevent the closing of the signaling circuit under the control of the signal detector in response to asymmetrical voice currents. According to a further feature, a signal receiver of the aforementioned character includes a delay network which enables closing of the signaling circuit only if the symmetrical current of signaling frequency persists for a predetermined interval of time.

The copending application of W. W. Fritschi, Serial No. 440,140, filed April 23, 1942, also covers a system in which the difference in wave form between signal currents and speech currents is utilized to prevent signal operation in response to speech currents.

A clear and complete understanding of the invention will be facilitated by considering a signal receiver embodying the features of the invention, one such receiver being shown schematically in the drawing which forms a part of this specification.

The drawing, which consists of a single figure, shows a telephone line L1 connected to a signal receiver SR comprising an amplifier and delay network, a differential detector, and a signal detector.

The line L1 is a line over which voice currents and voice frequency signaling currents are transmitted and noise or other interference currents are usually present in some degree. The line L1 is connected to the amplifier and delay network by a transformer 10, to the differential detector by a transformer 30, and to the signal detector by a transformer 60, the primary windings of these transformers being connected in parallel, as shown, or in series if so desired. If the signaling current to which response is desired consists of current of a particular frequency characteristic, a band-pass filter is included between the line and the primary winding of transformer 60 as shown in the drawing or one of the windings of the transformer 60 may be included in a tuned network through which potentials of only the desired frequency are applied to the grid of tube 61.

The amplifier consists of two vacuum tubes 11 and 12 connected as amplifiers in push-pull relationship, retard coils 13 and 14, condensers 15 and 16 and the primary winding of transformer 17. The delay network comprises relays 19, 20 and 27 which are controlled by the output of the amplifier for enabling the operation of the signal relay 62 if and when signaling current is transmitted over line L1 for a predetermined interval of time, for instance .020 second. The secondary winding of transformer 17 is connected through the full-wave rectifier 18 to the upper operating winding of relay 19. Relay 19 is a polarized relay, the left contact of which is normally closed due to the energization of its lower biasing winding. When the current in primary winding of transformer 17 builds up to a high enough value, the potential induced in the secondary winding causes the operative energization of the upper winding of relay 19, whereupon relay 19 opens its left contact, thereby opening a normally closed circuit through the upper, operating winding of polarized relay 27. The energization of the upper winding of relay 27 is maintained for a short interval of time while condenser 24 is charging, after which the energization of the lower biasing winding of relay 27 becomes effective to close the right contact of this relay to connect condenser

26 in series with resistance 22 and with the upper, operating winding of polarized relay 20. While condenser 26 is charging, the upper winding of relay 20 is operatively energized to effect the closing of the right contact of relay 20 and thereby connect ground potential to conductor 29, thence through back contacts of relays 57 and 58 to conductor 59 to enable the operation of signal relay 62. The current charging condenser 26 maintains the operative energization of the upper winding of relay 20 for about .040 second, after which the lower biasing winding of relay 20 restores the contact springs to normal, thereby disconnecting ground potential from conductor 29. If relay 19 is being held operated by current in line L1, the release of relay 20 is ineffective to cause the reoperation of relay 27; but, as soon as both of relays 19 and 20 have released, the upper winding of relay 27 is again energized and relay 27 closes its left contact to discharge condenser 26. Thus, about .020 second after the start of a current in line L1, ground is connected to conductor 29; and, at the end of an interval of .040 second, ground is disconnected from conductor 29, the continued operation of relay 19 being ineffective to again connect ground potential to conductor 29.

The differential detector comprises linear amplifier tubes 31 and 32, transformer 35, linear amplifier tubes 41 and 42, transformer 45, and amplifier detector tubes 51 and 52 so connected that the negative and positive half cycles of the voltage induced in the secondary winding of transformer 30 are amplified and applied through transformer 45 to the grids of self-biasing detector tubes 51 and 52. The voltages applied through transformer 45 cause rectified currents in the grid-cathode circuits of tubes 51 and 52, thereby effecting the charging of condensers 47 and 48; so that the bias of both of these tubes is increased until the effective grid voltage is almost equal to the peak voltage of the applied signal. If the current in line L1 is asymmetric in wave form, the final, small current which maintains the charge in condensers 47 and 48, results from the highest positive peak voltage; and the grid of that one of tubes 51 and 52, to which this peak voltage is applied, is less negative than the grid of the other of these tubes. Therefore, the current in the anode-cathode circuit of the detector tube to which the peak positive voltage is applied will be larger than the current in the anode-cathode circuit of the other of these detector tubes. A portion of the self-biasing voltage developed by detector tubes 51 and 52 is included in the bias of the variable mu amplifier tubes 31 and 32 as an automatic sensitivity control; so that the linear amplifier tubes will not be overloaded by loud speech or tones. Each of relays 57 and 58 is a polarized relay having a normally energized biasing winding for holding the contacts in the position shown in the drawing. The current in the output circuit of tube 51 energizes the middle winding of relay 57 and upper winding of relay 58 in series; and the current in the output circuit of tube 52 energizes the middle winding of relay 58 and lower winding of relay 57. The upper and middle windings of relay 58 and the middle and lower windings of relay 57 are connected so as to be differentially energized; so that, as long as the current in line L1 is symmetrical, neither of relays 57 and 58 is operated. And in this case the connection of ground potential to conductor 29 by the operation of relay 20, as above described, closes the anode-cathode circuit of tube 61; so that current of signaling frequency of a high enough energy level to overcome the normal negative bias in the grid-cathode circuit effects the operation of signal relay 62. Relay 62 in turn controls circuits through conductors 63 and 64 to perform any desired signaling operation.

If, however, the negative half cycles of current in line L1 are of higher amplitude than the positive half cycles or the positive half cycles are of higher amplitude than the negative half cycles, the output of tubes 51 and 52 will be sufficiently unbalanced to effect the operation of the one or the other of relays 57 and 58. The condenser 53 is to by-pass the alternating current components of the detected signal and to permit only the direct current components to pass through the differential windings of relays 57 and 58. The operation of either one of relays 57 and 58 opens the normal connection between conductors 29 and 59 to prevent the closing of the anode-cathode circuit of tube 61 of the signal detector and thereby prevent the operation of signal relay 62.

What is claimed is:

1. In a signaling system in which signals are transmitted by alternating current of symmetrical wave form within the voice frequency range, a signal receiver comprising an input circuit, a signal detector connected to said input circuit, a signal device connected for operation by current in the output circuit of said detector, an asymmetry detector for detecting asymmetry in the wave form of the current in said input circuit, and means controlled by said asymmetry detector for preventing the operation of said signal device in response to voice currents or other currents which are asymmetric in wave form.

2. In a signaling system comprising a line over which voice currents and signaling currents of one or more frequencies within the voice range are transmitted, the signaling currents being symmetrical in wave form, a signal receiver connected to said line, said receiver comprising an input circuit, a signal device, means including a detector operatively connecting said device to said input circuit, an asymmetry detector connected to said input circuit for detecting whether the current therein is of asymmetric wave form, and means rendered effective by said asymmetry detector in response to current of asymmetric wave form in said input circuit for preventing the operation of said signal device.

3. In a signaling system in which signals are transmitted by alternating currents within the voice frequency range, said signaling current being symmetrical in wave form, a signal receiver comprising an input circuit, a signal detector connected to said input circuit, a signal device connected to the output circuit of said detector, an asymmetry detector connected to said input circuit, means controlled by said asymmetry detector responsive to voice currents or other current of asymmetric wave form in said input circuit for preventing the operation of said signal detector, and means comprising a delay network connected to said input circuit for rendering said signal detector inoperative until the current in said input circuit has continued for a predetermined interval of time.

4. In a signalling system in which signals are transmitted by alternating current within the voice frequency range, said signaling current being symmetrical in wave form, a signal receiver comprising an input circuit, a signal de-

vice, means comprising a normally inoperative signal detector connecting said device to said input circuit for operation in response to signaling current, an asymmetry detector connected to said input circuit, means comprising a delay network responsive to current in said input circuit for rendering said signal detector operative when the current in said input circuit has continued for a predetermined interval of time, and means rendered effective by the operation of said asymmetry detector in case the current in said input circuit is asymmetrical in wave form for preventing the operation of said signal detector.

5. In a signaling system in which signals are transmitted by alternating current of a particular frequency characteristic within the voice frequency range, the signaling current being symmetrical in wave form, a signal receiver comprising an input circuit, a signal detector, a band-pass filter tuned to transmit current of said particular frequency characteristic connecting said signal detector to said input circuit, a signal device connected for operation by current in the output circuit of said signal detector, an asymmetry detector for detecting asymmetry in the wave form of the current in said input circuit, and means controlled by said asymmetry detector for preventing the operation of said signal device in response to voice currents or other currents of said particular frequency characteristic which are asymmetric in wave form.

6. In a signaling system in which signals are transmitted by alternating current of a particular frequency characteristic within the voice frequency range, said signaling current being symmetrical in wave form, a signal receiver comprising an input circuit, a signal detector, a band-pass filter tuned to said particular frequency characteristic connecting said signal detector to said input circuit, a signal device connected to the output circuit of said detector, an asymmetry detector connected to said input circuit, means controlled by said asymmetry detector responsive to voice currents or other current of asymmetric wave form in said input circuit for preventing the operation of said signal detector, and means comprising a delay network connected to said input circuit for rendering said signal detector inoperative until the current in said input circuit has continued for a predetermined interval of time.

7. In a signaling system in which signals are transmitted by alternating current of a particular frequency characteristic within the voice frequency range, said signaling current being symmetrical in wave form, a signal receiver comprising an input circuit, a signal device, means comprising a normally inoperative signal detector for operating said device in response to signaling current, a band-pass filter connecting said signal detector to said input circuit, said filter tuned to pass current of said particular frequency characteristic, an asymmetry detector connected to said input circuit, means comprising a delay network responsive to current in said input circuit for rendering said signal detector operative when the current in said input circuit has continued for a predetermined interval of time, and means rendered effective by the operation of said asymmetry detector in response to current of asymmetrical wave form in said input circuit for preventing the operation of said signal detector.

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