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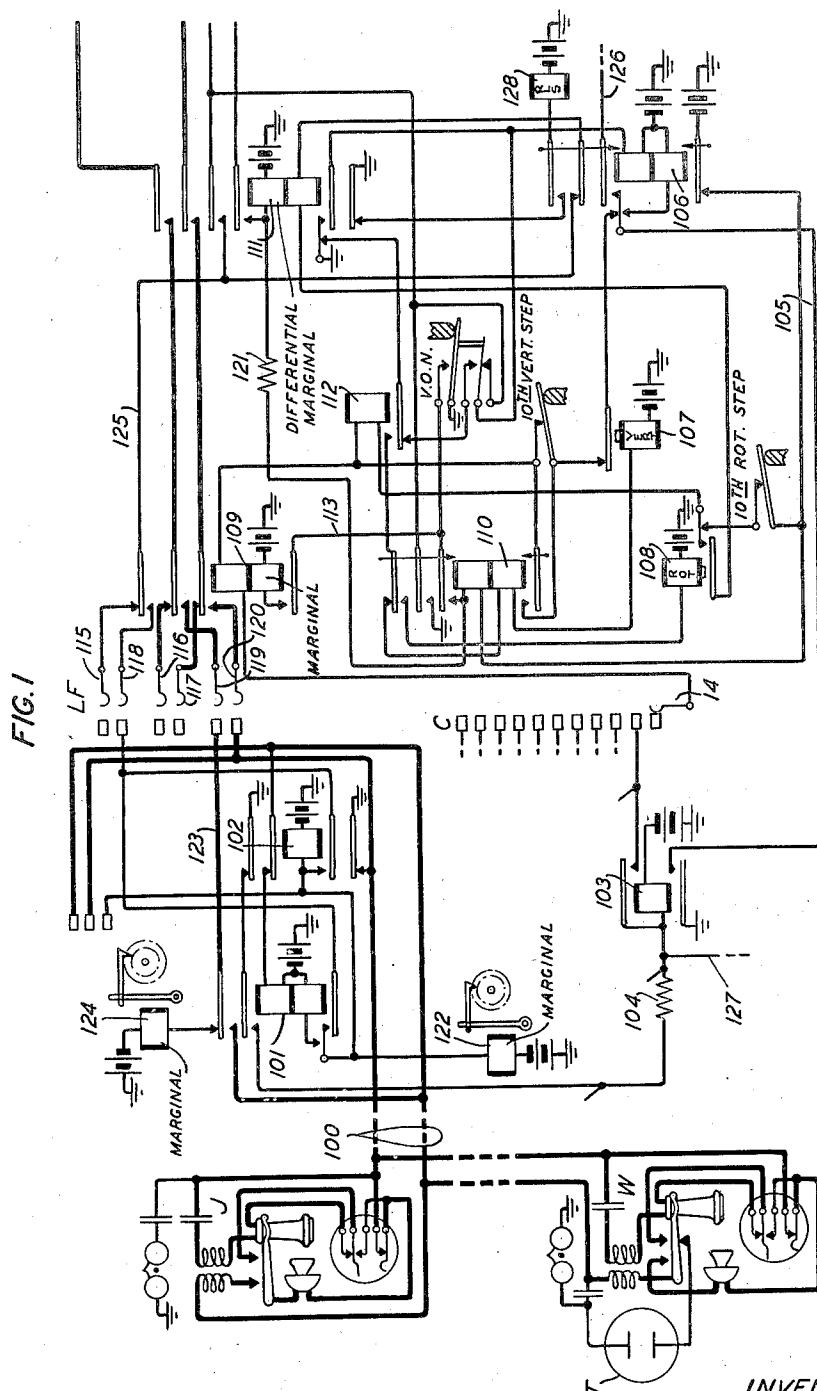
H. HOVLAND

2,008,281

TELEPHONE SYSTEM

Filed April 20, 1934

2 Sheets-Sheet 1



BY

INVENTOR
H. HOVLAND

M. B. McKenney
ATTORNEY

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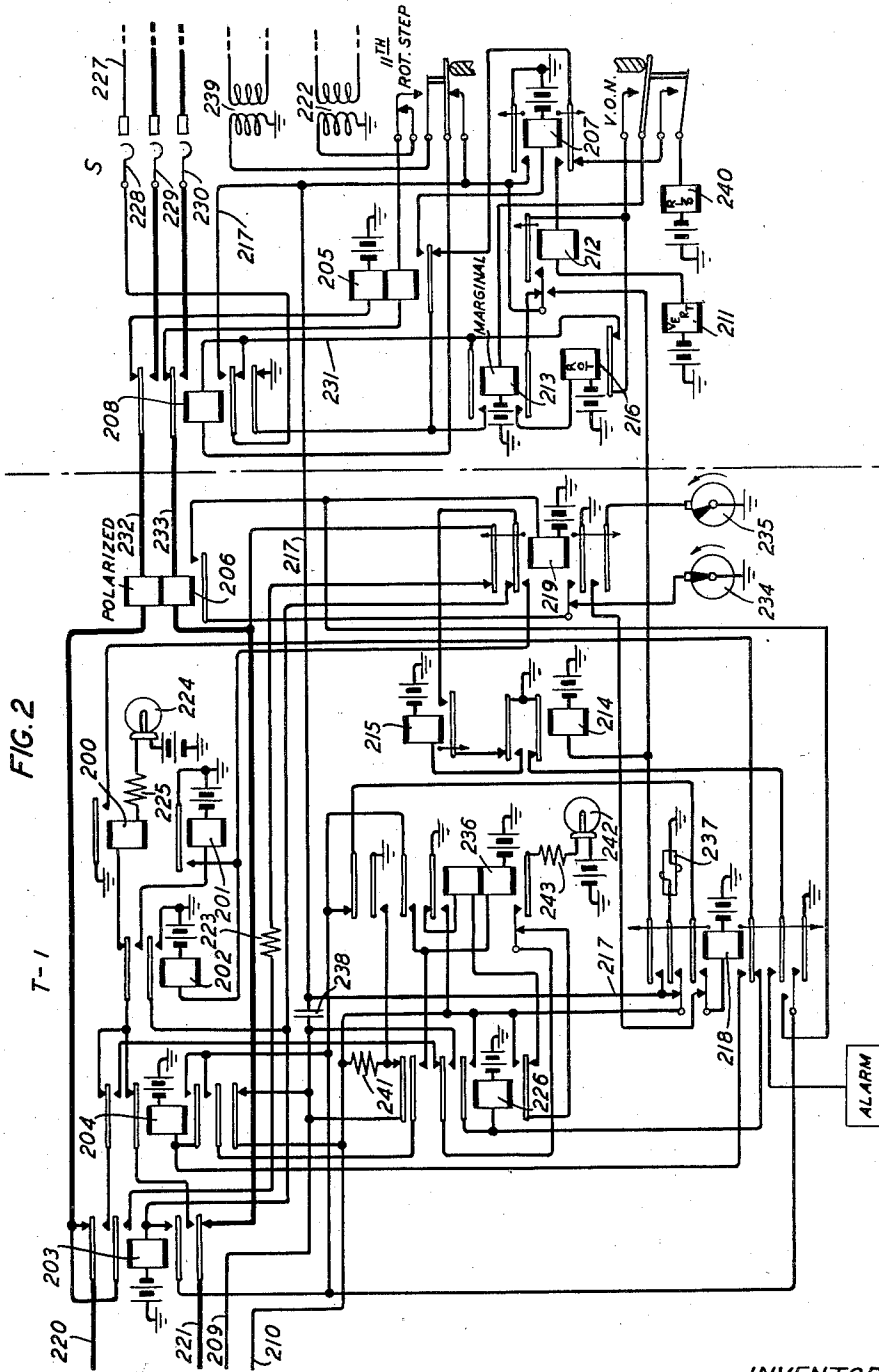
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INVENTOR
H. HOVLAND
BY

M. R. McFenney
ATTORNEY

UNITED STATES PATENT OFFICE

2,008,281

TELEPHONE SYSTEM

Henry Hovland, Williston Park, N. Y., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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9 Claims. (Cl. 179—8.5)

This invention relates to telephone systems and particularly to those involving party lines equipped for message register service.

Its objects are to secure improvements in the identification of a calling station on a party line, to guard against the inaccurate charging of calls made by the different subscribers, to enable a test of the identifying equipment on every call, and to otherwise improve systems of this kind.

A feature of the invention is a party-line system in which an identification device, such as a space-discharge tube, is provided at one of the stations, together with means at the central office for connecting a source of identification current to the line, when a call is made, to determine the presence or absence of said tube, and in which a test is made after the calling party has replaced his receiver to determine whether or not said identification device is in operative condition. In this way it is possible to determine the accuracy of the identification test, which assumes that the tube or other device is in operative condition, since the subsequent test for operativeness is made when all receivers are on the switch-hooks, at which time it is definitely known that the tube is connected in circuit with the line.

Another feature is an arrangement in which one of the registers of a two-party line is connected to the sleeve conductor and the other register to one of the talking conductors, and in which the latter register is selectively connected to the line for operation by means of the line relay. Since it is desirable to have the register disconnected from the talking conductor during conversation, this is accomplished by holding the line relay operated to hold open the register circuit. At the end of conversation, dependent on which party made the call, either the register on the sleeve is operated or the line relay is released to close the circuit to the register on the talking conductor, following which this latter register is actuated. In this case, it is necessary to hold the cut-off relay operated to prevent the subscriber from reoperating the line relay and thus disconnecting the register before it is operated.

These and other features of the invention will be more clearly understood from a consideration of the following detailed description, which should be taken in conjunction with the accompanying drawings, and also from the appended claims.

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

Fig. 1 diagrammatically represents two subscribers' stations J and W connected by a com-

mon line 100 to terminals in one bank of the line-finder switch. This line-finder LF has two banks and two sets of brushes. The lines of one group, including line 100, are connected to terminals in one bank (upper) to which the brushes 115, 116 and 117 have access; and the lines of the other group (none shown) are connected to terminals in the other bank (lower) to which the brushes 118, 119 and 120 have access. Whenever a call is originated over a line to which the line-finder has access, a ground is connected to the commutator segment corresponding to the level in which the terminals of this line are located. This ground connection is controlled by the single group relay 103 for all of the lines connected to the terminals of that level of both banks.

Since but one set of two sets of brushes has access to the terminals of a particular line, the required set of brushes must be rendered effective, to the exclusion of the other set, at or before the finding of the terminals of the calling line. To this end the aforementioned group relay is arranged to connect the corresponding commutator segment to ground through resistance 104 if the calling line is connected to terminals in the upper bank, and to connect the segment directly to ground if the calling line is connected to terminals in the lower bank.

Fig. 2 shows a trunk circuit T—1 and a first selector S for extending the connection to a called station (not shown) through a second selector (not shown) and connector (not shown) in the well known manner. The trunk circuit T—1 is individual to the line-finder LF, shown in Fig. 1, and to the selector S. The line-finder and selector are of the well known Strowger type, but the invention may be applied to systems using other types of switches.

The subscriber's set at W, known as the ring subset, is equipped with an identifying space-discharge tube T, so arranged that the removal of the receiver from the receiver hook disconnects the tube from the associated line. This tube may be of any desirable construction and may be charged with any suitable substance such as neon. The subscriber's set at J, known as the tip subset, is not equipped with a space-discharge tube. Each station is also equipped with a dial for controlling the operation of the switches used in extending a connection to the called station.

The line-finder switch is equipped with two banks and two sets of brushes similar to the switch disclosed in Patent 1,809,124, issued to Hovland on June 9, 1931, but the associated cir-

cuit is somewhat different from that shown in the patent to Hovland. Upon the origination of a call at either of stations J or W of line 100, the line-finder LF (or, if this line-finder is busy, 5 some other line-finder to whose terminal bank the line 100 is multiplied) is effective to associate the proper set of brushes with the terminals to which the line is connected. The calling line is thereby extended to the trunk circuit which serves to connect the line-finder with its associated selector S. 10

The trunk circuit T—1 is arranged in accordance with this invention to identify the calling station on a two-party line and to operate the message register which is individual to the calling station. In order to determine the accuracy of the first or identification test, two subsequent tests are applied to the calling subscriber's line. The first or identification test is applied after the 20 first digit has been dialed, whereupon the test battery is connected to the tip and ring conductors of the calling line through the test relay 200 to detect the presence or absence of the space-discharge tube T and thereby identify the calling subscriber's station. Thus, if the call originated at station J, the aforementioned battery will be impressed across the electrodes of the space discharge tube T, associated with station W, thereby causing the said tube to ionize and become sufficiently conductive to provide an operating circuit for test relay 200. If the call originated at station W, the space-discharge tube is disconnected from the circuit, when the receiver at the calling station W is removed from the receiver hook, and consequently the test relay 200 does not have an operating circuit. 35

The second test is made, after the calling subscriber disconnects following a completed call, to determine whether there is a resistance leak of excessive conductivity from the line conductors of the calling line, to ground. This test is made by connecting the negative pole of the central office battery to the tip and ring conductors of the calling line through the winding of relay 201. 40 This voltage is not sufficient to ionize the tube T, but, if a leak of sufficient conductivity exists between the line conductors and ground, relay 201 will operate and prevent subsequent registration. If the leak test is satisfactory, as indicated by the non-operation of relay 201, a third test is initiated, to determine whether or not the space-discharge tube T is in operative condition. This test follows the second test and is made by reassociating the test relay 200 with the tip and ring conductors of the calling line. The test relay 200, if operated under this condition, indicates that the space-discharge tube is functioning satisfactorily; but, if relay 200 fails to operate, an unsatisfactory test results and subsequent operation of the message register associated with the subscriber's line is blocked. These operations are best explained by a detailed description of the operation of the circuits shown in the drawing. 50

Assume that a call is originated by the removal of the receiver from the receiver hook at either of stations J or W, that brushes 115, 116 and 117 are associated with lines terminating in the upper group and that brushes 118, 119 and 120 are associated with lines terminating in the lower group. Line relay 101 operates in an obvious circuit over the line 100 thereby connecting its lower winding in parallel with the winding of the cut-off relay 102 and in parallel with tip party (J) register 122 to the sleeve terminal associated with line 100 in the bank of line-finder LF; line relay 75

101 connects the ring conductor of line 100 to conductor 123 and also closes a circuit for operating group relay 103, from ground at the back contacts of the cut-off relay 102, through the upper inner front contact of relay 101, resistance 104, and through the winding of group relay 103 to battery. 5

In operating, group relay 103 closes a circuit from ground through its lower front contacts, over conductor 105, through the upper back contacts of relay 106, back contact of vertical magnet 107, normally closed contacts of the "10th vertical step" springs, winding of relay 112, back contact of rotary magnet 108, closed contact of the "10th rotary step" springs, and through the lower back contact of relay 106 to battery. The closing of this circuit is effective to operate the interrupter relay 112. Relay 112 closes a circuit from ground through its front contact, the upper outer back contact and lower winding of relay 110, and through the winding of vertical magnet 107 to battery. The vertical magnet 107 is thereby operated to advance the shaft and brushes of the line-finder LF up to the first level; but relay 110 is slow to operate and does not operate on the 25 pulses of current through its winding during the vertical movement of the switch. The vertical off-normal springs VON are actuated when the shaft is advanced out of its normal position thereby connecting ground to conductor 113. The operation of magnet 107 also opens the circuit through the winding of relay 112, thereby causing the release of relay 112. The release of relay 112 opens the aforementioned circuit through the lower winding of relay 110 and winding of vertical magnet 107, thereby causing the release of magnet 107. The release of magnet 107 again closes the circuit through the winding of relay 112. Thus interrupter relay 112 and vertical stepping magnet 107 alternately operate and release to 40 advance the shaft and brushes of line-finder LF until the level of the calling line is reached.

Let it be assumed that line 100 is connected to terminals in the first level of the upper bank and that the aforementioned operation of group relay 103 is effective to connect ground through the upper outer back contact of cut-off relay 102, the upper inner front contact of relay 101, resistance 104, and through the upper front contact of relay 103, to the first segment of commutator C. 50 When the shaft and brushes have been advanced to this level, a circuit is closed from the grounded first segment of commutator C, through commutator brush 14, upper winding of relay 109, winding of relay 112, back contact of rotary magnet 108, closed contacts of the "10th rotary step" springs to battery at the lower back contact of relay 106. Relay 112 is held operated in this circuit even though the vertical magnet 107 has opened its back contact; but relay 109 is 60 marginal and does not operate at this time. Relay 112 maintains the operation of vertical magnet 107 in a circuit including the lower winding of relay 110 as aforementioned. This circuit is closed for a sufficient length of time to partially operate slow-to-operate relay 110. Relay 110 is energized sufficiently to operate its inner upper front contact and thus close a circuit from ground at upper contacts of VON springs, upper inner front contact of relay 110, thence in parallel, one 70 path extending through the upper winding of relay 110 to battery at the lower back contact of relay 106, and the other extending through resistance 121 and upper winding of relay 111 to battery. Relay 110 is completely operated in this 75

circuit; but relay 111 is marginal and does not operate at this time. Relay 110 opens the circuit through the vertical magnet thereby causing its release. The release of magnet 107 again closes the circuit through the winding of relay 112, over conductor 105 to the ground at group relay 103. In case the calling line is connected to terminals on the tenth level, the circuit through the winding of relay 112 is maintained through the lower front contact of relay 110, instead of through the "10th vertical step" springs. Relay 110 also closes a circuit for operating the rotary magnet 108; this circuit may be traced from battery through the winding of magnet 108, the upper outer front contact of relay 110, front contact of relay 112 to ground at the lower inner back contact of relay 111. The operation of the rotary magnet advances both sets of brushes into engagement with the first set of terminals in the previously selected level. Since the marginal relay 109 was not operated, brushes 115, 116 and 117 are effective on the call in question to the exclusion of brushes 118, 119 and 120.

If the calling line is not connected to the first set of terminals in the selected level, the sleeve terminal tests busy or idle, depending upon whether the line associated therewith is busy or idle; but in either case the interrupter relay 112 is released by the operation of rotary magnet 108. The release of relay 112, opens the circuit through the winding of magnet 108. The release of magnet 108 again closes the circuit for operating relay 112; and the reoperation of relay 112 closes the circuit for reoperating magnet 108. Thus the interrupter relay 112 and the rotary stepping magnet alternately operate and release to advance the brushes successively from one set of terminals to the next until the terminals of the calling line are reached.

When brush 115 makes contact with the sleeve terminal of the calling line, relay 112 is held operated to prevent further advance of the brushes; the circuit for holding relay 112 may be traced from battery through the winding of relay 102, in parallel with the lower winding and front contact of relay 101, and in parallel with the winding of register 122, sleeve terminal and brush 115, conductor 125, upper middle back contact of relay 106, lower winding of relay 111, front contact of magnet 108, winding of relay 112, lower front contact of relay 110, back contact of magnet 107, back contact of relay 106, and over conductor 105 to ground at contact of group relay 103. This circuit is also effective to operate the cut-off relay 102; to operate relay 111; and to hold relay 101 operated. The tip party (J) register 122 is marginal and does not operate at this time. The current through the lower winding of relay 111 electromagnetically aids the current flowing through its upper winding sufficiently to close the upper inner front contact of said relay and thus close a circuit from battery through its upper winding, hold conductor 210, lower outer back contact of relay 204, sleeve conductor 209, to ground at upper middle front contact of relay 110; the energization of the upper winding of relay 111 causes the complete operation of this relay. If, during the rotary advance of the switch, the sleeve brush 115 encounters a busy sleeve terminal, on which booster-battery is being applied, for the purpose of operating the subscriber's register, the current through the lower winding of relay 111 electromagnetically opposes the current flowing through its upper winding

and thereby prevents a false operation of relay 111.

The aforementioned operation of cut-off relay 102 disconnects the conductors of line 100 from the windings of line relay 101 but relay 101 does not release since its holding winding is energized in parallel with the winding of the cut-off relay 102. The operation of relay 102 also opens the circuit through the winding of group relay 103, and the release of relay 103 disconnects the ground from start conductor 105. With brush 115 in contact with the sleeve terminal of line 100 the potential is such as to indicate that the line is busy and to prevent any other hunting switch or connector from stopping on the terminals of this line.

The complete operation of relay 111 extends the connection from line 100 through its upper front contacts to the winding of relay 206 and thence through the windings of line relay 205 of selector S. The circuit for operating relay 205 may be traced from battery through its upper winding, upper outer back contact of relay 208, upper winding of polarized relay 206, upper outer back contact of relay 203, ring conductor 220, upper outer front contact of relay 111, upper middle back contact of relay 109, brush 116 and ring terminal of line finder LF, conductor 123, upper outer front contact of line relay 101, ring conductor of line 100, through the calling subscriber's instrument, back over the tip conductor of line 100, through tip terminal and brush 117 of line-finder LF, upper inner back contact of relay 109, upper next to outer front contact of relay 111, tip conductor 221, lower outer back contact of relay 203, lower winding of polarized relay 206, upper inner back contact of relay 208, lower winding of relay 205, upper normally made contact of "11th rotary step" springs, and through left winding of "dial tone" transformer 222 to ground. Relay 111 also releases the rotary magnet 108, closes an obvious circuit for operating relay 106 and connects a direct ground to sleeve conductor 125 for holding the line relay 101 and cut-off relay 102. This circuit may be traced from sleeve conductor 125, upper next to inner front contact of relay 111 to ground at the upper middle front contact of relay 110. Relay 205 operated as aforementioned causes the operation of slow-to-release relay 207 in a circuit traced from ground at the lower outer back contact of relay 208, front contact of relay 205, and through winding of relay 207 to battery. Relay 207 connects a holding ground to sleeve conductor 209 and to hold conductor 210 so as to hold cut-off relay 102 and relay 111 respectively and independently of the ground at the upper middle front contact of relay 110. This circuit may be traced from ground at upper front contact of relay 207, conductor 217, back contact of relay 218 to hold conductor 210 and through lower back contact of relay 204 to sleeve conductor 209.

Relay 106, operated as aforementioned, opens the circuit through upper winding of relay 110 and opens the circuit through the winding of relay 112 thereby causing the release of said relays. With relay 106 operated, the start conductor 105 is extended through the upper inner front contact of relay 106 to conductor 125 which leads to the next line-finder in the group.

If a call is originated over a line connected to terminals in the lower bank associated with the lower bank of the switch it is necessary that relay 109 be operated in order to associate the brushes 118, 119 and 120 with the terminals of

lines terminating in this group. The initiating of a call for a line, terminating in the lower bank, causes the operation of group relay 103 as aforementioned. The line relays (not shown), for the lines associated with the lower bank of terminals are wired so that the aforementioned resistance 104 is not included in the circuit for operating group relay 103. Consequently, when the commutator brush 14 makes contact with a commutator segment, associated with the proper level, the current through the upper winding of relay 109 is sufficient to operate this relay so as to render brushes 118, 119 and 120 effective to the exclusion of brushes 115, 116 and 117. Relay 109 locks through its lower winding and front contact, over conductor 113, to ground at the upper front contact of VON springs.

When the subscriber at the calling station dials the first digit of the number of the called station the line relay 205 of selector S is alternately released and reoperated each time the subscriber's line loop is opened and closed at the dial. When the line relay 205 of selector S releases, a circuit is closed from battery, through the winding of the vertical stepping magnet 211, winding of relay 212, lower front contact of relay 207, back contact of relay 205 and through the lower outer back contact of relay 208 to ground. The magnet 211 and relay 212 both operate in this circuit. Relay 212 is a slow-to-release relay and remains operated until all of the impulses corresponding to each digit have been received. Relay 207 is also slow to release and holds during the receipt of this train of impulses. The operation of magnet 211 steps the shaft and brushes of selector S up to the first level of bank terminals. The reoperation of relay 205 releases the magnet 211, and each successive release and reoperation of relay 205 causes the operation and release of magnet 211. The shaft and brushes of the selector are raised in this manner, 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 VON are actuated and when relay 212 operates as hereinbefore described, a circuit is closed, for operating relay 213, from battery through the winding of relay 213, upper contact of the VON springs, front contact of relay 212 to ground at upper front contact of relay 207. Relay 212 also closes a circuit for operating relay 214 from battery through the winding of relay 214, front contact of relay 212 to ground at the upper front contact of relay 207. Relay 214 closes an obvious operating circuit for relay 215. Relay 213 locks in a circuit from battery through its winding and the upper contact of VON springs, through the back contact of rotary magnet 216, upper front contact of relay 213 and through the lower outer back contact of relay 208 to ground.

When all of the impulses originated by the dialing of the first digit of the called number have been received, the release of relay 212 of selector S opens the circuit for relay 214. Relay 214 released closes a circuit for operating relay 203 to initiate the identification test. This circuit may be traced from ground at upper outer back contact of relay 214, front contact of relay 215, upper inner back contact of relay 219 and through the winding of relay 203 to battery. Relay 214 also releases relay 215 but the latter is slow to release and remains energized, after its operating circuit is broken, for a sufficient length of time to complete the identification test. In operating, relay

203 (a) transfers the tip and ring conductors 221 and 220 from the windings of relay 205 to the winding of identification test relay 200, and (b) closes a circuit for holding line relay 205 of selector S. This latter circuit is traced from ring conductor 232, upper winding of relay 206, upper inner front contact of relay 203, through resistance 223, upper outer back contact of relay 219, lower winding of relay 206 to tip conductor 233. The release of relay 203 disconnects the identification test relay from the tip and ring conductors 221 and 220 and restores the continuity of these conductors.

If the call originated at station J (tip party), the identification test relay operates, during the time that its winding is connected to conductors 221 and 220 in a circuit traced from battery, lamp 224, resistance 225, winding of identification test relay 200, back contact of relay 202, upper back contacts of relay 204, front contacts of relay 203, over conductors 221 and 220, through the front contacts of relay 111, line-finder brushes 117 and 116 over the tip and ring conductors of line 100 and through the space-discharge tube T, at station W, to ground through the ringer. The voltage applied across the tube, by the circuit just traced, is sufficient to ionize said tube, thereby rendering it sufficiently conductive so that the resulting current flowing in the circuit operates relay 200. If, however, the call originated at station W (ring party) relay 200 does not operate for there is no identification tube at station J and the identification tube T at station W is rendered ineffective, when the receiver at the latter station is removed from the receiver hook. If relay 200 operates relay 226 also operates, in a circuit traced from ground at the front contact of relay 200, lower inner back contact of relay 218 and through the winding of relay 226 to battery. Relay 226 locks in a circuit through its upper inner front contacts, upper middle back contact of relay 218, to ground on conductor 217.

The release of relay 212 of selector S, after the dialing of the first digit, is also effective to close a circuit for operating the rotary stepping magnet 216; this circuit may be traced from battery through the winding of magnet 216, lower front contact of relay 213, normally closed contact of relay 212 to ground at upper front contact of relay 207. The rotary magnet 216 rotates the shaft of selector S one step so that the brushes 228, 229 and 230 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 213. The release of relay 213 causes the release of the rotary magnet. The release of magnet 216 closes a circuit from battery through the winding of relay 213, upper contact of the VON springs, back contact of magnet 216, conductor 231, winding of relay 208, lower closed contact of "11th rotary step" springs to ground at relay 207. Conductor 231 is also connected through the lower inner back contact of relay 208 and the sleeve brush 228 to the sleeve terminal of the first trunk in the selected level. If this trunk is idle relay 208 operates and relay 213 does not operate; but if the trunk is busy the winding of relay 208 is short circuited by ground (not shown) at sleeve terminal 227 so that relay 213 operates and relay 208 does not operate. The reoperation of relay 213 causes the reoperation of the rotary stepping magnet 216. The alternate operation and release of relay 213 and magnet 216 advance the

brushes of selector S step by step from one set of terminals to the next.

When an idle trunk is encountered relay 208 operates in series with relay 213; but relay 213 is marginal and does not operate. Relay 208 disconnects the tip and ring conductors 233 and 232 from the windings of line relay 205 and extends these conductors through brushes 230 and 229 over the tip and ring conductors of the selected trunk to the windings of the line relay in the second selector circuit (not shown). Relay 208 also establishes a temporary busy condition on the sleeve terminal of the selected trunk by connecting the sleeve conductor 217 through the lower inner front contact of relay 208 and brush 228 to the sleeve terminal 227. Relay 205 releases thereby causing the release of relay 207. Relay 207 is slow to release so that the ground at its upper front contact is not disconnected from sleeve conductor 217 until sufficient time has elapsed for the operation of the line relay of the second selector (not shown) to have been effective to cause a permanent ground to be connected from sleeve terminal 227, through brush 228, and the lower inner front contact of relay 208, to sleeve conductor 217.

If all trunks in the selected level are busy the selector, upon reaching the 11th rotary step, actuates "11th rotary step springs" thereby disconnecting transformer 222, which supplies the usual dial tone, from the lower winding of relay 205 and connecting thereto transformer 239, which furnishes a distinctive audible signal to indicate a "trunks busy" condition to the calling subscriber.

When the remaining digits of the called station's number are dialed by the calling subscriber, the second selector (not shown) and connector (not shown) are operated in the usual manner to extend the connection to the called subscriber's line.

Assume that the called line 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 source of talking current at the connector (not shown) for the calling subscriber's line is reversed, with respect to the tip and ring conductors of the line in the usual manner, so as to operate the polarized supervisory relay 206 in the trunk T-1.

The operation of the supervisory relay 206 closes a circuit for operating relay 219; this circuit may be traced from battery through the winding of relay 219, front contact of relay 206, lower back contact of relay 219 to the brush of interrupter 234. When the brush of interrupter 234 is connected to ground relay 219 operates and locks through the front contact of its make-before-break springs to ground. Relay 219 disconnects its initial operating ground at the brush of interrupter 234 and closes a circuit for operating relay 218, from the brush of interrupter 235, lower front contact of relay 219, and through upper inner back contact and winding of relay 218 to battery. When the brush of interrupter 235 is connected to ground relay 218 operates and locks in a circuit traced from ground at its lower outer front contact, upper outer back contact of relay 236 and through upper inner front contact of make-before-break springs and winding of relay 218 to battery. Interrupter 235 is so timed

with respect to interrupter 234 that a time interval of not less than two seconds elapses from the time ground is connected to the brush of interrupter 234 until ground is connected to the brush of interrupter 235. The closed period for both interrupters is approximately 0.5 second. This time delay is introduced to prevent a false indication of the charging operation if supervisory relay 206 is momentarily operated due to trunk or line busy signal. Relay 218 also provides a second locking circuit for relay 219. This circuit is traced from lower next to outer front contact of relay 218 through the winding of relay 219 to battery. With relay 218 operated, sleeve conductor 217 is disconnected from the sleeve conductor 209 and hold conductor 210, at the upper middle back contact of relay 218 and is connected to relay 214 at the upper outer front contact of relay 218; sleeve conductor 209 and hold conductor 210 are connected to ground, through retardation coil 237, at the make spring of the upper middle make-before-break springs of relay 218. Relay 214 is energized from ground on sleeve conductor 217 and in turn energizes slow-to-release relay 215 in an obvious circuit. Condenser 223 and retardation coil 237, associated with the sleeve conductors 217 and 209 of the selector S and trunk circuit T-1 are furnished to provide a suitable path for the transmission of the usual number checking tone.

When the calling subscriber replaces the receiver on the receiver hook, the line relay of the connector (not shown) releases. The connector switch and associated second selector (not shown) are returned to normal in the usual manner. When the sleeve ground is disconnected from the sleeve terminal 227 with which brush 228 is in contact, relay 208 of selector S and relays 214 and 206 of trunk T-1 are released. The release of relay 208 closes a circuit for operating the release magnet 240 and selector S is returned to normal in the usual manner. In releasing, relay 214 closes a circuit to momentarily operate relay 202 for initiating the conductance test of the calling subscriber's line. This circuit may be traced from ground at the upper outer back contact of relay 214, front contact of relay 215 upper inner front contact of relay 219 and through the winding of relay 202 to battery. This test is made to determine the presence or absence of a resistance leak from either the tip or ring conductors of the calling subscriber's line to ground. The necessity for this test resides in the condition, wherein the ring party (W) initiates a call and wherein said leak is of sufficient conductance to cause the operation of aforementioned identification test relay 200 and thereby identify the tip partly erroneously. Relay 202 operates relay 203 in an obvious circuit and connects the test relay 201 to tip and ring conductors 221 and 220 respectively. This circuit may be traced from battery through winding of relay 201, upper outer front contact of relay 202, upper back contacts of relay 204, front contacts of relay 203 to conductors 221 and 220 and thence over the tip and ring conductors of the calling subscriber's line as aforementioned. The battery potential applied to the line 100, in this case, is not sufficient to operate the space discharge tube T. If either the tip or ring conductor of line 100 presents a resistance leak to ground of excessive conductivity relay 201 will operate in the circuit just traced. However, if the line 100 presents a resistance leak to ground of normal conductivity relay 201 will not operate. If relay 201 operates it closes an

obvious locking circuit for relay 202 thereby preventing the subsequent release of the trunk T—1 from subscriber's line 100. The trunk circuit T—1 is so arranged that if its release is not effected within a fixed time, starting from the time the conductance test is initiated, the alarm circuit (not shown) will function to attract the attention of the maintenance force. The circuit for initiating said alarm is traced from ground at the upper inner back contact of relay 214 and through lower middle front contact of relay 218 to the alarm circuit.

To proceed with this description we will assume that the leak test is satisfactory. Slow-to-release relay 215 releases thereby causing the release of relay 202. Relay 203 however remains operated in a circuit through its lower inner front contact to ground at the lower outer front contact of relay 218. The release of relay 202 reconnects the identification test relay 200 to the tip and ring conductors 221 and 220 in an aforementioned circuit, for applying the third test. This test is made to determine whether or not the space discharge tube T is in operative condition and is made immediately after the leak test at a time when the receivers at both the tip and ring stations are on their respective receiver hooks as aforementioned.

If the said identification tube T is operative test relay 200 will operate as aforementioned and the trunk circuit T—1 will proceed to operate the proper meter associated with the calling subscriber's line; but if the test is not satisfactory test relay will remain non-operated and the trunk in this case will prevent registration and will cause the alarm circuit to function in an aforementioned manner. The necessity for this test resides in the condition wherein the tip party initiates a call and wherein the space discharge tube T is not in an operative condition. The identification test in this case should have caused the operation of identification test relay 200 thereby identifying the tip party; but with said tube in a non-operative condition said test relay remains non-operated thereby indicating the ring party erroneously. Thus the accuracy of the identification test is assured by the operation of test relay 200.

As to the operation of the meters associated with the two-party line 100; first the operation of the ring party (W) register will be described followed by a description of the operation of the tip party (J) register. The operation of relay 200 causes the operation of relay 204 in a circuit traced from ground at the front contact of relay 200, lower inner front contact of relay 218 and through winding of relay 204 to battery. Relay 204 locks through its lower inner front contact to ground at the lower outer front contact of relay 218. The short circuit across resistance 241 at the lower outer back contact of relay 204 is opened by the operation of relay 204 and resistance 241 is included in series with sleeve conductor 209. This circuit may be traced from sleeve conductor 209, upper outer back contact of relay 226, resistance 241, upper middle front contact of relay 218 and through retardation coil 237 to ground. The resistance introduced into the aforementioned sleeve circuit causes the release of line relay 101 but does not affect the cut-off relay 102. Relay 101 released disconnects conductor 123 from the ring conductor of line 100, to prevent the initiation of another call until the register has operated, and connects the register 124 thereto, thereby closing a circuit for

the operation of relay 236. This circuit may be traced from battery through winding of register 124, upper back contact of relay 101, ring terminal and brush 116 of the line-finder LF, upper middle back contact of relay 109, upper outer front contact of relay 111, ring conductor 220, upper outer front contact of relay 203, upper outer front contact of relay 204, upper middle back contact of relay 226, lower back contact of relay 236, lower back contact of relay 226, and through upper winding and upper inner back contact of relay 236 to ground. The provision for operating relay 236 in series with register 124 is made for the purpose of testing the release of line relay 101. If said line relay fails to release in series with resistance 241 as aforementioned relay 236 will not operate, the trunk T—1 will be held and an alarm will be effected, as aforementioned. Relay 236 (a) locks in a circuit traced from battery through its lower winding and upper next to inner front contact to ground at the lower outer front contact of relay 218; (b) opens the aforementioned locking circuit for slow-to-release relay 218; (c) connects a direct ground to the sleeve conductor 209, to guard against seizure by either another line-finder or connector, in a circuit traced from ground at upper next to outer front contact of relay 236, upper outer back contact of relay 226 to sleeve conductor 209; and (d) connects booster-battery to the ring conductor 220 for the purpose of operating the ring party (W) register 124. This circuit may be traced from booster-battery, through lamp 242, resistance 243, front contact of relay 236, upper back contact of relay 226, upper outer front contact of relay 204, upper outer front contact of relay 203 to ring conductor 220 and thence through the register 124 to battery over an aforementioned circuit.

Having described the operation of the circuit to effect registration when the ring party (W) initiates a call, a description will now be made of the operation of the circuit to effect registration when the tip party (J) initiates a call. As aforementioned, relay 226 is operated and locked when the identification test relay 200 identifies the tip party (J). The operation of the circuit, following the subscriber's replacement of the receiver on the receiver hook, is the same as described for the ring party (W) up to the point where relay 204 operates. Since the tip party (J) register 122 is associated with the sleeve circuit of the line-finder LF, by the line relay 101, it is not necessary to release relay 101 during the registration period. The line relay 101 is held operated in a circuit traced from ground through winding of retardation coil 237, upper middle front contact of relay 218, lower front contact of relay 226, lower back contact of relay 236, upper next to inner front contact of relay 226 to sleeve conductor 209 and thence through the winding of relay 101 in an aforementioned circuit. Relay 204 operated closes a circuit for operating relay 236 from ground at the lower front contact of relay 218, lower middle front contact of relay 204, upper next to outer front contact of relay 226 and through the lower winding of relay 236 to battery. Relay 236 disconnects ground from the sleeve conductor 209 and connects booster-battery thereto to operate the tip party (J) register 122. This circuit may be traced from booster-battery, through lamp 242, resistance 243, front contact of relay 236, upper next to inner front contact of relay 226, to sleeve conductor 209 and thence through the winding

of register 122 in parallel branches extending through contacts of relays 101 and 102. Relay 236 also opens the holding circuit for relay 218 thereby causing its release.

5 Relay 218 is slow to release and is designed so that it will remain operated for a sufficient length of time, after its holding circuit is opened, to effect registration. This relay releases, following the operation of relay 236 as aforementioned, 10 thereby releasing relays 219, 203, 204 and 236. Relay 236 removes ground from the hold conductor 209; releases relay 226, if operated; disconnects booster-battery from the sleeve conductor 209 (for tip party registration); disconnects booster-battery from the ring conductor 220 (for ring 15 party registration); and disconnects ground from the sleeve conductor 209 (for ring party registration). The trunk circuit T-1 is thus released and all apparatus is restored to normal. The dis- 20 connection of either booster-battery, or ground from sleeve conductor 209 causes the release of line relay 101 (if operated) and cut-off relay 102 thereby restoring the subscriber's line circuit to normal. The disconnection of ground from 25 the hold conductor 210 releases relay 111 of the line-finder LF. Relay 111 released closes a circuit for operating the release magnet 128; this circuit is traced from ground at the lower outer back contact of relay 111, upper outer front con- 30 tact of relay 106 and through the winding of release magnet 128 to battery. The operation of magnet 128 causes the shaft and brushes to restore to normal. With the VON springs thus restored to normal position ground is disconnect- 35 ed from conductor 113, thereby releasing relay 109. Relay 111 also opens the circuit through the upper winding of relay 106 thereby causing the release of relay 106 unless said relay is held operated through its lower winding and upper 40 inner front contacts to ground on starting conductor 105; thus relay 106 can not release if starting conductor 105 is grounded due to the origination of another call until the calling line has been found by some other line-finder in the 45 group. The release of relay 106 disconnects starting conductor 105 from conductor 126 and from the lower winding of relay 106. The line-finder LF is now ready for use on another call.

What is claimed is:

50 1. The combination in a telephone system of a line having a plurality of stations thereon, a register for each of said stations, an identification device at one of said stations, means effective 55 when a call is made on said line for testing the line for the presence of said device, means dependent on the result of said test for selecting one of said registers for operation, and means for testing said line to determine whether said de- 60 vice is in operative condition.

65 2. The combination in a telephone system of a line having a plurality of stations thereon, a register for each of said stations, an identification device at one of said stations, means responsive to a call by any one of the stations on said line for 70 testing the line to determine the presence of said device, means dependent on the result of said test for selecting one of said registers for operation, and means to test said line after the calling party replaces his receiver to determine 75 whether said device is in operative condition.

3. The combination in a telephone system of a line having a plurality of stations thereon, reg- 75 isters, one for each of said stations, an identification device connected to the line at one of said stations, means controlled by the subscriber for

disconnecting said device from the line, means for making a test of the line to determine the pres- 5 ence or absence of said device, means dependent upon said test for selecting one of said registers for operation, and means for testing said line to determine whether said device is in operative condition.

4. In a telephone system, a line having a plu- 10 rality of stations thereon, message registers, one for each of said stations, a space-discharge device at one of said stations, means effective when a call is made on said line for testing the line for the presence of said space-discharge device, 15 means controlled as a result of said test for selecting one of said registers for operation, and means for testing the line to determine whether said space-discharge device is in working condi- 20 tion.

5. In a telephone system, a line having a plu- 20 rality of stations thereon, message registers, one for each of said stations, a gas-filled tube connected to the line at one of said stations, means controlled by the subscriber for disconnecting 25 said tube from the line, means responsive to the initiation of a call on the line for testing said line to determine whether or not said tube has been disconnected from the line, means con- 30 trolled as a result of said test for selecting one of said registers, and means for subsequently testing said line to determine whether the tube is in operative condition.

6. In a telephone system, a party line, reg- 35 isters, one for each party on said line, a space-discharge tube connected to the line at one of said stations, means controlled by the party at said station for disconnecting said tube from the 40 line, means effective when a call is made at any one of said stations for testing the line to determine whether or not said tube is connected to the line, means controlled by said test means for se- 45 lecting one of said registers for operation, and means effective as a result of the replacement of the calling subscriber's receiver for again test- ing said line to determine whether said tube is in working condition.

7. In a telephone system, a subscriber's line, a 45 line relay therefore, a message register for said line, an operating circuit for said register in- cluding one of the talking conductors of the line, means for holding the line relay energized dur- 50 ing conversation over said line, and means for releasing said line relay to close said operating circuit.

8. In a telephone system, a party line, a line 55 relay therefor, registers, one for each of the parties on said line, an operating circuit for one of said registers including one of the talking con- ductors of said line, means for holding the line relay energized during conversation, and means 60 dependent on the station making the call for releasing the line relay to close said operating cir- cuit.

9. In a telephone system, a line having a plu- 65 rality of stations thereon, a line relay for said line, a message register for one of said stations, an operating circuit for said register including the control conductor of said line, a second reg- 70 ister for another of said stations, an operating circuit for said second register including one of the talking conductors of said line, means for holding the line relay in operated condition dur- 75 ing the conversation period, and means for caus- ing the release of said relay to close the operat- ing circuit of said second register.