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SIGNALING SYSTEM

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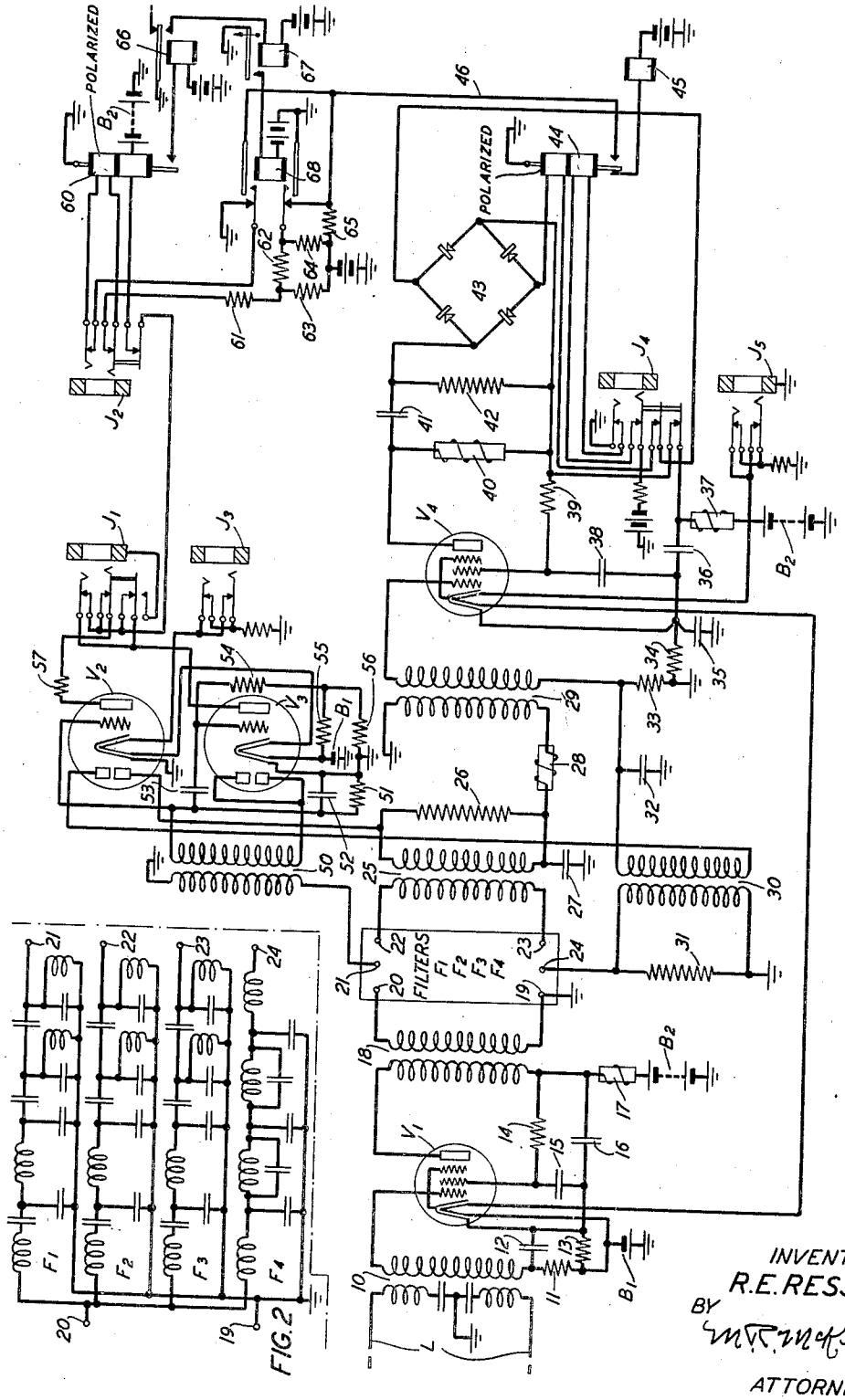

FIG. 1

FIG. 2

INVENTOR
R. E. RESSLER
BY
ATTORNEY

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SIGNALING SYSTEM

Ralph E. Ressler, Morristown, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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11 Claims. (Cl. 179—84)

This invention relates to signaling systems and particularly to systems comprising signal receiving means responsive to voice frequency signals.

Among the objects of the invention are an increase in the reliability of voice frequency signaling systems and the preventing of false operations of voice frequency signal receivers due to voice currents or to voice frequency currents other than those to which response is desired.

The invention is a signal receiver arranged to respond to primary or conditioning signals and to secondary signals, both the primary and secondary signals comprising currents of one or more particular frequencies. A feature of the invention is a signal receiver comprising conditioning means responsive to a primary or conditioning signal and comprising a polarized relay for response to secondary signals, the relay having a biasing winding which is controlled by the conditioning signal to render the relay operatively responsive to the secondary signals.

Another feature of the invention is a polarized relay which is conditioned by a primary signal for response to a secondary signal of one or more voice frequencies and comprising a winding which is effective to maintain the relay operated when subjected to voice currents of the frequency or frequencies used for the secondary signal. According to this feature, a reversal of the current in a biasing winding may be effected to prevent false response to voice currents of the frequency used for the secondary signal.

Another feature of the invention is a signal receiver comprising a signal relay operatively controlled by a two-tube detector-amplifier, a first one of the tubes being responsive to an impulse of signaling current to cause the release of the relay and the other of the tubes being immediately effective at the end of the impulse to effect and maintain the reoperation of the relay until the first tube again becomes effective to maintain the operation of the relay.

The invention and its features will be more readily understood by considering a signal receiver in which the invention is embodied, one such receiver being shown in the drawing which forms a part of this specification. The invention is, however, not limited in its application to the particular signaling system represented in the drawing but is generally applicable to any voice frequency signaling system.

Referring to the drawing:

Fig. 1 discloses a signal receiver comprising transformers 10, 18, 25, 29, 30 and 50, band-pass filters F1, F2, F3 and F4, thermionic tubes V1, V2, V3 and V4, signal receiving relays 44 and 60 and auxiliary relays 45, 66, 67 and 68; and

Fig. 2 shows the filters F1, F2, F3 and F4 in detail.

The line L to which the signal receiver is connected may be of any type, for instance, a two-conductor circuit or a phantom circuit, and is used for both signaling and talking. The line is, of course, also connected to signal transmitting means which is not shown and direction selective means are provided for preventing interference between the signal sending means and the signal receiver. Reference may be had to the patent to Crisson No. 1,755,243 of April 22, 1930 and to the patent to Meszar No. 1,835,802 of December 8, 1931 for disclosure of direction selective means suitable for use between the line L and signal receiver. The receiver is arranged so as to be non-responsive to voice currents, to respond to voice frequency signaling currents of two particular frequencies and having a particular beat frequency, and to respond to selective impulses or signals of a third particular frequency superimposed on the two particular frequencies. For instance, line seizure and certain other supervisory signals received over line L may consist of current of both 1280 cycles and 1920 cycles, and selective impulses and the disconnect signal may consist of current of 1600 cycles superimposed on the current of the other two frequencies. The signal receiver is arranged so that voice currents and voice frequency currents of frequencies other than the specified combinations of signaling frequencies do not effect a signal response, and current of all frequencies below 1200 cycles acts as a guard or blocking signal to prevent false operation. The frequencies used for signals outgoing over line L differ from the frequencies of the incoming signals. For instance, seizure and other outgoing supervisory signals may consist of current of 1440 and 2080 cycles and outgoing selective signals may consist of current of 1760 cycles.

Each of the tubes V1 and V4 is a six-element vacuum tube with a suppressor grid and an indirectly heated cathode. Each of the tubes V2 and V3 is a duo-diode triode with an indirectly heated cathode. Each of the filters F1, F2, F3 and F4 consists of inductors and capacitors of desired character. Filter F1 is designed to pass current of 1600 cycles, filter F2 to pass current of 1280 cycles, filter F3 to pass current of 1920 cycles, and filter F4 to pass current of all frequencies below 1200 cycles. Jacks J1, J2, J3, J4 and J5 are provided to facilitate testing of the

various tube circuits. A battery for energizing the heating elements of the tubes is designated B1 and a battery for supplying the anode-cathode circuits is designated B2. Other sources of current may be used in place of these batteries. Another battery is shown, without designation, for energizing the biasing windings of relays 44 and 60 and the windings of relays 45, 66, 67 and 68.

The line L is connected by transformer 10 to the grid of tube V1 the voltages impressed thereon being amplified by the tube. The resistor 11 and condenser 12 constitute a low-pass filter which prevents feedback from the anode to the control grid so that noise in the source of plate current cannot reach the grid. A resistor 13 is included in the cathode-anode circuit, the drop in potential through this resistor constituting a biasing voltage applied to the grid. The resistor 14 and condenser 15 constitute a low-pass filter for isolating the screen grid from the source of plate current. The condenser 16 and retard core 17 constitute a low-pass filter which prevents noise in the plate current source from entering the output circuit which includes the primary winding of transformer 18. The secondary winding of transformer 18 is connected to filters F1, F2, F3 and F4 in multiple. Current of 1600 cycles passes through filter F1 and the primary winding of transformer 50, the secondary winding being effective to impress corresponding voltages across the grid and cathode of tube V2 as hereinafter described. Current of 1280 cycles passes through filter F2 and current of 1920 cycles passes through filter F3, the output terminals 22 and 23 of these filters being connected to the primary winding of transformer 25, thus energizing this winding with current of both frequencies. The resistor 26 constitutes a terminating resistance for the filters F2 and F3. Current of less than 1200 cycles passes through filter F4 and the primary winding of transformer 30, the resistor 31 constituting a terminating resistance for the filter F4 which may be used to control the sensitivity of the guard channel. Currents of all other frequencies are suppressed by the filters. The reference characters used for the terminals of the filters in Fig. 2 are the same as in Fig. 1.

The secondary winding of transformer 25 is connected in series with the lower diode of tube V2, retard coil 28 and the primary winding of transformer 29. The diode acts as a rectifier so that the energization of the primary winding of transformer 25 by current of the two frequencies, 1280 and 1920 cycles, effects a fluctuating unidirectional energization of the primary winding of transformer 29. Voltages of 640 cycles, thereby induced in the secondary winding of transformer 29, are impressed across the cathode and grid of tube V4. The condenser 27 and retard coil 28 constitute a low-pass filter which suppresses currents of 1280 and 1920 cycles passed through transformer 25 and insures the impression of current of the beat frequency and no other on the grid of tube V4. The grid biasing circuit of tube V4 is traced from the cathode through resistors 34 and 33 and the secondary winding of transformer 29 to the grid. When signaling currents of 1280 and 1920 cycles are being received over line L and there is an inconsequential current of frequencies below 1200 cycles present in line L, the beat frequency voltages impressed on the grid of tube V4 cause corresponding changes in the current in the output of tube V4 through resistor 42 in parallel with rectifier 43 and the upper winding of relay 44 in series. The energization of the upper winding of relay 44 overcomes the energization of its lower biasing winding and effects the operation of this relay. The condenser 38 and resistor 39 constitute a low-pass filter which separates the screen grid of tube V4 from the anode circuit. The condenser 36 and retard coil 37 constitute a low-pass filter for preventing noise in the source of plate current from being impressed on the grid of tube V4. The retard coil 40 and condenser 41 are tuned to the beat frequency so that only voltages of the beat frequency are applied to rectifier 43 to effect operation of relay 44. The resistor 42 constitutes a shunt across the rectifier and relay winding and reduces the series resistance of the tuned elements 40 and 41 to obtain satisfactory tuning characteristics.

The secondary winding of transformer 30 is connected in series with the other diode of tube V2 and the resistor 33, the diode acting as a half wave rectifier. The unidirectional current, through resistor 33, responsive to an incoming current of frequencies below 1200 cycles, causes a drop in potential in resistor 33 which increases the negative bias on the grid of tube V4. Stronger voice currents effect greater reductions in the amplification of currents of the two signaling frequencies. Thus this arrangement makes it necessary that the ratio between current of the signaling frequencies and interfering currents such as noise or voice be not less than a certain minimum value before operation of relay 44 is effected. A condenser 32 is connected across resistor 33 to maintain the drop across resistor 33 for a short interval after the occurrence of voice currents. The resistor 34 is included in the anode-cathode circuit to provide a normal grid bias for tube V4. A condenser 35 by-passes resistor 34 to prevent noise in the source of plate current from reaching the grid of tube V4.

If a strong enough current of the two signaling frequencies 1280 and 1920 cycles to effect the operation of relay 44 is received over line L, relay 44 closes a circuit for operating the cut-off relay 45 and connects ground to conductor 46 to reduce the current in upper biasing winding of relay 60. The lower winding of relay 60 is normally energized in the opposite direction to the biasing winding but due to the large normal biasing current, the armature of relay 60 is held in the position shown in the drawing. When the biasing current is reduced by the operation of relay 44, relay 60 is operated by the current normally existing in its lower winding as hereinafter described. The operation of relay 60 closes a circuit for operating relay 66. Resistors 61, 62, 63, 64 and 65 have the resistances necessary to produce the desired control of the biasing winding of relay 60. Relay 66 closes a circuit for operating the slow-to-release relay 67 and relay 67 closes a circuit for operating relay 68. With relay 68 operated, the reduced biasing current through the upper winding of relay 60 is maintained until the two frequency signal ends and relay 44 releases. When relay 44 releases, the current in the upper winding of relay 60 is reversed to maintain the operation of relay 60 until dial impulses are received or until a disconnect signal is received, irrespective of whether the lower winding is or is not energized.

The tubes V2 and V3 constitute a detector system for controlling the signal relay 60, the lower winding of relay 60 being connected to the

anodes of both of these tubes. The grid of tube V3 is normally biased to prevent current in the anode circuit. The grid biasing circuit is traced from the cathode through resistors 56 and 54 to the grid. Resistors 55 and 56 form a potentiometer circuit across battery B1 and the grid bias is equal to the drop in potential through resistor 56. While there is no current of 1600 cycles in line L, the grid of tube V2 is at substantially the same potential as the cathode; and there is, therefore, a normally existing current in the anode-cathode circuit of tube V2 through the lower winding of relay 60. Since the upper biasing winding of relay 60 is normally energized by current in the opposite direction, relay 60 is operatively non-responsive to the energization of its lower winding until relays 44 and 45 have operated, as above described, in response to a two frequency signal. When a 1600 cycle current occurs in line L, the voltages induced in the secondary winding of transformer 50 cause a unidirectional current through the rectifying elements of tube V3 and resistor 51. The condenser 52 begins to charge and the grid of tube V2 becomes more negative due to the drop in potential through resistor 51. The condenser 53 also begins to charge in series with resistor 54. The time characteristics of the resistor 51 and condenser 52 are short so that the direct current potential thereacross is at all times substantially the same as the envelope of the voltage induced in the secondary winding of transformer 50. The time characteristics of the condenser 53 and resistor 54 are somewhat longer than those of condenser 52 and resistor 51 but are short enough to permit the potential of the grid of tube V3 to closely follow the envelope of the voltages induced in the secondary winding of transformer 50. The change in the potential of the grid of tube V2 stops the current through the anode and relay 60 releases. The grid of tube V3 also becomes more negative with respect to its cathode but this is without effect since the tube is normally biased to substantially prevent current in its anode-cathode circuit. While a 1600 cycle signal is being received, the condensers 52 and 53 become fully charged at which time there is no further drop in potential through resistor 54 due to charging current and therefore, the potential of the grid of tube V3 returns to its normal biasing value. At the end of the 1600 cycle signal, the direct current potential across resistor 51 is reduced at a rate depending on the characteristics of the filter F1. As soon as this reduction in potential starts, the potentials of the grids of tubes V2 and V3 become less negative due to the discharge of condensers 52 and 53 and since the grid of tube V3 was just at the cut-off point, a current is immediately started through the anode of tube V3 and the winding of relay 60. Relay 60 reoperates and by the time the charge on condenser 53 is dissipated and the grid of each of tubes V2 and V3 has been restored to the normal potential, current through the anode of tube V2 maintains the operative energization of the lower winding of relay 60. The time characteristics of the condenser 53 and resistor 54 must be such that anode current in tube V3 is maintained until the anode current in tube V2 is built up sufficiently to hold relay 60. Before the next 1600 cycle signal is received, the voltages in the circuit must reach a steady state so that relay 60 is held by current through the anode of tube V2 and there is little or no current through the anode of tube V3. The resistor 57 prevents an excessive current through the anode of tube V2. This detector system is arranged for satisfactory transmission of dial impulses over a reasonable range of signaling energy levels even when the discharge time of the filter F4 is comparatively long.

The signaling receiver is arranged for initial response to a seizure signal comprising current of 1280 and 1920 cycles, this signal being effective to operate relay 44 as above described. When the signal ends and relay 44 releases, relay 60 is held by the reversal of the current in its biasing winding; so that, if 1600 cycle current is received but current of both 1280 and 1920 cycles is not being received at the same time, the deenergization of the lower winding of relay 60 in response to the 1600 cycle current will be ineffective to cause the release of relay 60. The two-frequency signal is again transmitted just before dialing starts and the 1600 cycle dial impulses are superimposed on the 1280 cycle and 1920 cycle currents. Therefore, relay 44 is operated just before the first dial impulse is received to restore the current through the biasing winding to its biasing direction and thus enable the response of relay 60 to dial impulses. When the last impulse of a series is ended, relay 60 reoperates and when the two-frequency signal also ends, relay 44 releases and the current through the upper winding of relay 60 is again reversed to hold relay 60. Supervisory signals consisting of the two frequencies effect the operation of relays 44 and 45. A disconnect signal consists of all three frequencies, 1280 cycles, 1600 cycles and 1920 cycles, the 1600 cycle current being continued for a long enough interval to effect the release of relays 66, 67 and 68. If the current of the two frequencies does not continue after relay 68 releases, all relays remain normal.

Relay 45 is operated in response to all signals and may control a cut-off operation on calls in which the line L is further extended to an outgoing line. In such a case it is not desirable that dial impulses or other signals incoming over line L pass through to the outgoing line and the operation of relay 45 may be utilized to open the connection between the line L and the outgoing line.

In place of using rectifier elements in tubes V2 and V3 for rectifying the various signaling currents, separate rectifiers may be provided and may, of course, be either half-wave or full-wave rectifiers. Other changes and modifications may be made in the signal receiver within the scope of the invention.

The signal receiver described in this specification is also disclosed in an application of H. M. Pruden, Serial No. 304,307, filed on even date herewith; but the invention claimed in that application is a different invention from that claimed herein.

What is claimed is:

1. In combination a line and a signal receiver, said receiver comprising control means operatively responsive to a primary signal incoming over said line, a polarized relay for responding to a secondary signal incoming over said line, an operating winding and a biasing winding for sad relay, means normally energizing the operating winding, means normally energizing said biasing winding to maintain the armature of the relay in normal position, the operation of said control means being effective to reduce the current in said biasing winding to effect actuation of the armature to its alternate position, and means operatively responsive to secondary signals

for controlling the energization of said operating winding.

2. The combination of a line and a signal receiver according to claim 1, said primary signal consisting of current of two particular frequencies and said secondary signal comprising current of a third particular frequency.

3. The combination of a line and a signal receiver according to claim 1, said primary signal consisting of current of two particular frequencies and said secondary signal consisting of current of a third particular frequency superimposed on currents of said two particular frequencies.

4. The combination of a line and a signal receiver according to claim 1, said primary signals consisting of current of two particular frequencies and said secondary signal consisting of current of a third particular frequency superimposed on currents of said two particular frequencies, said biasing winding being effective to prevent the return of the armature of the polarized relay to normal position in response to current of said third frequency alone in said line.

5. In combination a line and a signal receiver, said receiver comprising control means operatively responsive to a primary signal incoming over said line, a polarized relay for responding to a secondary signal incoming over said line, an operating winding and a biasing winding for said relay, means normally energizing the operating winding, means normally energizing said biasing winding to maintain the armature of the relay in normal position, the operation of said control means being effective to reduce the current in said biasing winding to effect actuation of the armature to its alternate position, means operatively responsive to secondary signals for controlling the energization of said operating winding, and means rendered effective by the release of said control means at the end of a primary signal for holding said armature in its alternate position independent of said operating winding.

6. In combination a line and a signal receiver, said receiver comprising control means operatively responsive to a primary signal incoming over said line, a polarized relay for responding to a secondary signal incoming over said line, an operating winding and a biasing winding for said relay, means normally energizing the operating winding, means normally energizing said biasing winding to maintain the armature of the relay in normal position, the operation of said control means being effective to reduce the current in said biasing winding to effect actuation of the armature to its alternate position, means operatively responsive to secondary signals for controlling the energization of said operating winding, and means for reversing the current in said biasing winding at the end of a primary signal to hold said armature in its alternate position independent of said operating winding.

7. In a signaling system, a line and a signal receiver connected to said line, said receiver comprising a signal relay and means responsive to current of a particular frequency in said line for operatively controlling said relay, said means comprising two detectors, an operating winding of said relay connected in the output circuit of each of said detectors, control means effecting a current in the output circuit of one of said detectors to operatively energize said relay when there is no current of said frequency in said line and effecting a reduction of the current in said output circuit to release said relay when an impulse of signaling current of said frequency is received over said line, and other control means effecting a current in the output circuit of the other detector to reoperate said relay at the end of said impulse.

8. In a signaling system, a line and a signal receiver connected to said line, said receiver comprising a signal relay and means responsive to current of a particular frequency in said line for operatively controlling said relay, said means comprising two detectors, an operating winding of said relay connected in the output circuit of each of said detectors, control means effecting a current in the output circuit of one of said detectors to operatively energize said relay when there is no current of said frequency in said line and effecting a reduction of the current in said output circuit to release said relay when an impulse of signaling current of said frequency is received over said line, and other control means effecting a current in the output circuit of the other detector to reoperate said relay at the end of said impulse, said other control means being effective at all other times to substantially prevent current in the output circuit of said other detector.

9. In a signaling system, a line and a signal receiver connected to said line, said receiver comprising an impulse relay, circuit means responsive to signaling current of two particular frequencies in said line for operating said impulse relay, and circuit means for causing the release and reoperation of said impulse relay in response to each impulse of current of a third particular frequency in said line, said last-mentioned circuit means comprising two triodes, the winding of said relay being connected in series with the anode and cathode of each of said triodes, means for biasing the grid of one of said triodes to effect operation of said impulse relay when there is no current of said third frequency in said line and to cause release of said relay at the beginning of an impulse of current of said third particular frequency, means for biasing the grid of the other of said triodes so that there is substantially no current in its anode-cathode circuit when there is no current of said third frequency in said line, and means effective at the end of an impulse of said third particular frequency for causing a momentary current of sufficient amplitude in the anode-cathode circuit of said other of the triodes to quickly reoperate said impulse relay, the current in the anode-cathode circuit of said one of the triodes being effective to hold said relay reoperated after the current in the anode-cathode circuit of said other triode ceases.

10. In a signaling system, a line, two relays, one for response to signals consisting of current of two particular frequencies in said line, the other for response to signals consisting of current of a third particular frequency superimposed on currents of said two frequencies, a rectifier, the output of said rectifier connected to said one of the relays, an amplifier, means tuned to pass currents of a frequency equal to the difference between said two frequencies connecting the output of said amplifier to the input of said rectifier, another rectifier, means comprising a filter tuned to pass currents of said two particular frequencies connecting said line to the input of said other rectifier, means connecting the output of said other rectifier to the input of said amplifier, a third rectifier, the output of said third rectifier connected to the other of said relays, means comprising a filter tuned to said

third particular frequency connecting said line to the input of said third rectifier, means comprising said one relay for rendering said other relay responsive to current of said third frequency, means rendered effective by the release of said one relay while said other relay is operated for rendering the other relay non-responsive to current of said third frequency in said line, and means responsive to currents of frequencies other than said particular frequencies in case the current in said line includes said particular frequencies and other frequencies for preventing the operation of said one of the relays.

11. In a signaling system, a line, two relays, one for response to signals consisting of current of two particular frequencies in said line, the other for response to signals consisting of current of a third particular frequency superimposed on currents of said two frequencies, a rectifier, the output of said rectifier connected to said one of the relays, an amplifier, means tuned to pass currents of a frequency equal to the difference between said two frequencies connecting the output of said amplifier to the input of said rectifier, another rectifier, means comprising a filter tuned to pass currents of said two particular frequencies connecting said line to the input of said other rectifier, means connecting the output of said other rectifier to the input of said amplifier, a third rectifier, the output of said third rectifier connected to the other of said relays, means comprising a filter tuned to said third particular frequency connecting said line to the input of said third rectifier, means comprising said one relay for enabling the response of said other relay to current of said third frequency in said line, means rendered effective by the release of said one relay while said other relay is operated for rendering the other relay non-responsive to current of said third frequency in said line, and means responsive to currents of frequencies other than said particular frequencies in case the current in said line includes said particular frequencies and other frequencies for preventing the operation of said one of the relays.

RALPH E. RESSLER.