

May 18, 1943

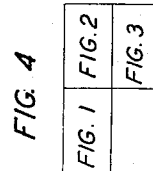
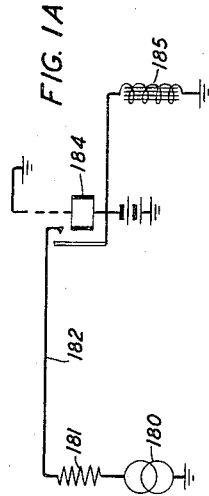
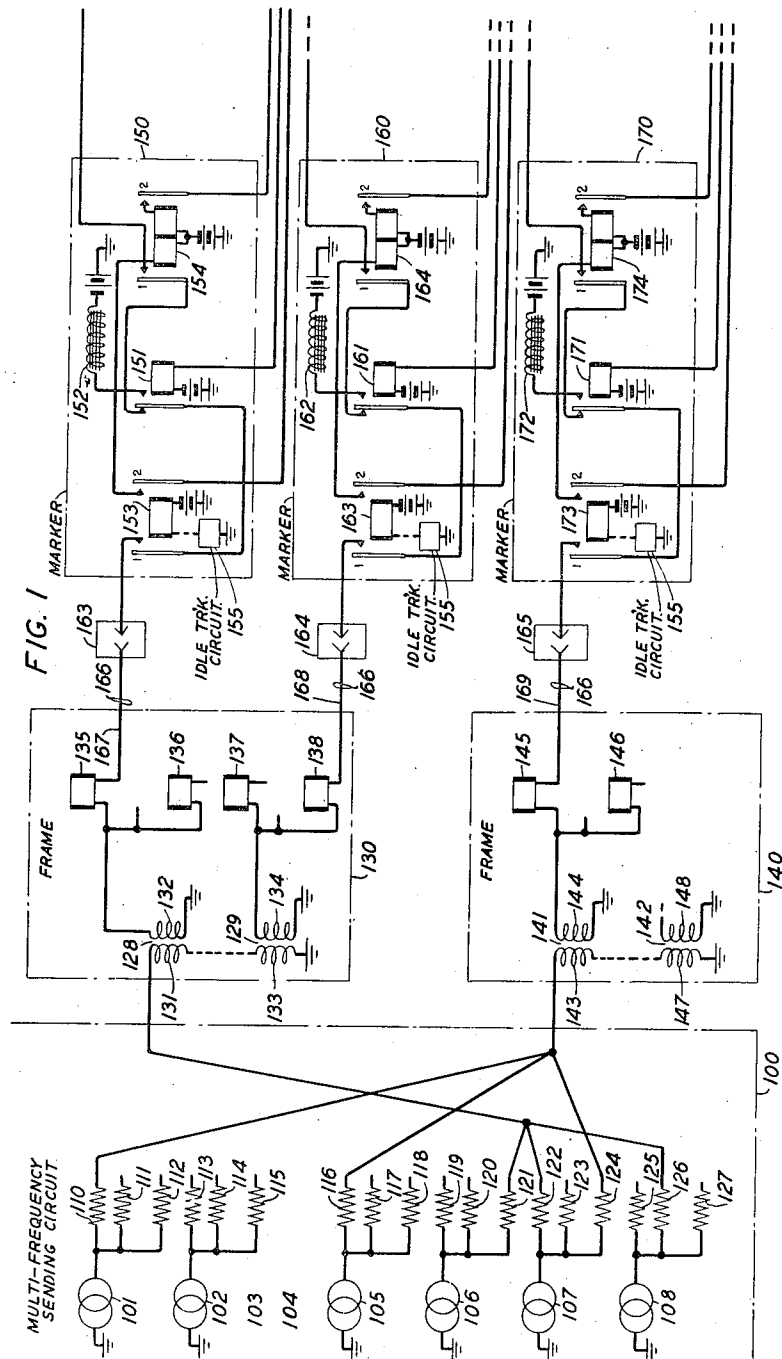
K. H. MÜLLER ET AL

2,319,339

SIGNALING SYSTEM

Filed May 22, 1940

3 Sheets-Sheet 1



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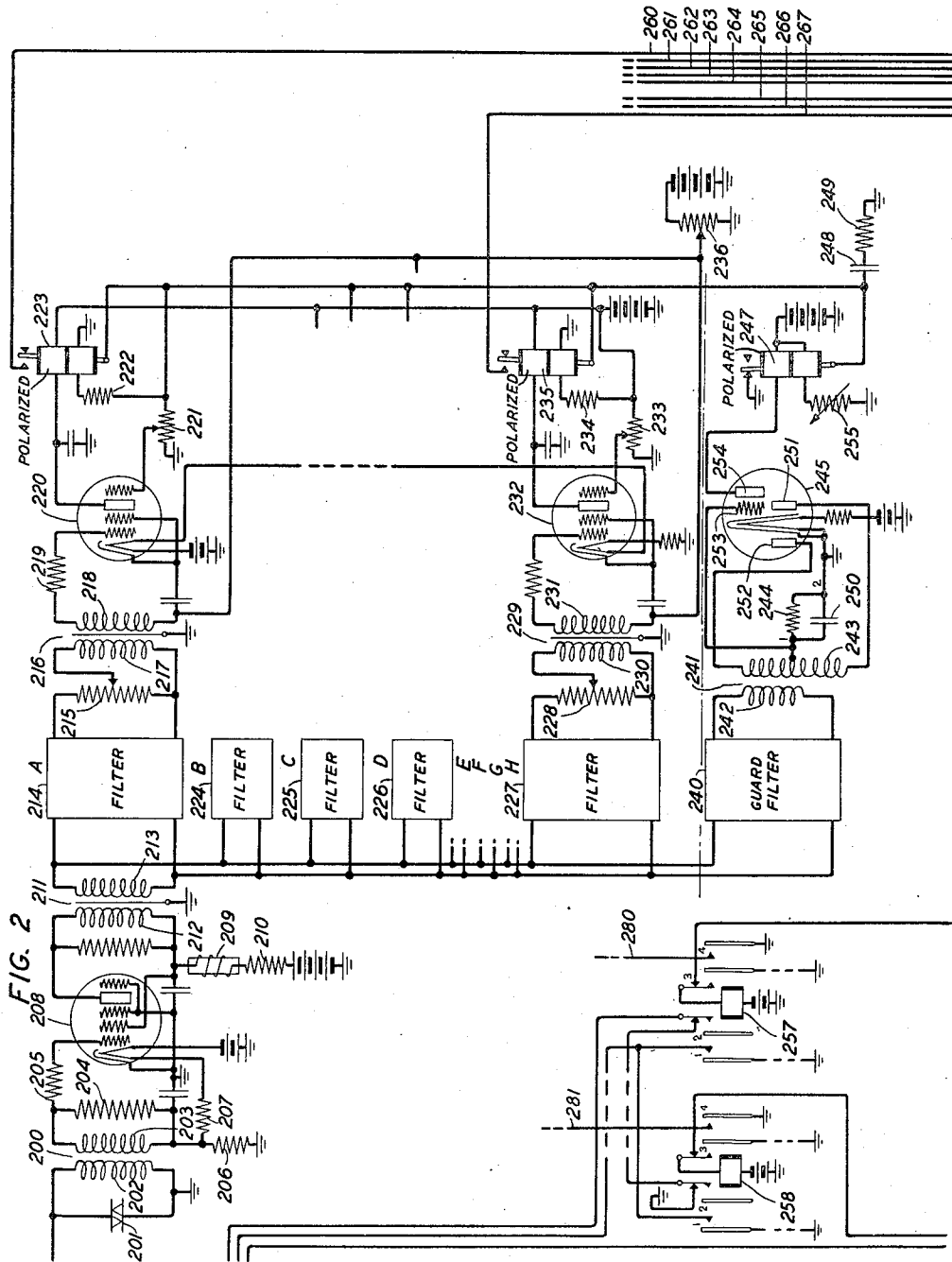
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SIGNALING SYSTEM

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3 Sheets-Sheet 2



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SIGNALING SYSTEM

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3 Sheets-Sheet 3

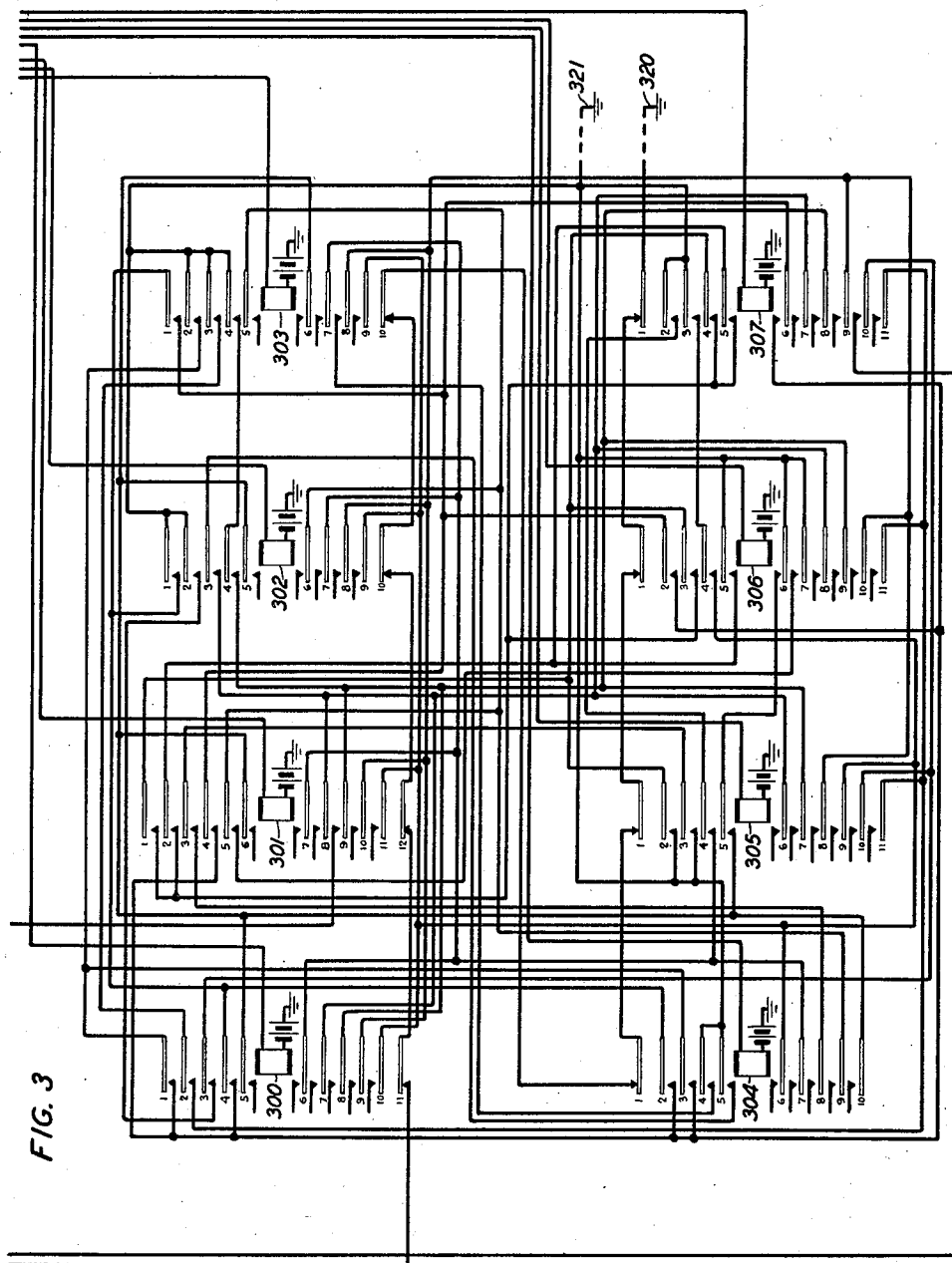


FIG. 3

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2,319,339

SIGNALING SYSTEM

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Application May 22, 1940, Serial No. 336,540

7 Claims. (Cl. 177—353)

This invention relates to signaling systems and more particularly to such systems including provisions for eliminating the effect of transient electrical signals from extraneous sources.

The objects of the invention are to safeguard signal receiving circuits against false operation and to obtain other advantages and improvements in signaling systems.

The invention as disclosed is applied to a multifrequency frame number indicating system, in an automatic switching telephone office which, however, is not proposed to limit its scope in other fields. According to the invention a plurality of signals of different frequencies are simultaneously transmitted over a single conductor to a receiving system comprising a plurality of receiving circuits, each tuned for receiving a particular frequency or band of frequencies. The receiving system is common to a plurality of equivalent units and associated circuits and may be connected through the contacts of the different equipment units for receiving signals of various combinations of electrical signaling waves. The system is different in its basic organization from radio systems and telegraph systems in that the signal transmitted is sustained until the output signal of the receivers has energized equipment which opens the transmitting circuit. Transient electrical signals from extraneous sources vary widely in frequency and not only have waves which would operate the tuned receiving circuits but include frequencies beyond the frequency range used for the operation of these receivers and consequently the latter waves may be used to disable the signal paths established by the operation of the plurality of receiving circuits.

One feature of the invention is a wave receiving system having a plurality of receiving circuits in multiple with a guard detector, the latter being arranged for energization by transient electrical wave signals which are outside a predetermined range of frequency bands used for energizing said plurality of receivers.

Another and related feature is in the use of a magnetically operable device in the guard detector arranged to disable the signaling paths of a plurality of receiving circuits without disabling the receiving circuits.

Another and related feature is a system of variable combined frequency signals within a predetermined range of frequencies for transmission to a plurality of tuned receiving circuits, each combination of waves being predetermined as a particular signal to a telephone system switching control unit, said plurality of tuned receiving cir-

cuits having a guard detector in multiple therewith operable by transient electrical currents beyond said range of frequencies to hold in abeyance the transmission of signals to said control unit for the duration of said transient signals.

These and other features will be discussed more fully in the following description.

To illustrate the teachings of the invention reference may be had to the accompanying drawings in which:

Figs. 1 to 3 when arranged as shown in Fig. 4 illustrate the multifrequency sending and receiving systems.

Fig. 1 illustrates a multifrequency sending circuit, switch frame equipment, and a plurality of switch controlling units or markers. Fig. 1A illustrates a circuit path from which transient electrical signals may be introduced into the multifrequency signal paths.

Fig. 2 illustrates a portion of a marker having a plurality of tuned receiving circuits in multiple with a guard detector.

Fig. 3 illustrates equipment of a marker which is variably operated by signal circuits established by the receiving circuits.

The guard detector shown in Fig. 2 in multiple with the receiver circuits A to H is furnished with a filter 240 having a selected frequency band which is a component of the disturbing frequencies that would cause false operation of the receivers but which is beyond a predetermined range of frequencies chosen for the operation of these receivers. This guard detector circuit has a diode-triode tube 245 which is normally at zero bias and therefore in this normal state a maximum plate current flows through the upper winding of relay 247 which maintains this relay normally operated to close a circuit through its contact for the signaling circuits of the receivers A to H. The bias of the triode tube 245 is, however, altered when, for example, a sending circuit is closed for transmitting selected frequencies to operate certain receivers, and at the same time a transient signal is impressed by induction or otherwise upon the sending circuit. Under this condition, a component of the transient signal passes through filter 240 to winding 242 of the detector input transformer 241. The output of this transformer is detected and amplified by the diode-triode tube 245. The full wave rectifying action of the diode causes a negative voltage to appear on terminal 1 of the grid leak resistance 244 from the rectifying elements 251 and 252. Since the grid 253 of the triode is connected, as shown, to the grid leak resistance, this negative

voltage appears on grid 253 and reduces the current flow through the plate circuit and consequently through the upper winding of relay 247 which causes the immediate release of this relay opening its contact to disable the receiver signaling circuit paths. Relay 247 therefore controls the effectualness of the receiver signaling circuits. Relay 247 is biased by the variable sensitivity control element 255 in series with its lower winding. This circuit is placed in a multiple with, but opposing, the operating winding of this relay. The sensitivity control element may be used to vary the adjustments for operating and releasing relay 247 with relation to normal and releasing values of current obtained under different circuit conditions.

During the period when a transient signal is impressed on the sending circuit, causing the magnetic relay 247 to be released, the electrical waves of different selected frequencies are continued from the sender to maintain the receivers energized as intended, which also maintains the contacts on the signaling relays, such as 223, closed. The transient signal may include electrical waves of a frequency which would falsely operate receivers other than the receivers intended for operation and will thus cause the operation of apparatus location signaling relays of Fig. 3 associated with the falsely energized receivers. In order to prevent the false energization of signaling circuits 260 to 267, they are opened by the removal of the common ground extending through the contact of relay 247 which is kept open until the transient signal impressed on the sending circuit has ceased. At this time the negative voltage is removed from grid 253 in the guard detector circuit and relay 247 is again operated from the normal current flow in the guard detector plate circuit and any receiving circuits falsely energized return to normal inactivity and release the signaling relays, such as 223, associated therewith. This now causes the completion of the selected signaling circuits established by the relays of the receivers extending over certain of the signaling paths 260 to 267, inclusive, according to the waves of selected frequencies transmitted from the sending circuit which are sustained until the signaling paths have been made effective and as a result of this the sending circuit has been opened.

The multifrequency signaling system for an automatic switching telephone office incorporating devices according to the invention arranged to send and receive apparatus location signals will now be fully described. The multifrequency sending circuit 100 comprises a plurality of electrical current sources or generators 101 to 108, inclusive, each sending a different frequency of current. These are connected through resistances and amplifiers as fully disclosed and described in patent application Serial No. 295,010 to King et al., filed September 15, 1939, issued as Patent 2,236,246, March 25, 1941. This patent application also discloses automatic switches with select magnets for operating these switches, and control devices known as markers, which have a multifrequency signaling system therein for identifying the location of switching equipment connected to trunk circuit equipment which has been selected by the marker. In this system, combinations of different frequencies are transmitted through coils such as 128, 129, 141 and 142 mounted on switch frames as shown. These combinations are made in order that a large number of identifying signals can be obtained from a

minimum number of current sources. The frame coils such as 128 and 129 represent a plurality of transformers mounted on one particular frame. The frequency combination for this frame is thus the same for all of the different switching apparatus mounted on this frame. The coils 135, 136, 137 and 138 represent select magnet coils associated with switches such as cross-bar switches well known in the art, the contacts of which are later closed by hold magnets. The select magnet operates to determine the horizontal level of contacts which is to be later closed by a hold magnet. The frame, such as frame 130, contains a large plurality of cross-bar switches, each switch having a plurality of horizontal levels and each level having a select magnet, such as 135, associated therewith.

Ordinarily, the contacts of each horizontal level are connected with a trunk circuit. This may either be an incoming trunk or an outgoing trunk and thus the select magnet is individual to a particular trunk circuit. The trunk circuits are divided in groups, some groups being small and others large. The trunk switches of a given group may be mounted on different frames, and consequently the fact that a selected trunk is a part of a particular group will not indicate the location of the switch connected to this trunk. In toll switching systems, trunks of a group may at times be transferred from one frame to another, depending upon the circumstances and load requirements for a distant office. Since there is no relation between trunk groups and the frame location of switches associated with said trunk groups, it is found necessary to transmit a signal to a marker giving the location of the switch or switch frame after this marker has selected an idle trunk. The reason for this requirement is full explained in the aforementioned patent to King et al.

The leads, such as 167, 168 and 169, connecting the select magnets with the marker extend through cables such as 166 to trunk group or trunk block relays indicated as 163, 164 and 165. A trunk group relay is one or more multicontact relays individual to a trunk group having contacts individual to the trunks of this group. This relay is operated by a marker when the marker wishes to select an idle trunk extending over a particular route. The test leads from all of the trunks in a group also extend through this trunk group relay to the marker to provide means for the marker to test the trunks of a group and find an available idle trunk. An idle trunk being found, the marker energizes a relay, such as relay 153, which is in a test group of relays having one relay for each trunk in the group tested. Consequently, if there are forty trunks in a group there are forty relays such as relay 153. The operation of this relay associates the select magnet of the switch level connected to this trunk through its contact 1, contact of relay 151, to the armature of relay 154. The idle trunk relay 153 also associates the left winding of relay 154 through its contact 2 to a chain of contacts on the relays of Fig. 3, comprising contact 11 of relay 300, contact 12 of relay 301, contact 10 of relay 302, contact 10 of relay 303, and contacts 1 of relays 304, 305, 306 and 307 to ground. This energizes relay 154 which establishes a locking circuit through its right winding to ground on contact 2 of relay 257 and establishes the fact that the relays of Fig. 3 are in their normal positions and prepared to receive location signals. The operation of relays 153 and 154 connects the

multifrequency sending circuit 100 with the receivers A to H of Fig. 2.

The frame coils 131 to 133 are connected with sending generators or current sources 106, 107 and 108 which send three different frequencies through coils 131 to 133 to ground. These frequencies are transmitted by induction through secondary coils 132 and 134, thence through the associated select magnets and over sending circuits to one or more control circuits or markers. Since any marker in the office can select an idle trunk on any frame, it is possible for a number of markers to simultaneously select idle trunks associated with switches on the same frame and to receive the same multifrequency signal substantially at the same instant. For example, the frequencies from generators 106, 107 and 108 are transmitted by induction through coil 132, select magnet 135, conductor 167, individual contact of trunk group relay 163, contact 1 of individual trunk test relay 153, contact of relay 151, contact 1 of relay 154, input winding 202 of transformer 200 to ground. These frequencies are amplified by the amplifier which includes tube 208 and the output of the amplifier is transmitted through transformer 211. These frequencies are thus transmitted to the receiving circuits, Fig. 2. Each receiving circuit A to H has a filter arranged for a particular band of frequencies and a tuned transformer also having a reed which vibrates at a particular frequency. Receiving circuits A and H are completely shown. The other receiving circuits are the same and are illustrated diagrammatically. Assuming that receiving circuits F, G, and H are tuned to receive the frequencies from current sources 106, 107 and 108, these receiving circuits are energized to establish a plate circuit for energizing the relay, such as 223 or 235, from the output current of the receiver. In this example, the relays associated with receivers F, G and H are energized which associate ground from the contact of guard detector relay 247 through contacts such as shown for relay 235 to conductors 265, 266 and 267, which extend through the windings of location signal relays 301, 302 and 303, to battery in each case. These three relays are operated for establishing a particular circuit through their combined contacts. This circuit extends from ground 321 through other apparatus to contact 4 of relay 303, contact 4 of relay 302, contact 8 of relay 301, through contact 3 and the winding of switching equipment location relay 257, to battery which operates the latter relay. This relay associates ground with conductor 280 for controlling the association of the marker equipment with a switch connected with the selected trunk on a particular frame. The relays of Fig. 3 each have a plurality of contacts thereon and the circuits through these contacts are arranged for as many combinations as there are location indications required. Accordingly, there are as many circuits through the contact combinations in the relay of Fig. 3 as there are equipment location relays, such as 257 and 258. The circuit for relay 258 extends from ground 321 through contact 2 of relay 302, contact 3 of relay 300, contact 10 of relay 307, contact and winding of relay 258 to battery. The operation of relay 257 establishes a locking circuit for itself to ground through contacts of other relays and opens the locking ground for relay 154 which releases. The release of relay 154 opens the sending circuit and releases

the receiving circuits which were energized. If the signaling circuits which are established by false operation of receiving circuits from transient electrical waves were effective for operating relays in Fig. 3, it may be seen that there would be too many relays operated in Fig. 3 to establish a useful circuit through the relay contacts. Only the receivers operated by the electrical current wave sources 101 to 108 correctly establish signal circuits which open the sending circuit. At this time or later, the ground is connected through contact 1 of relay 257 for energizing relay 151. This energizing circuit extends from ground through other relay contacts in the marker arranged for making certain tests before the energizing circuit is established. The operation of relay 151 associates battery through magnetic resistance 152, contact of relay 151, contact of trunk group relay 163, winding of the select magnet 135 of the idle trunk switch, coil 132 to ground, which energizes the select magnet for selecting the horizontal level of contacts associated with the idle trunk selected by the marker. The connection of this switch to a calling trunk may proceed from this point as fully described in the aforementioned patent to King et al. This invention is not particularly concerned with succeeding marker operations and therefore it appears unnecessary to encumber this application with a full description of the marker.

From the foregoing, it is apparent that the particular select magnet associated with the horizontal level connected to a selected trunk is individualized over the circuit extending to the receiving circuits of the marker. All of the select magnets of frame 130 are associated with the same combination of frequencies, but the marker which has selected an idle trunk is connected with only one of these select magnets and thus is associated with only one horizontal level of a particular switch. The trunk group multicontact relay, such as 163, individualizes the trunk group. Since the marker has selected only one trunk in this group, the line extending from the multifrequency sending circuit through an individual test relay to the receiving circuits is individual to a particular select magnet. Relay 257 in the marker is consequently at this time individual to this select magnet and to the horizontal level of the switch associated with the idle trunk selected by the marker.

There may be other markers in the telephone office which are, at the same time, operating in a similar capacity to the marker 150. These are represented as markers 160 and 170 which are diagrammatically shown and may be of the same structure as marker 150, each having receiving circuits therein. Markers 160 and 170 may either be operating receivers over other sending circuits or may be transmitting current to operate the select magnet at the same time that the sending circuit for marker 150 is functioning. The conductors 167, 168 and 169 may be carried through the same cable or adjacent cables on a large cable rack. There may be another cable on this rack carrying conductors, such as 182, having circuits associated therewith through which uncontrolled frequency signals are created by coincidental action of associated electrical equipment. Fig. 1A, diagrammatically illustrates a frequency generating device 180 which may be a generator of other sources of frequency signals from associated electrical equip-

ment. The operation of relay 184 in any function required in the telephone office connects this frequency source through resistance 181, conductor 182, contact of relay 184, through inductive winding or relay 185, to ground. A source of signaling current over a circuit of this character when in close proximity to cables carrying the sending circuits, such as 167, 168 and 169, may at times transmit by induction or otherwise transient signals to the multifrequency sending circuits. Another source of transient signals may be created when, for example, relays such as 161 and 171, or a plurality of such relays, are operated to energize the select magnets associated therewith at the same time that a multifrequency signal is sent through conductor 167. The application of current over an adjacent conductor creates a surge of current which at times cannot be controlled, particularly if the relay contact has become dirty or out of adjustment. An inductive discharge is also created when relays, such as 171 and 161, are released to cause the release of an associated select magnet. A number of circuits deenergized at the time that a signal is sent from a multifrequency sending circuit to the receiving circuits of another marker may cause a discharge which would create a transient frequency signal.

A majority of the foregoing disturbances could probably be avoided by running individual conductors in some manner over a large plurality of supporting racks. This would, however, unduly increase the expense of a telephone office and consume a large amount of space in the office. In order to avoid such great expense, the guard detector, arranged according to the invention, is placed in multiple with the receivers of the control circuits to prevent false location signals from being transmitted over the sending circuits to the equipment location relays, such as 257 and 258 in these control devices. To avoid such false signals, the receivers must be accurately operated. As previously stated, this is accomplished by altering the current flow in the guard detector to release relay 247 whenever a transient signal is received which is of a character that would falsely operate the receivers. The release of relay 247 opens the equipment location signaling circuits extending to the winding of relays 300 to 307, inclusive, so that at a time when transient signals are received none of these relays will be operated.

It is apparent from the foregoing that the combination of frequencies from the sending circuits is sustained through the transformer coils 128, 129, 141 and 142 and consequently after an idle trunk has been selected and relays such as 153 and 154 operated, this combination of frequencies is connected to the receiver amplifying circuit and extended through particular filters and amplifying circuits of receivers A to H which maintains particular receivers energized and maintains the relays, such as 223 and 235 associated therewith, energized. During the period when a transient signal is impressed upon the sending circuit, the signal circuits which are established by the operation of relays 223 to 235 in receivers A to H are disabled, but as soon as the transient signal has ceased relay 247 is again operated so that the receiving circuits complete their equipment location signal circuits, open the sending circuit and cause the marker to proceed with the establishment of the telephone connection.

What is claimed is:

1. In a signaling system, a plurality of sources of electrical current, said sources differing in frequency in steps within a predetermined frequency range, a plurality of receiving circuits each tuned to respond to a current source of one of said frequencies, means to establish a sending circuit for connecting selected sources to receiving circuits of said plurality, a relay having a contact in each receiving circuit, means in each receiving circuit responsive to its energization for energizing its relay to close its contact for establishing a signaling path, means responsive to the establishment of said contacts in selected receiving circuits for transmitting signals and for disconnecting said sending circuit from said receiving circuits, momentary surges of transient electrical currents of variable frequency acting to subject said receiving circuits to false operation, a guard detector connected to said sending circuit and independent of said receiving circuits responsive only to transient electrical currents of frequencies outside of said frequency range which are impressed on said sending circuit by said plurality of sources, a normally operated relay in said detector circuit having said signaling paths extended through its contact and means in said detector circuit for releasing its relay for rendering signal circuits established through the contacts of selected receiving circuit relays and through the contacts of non-selected receiving circuit relays operated by transient electrical currents ineffective for the duration of said transient electrical current surges and for preventing false disconnection of said sending circuit from said receiving circuits.

2. In a signaling system, a plurality of sources of electrical current, said sources differing in frequency in steps within a predetermined frequency range, a plurality of receiving circuits each tuned to respond to a current source of one of said frequencies, means to establish a sending circuit for connecting selected sources to receiving circuits of said plurality, a relay having a contact in each receiving circuit, means in each receiving circuit responsive to its energization for energizing its relay to close its contact for establishing a signaling path, means responsive to the establishment of said contacts in selected receiving circuits for transmitting signals and for disconnecting said sending circuit from said receiving circuits, momentary surges of transient electrical currents of variable frequency acting to subject said receiving circuits to false operation, a guard detector connected to said sending circuit and independent of said receiving circuits responsive only to transient electrical currents of frequencies outside of said frequency range which are impressed on said sending circuit by said plurality of sources, a normally operated relay in said detector circuit having said signaling paths extended through its contact and means in said detector circuit for releasing its relay for rendering signal circuits established through the contacts of selected receiving circuit relays and through the contacts of non-selected receiving circuit relays operated by transient electrical currents ineffective for the duration of said transient electrical current surges and for preventing false disconnection of said sending circuit from said receiving circuits, the reoperation of said detector relay making effective said means for transmitting signals corresponding to the selected

sources connected to the receiving circuits and for disconnecting said sending circuit.

3. In a signaling system, selectively operable electrical equipments, a plurality of sources of electrical currents of different frequencies, a plurality of receiving circuits each tuned to operate on current from one of said sources, current frequency responsive means in each receiving circuit for establishing a signaling circuit path, sending circuits between different plurality combinations of said sources and said plurality of receiving circuits, said plurality of sources in each combination being less than the total plurality of sources and less than the total plurality of receiving circuits, means responsive to the operation of one of said electrical equipments for establishing a sending circuit for connecting one of said combinations of sources to said total plurality of receiving circuits to operate the receiving circuits tuned to the frequencies of the sources in said combination and for sustaining said connection until said frequency responsive means have responded and established said signaling circuit paths and until corresponding signals have been transmitted, said sending circuit being subject to transient electrical currents of variable frequencies causing said total plurality of receiving circuits and said total plurality of frequency responsive means to be subject to false operation and a guard detector connected to said sending circuit responsive to transient electrical currents impressed on said sending circuit for disabling the signaling circuits of said total plurality of receiving circuits for the duration of the impression of transient electrical currents on said sending circuit and for reestablishing said signaling circuit paths to send signals corresponding to said sustained frequency currents upon the expiration of said transient signals.

4. In a signaling system, trunk circuits connected to switches mounted on different frames, a marker for controlling said trunk switching circuits, a plurality of sources of electrical currents of different frequencies, a plurality of receiving circuits in said marker each tuned to operate on current from one of said sources, current frequency responsive means in each receiving circuit for establishing an individual signal circuit path, selective sending circuits between different plurality combinations of said sources through said trunk switching frame equipment to said plurality of receiving circuits, said plurality of sources in each combination being less than the total plurality of sources and less than the total plurality of receiving circuits, means responsive to the selection of one of said trunks for establishing a sending circuit for connecting one of said combinations of sources to said total plurality of receiving circuits to operate the receiving circuits tuned to the frequencies of the sources in said combination and for sustaining said connection until corresponding signals have been transmitted and said sending circuit disconnected from said receiving circuits, said sending circuit being periodically subjected to transient electrical currents of variable frequencies, causing said total plurality of receiving circuits and said total plurality of frequency responsive means to be subject to false operation during said periods, a guard detector connected to said sending circuit having a tube and a relay normally operated by current in the plate circuit of said tube for closing said receiver signaling circuit paths through its contacts, said guard detector being responsive to

transient electrical currents impressed on said sending circuit for suppressing the current in said tube plate circuit to cause the release of said relay for the duration of said transient electrical currents to disable the signaling circuits of said total plurality of receiving circuits to prevent outgoing false signals and the false disconnection of said sending circuit during this period, switch frame circuits in said marker, sending circuit disconnect means in said marker, and means responsive to the reoperation of said relay for transmitting outgoing signals corresponding to said sustained frequencies for energizing the switch frame circuit and sending circuit disconnecting means in said marker.

5. In a signaling system, a plurality of sources of electrical currents each source differing in frequency, a plurality of sending circuits each connected to a combination of said sources, each combination comprising more than one of said sources, a plurality of receiving circuits each tuned for response to current from one of said current sources, a guard detector tuned to respond to current of a frequency different from the frequencies of said plurality of current sources, magnetically operable devices for connecting individual sending circuits to said plurality of receiving circuits and said guard detector, means for selecting and automatically energizing one of said devices for actuating more than one of said receiving circuits individually responsive to currents of the frequencies transmitted over the sending circuit so connected, means normally energized by the response of said receiving circuits for closing signaling paths and for releasing said device to disconnect the sending circuit from said receiving circuits, momentary surges of transient electrical currents of variable frequencies acting upon said sending circuit having a tendency to influence the responsive action of said plurality of receiving circuits and causing the response of said guard detector, and means responsive to said guard detector for rendering ineffective the signaling paths closed by said frequency responsive receiving circuits and for preventing the release of said magnetically operated device for the duration of said transient electrical currents and thereafter controlling the normal functioning of said receiving circuits from said current sources connected thereto.

6. In a signaling system, a plurality of sources of electrical currents each source differing in frequency, a plurality of sending circuits each connected to a combination of said sources, each combination comprising more than one of said current sources, a plurality of receiving circuits each tuned to respond to current from one of said current sources, a guard detector, means operable for connecting any of said sending circuits to said plurality of receiving circuits and said guard detector, means for operating a connecting means to cause the response of receiving circuits tuned to the frequencies of the current sources on the sending circuit so connected, means normally responsive to said receiving circuits for closing signaling paths and for causing the release of said connecting means, momentary surges of transient electrical currents of variable frequencies acting upon said sending circuit causing the response of said guard detector, said plurality of receiving circuits being subject to response from said transient electrical currents, said guard detector having a filter, a diode-tri-

ode tube, a full wave rectifier and a magnetic device normally energized in the plate circuit of said tube, said detector being tuned to respond to current of a frequency different from the frequency of said plurality of sources for suppressing the current flow in said plate circuit to release said magnetic device, said magnetic device when released serving to render ineffective the signaling paths closed by said frequency responsive receiving circuits and to prevent the disconnection of said current sources from said receiving circuits for the duration of said transient electrical currents and thereafter when operated controlling the normal functioning of said receiving circuits from said current sources connected thereto.

7. In a signaling system, a plurality of sources of electrical currents each source differing in frequency, a plurality of sending circuits each connected to a combination of said sources, each combination comprising more than one of said sources, a plurality of receiving circuits each tuned for response to current from one of said current sources, a guard detector tuned to respond to current of a frequency different from the frequencies of said plurality of current sources, electrically operable connecting devices for connecting a sending circuit to said plurality

of receiving circuits and said guard detector, a trunk, trunk selecting equipment, means for operating one of said connecting devices responsive to the selection of a trunk for actuating more than one of said plurality of receiving circuits tuned to the frequency transmitted over said sending circuit, trunk signaling devices, means in said receiving circuits for normally operating a trunk signaling device, means on said trunk signaling device for releasing said operated connecting device, momentary surges of transient electrical currents of variable frequencies including the guard detector frequency and some of the frequencies of the sources acting on said sending circuit causing the response of said guard detector and receiving circuits tuned to currents of the frequencies in said surges, and means in said guard detector for preventing the operation of said trunk signaling devices and consequently preventing the disconnection of said current sources from said receiving circuits for the duration of said transient electrical currents and for thereafter controlling the normal functioning of said receiving circuits from said current sources.

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