

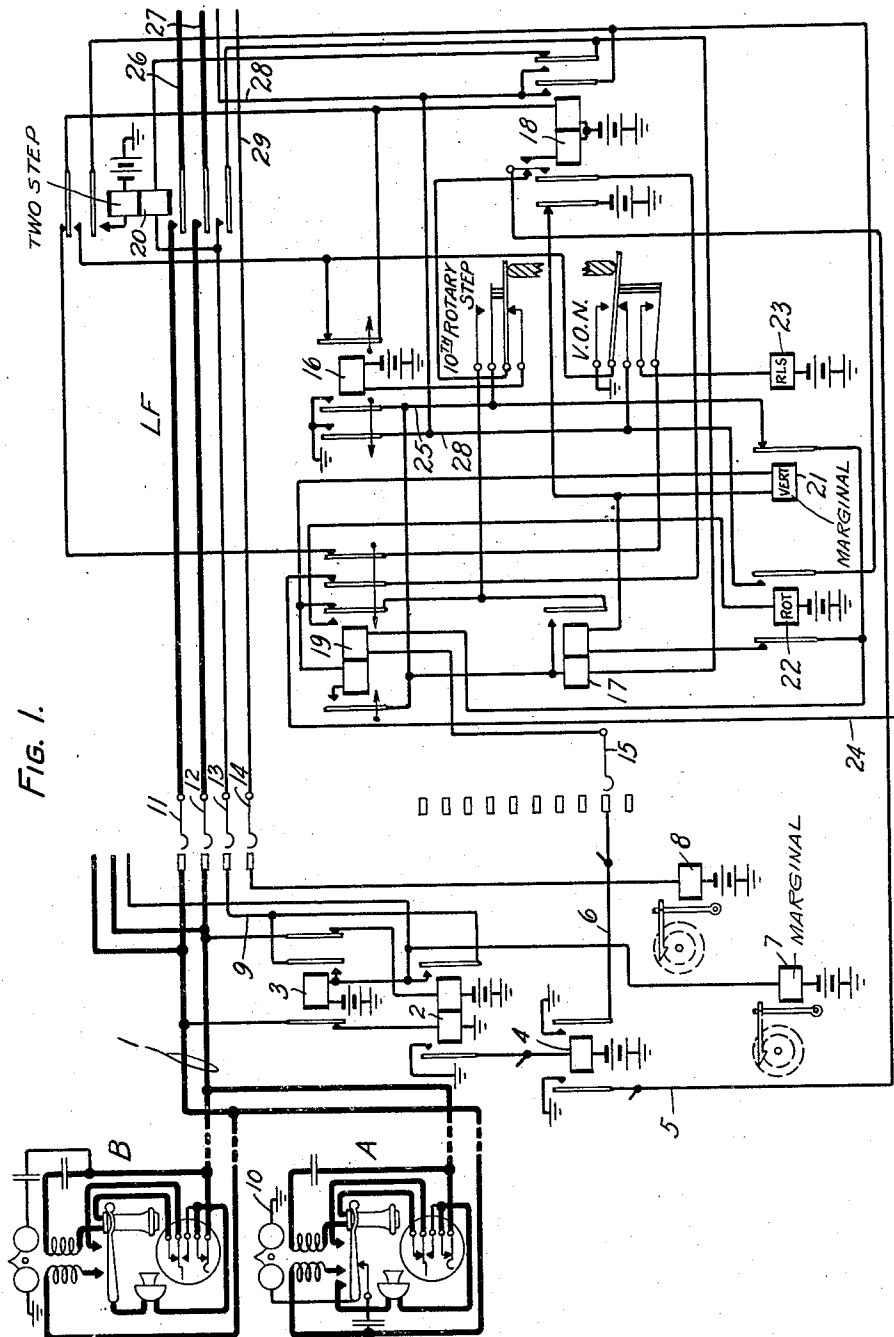
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H. HOVLAND
TELEPHONE EXCHANGE SYSTEM

1,823,688

Filed June 28, 1929

2 Sheets-Sheet 1



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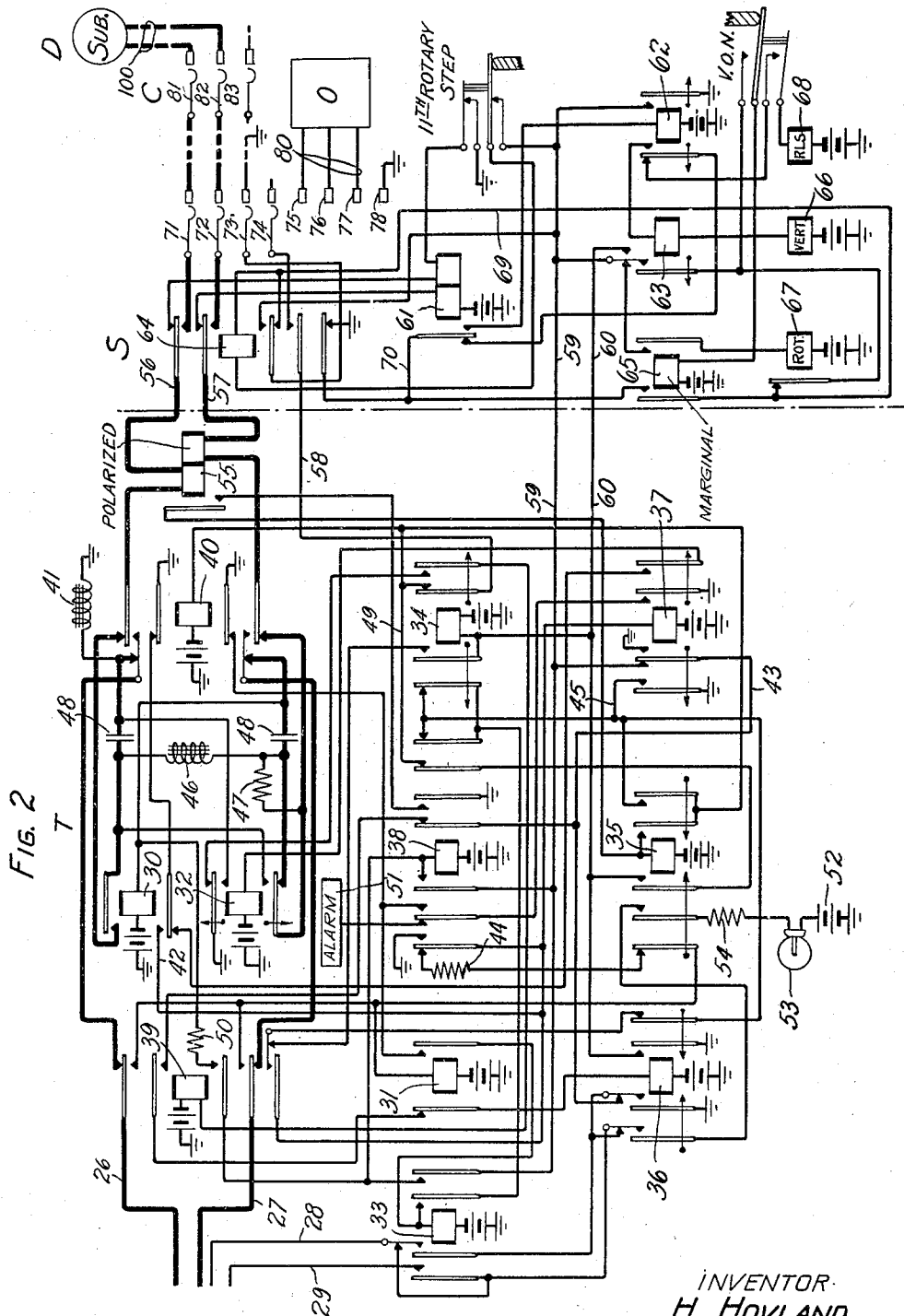
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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TELEPHONE EXCHANGE SYSTEM

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This invention relates to telephone systems and more particularly to party-line message registration in automatic telephone systems.

The object is to enable the performance of a more positive and reliable test of party-lines to identify the station originating the call.

According to this invention, means are provided for testing a party-line to determine which of the parties has originated the call, the test being made immediately after the calling subscriber has dialed the first digit of the called station's number. By making the test at this time the possibility of a false determination on account of the removal of the receiver at another station on the line is eliminated.

The drawings, comprising Figs. 1 and 2, disclose a portion of a step-by-step automatic telephone system in which this invention is embodied.

Fig. 1 diagrammatically represents a line-finder circuit LF and two subscriber's stations A and B, one of which is assumed to be a calling station. The stations A and B are connected by the line 1 to terminals in the bank of the line-finder switch LF and to terminals in the banks of other line-finders in the same group with LF. The subscriber's set at station A is arranged so that ground is connected to the line when the receiver is removed from the receiver-hook to originate a call and the subscriber's set at station B is arranged so that ground is not so connected. Two message registers are shown associated with the line 1, one for each of the stations A and B. The group relay 4 is common to a group of lines including the line 1; the starting conductor 5 connects to the first of a plurality of line-finders each of which has access to the line 1. During the time that a line-finder is engaged, the starting conductor is extended to the next idle line-finder in the same group. The line-finder switch LF, which is of the well known Strowger type, includes a commutator whose segments correspond to the groups of lines to which the line-finder has access; the associated commutator brush 15

is carried by the shaft of the line-finder switch so as to make contact with a given segment of the commutator while the multiple brushes 11 to 14 inclusive are positioned at the corresponding level of the multiple bank.

Fig. 2 diagrammatically represents a trunk circuit T, a selector circuit S, a connector circuit C, a subscriber's station D, and an operator's position O. The trunk circuit T, which is individual to the line-finder LF, shown in Fig. 1, and to the selector S is arranged to test the line of the calling subscriber, immediately after the first digit of the called subscriber's number has been dialed, to determine which of the two stations associated with the line has originated the call. The trunk circuit T is also arranged to operate the calling subscriber's message register if a talking connection is established between the calling and called stations and the call is one for which the calling subscriber should be charged. The selector S has access to groups of trunks, each trunk terminating at a connector switch or an operator's position; the brushes 71 to 74 inclusive of the selector switch are shown in contact with terminals which are connected to the connector circuit C. The connector C, which is represented by the brushes 81, 82 and 83, has access to groups of lines, one of which includes the line 100 which terminates at the subscriber's station D; the brushes of the connector switch are shown in contact with the terminals of the set to which the line 100 is connected.

The operation of the circuit shown in Figs. 1 and 2 will now be described in detail. Assume that a call is originated by the removal of the receiver from the receiver hook at either of stations A or B, and that the called station is the station D. The line relay 2, which is thereupon energized in an obvious circuit, closes a circuit for operating group relay 4. In operating, relay 4 connects ground to the starting conductor 5 and also connects ground over group conductor 6 to the commutator segment, of each of the line-finders associated with the starting conductor 5, corresponding to the group of multiple

bank terminals which include the set of terminals connected to line 1. As shown in Fig 1, conductor 6 is connected to the second commutator segment of line-finder switch 5 LF and it follows therefore that the set of multiple bank terminals, to which the line 1 is connected, is located in the second group (level) of the multiple bank.

Assuming that the line-finder LF is idle at the time that relay 4 operates, a circuit is closed from battery through the winding of slow-to-release relay 16, normally closed contacts of the 10th-rotary-step springs, and through the normally closed contacts of the continuity spring combination of relay 18, to ground over starting conductor 5. Relay 16 operates, thereby closing a circuit for operating stepping relay 17; this circuit may be traced from ground through the inner left-hand front contact of relay 16, through conductor 25, back contact of the vertical stepping magnet 21, back contact of the rotary stepping magnet 22, right-hand winding of relay 17, and through the outer left-hand back contact of relay 18, to battery. Relay 17 closes a circuit for energizing vertical stepping magnet 21; this circuit may be traced from the ground at relay 16 over conductor 25, through the front contact of relay 17, inner right-hand back contact of relay 19, winding of vertical stepping magnet 21, and through the outer left-hand back contact of relay 18, to battery. In energizing, the magnet 21 opens the circuit through the right-hand winding of stepping relay 17 and steps the shaft, carrying the multiple brushes 11, 12, 13 and 14 and the commutator brush 15, up one step to the first level. The release of relay 17, when the magnet 21 operates, opens the circuit through the winding of the stepping magnet 21. The release of magnet 21 closes the circuit through the right-hand winding of stepping relay 17. The alternate operation and release of magnet 21, as controlled by stepping relay 17, is effective to raise the shaft of the line-finder switch step-by-step. When raised to the level at which the commutator brush 15 is in contact with the group segment to which group conductor 6 connects, a circuit is closed from the ground at group relay 4 over conductor 6, through commutator brush 15, right-hand winding of relay 19, back contact of magnet 22, right-hand winding of relay 17, and through the outer left-hand back contact of relay 18, to battery. The closing of this circuit prevents the release of relay 17 and causes the operation of relay 19. In operating, relay 19 opens the circuit through the winding of vertical stepping magnet 21 so that magnet 21 releases. Relay 19 closes a circuit from battery through the outer left-hand back contact of relay 18, winding of vertical stepping magnet 21, left-hand winding and front contact

of relay 19, over conductor 25 to ground at relay 16. The current in this circuit is not strong enough to operate the magnet 21 but is effective to hold relay 19 after the rotary movement of the switch has opened the circuit through the right-hand winding of this relay at the commutator brush 15.

The aforementioned operation of relay 19 also closes a circuit for operating the rotary stepping magnet 22; this circuit may be traced from battery, through the winding of the rotary stepping magnet 22, inner right-hand front contact of relay 19, front contact of relay 17, and conductor 25, to ground at relay 16. The operation of rotary magnet 22 opens the circuit through the right-hand winding of stepping relay 17 and relay 17 releases. The release of relay 17 opens the circuit through the winding of the magnet 22 and the release of magnet 22 closes the circuit for operating relay 17. The alternate operation and release of the rotary stepping magnet 22, as controlled by stepping relay 17, is effective to rotate the shaft and brushes of line-finder LF step-by-step so that the multiple brushes 11 to 14 inclusive successively make contact with the sets of terminals in the previously selected level. When the sleeve brush 13 makes contact with the terminal associated with the line 1 a circuit is closed from battery through the windings of the cut-off relay 3 and the message register 7 in parallel, front contact of relay 2, over lead 9, through brush 13, lower winding of relay 20, right-hand back contact of relay 18, left-hand winding of relay 17, and over lead 25 to ground at relay 16. The current in this circuit is effective to operate the cut-off relay 3, to prevent the release of relay 17 and to close the inner upper front contact of relay 20. The message register 7 is marginal and does not operate at this time. Since relay 17 does not release the rotary magnet 22 remains operated and a circuit for operating the remaining contacts of relay 20 may be traced from battery through the upper winding and front contact of relay 20, front contact of magnet 22, conductor 28, and through the outer left-hand front contact of relay 16, to ground. In case the sleeve brush 13 passes over the grounded sleeve terminal of a busy line the opening of the circuit through the right-hand winding of relay 17 may induce sufficient current in the circuit through its left-hand winding to cause the operation of relay 20 (this circuit may be traced from ground at the sleeve terminal of the busy line, through the lower winding of relay 20, right-hand back contact of relay 18, left-hand winding of relay 17, and over conductor 25, to ground at relay 16). In this case the release of the rotary magnet 22 prevents the complete operation of relay 20.

The aforementioned complete operation of relay 20 connects the tip and ring brushes of the line-finder to the tip and ring conductors 26 and 27 of the trunk T and closes a circuit for operating relay 18. This circuit may be traced from battery through the right-hand winding of relay 18, through the outer upper front contact of relay 20, and through the upper front contact of the vertical off normal springs V. O. N. These springs were actuated when the line-finder shaft was moved out of its normal position. In operating, relay 18 opens the circuit through the lower winding of relay 20 and extends the connection, from the sleeve brush 13 of the line-finder switch through the lower front contact of relay 20 and the outer right-hand front contact of relay 18, to the sleeve conductor 28 of the trunk T. The closing of the inner right-hand front contact of relay 18 renders the circuit through the locking winding and front contact of relay 20 independent of the continued operation of rotary stepping magnet 22. The opening of the outer left-hand back contact of relay 18 disconnects battery from the winding of the vertical magnet 21 and from the right-hand winding of relay 17 thus causing the release of relay 17 and relay 19. The operation of relay 18 disconnects the starting conductor 5 from the winding of relay 16, and connects conductor 5 through its left-hand front contact to its left-hand winding. With relay 18 operated and relay 19 released the starting conductor is further extended through the left-hand front contact of relay 18 and the middle right-hand back contact of relay 19, over conductor 24 to the next line-finder which has access to the same groups of lines to which the line-finder LF has access. The aforementioned operation of cut-off relay 3 disconnects the windings of line relay 2 from the line thus causing the release of relay 2. In operating, relay 3 connects its winding through its own front contact to sleeve conductor 9 so that the release of relay 2 does not cause the release of relay 3. The group relay 4 releases unless a call has been originated at a station connected to some other line in the group of lines with which relay 4 is associated. The release of relay 4 disconnects ground from starting conductor 5 and thus opens the circuit through the winding of relay 16 if not already opened by the aforementioned operation of relay 18. Relay 16 is slow in releasing to insure the complete operation of relay 20 before the sleeve conductor 28 is disconnected from the ground at the front contact of relay 16.

With the line-finder brushes 11 and 12 connected to the tip and ring conductors 26 and 27 of trunk T, as hereinbefore described, line relay 30 of the trunk circuit T is operated. The circuit for operating relay 30

may be traced from battery through its winding, through the back contact of the lower continuity springs of relay 40, middle lower back contact of relay 39, conductor 27, middle lower front contact of relay 20, line-finder brush 12, ring conductor of line 1, through the calling subscriber's instrument, back over the tip conductor of line 1, through line-finder brush 11, inner lower front contact of relay 20, conductor 26, upper back contact of relay 39, back contact of the upper continuity springs of relay 40, and through retard coil 41, to ground. Relay 30 closes a circuit from ground through the inner upper back contact of relay 40, lower front contact of relay 30, lead 42, and through the winding of relay 37 to battery. Relay 37 operates thereby connecting ground through its inner left-hand front contact over lead 43, through normally closed contacts of both sets of continuity springs of relay 36, and through the normally closed contacts of the continuity springs of relay 33, to the sleeve conductor 28 of the line-finder LF. After the release of relay 16 as hereinbefore described, the cut-off relay 3 and relay 20 are held in the circuit over conductor 28 to ground at the contact of relay 37. Since relay 16 of the line-finder circuit is slow in releasing relay 37 is sure to operate and connect ground to conductor 28 before the ground at the outer front contact of relay 16 is disconnected from this conductor.

The aforementioned operation of relay 30 closes a circuit for operating the line relay 61 of the selector S; this circuit may be traced from battery through the left-hand winding of relay 61, inner upper back contact of relay 64, ring conductor 57, right-hand winding of polarized supervisory relay 55, outer lower back contact of relay 40, lower back contact of relay 32, retard coil 46, upper front contact of relay 30, outer upper back contact of relay 40, left-hand winding of relay 55, tip conductor 56, outer upper back contact of relay 64, right-hand winding of relay 61, upper back contact of the 11th rotary-step springs, to ground. The line relay 61 closes a circuit from battery through the winding of relay 62, front contact of relay 61, conductor 70, and through the outer lower back contact of relay 64, to ground. Relay 62 operates, thereby connecting ground through its right-hand front contact to the sleeve conductor 59 of the trunk T.

The afore-mentioned operation of relay 30 also closes a circuit for operating relay 31; this circuit may be traced from battery through the winding of relay 31, back contact of relay 35, resistance 44, outer left-hand back contact of relay 38, lead 42, lower front contact of relay 30, and through the inner upper back contact of relay 40, to ground.

Relay 31 closes a circuit for operating relay 33, which may be traced from battery, through the winding of relay 33, front contact of relay 31, and through the inner lower back contact of relay 40, to ground. Relay 33 locks through its inner right-hand front contact, through the outer right-hand back contact of relay 38 in parallel with the left-hand back contact of relay 34, lead 45, and through the outer left-hand front contact of relay 37, to ground. In operating, relay 33 closes a circuit, for operating relay 38, which may be traced from battery through the winding of relay 38, outer right-hand front contact of relay 33, over sleeve lead 59, to ground at relay 62 of selector S. Relay 38 locks through its inner left-hand front contact to the ground on sleeve lead 59. In operating, relay 38 causes the release of relay 31 and closes an obvious circuit for holding relay 37.

The circuit through the winding of the identification test relay 31 was closed as hereinbefore described, so as to be sure that this relay is in condition to determine which of the stations on the calling line has originated the call, when the identification test circuit is closed as hereinafter described. Should relay 38 fail to operate at this time the ground connected through the inner right-hand front contact of relay 37 and the inner left-hand back contact of relay 38 is effective to operate alarm circuit 51. Although the call may be completed, the charge control relay 35 is not operated and the charging circuit is not closed when the connection is released.

When the subscriber at the calling station dials the first digit of the number of the called station the line relay 30 of trunk T is alternately released and reoperated each time the subscriber's line loop is opened and closed at the dial. Each release and reoperation of relay 30 opens and closes the bridge through the retard coil 46 (across the tip and ring conductors 56 and 57 of the trunk to the selector S) and the line relay 61 of selector S is alternately released and reoperated in response to the dialing of the first digit of the called number. The release of line relay 30 of trunk T closes a circuit, for operating relay 32, from battery through the winding of relay 32, outer right-hand front contact of relay 37, back contact of relay 30, and through the inner upper back contact of relay 40 to ground. Relay 32 is slow to release and remains operated until all of the impulses created by the dialing of the first digit have been received. In operating, relay 32 short-circuits the winding of the retard coil 41, thus reducing the impedance of the dialing loop, and also short-circuits the windings of the retard coil 46 and resistance 47 to reduce the impedance of the trunk loop to the windings of the line

relay 61 of selector S. At the end of the train of impulses relay 30 reoperates and relay 32 releases. Resistance 47 is connected from the armature to the back contact of relay 32 to prevent the opening and closing of the trunk loop when relay 32 releases. Relay 37 is slow to release and holds during the receipt of each train of pulses which are originated by the dialing of the digits of the called station's number.

When the line relay 61 of selector S releases, a circuit is closed from battery, through the winding of the vertical stepping magnet 66, winding of relay 63, left-hand front contact of relay 62, back contact of relay 61, conductor 70, and through the outer lower back contact of relay 64, to ground. The magnet 66 and relay 63 both operate in this circuit. Relay 63 is a slow-to-release relay and remains operated until all of the impulses corresponding to the first digit have been received. Relay 62 is also slow to release and holds during the receipt of this train of impulses. The operation of magnet 66 steps the shaft and brushes of selector S up to the first level of bank terminals. The reoperation of line relay 61 releases the magnet 66, and each successive release and reoperation of relay 61 causes the operation and release of magnet 66. The shaft and brushes of the selector are in this manner raised, step-by-step, to the level through which the call may be extended toward the called station.

As soon as the shaft of selector S is moved off normal the vertical off normal springs V. O. N. are actuated and when relay 63 operates, as hereinbefore described, a circuit is closed, for operating relay 65, from battery through the winding of relay 65, upper contact of the V. O. N. springs, front contact of relay 63, and over sleeve conductor 59, to ground at relay 62. Relay 65 locks in a circuit from battery through its winding and the upper contact of the V. O. N. springs, through the back contact of the rotary stepping magnet 67, conductor 69, left-hand front contact of relay 65, and through the outer lower back contact of relay 64 to ground. The operation of relay 63 is also effective to connect ground from sleeve conductor 59 through a front contact of relay 63 to conductor 60 and thus cause the operation of relay 34 of the trunk circuit T. Relay 34 locks through its left-hand front contact, normally closed contacts of the continuity springs of relay 39, and through the right-hand back contact of relay 36, over conductor 45, to ground at relay 37. The operation of relay 34 causes the release of relay 33.

When all of the impulses, originated by the dialing of the first digit of the called number have been received, the release of relay 63 of selector S disconnects the ground

over sleeve conductor 59 from conductor 60; and the release of relay 32 of trunk T closes a circuit, for operating relay 39, from battery through the winding of relay 39, right-hand front contact of relay 34, and through the upper back contact of relay 32, to ground. In operating, relay 39 (a) transfers the tip and ring conductors 26 and 27 from the windings of relay 30 and retard coil 41 to the winding of identification test relay 31, (b) closes a circuit, for holding line relay 30, from battery through the winding of relay 30, resistance 50, inner lower front contact of relay 39, inner left-hand front contact of relay 38, over sleeve lead 59, to ground at relay 62 of selector S, and (c) opens the locking circuit of relay 34. Relay 34 releases since its operating circuit, over lead 60, has been opened by the release of relay 63 of selector S. The release of relay 34 causes the release of relay 39 whereby the conductors 26 and 27 are again connected to the windings of line relay 30 and retard coil 41. The release of relay 39 also disconnects the winding of identification test relay 31 from conductors 26 and 27.

If the call originated at station A, the identification test relay 31 operates during the time that its winding is connected over conductors 26 and 27 through the front contacts of relay 20, line-finder brushes 11 and 12 over the tip and ring conductors of line 1 to the identification ground 10 at the instrument of station A. If the call originated at station B, relay 31 does not operate for there is no identifying ground connection at station B. If relay 31 operates relay 33 operates; and relay 33 locks through its inner right-hand front contact and the outer-left-hand back contact of relay 34, over lead 45 to ground at relay 37. Relay 33 controls the message register operating circuit so that the register which corresponds to the calling station is operated, as hereinafter described, when a completed call, for which a charge is to be made, is released by the calling subscriber.

The release of relay 63 of selector S, after the dialing of the first digit, is also effective to close a circuit for operating the rotary stepping magnet 67; this circuit may be traced from battery through the winding of magnet 67, left-hand front contact of relay 65, normally closed contact of relay 63, over sleeve conductor 59, to ground at relay 62. The rotary magnet 67 rotates the shaft of selector S one step, so that the brushes 71, 72, 73 and 74 make contact with the terminals of the first trunk in the previously selected level. The operation of the rotary magnet causes the release of relay 65. The release of relay 65 causes the release of the rotary magnet. The release of magnet 67 closes a circuit from battery through the winding of relay 65, upper contact of the

V. O. N. springs, back contact of magnet 67, conductor 69, winding of relay 64, lower contact of the 11th-rotary-step springs, over conductor 59 to ground at relay 62. Conductor 69 is also connected through the inner lower back contact of relay 64 and the sleeve brush 73 to the sleeve terminal of the first trunk in the selected level. If this trunk is idle relay 64 operates and relay 65 does not operate; but if the trunk is busy the winding of relay 64 is short-circuited so that relay 65 operates and relay 64 does not operate. The reoperation of relay 65 causes the reoperation of the rotary stepping magnet 67. The alternate operation and release of relay 65 and magnet 67 advances the brushes of selector S step-by-step from one set of terminals to the next.

When an idle trunk is encountered relay 64 operates, thereby disconnecting the tip and ring conductors 56 and 57 from the windings of line relay 61 and extending these conductors through brushes 71 and 72 over the tip and ring conductors of the selected trunk to the windings of the line relay (not shown) of connector C. Relay 64 also establishes a temporary busy condition on the test terminal of the selected trunk by connecting the sleeve conductor 59 through the inner lower front contact of relay 64 to the sleeve brush 73. Relay 61 releases thereby causing the release of relay 62. Relay 62 is slow to release so that the ground at its left-hand front contact is not disconnected from sleeve conductor 59 until sufficient time has elapsed for the operation of the line relay (not shown) of connector C to have been effective to cause a permanent busy ground to be connected through brush 73, and the inner lower front contact of relay 64, to sleeve conductor 59.

When the remaining digits of the called station's number are dialed by the calling subscriber, line relay 30 and slow-to-release relay 32 of trunk T repeat the impulses over the trunk conductors 56 and 57 through the selector circuits S, to the line relay (not shown) of the connector C. The connector C is thus controlled to select the terminals of the line 100 of the called station. For a detailed explanation of the operation of the connector circuit reference may be had to pages 57 to 61 inclusive of the second edition of "Automatic Telephony" by Smith and Campbell.

Assume that the line 100 is idle, when connection is established therewith, that ringing potential is connected to the line, that the subscriber at the called station answers, and that the call is one for which the calling subscriber should be charged. When the receiver is removed from the receiver hook at the called station, the windings of the line relay (not shown) of the connector C are reversed, in the usual manner, with respect

to the tip and ring conductors 56 and 57 of the trunk T; and as a result the current through the windings of the polarized supervisory relay 55 is in the direction to operate this relay. The circuit for operating relay 55 may be traced from battery through one winding of the line relay (not shown) of the connector C over the tip conductor, through brush 71, outer upper front contact of relay 64, conductor 56, left-hand winding of relay 55, outer upper back contact of relay 40, upper front contact of relay 30, retard coil 46, lower back contact of relay 32, outer lower back contact of relay 40, right-hand winding of relay 55, conductor 57, inner upper front contact of relay 64, brush 72, over the ring conductor and through the other winding of the line relay (not shown) of connector C, to ground. The talking circuit may at this time be traced from trunk conductors 26 and 27 through condensers 48 to the trunk conductors 56 and 57 which connect to the selector S.

The operation of the supervisory relay 55 closes a circuit for operating relay 35; this circuit may be traced from battery through the winding of relay 35, front contact of relay 55, and through the right-hand front contact of relay 38, to ground. Relay 35 locks through its right-hand front contacts, over lead 45 to ground at relay 37. Relay 35 closes an obvious circuit from the ground at relay 37 over leads 45 and 49 for operating relay 40. Relay 40 disconnects the windings of the line relay 30 and retard coil 41 from trunk conductors 26 and 27 and disconnects the retard coil 46, resistance 47 and condensers 48 from trunk conductors 56 and 57. Relay 30 releases and the talking circuit is now traced directly from conductors 26 and 27, through the back contacts of relay 39, front contacts of relay 40, and windings of supervisory relay 55 to conductors 56 and 57. The line relay (not shown) of connector C is held operated in the circuit which includes the calling line until the calling subscriber releases the connection.

When the calling subscriber replaces the receiver on the receiver hook, the line relay (not shown) of connector C releases. The connector switch is returned to normal in the usual manner. When the sleeve ground at connector C is disconnected from the sleeve terminal with which brush 73 is in contact, relay 64 of selector S and relay 38 of trunk T are both released. The release of relay 64 closes a circuit for operating the release magnet 68 and selector S is returned to normal in the usual manner. In releasing, relay 38 closes a circuit for operating relay 34; this circuit may be traced from battery through the winding of relay 34, conductor 60, inner left-hand front contact of relay 35, middle right-hand back con-

tact of relay 38, conductor 49, outer right-hand front contact of relay 35, and over conductor 45, to ground at relay 37. Relay 34 closes again the circuit for operating relay 39. Relay 37 is slow in releasing so that it holds, after relay 38 releases, until relay 39 operates. Relay 39 prevents the release of relay 37 by closing a holding circuit which may be traced from battery through the winding of relay 37, outer lower front contact of relay 39, right-hand back contact of relay 36, and over lead 45, to ground at relay 37. The operation of relay 39 transfers the connection from the calling line, over conductors 26 and 27, to the winding of test relay 31. Since the calling subscriber has hung up the receiver test relay 31 fails to operate unless ground has been falsely (or otherwise) connected to the line. If relay 31 operates, the operation of relay 36 is prevented for relay 36 is slow in operating. In this case the line-finder does not release and the ground connected, through the inner right-hand front contact of relay 37 and the inner left-hand back contact of relay 38, is effective to operate the alarm circuits 51. If relay 31 does not operate, relay 36 operates in a circuit which may be traced from battery through the winding of relay 36, back contact of relay 31, inner upper front contact of relay 39, inner right-hand back contact of relay 38, and over conductor 43 to ground at relay 37. Relay 36 closes the circuit for operating the calling subscriber's message register.

If the call originated at station A the charging circuit is traced from booster battery 52, through lamp 53, resistance 54, middle left-hand front contact of relay 35, outer left-hand front contact of relay 36, outer left-hand front contact of relay 33 (relay 33 having been operated), conductor 29, line-finder brush 14, and through the winding of message register 8, to battery. If the call originated at station B the charging circuit is traced from the booster battery through the normally closed contacts of the continuity springs of relay 33 (relay 33 not having been operated), over sleeve conductor 28, outer right-hand front contact of relay 18, outer lower front contact of relay 20, line-finder brush 13, conductor 9, and through the windings of the cut-off relay 3 and message register 7 in parallel, to battery. Relay 36 connects ground through its right-hand front contact to conductor 60 to hold relay 34. This ground connection is extended from conductor 60 through the inner left-hand front contact of relay 35 and the middle right-hand back contact of relay 38, to conductor 49 thereby holding relays 35 and 40. If relay 33 has been operated, relay 36 also connects ground through the inner left-hand front contacts of relays 36 and 33 to the sleeve conductor 28, in place of the

ground over conductor 43 so as to prevent the release of the line finder LF until the register 8 has been operated. Relay 36 opens the holding circuit for relay 37. The release of relay 37 causes the release of relays 33 and 36. The release of relay 36 causes the release of relays 34, 35 and 40. The release of relay 34 causes the release of relay 39. Since relay 37 is slow-to-release the charging circuit is closed for a sufficient length of time to insure the operation of the calling subscriber's register. The release of relay 37 causes the release of line-finder relay 20 and cut-off relay 3. The release of relay 20 closes the circuit for operating the line-finder release magnet 23 thereby causing the line-finder to be restored to normal. Relay 18 releases when the line-finder switch reaches its normal position unless the starting conductor 5 is connected to ground by the operation of one or more of the group relays such as 4. In this event another line-finder is being started to find a calling line and relay 18 holds to prevent the operation of relay 16.

If the first digit dialed by the calling subscriber is such that the selector S seizes an idle trunk leading to an operator's position, the terminal with which the brush 74 makes contact is grounded; terminal 78 which is associated with the trunk 80 which leads to the operator's position 0 is, therefore, connected to ground as indicated. When relay 64 operates this ground is connected through brush 74, lower front contact of relay 64, conductor 58, and through the right-hand back contact of relay 34, to the winding of relay 40. Relay 40 operates thereby extending the connection from the calling line over trunk conductors 26 and 27 to trunk conductors 56 and 57 and through the brushes of selector S to the trunk leading to the operator's position. Talking battery is supplied to the calling station from the operator's position; and the current through the windings of the polarized supervisory relay 55 is not effective to operate relay 55 unless the call is further extended by the operator, in which case the operator may reverse the battery connected to the trunk so as to operate relay 55. In such a case the message register of the calling subscriber is operated, in the manner hereinbefore described, when the connection is released by the calling subscriber.

If a call is completed to a subscriber and no charge is to be made for the call, the polarized supervisory relay 55 is not operated and therefore the charge control relay 35 is not operated. Relay 38 holds to the ground on the sleeve conductor 59 until the connection is released. Relay 38 holds relay 37 and relay 37 holds relay 34. Relay 40 is not operated and the talking circuit includes the condensers 48; talking battery

is supplied to the calling station through the windings of the line relay 30 and retard coil 41. When the connection is released, relay 30 releases thereby opening the bridge across the trunk conductors 56 and 57 to release the line relay (not shown) of connector C. When the sleeve ground at connector C is disconnected, relay 38 releases. The release of relay 38 causes the release of relay 37, and disconnects ground from conductor 43 thereby causing the return of the line-finder LF to normal in the same manner as hereinbefore described.

The invention is not limited to a system using Strowger type switches but is applicable to all systems in which the line of a calling subscriber is extended in response to the operation of an impulse transmitter at the calling station and which are arranged for message-rate party-line service.

What is claimed is:

1. In a telephone system, a line having a plurality of subscribers' stations each of which possesses a distinguishing characteristic, a dial at each of said stations, a trunk, means effective upon the origination of a call at one of said stations for extending said line to said trunk, means associated with said trunk and rendered effective immediately after the dialing of a digit for testing said line to determine which of said stations is the calling station.

2. In an automatic telephone system, a line having a plurality of subscribers' stations one of which is a calling station, means for distinguishing each of said stations from the others, an impulse sender at said calling station, means for receiving impulses originated by the operation of said impulse sender, means for connecting said calling line to said impulse receiving means, and means rendered effective by the receipt of a series of impulses for testing the calling line to determine which of said stations is the calling station.

3. In an automatic telephone system, a line having a plurality of subscribers' stations one of which is a calling station, means for distinguishing each of said stations from the others, a calling device at said calling station, an automatic switch, means for extending said line to said automatic switch, means for selectively actuating said automatic switch in response to impulses originated by the operation of said calling device, and means rendered effective immediately after said switch has responded to a set of impulses for testing the calling line to determine which of said stations is the calling station.

4. In a telephone system, a line, a plurality of subscribers' stations permanently connected to said line, an identifying connection at one of said stations, an impulse transmitter at each of said stations, a message

register for each of said stations, an automatic switch, means for extending said line to said switch upon the origination of a call at one of said stations, means for selectively actuating said automatic switch in response to impulses originated by the operation of said impulse transmitter, means rendered effective by the receipt of a train of impulses for testing said line to determine which of said stations is the calling station, and means for operating the message register of said calling station.

5. In a telephone system, a line, a plurality of subscribers' stations permanently connected to said line, an identifying connection at one of said stations, a dial at each of said stations, a called station, an automatic switch, means for extending said line to said switch upon the origination of a call at one of said plurality of stations, means including said switch controlled by the dialing of the number of said called station for establishing a connection between said calling and said called stations, and means effective during the interval between the dialing of the first and second digits of the number of said called station for testing said line to determine which of said plurality of stations is the calling station.

6. In a telephone system, a calling subscriber's station, another subscriber's station, a line common to both of said stations, an identifying connection at one of said stations closed upon the origination of a call at said one of the stations, a dialing device at said calling station, a called station, means selectively actuated by the dialing of the number of said called station for establishing a connection between said calling and said called stations, and means connected to said line during the interval between the dialing of two of the digits of the number of said called station for determining the presence or absence of said identifying connection.

7. In a telephone system, a calling subscriber's station, another subscriber's station, a line common to both of said stations, means at one of said stations for distinguishing it from the other of said stations, a dial at said calling station, a called station, a trunk, means effective upon the origination of a call at either of said stations for extending said line to said trunk, means controlled by the actuation of said dial for establishing a connection between said calling and said called stations, and means effective immediately after the dialing of a digit of the number of said called station for determining whether said calling station is the station with which said distinguishing means are associated.

8. In a telephone system, a line having a plurality of subscribers' stations, distinguishing means at one of said stations, a dial at each of said stations, a trunk, means effective upon the origination of a call at one of

said stations for extending said line to said trunk, means controlled by the actuation of the dial at the calling station for further extending the connection from said line, and means effective between successive operations of said dial for determining whether the calling station is the one with which said distinguishing means are associated.

9. In a telephone system, a line having a plurality of subscribers' stations each of which possesses a distinguishing characteristic, a dial at each of said stations, a message register for each of said stations, a called station, a trunk, means effective upon the origination of a call at one of said plurality of stations for extending said line to said trunk, an automatic switch which is individual to said trunk and which is selectively actuated in response to the dialing of a digit, means effective immediately after the dialing of said digit for determining which of said plurality of stations is the calling station, means for completing the connection between said calling and said called stations, and means for operating that one of said message registers which is individual to said calling station.

10. In a telephone system, a line having a plurality of subscribers' stations each of which possesses an identifying characteristic, a dial at each of said stations, a message register for each of said stations, a called station, a trunk, means effective upon the origination of a call at one of said plurality of stations for extending said line to said trunk, an automatic switch individual to said trunk, means associated with said trunk for receiving impulses originated by the operation of the dial at said calling station, means associated with said trunk for repeating impulses, means effective immediately after the dialing of a digit for determining which of said plurality of stations is the calling station, means for completing the connection between said calling and said called stations, and means effective in the event that a talking connection is established between said calling and called stations for disconnecting said impulse repeating means and for operating that one of said message registers which is individual to said calling station.

11. In a telephone system, a line having a plurality of subscribers' stations each of which possesses an identifying characteristic, a dial at each of said stations, an operator's position arranged to feed talking battery to said calling station, a trunk, means effective upon the origination of a call at one of said stations for extending said line to said trunk, means associated with said trunk for receiving impulses originated by the operation of the dial at said calling station, means associated with said trunk for repeating impulses, means effective im-

mediately after the dialing of a digit for
testing said line to determine which of said
stations is the calling station, means for
completing the connection between said
5 calling station and said operator's position,
and means for disconnecting said impulse
repeating means from said trunk.

In witness whereof, I hereunto subscribe
my name this 21st day of June, 1929.

10 HENRY HOVLAND.

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