Aug. 26, 1941. A. W. HORTON, JR 2,253,621

SIGNALING SYSTEM

Filed April 5, 1940

FIG. 1

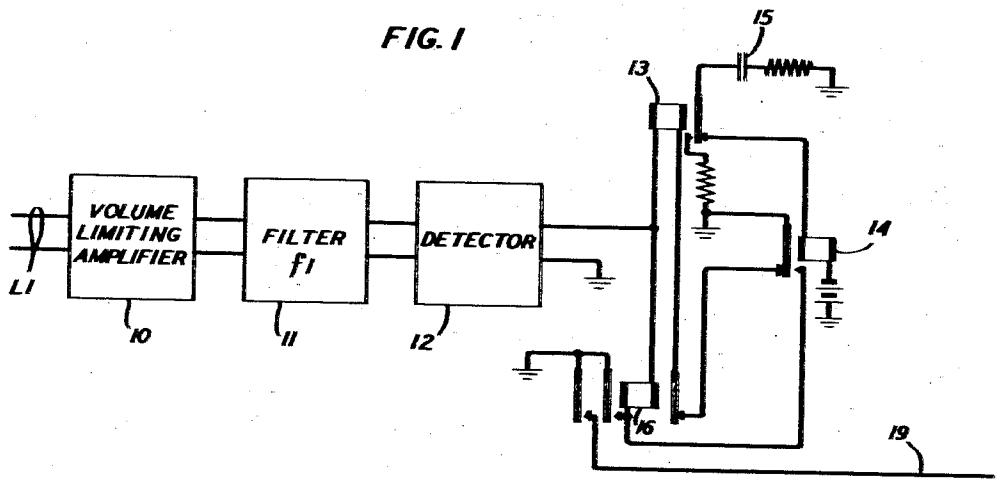
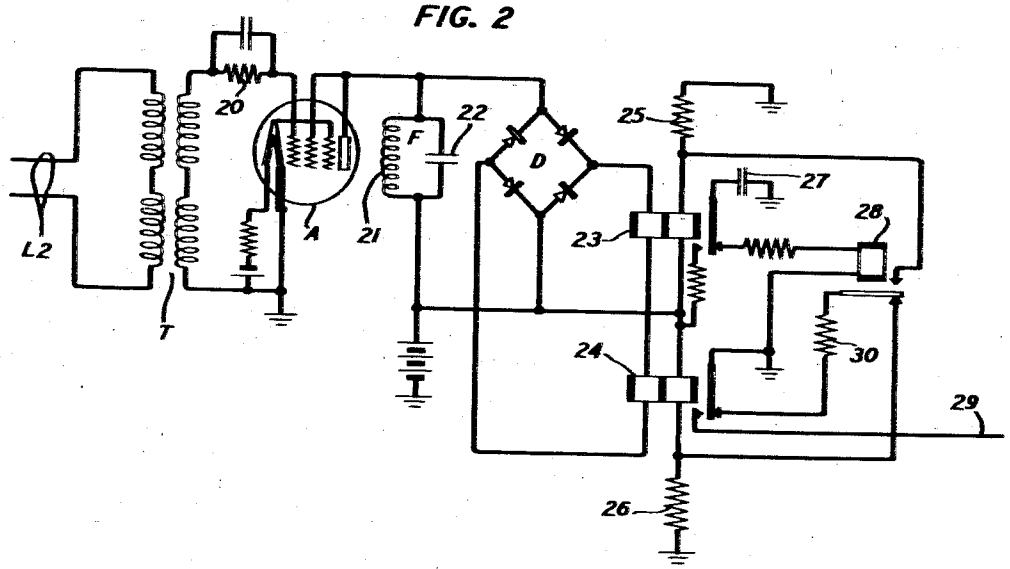


FIG. 2



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Patented Aug. 26, 1941

2,253,621

UNITED STATES PATENT OFFICE

2,253,621

SIGNALING SYSTEM

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Application April 5, 1940, Serial No. 327,963

6 Claims. (Cl. 179—16)

This invention relates to communication systems and particularly to telephone systems employing voice frequency signaling currents.

Objects of the invention are an increase in the efficiency and reliability of voice frequency signaling in communication systems. A particular object is the provision of a voice frequency signal receiver giving adequate protection against false operations with a minimum of apparatus.

This invention is a signal receiver operatively responsive to signals consisting of a current of a particular voice frequency characteristic followed within a predetermined interval of time by a current of the same frequency characteristic. The particular frequency or combination of frequencies and silent interval comprising the signal is of infrequent occurrence in voice currents; and, consequently, false operation by voice currents is largely prevented. Further prevention of false operation by voice currents is obtained by limiting the current input to a value which is operatively effective only if substantially all of the input is of said characteristic.

A feature of the invention is a signal receiver of the aforementioned character in which false operation is further prevented by an interlocking relay arrangement.

A clear and complete understanding of the invention will be facilitated by considering specific circuit arrangements in which the invention is embodied, two such arrangements being shown schematically in the drawing which forms a part of this specification.

Referring to the drawing:

Fig. 1 shows a line L1 and a signal receiver comprising a volume limiting amplifier 10, a filter 11, a detector 12, and relays 13, 14 and 16; and

Fig. 2 shows a line L2 and a signal receiver comprising an input transformer T, a volume limiting amplifier A, a filter F, a detector D, and relays 23, 24 and 28.

Consider first the arrangement shown in Fig. 1, in which all currents in line L1, signaling current, voice current, and noise or other interference current, is amplified by the volume limiting amplifier 10 which may be similar to any one of those disclosed in the patent to G. T. Lorance 1,654,085, granted December 27, 1927, or to any one of those disclosed in the patent to E. Peterson 1,830,240, granted November 3, 1931. The signaling current may be of one particular frequency or combination of frequencies, for instance, 1900 cycles, the filter 11 being designed to pass current of the signaling characteristic without passing current of other frequency characteristics. The current passed by filter 11 is rectified by detector 12 to energize the winding of relay 13 or the winding of relay 16. The amplifier 10 limits the current input to the filter 11 to a value which is sufficient to effect the operation of relay 13, or relay 16, when all of the current is of the signaling characteristic but which is insufficient to effect the operation of either relay unless substantially all of the current in line L1 is of this character.

Upon transmission of a signal over line L1, the current is substantially all of the particular frequency characteristic to which the filter 11 is tuned, and the current through the winding of relay 13 effects the operation of this relay. Relay 13 closes a circuit for discharging condenser 15 and remains operated until the signaling current in line L1 ends. The release of relay 13 connects condenser 15 in series with the winding of relay 14; and relay 14 is operated for a short and predetermined interval of time by the current charging condenser 15. Relay 14 opens the operating circuit of relay 13 and closes the operating circuit of relay 16. If the operation and release of relay 13 resulted from the transmission of a signal and was not due to voice or noise currents in line L1, the current of the signaling frequency characteristic again builds up to operating value before relay 14 releases, and the output of detector 12 now effects the operation of relay 16. Relay 16 closes a locking circuit which maintains its operation by the signaling current after relay 14 releases. Relay 16 also holds open the operating circuit of relay 13 and closes a circuit through conductor 19 to effect any desired signal response. When the signaling current in line L1 ends, relay 16 releases, thereby opening the circuit through conductor 19 to end the signal response and again closing the operating circuit of relay 13.

Consider now the arrangement shown in Fig. 2 in which all current in line L2 is transmitted through transformer T to the grid circuit of the amplifier A. The resistance of element 20 is high so as to limit the potential of the grid and, therefore, the current in the plate circuit of the amplifier. The filter F consists of coil 21 and condenser 22 of such inductance and capacity, respectively, as to offer substantially infinite impedance to current of a particular signaling frequency; and, therefore, current of this frequency is passed through detector D to energize the left windings of relays 23 and 24.

The detector D consists of rectifier elements of the dry type arranged to constitute a full wave rectifier. The right windings of relays 23 and 24 are normally biased to oppose current in the operating windings. With relay 28 normal, relay 23 is operable by its left winding in response to signaling current in line L2, but relay 24 is not operable because with resistor 30 in parallel with resistor 26, the current in the biasing winding is sufficient to prevent its operation.

Upon transmission of a signal over line L2, the current is substantially all of the signaling frequency and the left windings of relays 23 and 24 are thereby energized sufficiently to effect the operation of relay 23 but not to effect the operation of relay 24. Relay 23 closes a circuit for charging condenser 27. When the signaling current ends, relay 23 releases, closing a circuit through the winding of relay 28 for discharging condenser 27. Relay 28 is operatively energized by the discharge current for a predetermined interval of time. While relay 28 is operated, the resistor 30 is disconnected from the biasing winding of relay 24 to decrease the current through this winding and is connected in parallel with resistor 25 to increase the current in the biasing winding of relay 23. If now the operation and release of relay 23 resulted from the transmission of a signal over line L2, current of the signaling frequency again builds up, before relay 28 releases, to cause the operation of relay 24. Relay 23 is at this time inoperable due to the increase of the current in its biasing winding. Relay 24 closes a signal circuit over conductor 29 and prevents an increase in the current through its own biasing winding when relay 28 releases. When the signaling current again ends, relay 24 releases, restoring the normal biasing conditions and opening the circuit through conductor 29. Thus a signal comprising current of the signaling frequency in line L2 interrupted for a predetermined interval of time effects a closure and opening of the signal circuit through conductor 29.

What is claimed is:

1. A signal receiver for responding to signals each comprising current of a particular frequency characteristic, followed by a like current within a predetermined interval of time after the termination of the first-mentioned current, said receiver comprising two relays, one relay for response to the current preceding said termination, and the other relay for response to the current succeeding said termination, a filter for passing from said line to said relays current of only said frequency characteristic, and means for limiting the input to said filter to a value which is sufficient for operating the one or the other of said relays only if substantially all of said input is of said frequency characteristic, thereby preventing false operation of either of said relays responsive to interfering currents having a component of said frequency characteristic.

2. In a signal receiver according to claim 1, circuit means for at all times preventing the operation of said other relay except during said predetermined interval after the termination of a current which has effected the operation of said one relay.

3. A voice frequency signal receiver adapted to respond to signals consisting of a current of a particular frequency and an interruption of said current for a predetermined interval of time, said receiver comprising signal relays, a filter for passing to said relays current of only said particular frequency, only one of said relays being normally connected for responding to said signaling current, means responsive to the release of said first relay upon interruption of said current for rendering said second relay operatively responsive for a predetermined interval of time to signaling current passed by said filter, a signal circuit closed by the operation of said second relay, and means for limiting the current input to said filter to a value sufficient for effecting the operation of a signal relay only if substantially all of the input current is of said particular frequency.

4. In a telephone system, a line, signal relays for operation in response to signals transmitted over said line, each signal consisting of current of a particular frequency characteristic, the termination of this current, and a current of like character within a definite interval of time after said termination, a filter and detector for passing to said relays current of only said characteristic, an amplifier for amplifying all current in said line and for limiting the input to said filter to a value which is sufficient for operating a signal relay only when all of the input is of said frequency characteristic, an auxiliary relay, a circuit closed upon release of a first one of said relays following its operation by a current of said characteristic for operating said auxiliary relay for a predetermined interval of time at the end of which said auxiliary relay releases, means actuated by said auxiliary relay for preventing a reoperation of said first signal relay and for rendering a second one of said signal relays operatively responsive to the signaling current of said characteristic, and a signal circuit closed by the operation of said second signal relay.

5. In a telephone system, according to claim 4, means for preventing the reoperation of said first signal relay until after said second signal relay releases.

6. In a telephone system, a line, a signal receiver connected to said line for responding to signals transmitted over said line, each signal consisting of a current of a particular frequency characteristic, the termination of said current, and another current of said chaacteristic within a definite interval of time after said termination, said receiver comprising two signal relays and an auxiliary relay, a filter and a detector for passing to said relays current only of said characteristic, means for limiting the input to said filter to a value sufficient for operating a signal relay only when substantially all of the current in said line is of said characteristic, an operating winding and a biasing winding for each of said relays, a first one of said relays being normally biased to allow its operation by signaling current and a second one of said relays being normally biased to prevent its operation by signaling current in said line, a circuit for actuating said auxiliary relay responsive to the operation and release of said first signal relay and for holding said auxiliary relay operated for a definite and predetermined interval of time, means effective while said auxiliary relay is operated for increasing the bias of said first signal relay to render it non-responsive and for decreasing the bias of said second signal relay to render it responsive to signaling current in said line, and a signal circuit closed by the operation of said second signal relay.

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