July 2, 1929. R. L. STOKELY 1,719,091

TELEPHONE EXCHANGE SYSTEM

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FIG. 1.

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FIG. 2.

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TELEPHONE EXCHANGE SYSTEM

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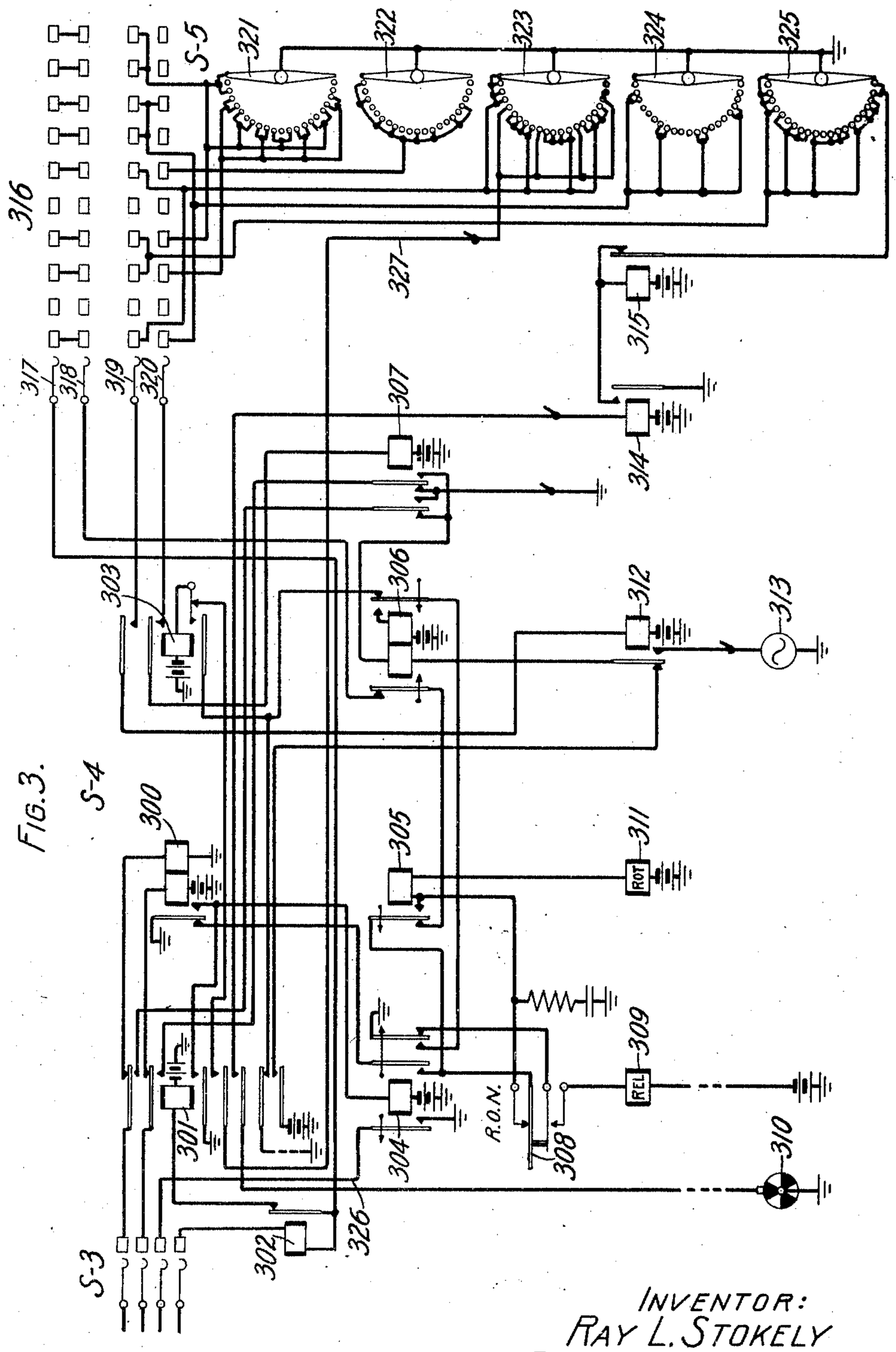

FIG. 3.

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Patented July 2, 1929. 1,719,091

UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

Application filed July 14, 1927. Serial No. 205,540.

This invention relates to telephone exchange systems and more particularly to improvements in party line service.

According to this invention, a subscriber on a non-message rate party line may make a revertive call by setting up a connection over automatic switches to seize a revertive ringing device which applies ringing current to the calling line whereas, when a subscriber on a message rate party line attempts to make a revertive call by setting up a connection to the ringing device, the connection thus established is automatically released to defeat the attempt, requiring him to first call the operator.

The drawing consists of three figures, which, when arranged in order, disclose a portion of a step-by-step automatic system embodying the present invention. Fig. 1 illustrates two party lines and the line finders for extending them. Fig. 2 illustrates certain of the selector switches and an operator's position diagrammatically. This figure also shows the details of a message register trunk. Fig. 3 shows a special revertive calling switch and a revertive signaling mechanism.

Where an exchange serves a number of party lines, it may often be desirable to equip some of these lines with message registers for charging calls, while other lines are not so equipped but may be charged on a flat rate basis. Since each call originating on a flat rate line does not have to be registered, the revertive calls may be made without the assistance of an operator. On the message register party lines, however, it is desirable to have the subscriber call an operator when he wishes to make a revertive call. In this way the operator has charge of the connection and tends to the registration of the call against the proper party.

In the system illustrated, a non-message rate party line 100 having two substations 101 and 102 terminates in the bank of the line finder F^1, which may be of any well known type such as a two-movement step-by-step switch. When either party on such a line initiates a call the finder F^1 extends the line over a trunk 130 to a first selector S. The subscriber thereupon controls the selector S and succeeding selectors S^2 and S^3 to extend his line to a special revertive calling selector S^4. The switch S^4 has access through its terminal bank 316 to a code revertive ringing mechanism S^5. The subscriber sets the switch S^4 on different bank contacts and the mechanism S^5 causes ringing current to be sent back over the calling line in different code combinations to signal any desired party thereon. The switch S^4 is of the single motion rotary step-by-step type.

The message register party line such as the line 103, having substations 104 and 105, terminates in the bank of line finder F^2. The switch F^2 is of the two-movement step-by-step type having tip and ring brushes 106 and 107 cooperating with the bank 110 of tip and ring terminals and also auxiliary brushes 108 and 109 carried by the same shaft and cooperating with the bank of terminals 111. The switch F^2 also has a vertical commutator strip 117 and coacting brush 118. The subscriber of one of these message register party lines on initiating a call sets the finder F^2 in motion to extend his line over a trunk 131 to the first selector S^1. The trunk 131 leading to the first selector is a special message register trunk and is provided with equipment for making a test of the calling line to determine which party initiated the call and for selectively operating the message registers. The switch S^1, shown diagrammatically, is positioned by the calling subscriber to seize the trunk 223 leading to the operator's position in case he is making a revertive call. The operator ascertains the number of the wanted party and assists in establishing the connection and causes the operation of the message register, all in the usual and well known manner.

If the message register party line subscriber wishes to make a direct connection, he may do so by operating the selector S^1 to seize a trunk leading to the succeeding selector S^2 which may be positioned to extend his line in the proper direction.

Should the subscriber of a message rate party line, such as the line 103, attempt to make a revertive call by extending his line to the special selector S^4 and seizing the revertive ringing device S^5, the circuits are so arranged that as soon as he replaces his receiver on the hook to await the application of ringing current, the entire connection is automatically released, thus defeating the attempt.

A detailed description will now be given

of the manner in which the system operates when a non-message register party line makes a revertive call.

If the subscriber at substation 101 wishes to call the subscriber at station 102 he initiates the call in the usual manner causing the operation of the line finder F^1. He thereupon manipulates his impulse transmitter to position the selectors S^2 and S^3 to extend the line to the switch S^4. The impulse relay 300 is operated in a circuit from ground, through its right winding, upper contact of relay 301, thence over the tip side of the connection, through the subscriber's loop and returning over the ring side of the connection through the back contact of relay 301, left winding of relay 300 to battery and ground. Relay 300 closes an obvious circuit for slow release relay 304. Relay 304 at its left contact applies ground to the sleeve conductor 326.

The calling subscriber now transmits a series of impulses to set the switch S^4 in such a position that the code signaling device S^5 will cause the sending of a code identifying the called subscriber's station 102. On the first opening of the line, relay 300 releases and closes a circuit from ground, through its back contact, inner right contact of relay 304, closed contacts of the spring combination 308, winding of slow release relay 305, winding of the stepping magnet 311 to battery. Relay 305 operates and shifts the stepping circuit so that it now leads through the front contact and winding of said relay independent of the springs 308 which shift on the first step of the selector. The magnet 311 steps the brushes 317 to 320 inclusive of the switch S^4. For each succeeding impulse, the magnet 311 operates. At the end of the series the brushes of the switch S^4 are positioned on the corresponding set of terminals in the bank 316. For the sake of description it will be assumed that the brushes have been driven to the first set of terminals in the bank.

Following the last set of impulses, the calling subscriber replaces his receiver on the switchhook to await the signaling of the called party. Relay 300 releases in response to the replacement of the receiver and in doing so completes a circuit from ground through its left contact, front contact of relay 304, which remains energized for an interval, back contact of relay 305, which releases following the completion of the impulse series, contact of relay 306, through brushes 318 and 317 and the connected terminals, contact of relay 302, winding of relay 301 to battery. Relay 301 operates and closes a substitute holding circuit for relay 304. Relay 301 also completes a circuit from battery, through the winding of relay 314, contact of relay 301, interrupter 310 to ground. At each closure of the interrupter the relay 314 operates and completes a circuit for the stepping magnet 315 of the switch S^5. The magnet 315 advances the brushes 321 to 325 inclusive from position to position.

When the brush 323 reaches its fifth terminal, a circuit is closed from ground, through said brush, conductor 327, contact of relay 301, contact and winding of relay 303 to battery. Relay 303 operates and locks through its front contact, contact of relay 306, to ground at the front contact of relay 304.

In positions 6 to 9 inclusive of the switch S^5 a circuit is completed from ground, through the brush 323, brush 319, contact of relay 303, winding of relay 312 to battery. Relay 312 operates and connects the generator 313 in a circuit through the left winding of relay 306, back contact of relay 307, front contact of relay 301, to the tip side of the calling line. The ring side of the line is connected through the contact of relay 301 and the inner back contact of relay 307 to ground. Current from the generator 313 operates the call bells connected to the tip side of the line for an interval measured by the time required by the switch S^5 to pass through two positions. In positions 8 and 9 of the switch S^5 a circuit is completed from ground, through the brush 324, thence over brush 320, contact of relay 303, winding of relay 307 to battery. Relay 307 shifts the circuit of the generator to the ring side of the line and shifts the ground connection to the tip side. This causes the bells on the other side of the line to ring for an interval equivalent to two positions of the switch S^5.

In position 10 of the switch S^5 the pick-up conductor 327 is again grounded, but since the relay 303 has already operated nothing happens at this time. In positions 11 to 14 inclusive signals of the same code are applied to the party line. By means of this code the calling subscriber's bell is rung for an interval of time following which the called subscriber's bell is rung for an equal interval. It will be obvious by inspecting the connections of the switch S^5 that other codes may be obtained by positioning the switch S^4 at different points in its contact bank.

When the called party answers, the ringing trip relay 306 operates and locks through its right winding to the contact of relay 304. Relay 306 releases the relay 301 which disconnects the ringing circuit and reconnects the relay 300 to the calling line. Relay 300 operates reclosing the circuit of relay 304 which holds the connection. Relays 303, 312 and 307 are released and the switch S^5 ceases its stepping action. Talking current is fed to the party line through the windings of the relay 300.

At the end of the conversation the parties

replace their receivers releasing the relay 300 which in turn releases the relay 304. Relay 304 closes a circuit from ground, through its outer back contact, closed contact of the off normal spring combination 308, release magnet 309 to battery. Magnet 309 releases the switch S^4 to normal. The removal of ground potential from the conductor 326 causes the release of relays S^3, S^2 and S and the finder F^1 in the well known manner.

It will now be assumed that the subscriber at station 104 on the party line 103 makes a revertive call by dialing the proper number to extend his line to the operator's position O. On removing his receiver from the switchhook, the calling subscriber completes a circuit from battery, through the right winding of relay 112, contact of relay 113, thence over the loop of the line and returning to the left winding of relay 112. Relay 112 closes an obvious circuit for the group relay 121. Relay 121 places ground potential on the group segment 129 and also on the start wire 132 completing a circuit through the normal contact of relay 120, closed contact of the spring combination 128, winding of the slow release relay 119 to battery. Relay 119 closes a circuit for relay 122 traceable from battery, through the otuer left contact of relay 120, right winding of relay 122, left contact of magnet 126, contact of magnet 125, conductor 133 to ground at the outer contact of relay 119. Relay 122 closes a circuit as follows for the vertical magnet 125: battery, through the outer contact of relay 120, winding of magnet 125, right back contact of relay 140, contact of relay 122 to ground at the contact of relay 119. The magnet 125 steps the brushes 106 to 109 inclusive up to the first level of contacts. Magnet 125 opens the circuit of relay 122 which releases and opens the circuit of the magnet. The magnet in turn releases and recloses the circuit and relay. This action continues until the brushes reach the level containing the calling subscriber's line 103. At this time a circuit is closed from battery, through the right winding of relay 122, contact of magnet 126, left winding of slow relay 140, brush 118 to the grounded segment 129. Relay 122 operates and holds the circuit of magnet 125 closed to prevent further stepping of the switch. Relay 140 operates and locks in a circuit from battery, through the winding of magnet 125, right winding and contact of relay 140 to ground at the contact of relay 119.

Relay 140 also closes a circuit for the rotary stepping magnet 126 traceable from battery, through the winding of said magnet, front contact of relay 140, contact of relay 122 to ground at the contact of relay 119. The magnet 126 rotates the brushes on the first set of terminals in the contact banks. Magnet 126 opens the circuit of relay 122 which releases in turn releasing the circuit and the magnet. This interrupting action continues until the brushes reach the terminals of the calling line 103. At this time a circuit is completed from battery through the winding of relay 113 and register 114 in parallel, contact of relay 112, thence over the test brush 108, upper winding of relay 116, back contact of relay 120, left winding of relay 122 to ground. Relay 116 operates and relay 122 remains energized, but the relay 113 and register 114 do not operate in this circuit. Relay 122 by remaining energized prevents further stepping of the switch. Relay 116 completes an operating circuit for relay 120 from battery, through the left winding of the latter relay, front contact of relay 116, conductor 134 to ground at the contacts of spring combination 127. Relay 120 in operating shifts the start wire 132 to the out start conductor 135 and opens the circuit of slow-release relay 119. At the time relay 116 operates it locks temporarily in a circuit from battery, through its lower winding and contact, front contact of magnet 126 to ground at the contact of relay 119. Before relay 119 deenergizes following the opening of its circuit, a substitute holding circuit for relay 116 is closed from battery, through the winding and contact of the latter relay, inner left front contact of relay 120 to ground on the sleeve conductor 136. The manner in which ground is placed on this conductor will be described presently. The release of relay 119 opens the circuit of relays 122 and 140. When ground potential is applied to the sleeve conductor 136 the cut off relay 113 operates in a circuit from battery, through its winding, right contact of relay 112, brush 108, contact of relay 116, to conductor 136 through the front contact of relay 120. Relay 113 releases the line relay 112.

As soon as relay 116 operates, the tip and ring conductors of the calling line are extended over the trunk 131 to operate the impulse relay 206. The circuit for relay 206 leads through the brush 201, over the ring side of the connection and returning through the brush 200 to ground through the impedance 207. Relay 206 in operating completes a circuit for the impulse relay at the selector switch S^1. This circuit extends over the ring side of the connection to the right winding of polarized relay 214, contact of relay 206, winding of relay 210, upper back contact of relay 209, left winding of relay 214, thence over the tip side of the trunk to the switch S^1. Relay 210 operates, closing an obvious circuit for slow-operate relay 211. Relay 211 in turn closes an obvious circuit for relay 209. The flow of current in the circuit above traced

is in such a direction as not to operate the relay 214.

In the well known manner, ground potential is placed on the sleeve conductor 224 as soon as the selector S^1 is seized. This causes the operation of relay 216. Relay 216 completes a circuit from ground, through the impedance 220, front contact of relay 216, through the sleeve conductor 136 leading back to the line finder switch F^2. Relay 216 also closes a circuit from ground, through its outer right contact, brush 203, contact and winding of magnet 221 to battery. Magnet 221 advances the brushes 200 to 205 inclusive to their second position terminals.

In position 2 of the control switch slow-operate relay 218 is energized in a circuit from battery, through its winding, resistance 222 to ground at the brush 202. Relay 218 closes an obvious circuit for slow-release relay 219. Relay 219 completes a circuit from ground, through the front contact of relay 218, inner left contact of relay 219, normal contact of slow-release relay 212, conductor 225, brush 203, contact of winding of magnet 221 to battery. Magnet 221 interrupts its circuit and steps the switch into position 3, releasing relays 218 and 219. The switch stays in this position during the dialing by the calling subscriber.

The calling subscriber manipulates his dial to transmit the digit impulses, releasing and operating in succession the impulse relay 206. On the first release of relay 206, relay 211 releases in turn releasing relay 209. Since relay 211 is slow to operate it does not attract its armature during the sending of impulses. Relay 206 in releasing opens the circuit leading to the switch S^1 thus repeating the impulses to said switch to cause its operation. The switch S^1 is thus positioned to seize the trunk 223 leading to the operator's position O. The operator answers the call and ascertains the number of the wanted party. In any well known manner she may apply ringing current to the line to signal the wanted party and when conversation commences or at any suitable time, she may cause the reversal of current to operate the polarized relay 214.

At the time the control switch reaches position 3 a circuit is closed from battery, through the winding of slow-release relay 217 to ground at the brush 202. Relay 217 closes a circuit from battery, through the winding of slow-release relay 212, back contact of relay 219 to ground at the front contact of relay 217. When the polarized relay 214 operates a circuit is closed from battery, through the winding of relay 213, front contact of relay 212, back contact of relay 219 to ground at the front contact of relay 217. Relay 213 closes a circuit from ground, through its outer left contact, conductor 228, through the brush 203 to the stepping magnet 221 to advance the switch into position 4. In position 4 a circuit is closed from ground, through the front contact of relay 217, left back contact of relay 219, brush 203 to the magnet 221 advancing the switch into position 5. In position 5 the original circuit of relay 206 is opened but the relay is now held over a circuit from battery, through its winding, resistance 226, conductor 227, inner left front contact of relay 216, to ground at the brush 205.

The switch is advanced to position 6 by means of a circuit from ground, through the right front contact of relay 217, back contact of relay 219, front contact of relay 212, brush 203, to the magnet 221. In position 6 the relay 217 releases in turn opening the original circuit of relay 212. Relay 212, however, is held in a circuit from battery, through its winding and front contact, to ground at the brush 202. When relay 217 closes its right back contact, it completes a circuit for driving the switch from position 6 into position 9.

While the switch is passing through positions 6, 7 and 8 a test is made of the calling line to determine which party has initiated the call. It will be assumed that the station 104 in calling applies an identifying ground potential to the tip and ring conductors of the line. The manner in which a test of this kind is performed is explained and described in detail in the patent to Taggart et al., 1,513,351, granted October 28, 1924.

With the control switch passing through positions 6, 7 and 8, a test circuit is completed from battery, through the winding of relay 218, thence in parallel through the brushes 201 and 200 to the two sides of the subscriber's line to ground at the substation 104. Relay 218 operates and closes an operating circuit for relay 219. Relay 219 locks in a circuit from battery, through its inner left contact to ground at the brush 202. When the control switch reaches position 9 relay 218 releases. The switch is driven out of positions 9 and 10 and into position 11 by means of a circuit from battery, through the winding and contact of magnet 221, brush 203, conductor 228, front contact of relay 212, to ground at the brush 202. In position 11 a circuit is closed from battery, through the resistance 242, inner right contact of relay 213, brush 205 to ground. This circuit shunts the relay 212. Relay 212 in releasing completes a holding circuit for relay 213 traceable from battery, through the winding of the latter relay, normal contacts of relay 212 to ground at the brush 202. In position 11 conversation takes place. In this position relay 206 releases. The tip conductor of the calling line is extended through the

brush 200, thence over conductor 230, front contact of relay 216, through the winding of relay 214, to the selector switch S^1. The ring conductor is likewise extended through the brush 201, conductor 231, contact of relay 216, to the selector switch S^1.

At the end of conversation the selector S^1 is released, removing ground potential from conductor 224 to permit the release of relay 216. Relay 216 advances the control switch into position 12 by means of a circuit from ground, through its outer right back contact, left back contact of relay 217, and the brush 203. The control switch advances from position 12 to position 18 by means of an obvious circuit. During these positions, the test relay 218 is again connected to the tip and ring conductors of the calling line to determine if the ground potential has been removed as it should be, or whether the ground potential first encountered was due to an unstandard condition. The circuit for relay 218 may be traced from battery, through its winding, inner right contact of relay 219, and thence through the brushes 201 and 200 to the calling line. If the line is in standard condition the relay 218 does not operate and the switch is driven out of position 18 and into position 19 over a circuit including the back contact of relay 218.

The switch advances from position 19 by means of a circuit from magnet 221, through the brush 203, conductor 233 to the interrupter 235. In position 20, the switch is advanced by means of a circuit from the magnet 221, through the brush 203, conductor 234 and interrupter 236. The switch remains in position 21 until the interrupter 235 again closes. In this position the calling subscriber's message register 115 is operated. The circuit may be traced from the positive pole of booster battery, through the lamp 215, resistance 237, front contact of relay 213, brush 204, outer right front contact of relay 219, conductor 238, front contact of relay 116, brush 109, and thence through the register 115 to the negative pole of battery and ground. When the interrupter 235 again closes, the control switch advances out of position 21 into position 22 from whence it is moved into its normal position over an obvious circuit including the brush 203.

The removal of ground potential from the conductor 136 permits the relay 116 to release. Relay 116 completes a circuit from battery, through the release magnet 124, closed contacts of the spring combination 127, contact of relay 140, back contact of relay 116, left back contact of relay 119 to the grounded conductor 134. Magnet 124 releases the finder F^2 opening the holding circuit of relay 120.

It will next be assumed that the calling party on the line 103 attempts to make a revertive call by setting up a connection to the ringing device S^5. The operation of the line finder F^2 and of the selectors S^1, S^2 and S^3 takes place as already described to extend the calling line to the special selector S^4. The switch S^4 responds to the impulses dialed and positions its brushes on the selected set of terminals in the bank 316. As soon as the calling party hangs up his receiver to await the signaling of the called subscriber, a circuit is completed from ground, through the back contact of relay 300, inner front contact of relay 304, back contact of relay 305, left contact of relay 306, brushes 318 and 317 and the connected terminals, winding of relay 302, through the brushes of selectors S^3, S^2, and S^1, conductor 240, conductor 228, brush 203, contact and winding of the magnet 221 to battery. It will be recalled that the control switch in Fig. 2 is standing in position 3 at this time. The relay 302 operates in this circuit and prevents the operation of relay 301. Since the relay 300 is deenergized and since relay 301 does not operate, relay 304 releases after an interval. Relay 304 in releasing closes the circuit of the release magnet 309 to restore the switch S^4. Relay 304 in removing ground potential from the sleeve conductor 326 causes the release of switches S^3, S^2 and S^1 and the deenergization of relay 216. Relay 216 closes a circuit through the contact of relay 217 for driving the control switch out of position 3 and into position 4. From position 4 the switch is driven through succeeding positions over circuits similar to those already described into its normal position. The line finder switch S^2 is also released in the manner described. Thus the attempt on the part of the subscriber of a message register party line to make a revertive call, without the assistance of the operator, is defeated.

The switches disclosed in this system are of the step-by-step type. The line finder F^2 is similar to the one disclosed and described in the patent to Carpenter No. 1,567,240, granted December 29, 1925, with certain modifications.

What is claimed is:

1. In a telephone system, lines of different classes, a plurality of automatic switches, a revertive calling device, means for setting said switches to extend any one of said lines to the revertive calling device, and means responsive to the extension of lines of a certain class to such device for automatically releasing the connection.

2. In combination, a number of party lines, automatic switches, a revertive calling device, means controlled by certain of said lines for extending such lines over said switches to said device to make revertive calls, and means effective in response to the extension of other of said lines to said de-

vice for automatically releasing the connection.

3. In combination, a number of party lines, automatic switches, a revertive calling device, means for operating said switches to extend any of said lines to the calling device, means responsive to the extension of certain lines for rendering said device effective to send signals over the extended connection, and means responsive to the extension of other lines for automatically releasing the switches.

4. In a telephone system, a plurality of party lines, a series of selector switches, a revertive calling mechanism, means for setting said selector switches to extend any of said lines to the calling mechanism, ringers at the substations of said lines, means responsive to the extension of one of the lines to said mechanism for rendering it effective to operate the ringers of such line, and means responsive to the extension of another line to said mechanism for releasing the connection.

5. In a telephone system, a plurality of party lines, selector switches, a signaling device, an operator's position, means controlled by a subscriber of one of said lines for setting said switches to extend his line to said signaling device, means operated by said device for signaling the parties of said last mentioned line, means controlled by a party on another line for setting said switches to extend his line either to the operator's position or to said device, and means responsive to the extension of said last line to the signaling device for releasing the connection.

6. In combination, a number of party lines, a revertive ringing device, a selector switch, means for extending said lines over separate paths to said selector, means for operating the selector from either line to seize said ringing device, said device serving to signal the subscribers on a calling party line, and means in the path over which one of said lines is extended for effecting the release of the connection responsive to the seizure of said ringing device.

7. In combination, party lines equipped with message registers, party lines not equipped with message registers, a revertive ringing device, selector switches operable to extend any one of said lines to the ringing device, said device serving to send ringing current over a non-message register calling party line, and means responsive to the extension of a message register line to said device for automatically releasing the connection.

8. In a telephone system, two different party lines, a series of selector switches, a revertive calling mechanism, means for setting said switches to extend either of said lines to the calling mechanism, ringers at the substations of said lines, means responsive to the extension of one of said lines to said mechanism and controlled by the calling party's switchhook for rendering said mechanism effective to operate the ringers of such line, and means responsive to the connection of the other line to said mechanism and controlled by the calling party's switchhook for releasing the connection.

In witness whereof, I hereunto subscribe my name this 12th day of July, A. D. 1927.

RAY L. STOKELY.