April 26, 1949. M. E. MALONEY 2,468,299

SUPERVISORY SIGNALING IN TELEPHONE OR LIKE SWITCHING SYSTEMS

Filed July 7, 1945 3 Sheets-Sheet 1

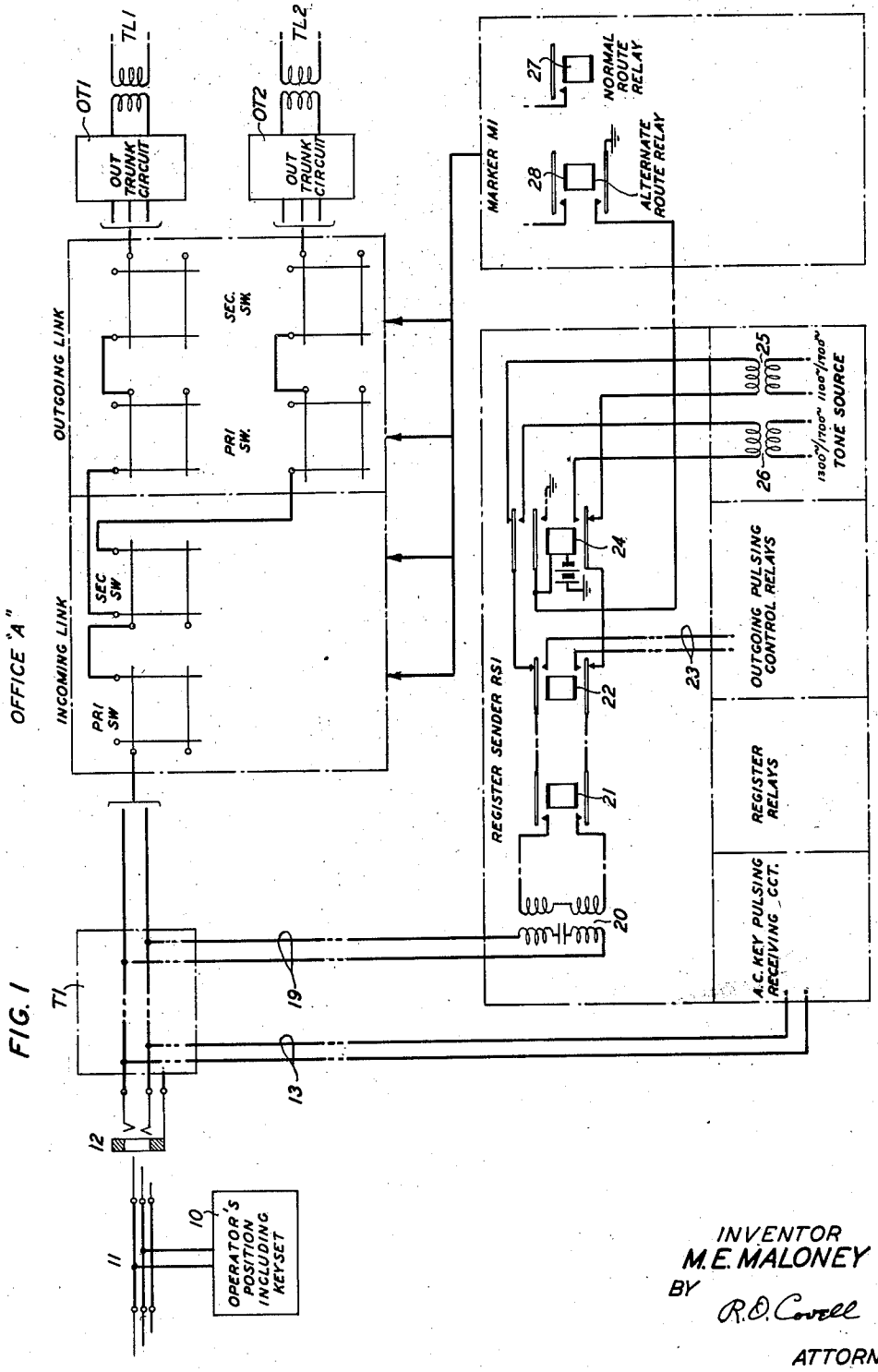

FIG. 1

INVENTOR
M. E. MALONEY
BY
R. D. Covell
ATTORNEY

April 26, 1949. M. E. MALONEY 2,468,299

SUPERVISORY SIGNALING IN TELEPHONE OR LIKE SWITCHING SYSTEMS

Filed July 7, 1945 3 Sheets-Sheet 2

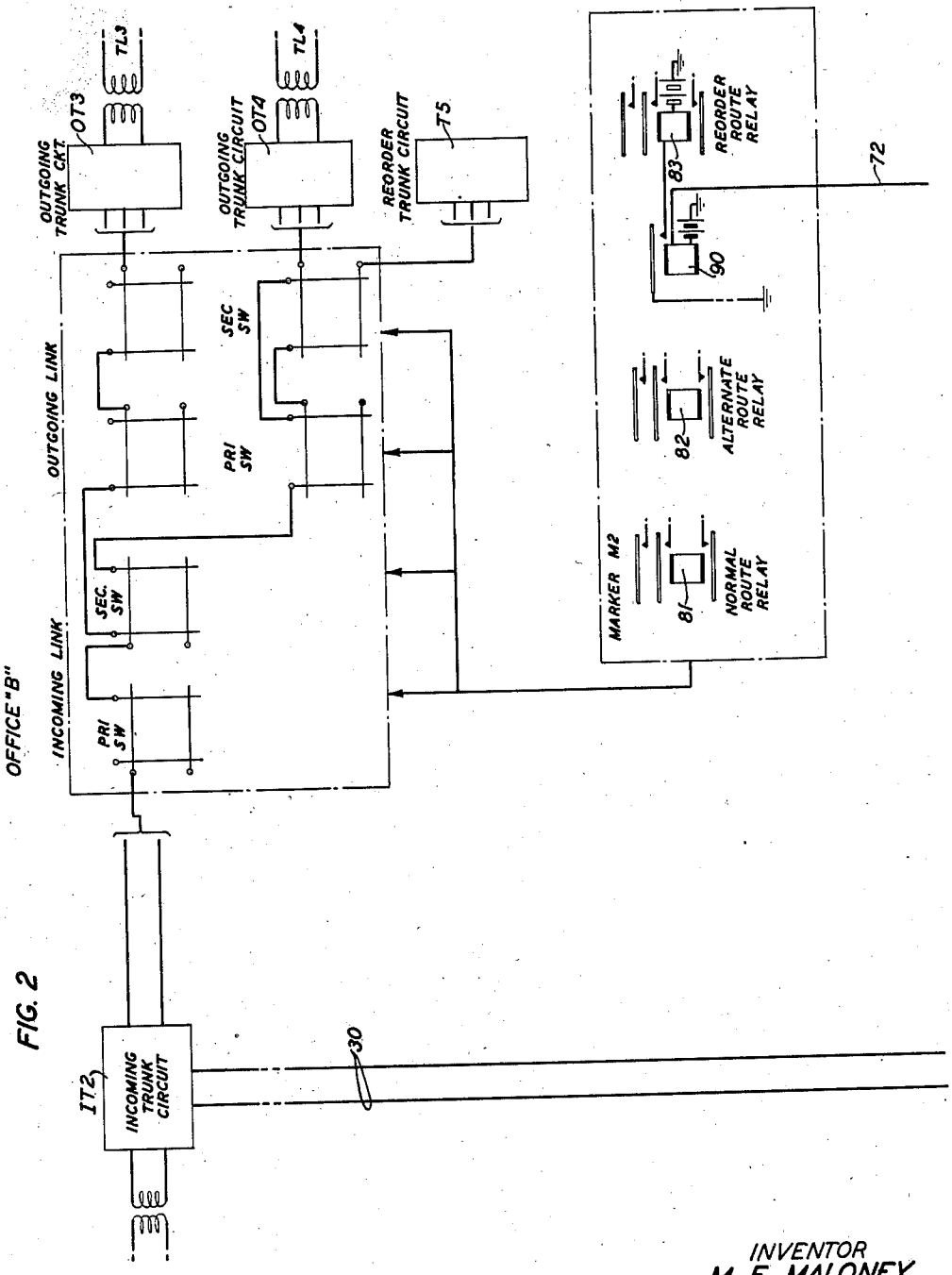

FIG. 2

INVENTOR
M. E. MALONEY

BY R. O. Covell

ATTORNEY

April 26, 1949. M. E. MALONEY 2,468,299

SUPERVISORY SIGNALING IN TELEPHONE OR LIKE SWITCHING SYSTEMS

Filed July 7, 1945 3 Sheets-Sheet 3

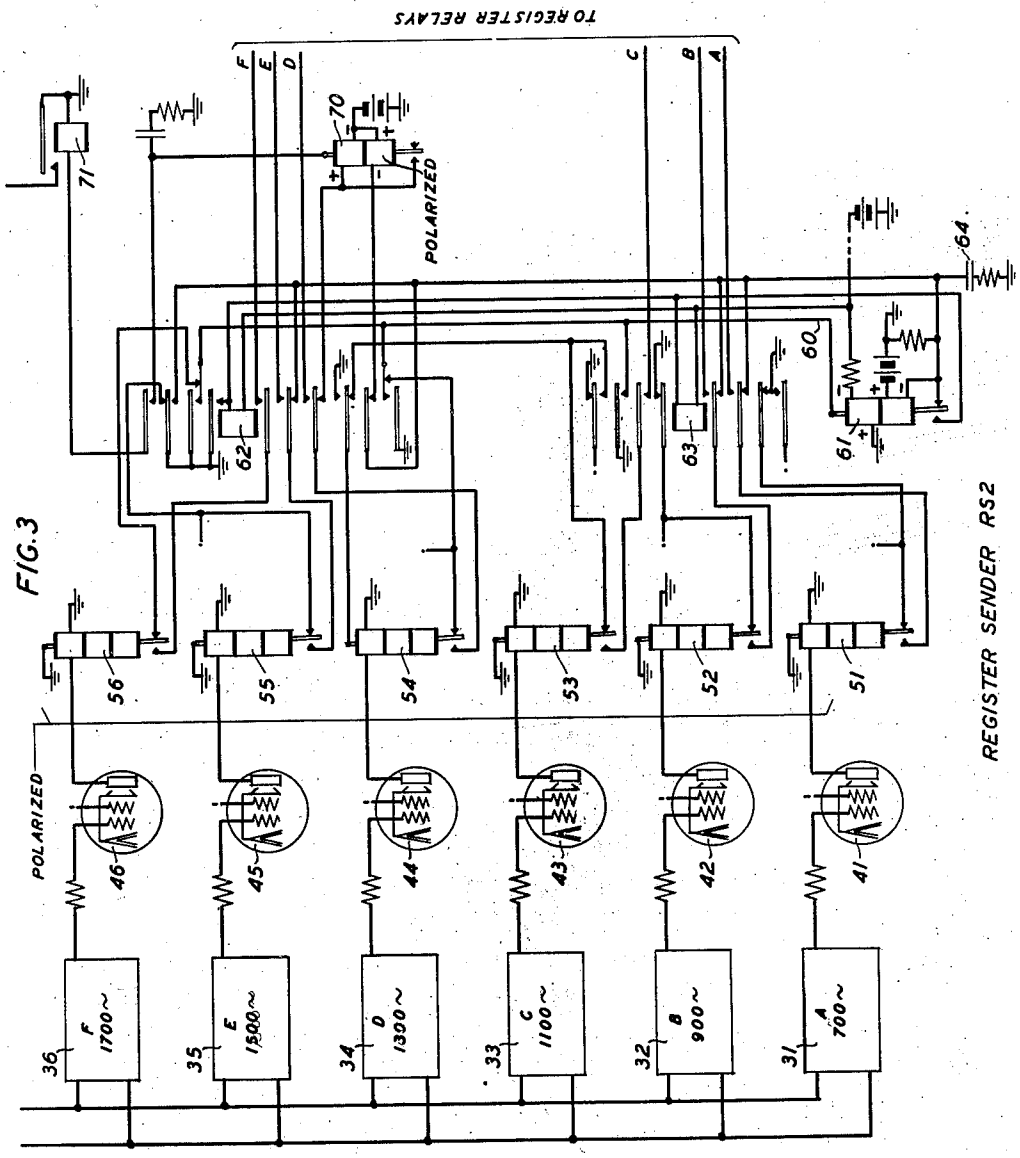

FIG. 3

INVENTOR
M. E. MALONEY

BY R. O. Cowell

ATTORNEY

Patented Apr. 26, 1949 2,468,299

UNITED STATES PATENT OFFICE

2,468,299

SUPERVISORY SIGNALING IN TELEPHONE OR LIKE SWITCHING SYSTEMS

Martin E. Maloney, Flushing, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application July 7, 1945, Serial No. 603,684

7 Claims. (Cl. 179—27)

1

This invention relates to signaling systems and particularly to signaling adapted for use in automatic telephone systems.

Objects of the invention are an increase in the flexibility and efficiency of automatic telephone systems and the provision of the necessary signals for obtaining the desired control in such systems.

In automatic telephone systems of the marker controlled type it is known to first test the direct trunks over which a call may be completed and if all of the direct trunks are busy to test the trunks in an alternate route group. The alternate routing of toll calls is more complex than the alternate routing of local calls through tandem offices because toll connections may be built up through a plurality of intermediate switching points and because of the multiplicity of routes which may be used to reach the terminating toll office. In manual toll systems, the choice of alternate routes is under the control of the originating toll operator because a call is usually returned to the originating operator when a trunk's busy condition is encountered. In dial systems, the cost and complexity of returning calls to the originating point make it desirable always to proceed as far as possible along the route originally chosen. When a marker in a toll office A finds all trunks to toll office B busy, the call is extended over a trunk to an alternate toll office C. If at that time, there is an idle trunk from office C to office B the call is completed thereover; but if there is no idle trunk from office C to office B, the marker in office C may either try its alternate route to office B or send back an overflow signal. A second alternate route may lead to a third or, worse, the alternate route from office C to office B may be through office A; and both of such conditions are objectionable. If an overflow signal be given and the originating operator waits for the overflow signal to change to the recorder signal when an idle trunk becomes available at office C, trunks directly from office A to office B may become available without the operator knowing that this is so.

A way of circumventing these difficulties is to tell the alternate route office C that the incoming call is an alternate route call and, if the call cannot be further extended over a regular route

2

to office B, that a reorder signal be given to office A. The register sender at office A recognizes the reorder signal as an alternate route all-trunks-busy signal, drops the connection to office C, calls for a new marker and asks for the original route to office B and also tells the new marker not to try the alternate route. This method prevents alternate routing back to the office in which an alternate route was first chosen and gives the overflow signal from the last normal route office in the connection.

A feature of the invention is the provision of means in an automatic toll office comprising sender-marker controlled switches for transmitting over a selected trunk a particular signal if the call is being routed over a trunk in the normal route group and a different signal if the call is being routed over a trunk in the alternate route group.

Another feature of the invention is the provision of means in an automatic toll office comprising sender-marker controlled switches for extending an incoming call either through a trunk in the normal route group or through a trunk in the alternate route group if the office is the normal route for completing the call from the preceding office and for extending a call only through a trunk in the normal route group if the office is the alternate route for completing the call from the preceding office.

Another feature of the invention is the provision of means in an automatic toll office comprising sender-marker controlled switches for extending the call only through a trunk in the normal route group if the office is the alternate route for completing a call from the preceding office and for transmitting a reorder signal to the preceding office in case all of the normal route trunks are busy.

These and other features of the invention are embodied in the telephone system shown schematically in the drawings which form a part of this specification. The invention is not limited in its application to the particular system shown in the drawings but is generally applicable to automatic telephone systems in which common control means is provided for controlling the operation of switches, of whatever type, through which desired connections are established.

Referring to drawing:

Fig. 1 shows a toll office A comprising an outward or originating toll operator's position 10 and cord 11, a jack ended trunk circuit T1, incoming and outgoing link switches of the cross bar type, outgoing trunks OT1 and OT2 and common control equipment including the register-sender RS1 and marker M1; and

Figs. 2 and 3 show another toll office B comprising an incoming trunk circuit IT2, incoming and outgoing link switches of the cross bar type, outgoing trunks OT3 and OT4, a reorder trunk circuit T5, and common control equipment including the marker M2 and register-sender RS2.

The toll operator position 10 includes a key set of the type which transmits alternating current signals, each of which consists of current of a different two out of six frequencies. Reference may be had to the patent application Serial No. 550,070, filed August 18, 1944, by B. McKim and O. Myers, U. S. Patent No. 2,382,893, granted August 14, 1945, for disclosure of a system in which an operator's position includes a key set for transmitting such signals. The cross bar switches, register-sender RS1 and marker M1 are generally similar to those disclosed in detail in the patents to Carpenter 2,089,921 granted August 10, 1937, and 2,093,117 granted September 14, 1937, and in the patent to G. V. King et al. 2,236,246 granted March 25, 1941. Reference may be had to the aforementioned application of B. McKim and O. Myers for disclosure of a register-sender arranged to receive and register alternating current two-frequency signals and arranged to transmit like signals over the selected outgoing trunk. The register-sender RS1 differs from the sender of the McKim-Myers patent only in that it is arranged to transmit two different gate or KP signals, one in case the selected trunk is in the normal route group and the other in case the selected trunk is in the alternate route group. The marker M1 is similar to the marker of the aforementioned King et al. patent except that the alternate route relay, which is operated when all of the trunks in the normal route group are busy, includes a contact for operating the relay in the register-sender which controls the KP signals which are transmitted over a selected trunk.

The incoming trunk circuit IT2, switches, register-sender RS2 and marker M2 are similar to the corresponding circuits disclosed in the aforementioned McKim-Myers application and King et al. patent except that the alternating current key pulsing receiving circuit of the register-sender RS2 is arranged to receive either one of two different KP signals, one of which indicates the call is being extended over a trunk in a normal route group and the other of which indicates the call is being extended over a trunk in the alternate route group from the preceding office. The marker M2 differs from the markers disclosed in the McKim-Myers application and King et al. patent in that it includes a relay which is operated when the call being handled is an alternate route call to prevent the marker from testing trunks in the alternate route group if all of the outgoing trunks in the normal route group are busy.

Assume now that the toll operator at position 10 has answered a call from a local subscriber and is extending the call through cord 11, jack 12 and trunk circuit T1. An idle register-sender is thereupon attached to the trunk T1 and a sender attached signal is transmitted to the operator position; whereupon the operator actuates the KP key to send a signal to prepare the register-sender RS1 for receipt of office code and numerical digit signals which are transmitted by operation of the operators key set through the cord, jack and trunk T1, over conductors 13 to the register-sender RS1. The key pulsing signals are received and registered in the sender RS1; and a marker M1 is attached to the sender in usual manner when the office code digits have been received. The marker M1 thereupon receives the toll code digits from the register-sender and translates these digits to effect the operation of a route relay 27. The marker M1 then tests the trunks in the normal route group and routes the call over an idle trunk, for instance, the trunk circuit OT1, by controlling the operation of the incoming and outgoing switches. If all of the trunks in the normal route group are busy, the route relay 27 is released and the alternate route relay 28 is operated; and the marker then tests the trunks in the alternate route group and routes the call over an idle trunk, for instance, the trunk circuit OT2, by controlling the operation of the district and office switches. The operation of the route relay 27 or the alternate route relay 28 effects the transmission to the register-sender of information needed to complete disposition of the call.

Assume further that the call is one routed through a plurality of toll offices and that the selected outgoing trunk circuit is arranged for alternating current pulsing to the next office. When the call is extended to the outgoing trunk circuit, a connect signal is transmitted over the associated toll line to the distant office to effect the connection of the associated incoming trunk circuit to a register-sender. When a sender-attached signal is transmitted back over the toll line to the outgoing trunk circuit, the register-sender in the originating toll office, transmits a KP signal to prepare the register-sender in the next office for the receipt of toll and local office code and numerical signals. Only so much of the register-sender is shown as is necessary for the transmission of the required KP signal. Relays 21 and 22 correspond to relays 3406 and 2910 respectively of the aforementioned McKim-Myers application. If the route relay 27 controls the selection of an outgoing trunk circuit, relay 24 of the register-sender remains normal and the KP signal transmitted consists of an impulse of alternating current of frequencies 1100 cycles per second and 1700 cycles per second. The circuit path for effecting this transmission is traced from the secondary winding of tone source transformer 25, through back contacts of relays 24 and 22, front contacts of relay 21, transformer 20, conductors 19, the selected channel through the incoming and outgoing switches and the outgoing trunk circuit OT1 to the toll line TL1. If, however, the alternate route relay 28 controls the selection of an outgoing trunk circuit, relay 24 of the register-sender is operated. Relay 24 locks until the sender is released, and with relay 24 operated, the KP signal transmitted consists of an impulse of alternating current of frequencies 1300 cycles per second and 1700 cycles per second. The circuit path for effecting this transmission is traced from the secondary winding of transformer 26, through front contacts of relay 24, thence to the outgoing trunk circuit OT2 and toll line TL2. In either case, when the KP signal has been transmitted, relay 22 is operated to connect the outgoing pulsing control relays through conductors 23 to the selected outgoing trunk circuit, thereby to effect the transmission of the signals representing the toll and local office codes and nu-

merical digits registered in the register-sender RS1, in the manner described in detail in the aforementioned McKim-Myers application.

Referring now to the office B shown in Figs. 2 and 3, the receipt of a connect signal by incoming trunk circuit IT2 over the associated toll line from a preceding toll office effects the connection of an idle register-sender RS2 to the trunk circuit, and a sender-attached signal is transmitted from this sender over the toll line to the preceding office. The register-sender is arranged to receive alternating current signals, the first signal being a KP signal. The signal impulse receiving circuit shown in Fig. 3 is similar to that disclosed in Fig. 32 of the aforementioned McKim-Myers application but is modified to selectively respond to a KP signal consisting of current of frequencies 1100 and 1700 cycles per second and a KP signal consisting of current of frequencies 1300 and 1700 cycles per second, the particular combination of frequencies making up the KP signal depending on whether office B is in the regular route or in the alternate route for the call in question. Assume first that the normal route KP signal is received. The current of 1100 cycles per second passes through filter 33, energizes tube 43 and effects the operation of relay 53; and the current of 1700 cycles per second passes through filter 36, energizes tube 46, and effects the operation of relay 56. With both of relays 53 and 56 operated, conductor 60 is disconnected from ground thereby deenergizing the normally energized lower windings of polarized relays 61 and 70. With the lower winding of relay 61 deenergized, the energization of the upper winding becomes effective to open the right contact and close the left contact of this relay, this action being delayed for about .048 second by the charging of condenser 64. As soon after relay 61 is operated as either of relays 53 or 56 releases, ground is again connected to conductor 60, thence through the left contact of relay 61 and windings of both of relays 62 and 63 to battery thereby causing the operation of both of relays 62 and 63. The operations of relays 62 and 63 connect the front contacts of the signal receiving relays 51, 52, 53, 54, 55 and 56 to conductors A, B, C, D, E and F which are connected to the register relays which register the code and numerical digits. It is to be noted that relay 70 is not affected when the KP signal received consists of 1100 and 1700 cycles per second since neither of its windings will be energized when ground is disconnected from conductor 60 as above described. The call is thereafter completed under the control of an associated marker M2 in usual manner. If an idle trunk is available in the group identified by the operated normal route relay, such as route relay 81, the call will proceed over the normal route; but if all of these trunks are busy, the alternate route relay will be operated to effect extension of the call over a trunk in the alternate route group.

Assume next that the incoming call is extended to trunk circuit IT1 of office B as an alternate route, in which case the KP signal received will consist of frequencies 1300 and 1700 cycles per second. The current of 1300 cycles per second passes through filter 34 to energize tube 44 and operate relay 54; and the current of 1700 cycles per second passes through filter 36 to energize tube 46 and operate relay 56. With both of relays 54 and 56 operated, ground is disconnected from conductor 60 to cause the deenergization of the lower windings of relays 61 and 70; and relay 61 is operated to open its right contact and close its left contact, the same as for the normal route KP signal. However, since relay 54 is operated, a circuit path is closed for maintaining the energization of the upper winding of relay 70; this circuit path is traced from the upper winding of relay 70, through a back contact of relay 62, left contact of relay 54, another back contact of relay 62, and right contact of relay 53 to ground. Relay 70 is thus operated to close its left contact; and when relays 62 and 63 are operated by the closing of the left contact of relay 60, relay 70 is locked through its upper winding in series with the winding of relay 71. The lower winding of relay 70 cannot again be energized while relay 62 is operated. When a marker M2 is associated with the register sender RS2, ground is connected to conductor 72 to operate relay 90 in the marker, thereby to indicate to the marker that the call is not to be routed through an alternate route in case all of the trunks in the normal route are busy. Consequently, when all normal route trunks are busy, the reorder route relay 83 is operated, a reorder trunk is selected and a reorder signal is transmitted to the preceding office.

What is claimed is:

1. In a trunking and signaling system, two groups of trunk lines, means for effecting the selection of an idle line in one of said groups, means for effecting the selection of an idle line in the other of said groups in case all of the lines in said one group are busy, means for transmitting a signal of one character over the selected line if in said one group and a signal of a different character over the selected line if in said other group, and means for transmitting selective signals over the selected line following said signal of the one character or the other, the selective signals then transmitted being the same if the selected line is in said one group as if the selected line is in said other group.

2. In a signaling system, a line, signal receiving means responsive to a plurality of different selective signals incoming over said line, certain of said signals being letter or numerical digit signals and other signals being gate signals one of which precedes the first digit signal, only, of each train of letter or numerical digit signals, means for registering the letter code or numerical digit signals received, and means responsive to any one of said different gate signals for enabling the operation of said registering means.

3. In a signaling system, a line, signal receiving means responsive to a plurality of different selective signals incoming over said line, each different signal consisting of an impulse of alternating current of a different combination of two frequencies, certain of said signals being letter or numerical digit signals and other signals being gate signals one of which precedes the first digit signal, only, of each train of letter or numerical digit signals, and means responsive to any one of said different gate signals for enabling the operation of said registering means.

4. In a trunking and signaling system, an incoming trunk circuit, groups of outgoing trunk circuit, a register-sender connected to said trunk circuit and comprising signal receiving means responsive to a plurality of different signals, each of certain of said signals constituting a preparatory signal and other of said signals constituting office code and numerical digit signals, said register-sender further comprising registers settable responsive to said office code and numerical digit

signals, means responsive to any of said different preparatory signals for enabling the setting of said registers, means comprising a marker controlled in accordance with the setting of office code registers for determining the route of the call and for connecting said incoming trunk circuit to an idle outgoing trunk circuit in the normal route group or to an idle outgoing trunk circuit in an alternate route group in case all of the trunks in the normal route group are busy, and means rendered effective in case the preparatory signal received to enable the setting of the registers is a particular signal for preventing the connection of the incoming trunk circuit to a trunk in the alternate route group.

5. In a trunking and signaling system, an incoming trunk circuit, groups of outgoing trunk circuits, a register-sender connected to said trunk circuit and comprising signal receiving means responsive to a plurality of different signals, each different signal consisting of an alternating current impulse of a different combination of two freqnencies, each of certain of said signals constitsting a preparatory signal and others of said signals constituting office code and numerical digit signals, said register-sender further comprising registers settable responsive to said office code and numerical digit signals, means responsive to any of said different preparatory signals for enabling the setting of said registers, means comprising a marker controlled in accordance with the setting of the office code registers for determining the route of the call and for connecting said incoming trunk circuit to an idle outgoing trunk circuit in the normal route group or to an idle outgoing trunk circuit in an alternate route group in case all of the trunks in the normal route group are busy, and means rendered effective in case the preparatory signal received to enable the setting of the registers is a particular signal for preventing the connection of the incoming trunk circuit to a trunk in the alternate route group.

6. In a trunking and signaling system, a first office comprising a register-sender, a plurality of groups of outgoing trunks and a marker, said marker having means controlled in accordance with the setting of registers in the register-sender for affecting the selection of a trunk in the normal route group and for effecting the selection of a trunk in the alternate route group in case all of the trunks in the normal route group are busy, means in the register-sender of the first office for transmitting a preparatory signal of one character through the selected trunk if in the normal route group and of a different character if in the alternate route group, means in the register-sender for transmitting office code and numerical digit signals through the selected trunk following the preparatory signal, a second office terminating the trunks in said normal route group, a third office terminating the trunks in said alternate route group, each of said second and third offices comprising incoming trunk circuits, outgoing trunk circuits, register-senders, markers and switches, means effective in response to seizure in said first office of an outgoing trunk circuit in said normal route group for connecting an idle register-sender with the associated incoming trunk circuit in said second office, means effective in response to seizure in said first office of an outgoing trunk in said alternate route group for connecting an idle register-sender with the associated incoming trunk circuit in said third office, means in the register-

senders of said second and third offices for responding to either type of preparatory signal and to office code and numerical digit signals to register the office code and numerical digits, means comprising a register-sender in said second office connected to an incoming trunk circuit associated with an outgoing trunk circuit in the normal route group of said first office and comprising a marker in said second office for connecting said incoming trunk circuit to an outgoing trunk circuit in a normal route group outgoing from the second office or to an outgoing trunk circuit in an alternate route group outgoing from the second office if all of the trunk circuits in the normal route group are busy, and means comprising a register-sender in said third office connected to an incoming trunk circuit associated with an outgoing trunk circuit in an alternate route group of said first office and comprising a marker in said third office for connecting said incoming trunk circuit to an outgoing trunk circuit in a normal route group outgoing from said third office but not to an outgoing trunk circuit in the alternate route group outgoing from said third office.

7. In a trunking and signaling system, a first office comprising a register-sender, a plurality of groups of outgoing trunks and a marker, said marker having means controlled in accordance with the setting of registers in the register-sender for effecting the selection of a trunk in the normal route group and for effecting the selection of a trunk in the alternate route group in case all of the trunks in the normal route group are busy, means in the register-sender of the first office for transmitting a preparatory signal of one character through the selected trunk if in the normal route group and of a different character if in the alternate route group, means in the register-sender for transmitting office code and numerical digit signals through the selected trunk following the preparatory signal, a second office terminating the trunks in said normal route group, a third office terminating the trunks in said alternate route group, each of said second and third offices comprising incoming trunk circuits, outgoing trunk circuits, register-senders, markers and switches, means effective in response to seizure of an outgoing trunk circuit in said normal route group for connecting an idle register-sender with the associated incoming trunk circuit in said second office, means effective in response to seizure of an outgoing trunk in said alternate route group for connecting an idle register-sender with the associated incoming trunk circuit in said third office, means in the register-senders for responding to either type of preparatory signal and to office code and numerical digit signals to register the office code and numerical digit, means comprising a register-sender in said second office connected to an incoming trunk circuit associated with an outgoing trunk circuit in the normal route group of said first office and comprising a marker in said second office for connecting said incoming trunk circuit to an outgoing trunk circuit in a normal route group outgoing from said second office or to an outgoing trunk circuit in an alternate route group outgoing from said second office if all of the trunk circuits in the normal route group are busy, and means comprising a register-sender in said third office connected to an incoming trunk circuit associated with an outgoing trunk circuit in an alternate route group of said first office and com-

prising a marker in said third office for connecting said incoming trunk circuit to an outgoing trunk circuit in a normal route group outgoing from said third office or to a reorder circuit for transmitting a reorder signal to said first office, but not to an outgoing trunk circuit in the alternate route group outgoing from said third office.

MARTIN E. MALONEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,609,339	Williams	Dec. 7, 1926
1,798,495	Radke	Mar. 31, 1931
2,261,370	Hersey	Nov. 4, 1941
2,265,235	Keyser	Dec. 9, 1941
2,302,071	Taylor	Nov. 17, 1942
2,383,541	Gillings	Aug. 28, 1945