

March 15, 1932.

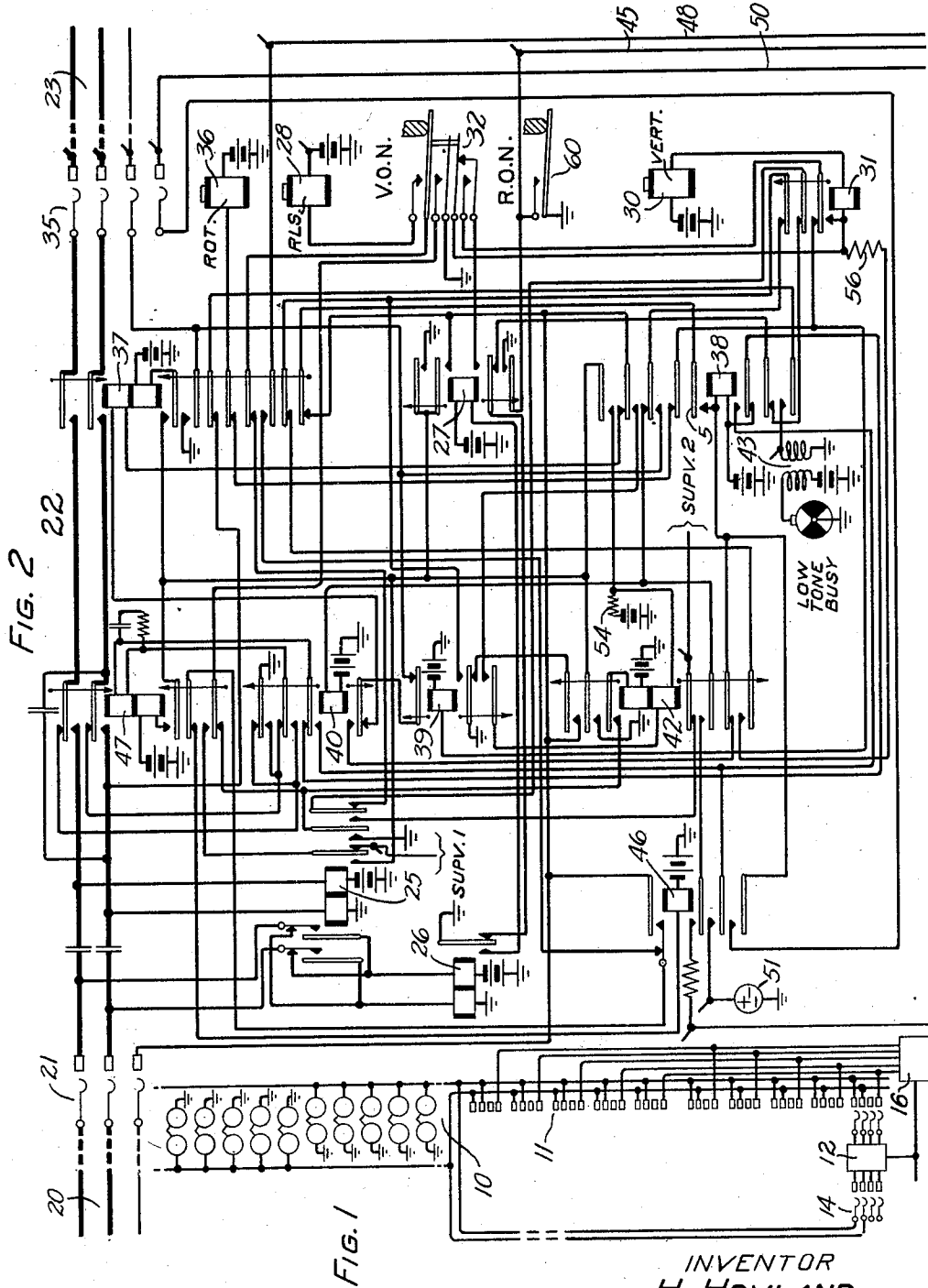
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1,849,087

TELEPHONE SYSTEM

Filed May 14, 1930

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

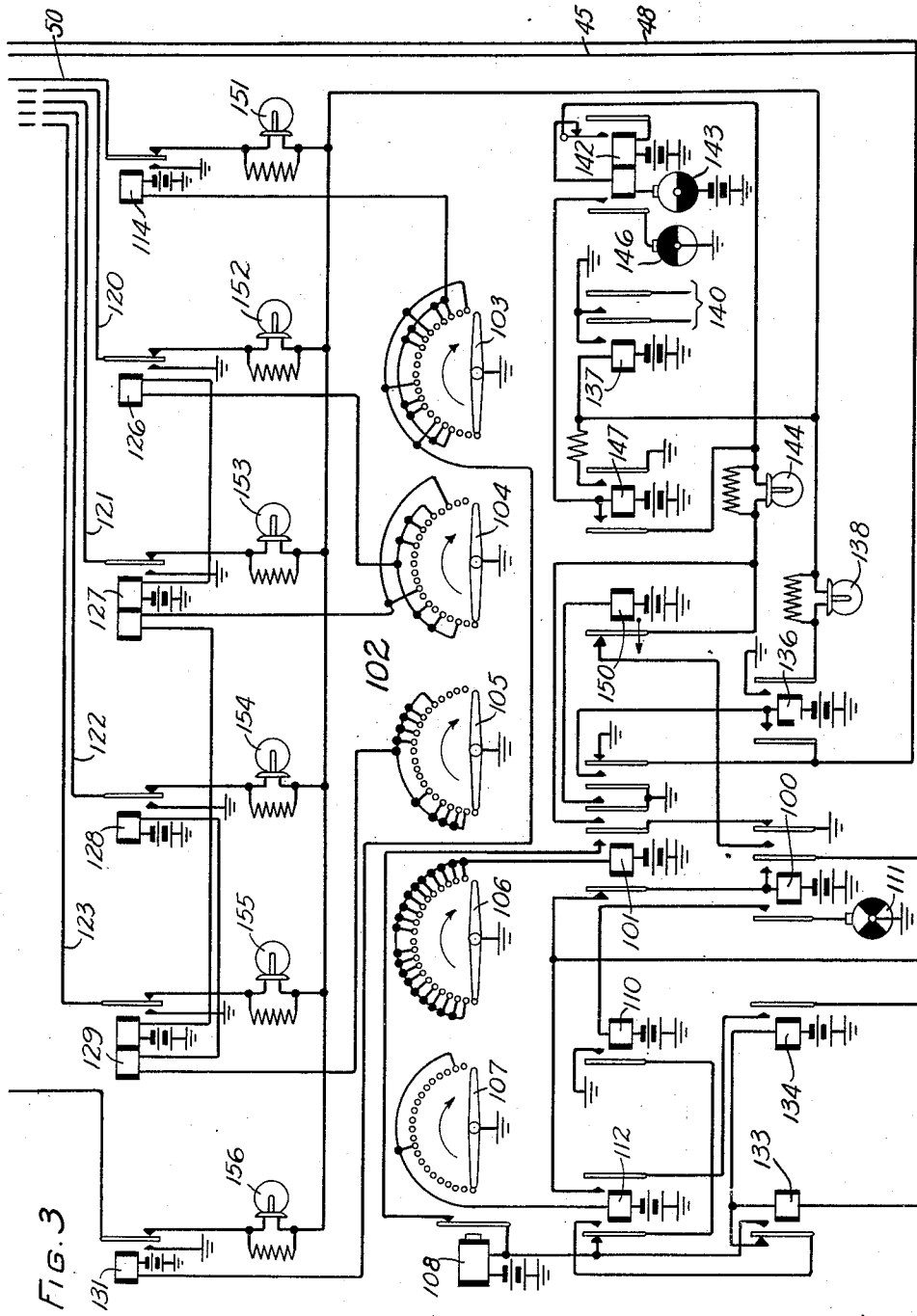


FIG. 3

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## TELEPHONE SYSTEM

Application filed May 14, 1930. Serial No. 452,155.

This invention relates to telephone systems, and particularly to party line telephone systems.

An object of the invention is to simplify and improve the signaling of party line subscribers.

Heretofore subscribers on a party line have been signaled by having a connector switch select the party line through different corresponding terminal points and thus cause interrupter devices common to a plurality of connectors to be actuated to transmit code signals comprising one or more impulses of either polarity or of different frequencies to the line depending on the terminal point selected. It has also been the practice to transpose the talking conductors at the terminal points to cause signals to be transmitted over the tip or the ring conductor to actuate correspondingly responsive signaling apparatus at the subscribers' stations on the line.

In systems of this kind when revertive calls are made a signal may be operated at an operator's position to notify the operator that such a call has been attempted. In response the operator may then actuate a key and instruct the calling subscriber to replace his receiver on the hook, the effect of these two operations being that the calling subscriber and the called subscriber's bells are alternately actuated in accordance with the respective subscribers code signals.

A feature of this invention is a system of this kind in which signal current interrupters are individual to the connector switches and common control means are provided whereby when a connector seizes the party line through any of the terminal points the individual interrupters are controlled to transmit the code signals.

Another feature of this invention is a system in which revertive calls are made with the knowledge on the part of the calling subscriber that the called subscriber's station is on the same line and whereby, in response to the calling subscriber hanging up his receiver on receipt of the usual busy signal, the desired subscriber's bell is actuated with the proper code signal; the calling subscriber's bell is actuated by a special revertive

call code signal to notify him that the desired subscriber's bell has been rung in case the calling subscriber's bell is located on the opposite side of the line from that of the called subscriber, and all switches preceding the connector are released.

Another feature is a system whereby the connections to the interrupters from the common control means are not completed until the common control means is in condition to control said interrupters to transmit complete code signals regardless of what time the connector completes the connection to the desired line and in case the common control means is engaged by another connector.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows, in general, the circuit connections for a ten party subscriber's line;

Fig. 2 shows a connector circuit embodying the features of this invention with a selector switch in diagrammatic form for connecting subscribers' lines through this connector; and

Fig. 3 shows a control circuit common to a plurality of connectors for supplying the five different codes required in this system.

Referring to Fig. 1, party line 10 has been shown with the ringers of the ten subscribers connected, five to one conductor and five to the other conductor. Ten sets of multiple terminals for this party line have also been shown at 11 with a connector 12 in diagrammatic form having access to the ten sets of terminals. The upper five sets of terminals have their tip and ring terminals connected to the line 10 in the reverse order to the connections for the tip and ring terminals of the lower five sets of terminals. A selector 14 has been shown in diagrammatic form which may be actuated to select a connector which may in turn be actuated to select one out of the ten sets of terminals and by this selection cause the correct code signal to be transmitted to the desired party by means of the common equipment shown at 16 in diagrammatic form. Five code signals for ringing the ten parties are provided and consist of two, three or four short impulses or one long and one short or one long and two short impulses each transmitted through the ring

terminals to signal any one of the five parties on either line conductor. The revertive signal will consist of one short impulse transmitted over either conductor.

5 A detailed description will now be made of the functioning of this system, first in connection with a call from a party line subscriber on line 20 through the selector 21 and connector 22 to a party line subscriber on another line 23; second, a description will be made of a call from a party line subscriber on line 20 through selector 21 and connector 22 to a subscriber's station on line 23, and assuming that this line is the same as the one on which the calling subscriber's station is located, in other words, a so-called "revertive" call.

Referring now to the first type of connection, when the subscriber on line 20 has selected through the selector 21 and connector 22, a circuit is completed for the operation of the connector 22 to select a desired subscriber's line. This circuit will be completed through the subscriber's dial over the tip and ring conductors, the make-before-break contacts of relay 25, the windings of relay 26 to battery and ground. Relay 26 is thereby operated and a circuit is completed for the operation of relay 27 from battery, winding of relay 27, armature and front contact of relay 26 to ground. Relay 27 in operating connects at its upper armatures and front contacts the sleeve lead to the selector 21 to ground, for the purpose of holding the preceding switches used in this connection. This relay also opens a circuit for the release magnet 28 at its lower inner armature and back contact and prepares an operating circuit for the vertical magnet 30 as well as a number of other circuits which will be described hereinafter. Relay 27 due to its slow-to-release characteristics will remain operated during the pulsing operation of relay 26. The first release of relay 26 in response to the first series of impulses sent out from the calling subscriber's station, after the seizure of the circuit of this connector, closes a circuit for the vertical magnet 30 from battery, winding of this magnet, winding of the change-over relay 31, normal contacts of the vertical off-normal contacts 32, lower inner armature and front contact of relay 27, armature and back contact of relay 26 to ground. Both the vertical magnet and the change-over relay 31 operate on this circuit and relay 31 being slow to release remains operated during the succeeding impulses transmitted to the vertical magnet 30. As soon as the vertical magnet has taken one step, the original circuit for this magnet is changed to pass through the upper inner armature and front contact of relay 31 and the lower closed contacts 32. The succeeding impulses of this series now cause the vertical magnet to advance the brushes 35 to the proper level in the bank of

connector 22 in which the desired subscriber's line is located.

When the pulses cease relay 31 releases and prepares a circuit for the rotary magnet 36 which will be closed as follows when relay 26 releases in response to the first of the second series of impulses: battery, winding of magnet 36, fourth lower armature and back contact of relay 37, second upper armature and back contact of relay 38, upper inner armature and back contact of relay 31, lower closed contacts 32, inner lower armature and front contact of relay 27, armature and back contact of relay 26 to ground. Relay 39 also operates at the first release of relay 26 over a circuit from battery, winding of relay 39, upper inner armature and back contact of relay 31 over the circuit traced for the rotary magnet to ground at the armature and back contact of relay 26. Relay 39 is slow-to-release, so that it will remain operated during the sending of the second series of impulses. Relay 39 closes a circuit for the operation of relay 40 from battery, winding of relay 40, third upper armature and back contact of relay 38, upper outer armature and back contact of relay 31, lower inner armature and front contact of relay 39 to ground. Relay 40 prepares circuits for making a busy test on the called line terminals as will be hereinafter described.

When the impulses of the second series have been transmitted, relay 39 releases and opens the circuit for relay 40 and also closes a circuit for making a busy test which takes place before relay 40 releases, as it will be noted that this relay is slow to release. If the terminals of the called line 23 are busy a ground connection will be found on the sleeve conductor and this ground causes the operation of relay 38 before relay 40 releases. This circuit may be traced from battery, winding of relay 38, third lower armature and back contact of relay 42, lower armature and front contact of relay 40, upper armature and back contact of relay 39 to ground on the sleeve conductor of line 23. Relay 38 provides a locking circuit for itself from battery winding of relay 38 and its upper inner armature and front contact, lower outer armature and back contact of relay 37 to ground at the upper armatures and front contacts of relay 27. Relay 38 closes a circuit from the busy tone equipment at 43 through its lower outer armature and front contact, third lower armature and back contact of relay 37 to the ring conductor leading to the calling subscriber's line 20.

If the called line is idle relay 38 will not operate at this time so that on the release of relays 39 and 40 the sleeve conductor from the called line 23 is connected to ground to make this line busy over a circuit from battery through the usual cut off relay of the called line over this sleeve conductor, upper

armature and back contact of relay 39; lower armature and back contact of relay 40; upper winding of relay 37, fourth upper armature and back contact of relay 38 to ground at the upper armatures and front contacts of relay 27. This ground connection serves as a ground potential for the sleeve conductor until the relay 37 operates, which it does in this circuit, sufficiently to close a connection through its lower inner armature and front contact for the lower winding of this relay. Relay 37 now fully operates through a circuit established from battery through the lower winding and this lower inner armature and front contact to ground at the upper outer armature and front contact of relay 27. When relay 37 operates fully a direct ground, connection is established for the sleeve conductor at the second lower armature and front contact of relay 37. Relay 37 also closes a connection over the tip and ring conductors to the called line 23 for the purpose of applying ringing signal to call the desired subscriber on this line.

It should be noted that the operation of relay 27 a circuit was completed to ground at the lower armature and front contact of this relay over lead 45 for the purpose of starting the common control equipment shown in Fig. 3 to supply the ringing signal. This circuit may be traced from battery through the winding of the start relay 100, left armature and back contact of relay 101, lead 45 to ground at the lower outer armature and front contact of relay 27. In Fig. 3, the switch 102 consists of five terminal banks 103 to 107 and associated brushes driven in a step-by-step manner by a stepping magnet 108 for the purpose of supplying signaling codes for calling the subscribers on party lines as will hereinafter be described. In this case, a single impulse of signaling current will be supplied at intervals for calling a subscriber on line 23 and this signal is supplied when interrupter relay 38 is operated which does not however occur until relay 46 is operated. The circuit for relay 46 will be closed when the common control equipment is in a normal position, such as is shown in Figure 3 with the brushes of the banks 103 to 107 standing on the zero terminals or on the 11th terminals. In either case relay 101 will be in a release condition. This relay 46 will, therefore, not operate to start ringing until a complete series of code signals have been transmitted. This is for the purpose of preventing mutilated signals from being transmitted in case the common equipment is in use by some other connector, in which case, the brushes may be traveling between positions 1 and 10 or 11 and 22. If it is assumed that the brushes of the switch 102 are located in the position shown, the circuit for relay 46 will be completed, from battery, winding of relay 46, second lower armature and back contact of

relay 47, make-before-break contacts of relay 46, sixth lower armature and front contact of relay 37, conductor 48, outer right-hand armature and back contact of relay 101 to ground. Relay 46 in operating closes a locking circuit for itself from battery through the winding of this relay, second lower armature and back contact of relay 47, upper armature and front contact of relay 46 to ground at the upper armatures and front contacts of relay 27.

On the operation of the start relay 100, a circuit was completed for locking this relay from battery through its inner right-hand armature and front contact to the ground on lead 45 independent of the connection through the left-hand armature and back contact of relay 101. The start relay 100 in operating closes at its left-hand armature and front contact a circuit for the alternate operation and release of relay 110 under control of an interrupter 111. Relay 110 controls the pulsing circuit for the magnet 108 extending through the left-hand armature and back contact of relay 112. Magnet 108 will now step the brushes of the banks 103 to 107 over their terminals to control the application of ringing signal codes. It should be noted that on the third step of brush 103 a circuit will be completed for the operation of relay 114 from battery winding of relay 114, third terminal of the bank 103 and the brush thereof to ground. This relay is also operated on the fourth, seventh, eighth, fourteenth, fifteenth, eighteenth and nineteenth steps of the brush of the bank 103. On each operation of relay 114 a circuit is completed from battery, winding of relay 38, lower outer armature and front contact of relay 46, the fourth brush of connector 20 and the corresponding terminal of line 23, lead 50, armature and front contact of relay 114 to ground. This causes the operation of relay 38 each time relay 114 is operated. It should, however, be noted that the brush of bank 103 will bridge two adjacent terminals and relay 114 will therefore remain operated during the third and fourth, the seventh and eighth, the fourteenth and fifteenth and the eighteenth and nineteenth steps so that relay 38 due to these operations of relay 114 will be operated four times while the brush travels from positions 1 to 22. In this manner two periods of operation of relay 38 will take place for each half operation of the switch 102. These operations of switch 102 will therefore cause the application of ringing signals to the line 23 comprising a code of two impulses repeated at intervals. It will be later explained how different code signals will be selected when other subscribers located on the same party line are called. The operation of relay 38 completes the signaling circuit for transmitting ringing current from the source 51 to the called line as follows:

source 51, second lower armature and front contact of relay 46, inner lower armature and front contact of relay 38, inner upper armature and back contact of relay 40, upper winding of relay 47, second upper armature and back contact of relay 40, inner upper armature and back contact of relay 47, the ring conductor of connector 22 and upper inner armature and front contact of relay 37 to the ring brush and ring conductor of line 23 to the bell of the called subscriber's station.

These signals will be repeated until the called subscriber answers, when the ringing trip relay 47 will operate, Relay 47 operates sufficiently to close a circuit from battery, lower winding of relay 47 and its lower inner armature and front contact to ground at the upper outer armature and front contact of relay 27. This circuit will then cause the relay 47 to become fully operated, to complete the connection at its upper armatures and front contacts over the tip and ring conductors of connector 22 between the two subscribers. Talking battery for the called subscriber is supplied from battery and ground through the windings of relay 25. Relay 25 is now operated and the operation of relay 47 opens the holding circuit of relay 46 which releases and opens the circuit for relay 38 to prevent it from being further controlled by relay 114 and to discontinue the ringing. Relay 25 in operating also reverses the battery and ground connection through the windings of relay 26 at its left-hand armatures and front contacts for supervisory purposes or metering services which are of no importance in connection with this invention.

The following description relates to the selection of a signaling code for calling a subscriber on a party line, when an idle connector is found, it will be actuated by impulses to select one of the ten sets of terminals of the desired party line representing the desired subscriber's number and thereby causing the common equipment shown in Fig. 3 to be actuated to control through the connection for the fourth terminal relay 38 in a manner to transmit the proper code signal. In the connector 22 the fourth terminal has been connected through lead 50 for control by relay 114. This will cause as hereinbefore explained a code comprising two impulses to be repeated at fixed intervals. If the connector had selected a set of terminals in which the fourth terminal had been connected to conductor 120 a code of three impulses would have been transmitted at fixed intervals, or if conductor 121 had been connected to the fourth terminal a series of four impulses would have been transmitted or if conductor 122 had been connected to the fourth terminal a series of impulses comprising one long impulse followed by one short

impulse would have been transmitted, or if conductor 123 had been connected to the fourth terminal a code comprising one long impulse and two short impulses would have been transmitted. It is therefore evident that the five subscribers having their ringers connected to one conductor may be rung by five distinguishing codes and that the five subscribers having their ringers connected to the other conductor may be rung by the same five distinguishing codes. The selection of the set of terminals will determine the conductor over which the code is to be transmitted and the connection for the fourth terminal in the selected set will determine the code itself.

In the case where the fourth terminal is connected to conductor 120 relay 38 will be actuated and release to cause three impulses to be transmitted from the source 51. In this case the brush of the bank 104 will, as shown, close a circuit for relay 126 from battery through the right-hand winding of relay 127, winding of relay 126, to the second, fourth and sixth, and then after a short interval to the thirteenth, fifteenth and seventeenth terminals of bank 104 to the brush thereof to ground. In the case where four impulses are to be transmitted, relay 127 will control lead 121 to cause relay 38 to be actuated four times with a short interval between the sets of impulses. In this case relay 127 will be operated when the brush of bank 103 makes contact with the second, fourth, sixth, and eighth, and then after a short interval with the thirteenth, fifteenth, seventeenth and nineteenth terminals. For the first three terminals in each group of impulses the circuit will be closed through the right-hand winding of relay 127 and for the fourth impulse the circuit will be closed through the left-hand winding of this relay as shown. In the case where one long impulse, followed by one short impulse, are to be transmitted, relay 128 will be operated from the bank 105 over a circuit from battery through the winding of relay 128 and left-hand winding of relay 129 to ground at the brush of bank 105 at terminals one to four and 6 and again after a short interval at terminals 11 to 14 and 16. Relay 128 will remain operated to cause the long impulses while the brush travels over the first three terminals in each group. In the case where a long impulse followed by two short impulses are to be transmitted, relay 129 controls the operation of relay 38. In this case, in addition to the circuit completed through bank 105 for the first long impulse and the second short impulse, relay 129 is also operated when the brush of bank 104 makes contact with the eighth and the nineteenth terminals.

When a connection is made from one party line subscriber to another and their telephone sets are connected to the same line a so-called revertive call is made. Such a call will now

be described. In this case the operation of the circuit is practically the same as hereinbefore described, except that when the busy tone is received by the calling subscriber, he will know that the party called is on the same line and has been instructed to hang up his receiver and wait for the desired subscriber to be called and for the reception of a revertive call signal that he will recognize as such. This revertive signal will only be received in case the desired subscriber's ringer is not located on the same conductor as his own ringer but on the other conductor. In case the called subscriber's ringer is located on the same conductor as his own he will, of course, recognize the calling signal code when it is transmitted to actuate the called subscriber's ringer, as his own ringer would also be operated by the same code.

The operations of the circuits are as follows. When the calling subscriber hangs up his receiver after having received the busy signal, relay 26 is released. Relay 26 in releasing closes a circuit for the operation of relay 39 before relay 27 releases as follows: battery, winding of this relay, upper inner armature and back contact of relay 31, vertical off-normal contact 32, inner lower armature and front contact of relay 27 to ground at the armature and back contact of relay 26. This operation of relay 39 takes place before relay 27 has time to release due to the slow release characteristics of this latter relay. Relay 39 in operating applies a ground to the sleeve conductor of connector 22 over a circuit as follows: ground, lower inner armature and front contact of relay 39, upper outer armature and back contact of relay 31, third upper armature and front contact of relay 38, sleeve terminals of line 23. This ground connection makes the line busy from the sleeve terminal of connector 22. When relay 27 now releases the original holding ground for the preceding switches is removed from the sleeve conductor to selector 21 at the upper armatures of this relay. However, the substitute ground from the lower inner armature and front contact of relay 39 is now extended over the sleeve terminal of line 23, which is the same as the calling line, to the sleeve circuits of the intermediate switches and selector 21 to hold them and for other purposes as will presently become apparent. Relay 27 also in releasing removes the shunt circuit for the lower winding of relay 42 from battery through resistance 54 and the upper armature and front contact of relay 38 to ground at the upper armature and front contact of relay 27. Relay 42 will now therefore operate from battery through resistance 54, lower winding of relay 42, lower outer armature and front contact of relay 39, fourth upper armature and contact of relay 38 to the above mentioned substitute ground on the sleeve conductor from the selector 21.

This circuit causes relay 42 to operate sufficiently to close an energizing circuit for itself from battery through the upper winding and upper inner armature and front contact of relay 42, third lower armature and back contact of relay 47, middle made contacts of the vertical off-normal contact 32 to ground. This circuit fully energizes relay 42 to close the remaining connections controlled thereby. Relay 42 in operating closes a circuit for the operation of relay 31 as follows: battery, winding of magnet 30, winding of relay 31, resistance 56, lower outer armature and front contact of relay 42, seventh lower armature and back contact of relay 37 to ground at the lower inner armature and front contact of relay 39. Due to the resistance 56 in this circuit the vertical magnet will not operate. Relay 31 in operating opens at its upper outer armature and back contact the ground connection supplied from the lower armature and front contact of relay 39 as hereinbefore traced through the sleeve terminal of connector 22, the intermediate switches and the selector 21. This removal of the ground connection from the sleeve causes the release of all the preceding switches including selector 21. Connector 22 will not be released as the circuit for the release magnet is maintained open at the second upper armature and back contact of relay 31 even though this circuit will be closed on the release of relay 38 at the second lower armature and back contact. It should be noted that relay 38 does not release until the ground is removed from the sleeve to open its locking circuit over its upper inner armature and front contact.

Relay 39 also releases due to the operation of relay 31 as the circuit therefor is opened at the upper inner armature and back contact of relay 31. Relay 39 is slow in releasing so as to permit the above operations to take place as described. When relay 39 is released the circuit for the sleeve conductor of line 23 is again closed to ground to make the line busy. This ground extends from the lower inner armature and back contact of relay 39, upper outer armature and front contact of relay 42, fourth upper armature and back contact of relay 38, upper winding of relay 37, lower armature and back contact of relay 40, upper armature and back contact of relay 39 to the sleeve. As battery is now present on this conductor through the winding of the usual cut-off relay not shown relay 37 will operate sufficiently in this circuit to close a circuit hereinbefore traced for the lower winding to cause the relay to fully operate. The release of relay 39 also allows relay 31 to release but this relay is slow in releasing and, therefore, remains operated long enough to permit the partial operation of relay 37.

Relay 37 in operating closes a connection



for the tip and ring conductors through to the ring tripping relay 47 for the application of ringing current and relay 46 is now operated over a circuit as hereinbefore traced for this relay, completed over lead 48 while the common control equipment is in normal position or in position 11. The operation of relay 38 will now be controlled by the switch 113 to transmit the proper ringing current to the desired called subscriber. It should also be noted that on bank 102, the brush thereof will when it connects with the terminals 5, 10, 15 and 20, close an obvious circuit for the operation of relay 131. This relay in operating at these periods will close a circuit for the momentary operation of relay 40 from battery winding of relay 40, second lower armature and front contact of relay 42, lower inner armature and front contact of relay 46 to ground at the armature and front contact of relay 131. Relay 40 in operating causes an impulse from source 51 to be transmitted over the tip or ring conductor to ring the calling subscriber's bell provided it is on the opposite conductor from that on which the called subscriber's bell is located. This circuit may be traced from source 51, second lower armature and front contact of relay 46, upper inner armature and front contact of relay 40, upper winding of relay 47, second upper armature and front contact of relay 40, upper outer armature and back contact of relay 47, tip conductor of connector 22, upper armature and front contact of relay 37 over the tip brush to the called party line. This is for the purpose of notifying the calling subscriber under these circumstances that the called subscriber's station has been run. In case the calling subscriber's bell is on the same conductor as the called subscriber's bell the calling subscriber's bell will of course receive the same code as the called subscriber's bell. When the subscriber at the called station answers, relay 47 is operated as hereinbefore described and talking battery is supplied to the line through the windings of relay 25. On the operation of relay 47 the holding circuit for the upper winding of relay 42 is opened at the third lower armature and back contact of relay 47 but relay 42 is slow in releasing so that it will be held operated from the connection completed to ground for this holding circuit on the second outer armature and front contact of relay 53 which operates when the called subscriber answers. If the called station does not answer, the calling subscriber must remove his receiver from the hook to trip the ringing to release the connection.

If in a connection that is not a revertive call, the subscriber at the called station disconnects before the subscriber at the calling station disconnects, relay 25 is released, causing the release of relays 47, 37 and 42, and

then when the subscriber at the calling station disconnects, relay 26 releases, causing the release of relay 27. The circuit is then closed for the operation of the release magnet 28 as follows: from battery, winding of this magnet, upper made contacts of the vertical off-normal contacts 32, fourth lower armature and back contacts of relay 37, outer right-hand armature and back contacts of relay 25, middle upper armature and back contact of relay 31, middle lower armature and back contact of relay 33, inner lower armature and back contact of relay 37, armature and back contact of relay 26 to ground. This circuit is opened at the vertical off-normal contacts 32 when the switch has returned to normal.

If the subscriber at the calling station disconnects before the subscriber at the called station relay 25 remains operated and holds relays 47, 37 and 42 operated through its inner right-hand armature and front contact, third lower armature and front contact of relay 47, middle made contacts of vertical off-normal contacts 32 to ground. Relays 26 and 27 release when the subscriber at the calling station disconnects and a momentary circuit is closed for the operation of relay 39 before relay 27 releases as follows: battery, winding of relay 39, inner upper armature and back contact of relay 31, lower made contacts of vertical off-normal contacts 32, inner lower armature and front contact of relay 27 to ground at the armature and back contact of relay 26. Relay 39 operating, removes the ground connection for the sleeve conductor to the preceding switches which are thereby released. Then when relay 39 releases, the ground potential is again applied to the sleeve conductor to prevent the connector from being seized until it is released by the called subscriber hanging up his receiver when relay 25 releases and causes the release of the other relays as hereinbefore described.

In case of a revertive call relay 25 remains operated until both subscribers on the party line have replaced their receivers. The release of relay 25 causes the release of the remaining relays in the circuit and restores the connector to normal.

In releasing the circuits of the common control equipment shown in Fig. 3 it should be noted that relay 101 was operated as soon as the brush of bank 106 left a normal position. The operation of this relay will then partially close a self-interrupting circuit for the operating magnet 108 which is fully completed when relay 100 releases due to the removal of the ground connection from lead 45 when the connector is restored to normal due to the release of relay 27 and the opening of the rotary off-normal contact 60. This circuit may be traced from battery through the winding of magnet 108 and its self-interrupting armature and back contact, inner right-hand



armature and front contact of relay 101, outer right-hand armature and back contact of relay 100 to ground. On the release of relay 100 the pulsing circuit controlled by interrupter 111 is also opened. It should be noted that on the eleventh step of the switch 113 the brush of bank 106 opens the circuit for relay 101, so that the switch 113 may either stand with its brushes in the normal position shown in Fig. 3 or with their brushes in the normal eleventh position.

In order to provide a pause between the series of signaling impulses as determined by the first half and the second half of the banks of the switch 113, relays 112, 133 and 134 are provided. Assuming then, for example, that the eleventh position has been reached in the operation of the switch 113, the brush of bank 107 will close in this position an obvious circuit for the operation of relay 112. This relay in operating transfers the pulsing circuit for magnet 108 to close a circuit for relay 134 when relay 110 is operated as follows: battery, winding of relay 134, armature and back contact of relay 133, left-hand armature and front contact of relay 112 to ground at the armature and front contact of relay 110. Then when relay 110 is released a circuit is closed for the operation of relay 133 in series with relay 134 as follows: from battery through the winding of relays 134 and 113 in series, and front contact of relay 134, right-hand armature and front contact of relay 112 to ground on lead 45. Relay 133 in operating opens the original for energizing relay 134 and closes a circuit for the winding of the magnet 108 so that on the next operation of relay 110 magnet 107 operates over a circuit as follows: battery, winding of this magnet, armature and front contact of relay 133, left-hand armature and front contact of relay 112 to ground at the armature and front contact of relay 110. Magnet 107 now moves the brushes of switch 113 into the twelfth position and the switch will then continue to be operated under control of the interrupter 111 as hereinbefore described. Relay 112 now releases to cause the release of relays 133 and 134. An alarm circuit arrangement has been provided to indicate irregularities in the performance of these circuits, in one case if a false ground connection should for some reason or other, be applied on conductor 48 and in another case, if the start relay 110 should fail to start the switch 113 in operation. In the first instance, the false ground connection on lead 48 would, while relay 101 is operated, close a circuit through the outer armature and front contact from this ground through the winding of relay 136 to battery and thus cause this relay to be operated and remain locked through its left-hand armature and front contact as long as this ground remains. A circuit will now be completed from battery

through the winding of relay 137, lamp 138, right-hand armature and front contact of relay 136 to ground. Lamp 138 will then light and relay 137 will operate. Relay 137 in operating closes an alarm circuit connected at 140 (not shown) for the lighting of a pilot lamp and for the sounding of an alarm signal.

If the switch 113 for any reason fails to operate when the start relay is operated, a circuit is prepared for the operation of relay 142. When the interrupter 143 closes a circuit to battery this circuit may be traced from battery, interrupter 143, left-hand winding and make-before-break contacts of relay 142, lamp 144, armature and back contact of relay 150, outer right-hand armature and front contact of relay 100 to ground. Relay 142 locks itself through its right-hand winding and when the interrupter 146 applies ground to the left-hand armature of relay 142 a circuit is completed for relay 147. This relay in operating locks itself in series with the lamp 144 to the ground at the outer right-hand armature and front contact of relay 100. Relay 147 also closes an obvious circuit for relay 137 which in operating closes the alarm circuits at 140. If for any reason the switch 113 fails to continue to step after having once started, relay 101 closes circuits for the operation of relays 142, 147, 137, and for the lamp 144 as above described. Relay 150 is normally operated when relay 101 is operated to open the circuit for relay 142 closed by the operation of relay 100 to prevent the alarm circuits from functioning under normal conditions. Relay 137 will also be operated to close an alarm circuit if an accidental ground is applied on conductor 50 or on the other conductors leading to other party line terminals. The circuits in these instances will extend over the right-hand armatures and back contacts of relays 114, 126, 127, 128, 129 and 131 respectively and the associated lamps 151, 152, 153, 154, 155, and 156 will be lighted respectively to indicate on what lead the false ground connection has been made, while relay 137 will be operated to sound the alarm.

It should be understood that while the invention has only been disclosed in connection with one circuit arrangement it could readily be applied to a number of other systems without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, a line, a plurality of switches, means for establishing a connection from one of said switches to said line, a signal source, means associated with each switch including a relay variably operable to produce codes of signals from said source for transmission to said line, a common device for actuating said relay to produce various code signals, and means for selectively determining the type of code signals to be produced and transmitted.

2. In a telephone system, a line, a switch,

a source of signaling current, means associated with each switch including a current interrupting device variably operable to produce codes of signals from said source for transmission over said line, and means responsive to the establishment of a connection between said switch and line for operating said device in a particular manner depending on the terminal point to which the connection is established to produce and transmit a corresponding signaling current code over the line.

3. In a telephone system, a line, a plurality of switches, means for establishing connections from one of said switches to said line, a signal current source, means associated with each switch including a relay variably operable to produce codes of signals from said source for transmission to said line, a common device for actuating said relay to produce various code signals, means for selectively determining the type of code signals to be produced and transmitted, and means for preventing the production and transmission of a selective code signal except at the beginning of a code.

4. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same party line for connecting the line with terminal points of said line identifying the desired subscriber, and means responsive to the calling subscriber thereafter hanging up his receiver for signaling the desired subscriber with a code signal identifying said subscriber and for signaling the calling subscriber with a code signal assigned as a notifying signal that the desired subscriber has been called and for partially releasing the connection between the line and said terminal points established by said switching means.

5. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same line, for selecting a terminal point on said line identifying the desired subscriber, means operative after said terminal point has been selected for signaling the desired subscriber with a code signal identifying said subscriber and for signaling the calling subscriber with a code signal assigned as a notifying signal that the desired subscriber has been called.

6. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same party line, for selecting a terminal point on said line identifying the desired subscriber, means operative after said terminal point has been selected for alternately signaling the desired subscriber with a code signal identifying said subscriber and for signaling the calling subscriber with another

code signal assigned as an identifying signal that the desired subscriber has been called.

7. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same line, for selecting a terminal point on said line identifying the desired subscriber, means operative after said terminal point has been selected for signaling the desired subscriber with a code signal identifying said subscriber and for signaling the calling subscriber with a code signal assigned as a notifying signal that the desired subscriber has been called, said code signals being transmitted through the selected terminal point.

8. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same line for selecting terminal points on said line identifying the desired subscriber, a relay responsive to said selection and to the calling subscriber hanging up his receiver, means including another relay responsive to the operation of said first relay for transmitting through said terminal points a code signal to call the desired subscriber, means including a third relay responsive to the operation of said first relay for transmitting through said terminal points another code signal to notify the calling subscriber that the desired subscriber has been called.

9. In a telephone system, subscribers' lines including party lines, means including a connector responsive to one subscriber calling another on the same line for selecting a terminal point identifying the desired subscriber, a source of signaling current, a current interrupting device associated with said connector, another current interrupting device associated with said connector, and means for controlling said first device to transmit a signal current code to the calling subscriber's station and for controlling said second device to transmit a signal current code to the called subscribers' stations.

10. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same line for selecting a terminal point on the same line identifying the desired subscriber, a relay responsive to said selection and to the calling subscriber hanging up his receiver, and means responsive to the operation of said relay for transmitting over said line a signal to call the desired subscriber and another signal to notify the calling subscriber that the desired subscriber has been called.

11. In a telephone system, subscribers' lines including party lines, switching means responsive to one subscriber calling another on the same line for selecting a terminal point on the same line identifying the desired subscriber, a relay responsive to said selection and to the calling subscriber hanging up his

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receiver, and means responsive to the operation of said relay for transmitting over said line a signal to call the desired subscriber, another signal to notify the calling subscriber that the desired subscriber has been called and for partially releasing the connection established by said switching means.

12. In a telephone system, subscribers' lines including party lines, a connector, means for extending a connection from a party line to said connector, means in said connector for completing said connection to a desired line, a relay operated when the calling subscriber hangs up his receiver, and means responsive to the operation of said relay only when the calling and called subscribers are on the same party line for releasing said connection extending means but maintaining said connector in connection with said party line during conversation.

13. In a telephone system, subscribers' lines including party lines, a connector, means for extending a connection from a party line to said connector, means in said connector for completing said connection to a desired line, a relay operated when the calling subscriber hangs up his receiver, means responsive only when the calling and called subscribers are on the same party line to the operation of said relay for releasing said connecting extending means but maintaining said connector in connection with said party line, and for transmitting signals to call the desired subscriber and for notifying the calling subscriber that the desired subscriber has been called.

In witness whereof, I hereunto subscribe my name this 8th day of May, 1930.

HENRY HÖVLAND.

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