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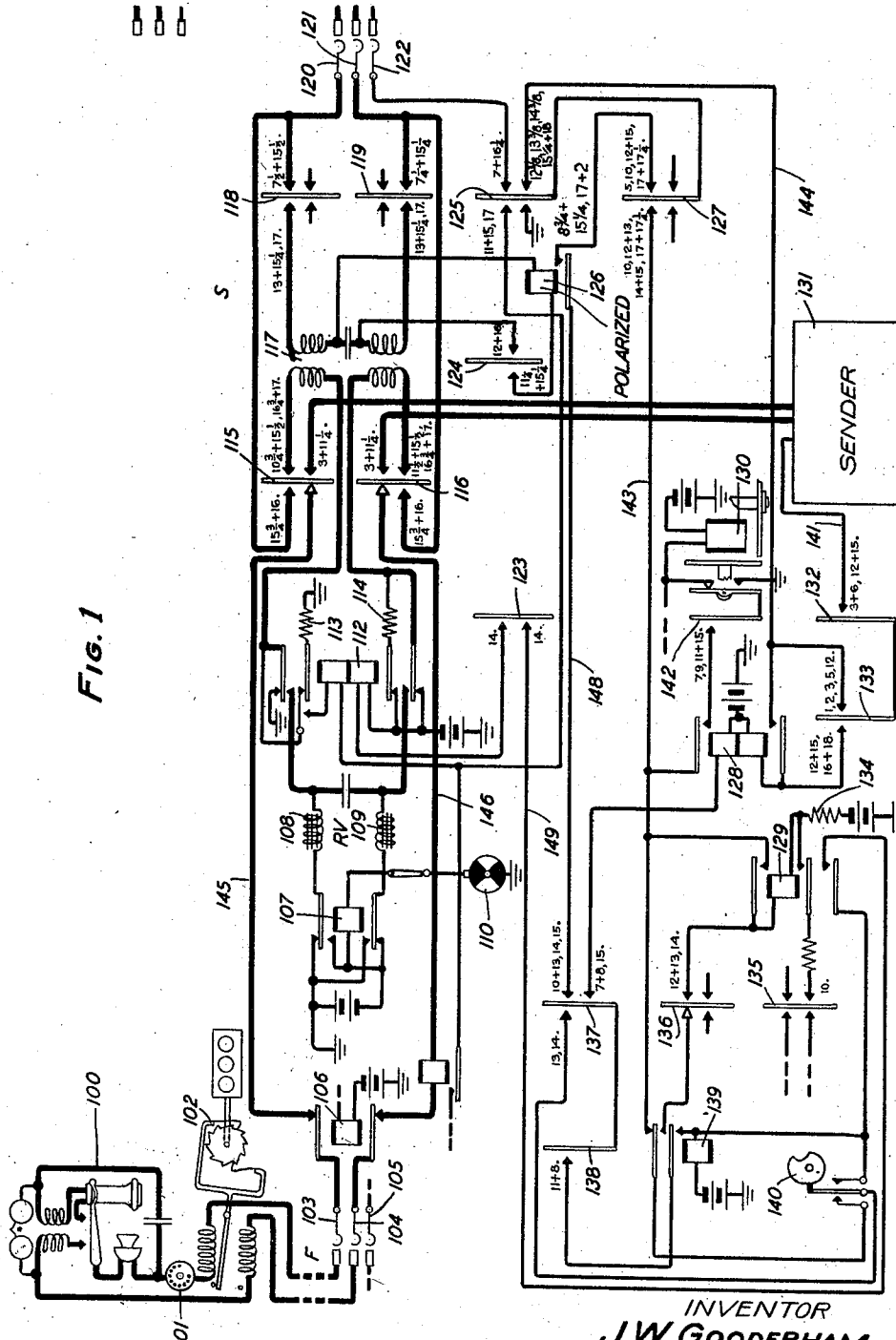
J. W. GOODERHAM

1,814,248

TELEPHONE SYSTEM

Filed Aug. 20, 1930

2 Sheets-Sheet 1



INVENTOR
J. W. GOODERHAM
BY *M. B. Kenna*
ATTORNEY

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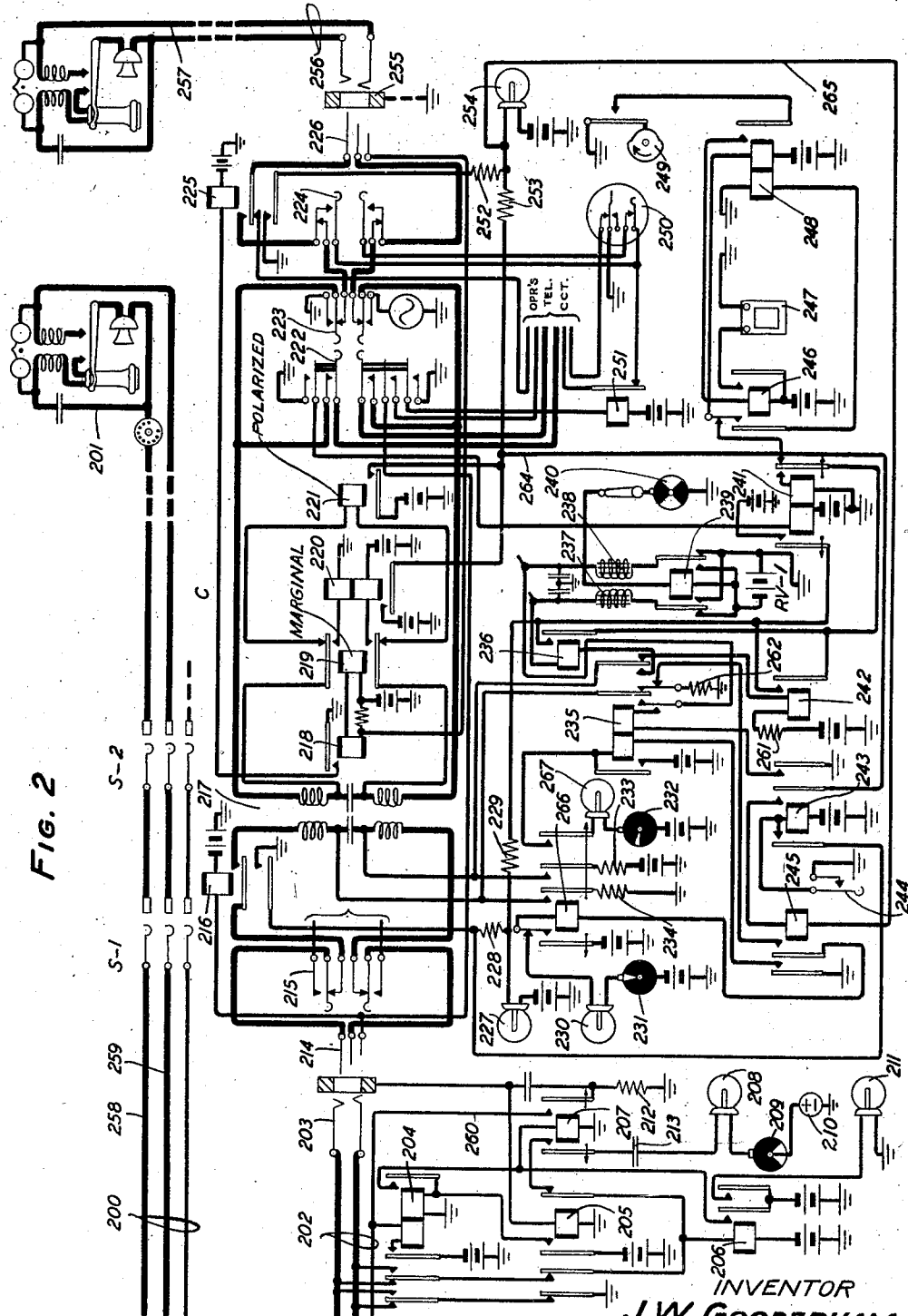
J. W. GOODERHAM

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INVENTOR
J. W. GOODERHAM
BY *M. B. M. J. J. J.*
ATTORNEY

UNITED STATES PATENT OFFICE

JOHN W. GOODERHAM, OF LARCHMONT, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE SYSTEM

Application filed August 20, 1930, Serial No. 476,548.

This invention relates to telephone systems and particularly to systems involving both automatic switches and operators' circuits for establishing connections, and in which the service charges are assessed by registers associated with the subscribers' lines.

The objects of the invention are to safeguard the subscribers against false operation of their registers when certain kinds of calls are made, to enable the substitution of a special register operating battery for the regular battery without interfering with the usual operation of the system, and to otherwise improve systems of this character.

It has been proposed heretofore to charge the subscriber for the service he receives by means of a register located at the substation and arranged to be operated periodically during the conversation by reversals of current supplied to the subscriber's line from the talking battery. When the subscriber's line is extended over a selector switch to a trunk leading to an operator's position, the operator responds by inserting the plug of one of her circuits in the jack in which the trunk terminates. This causes a flow of current to the trunk in such a direction as to operate a polarized relay to cause the subscriber's line to be extended directly through the selector switch to the source of current in the operator's cord circuit. In order that the connection may be held under the control of the subscriber after the operator has disconnected, it is necessary to associate a source of current with the trunk circuit. This source, which is normally connected to the trunk in such a direction as not to affect the polarized relay when the connection is extended thereto, is disconnected when the operator answers the call and is again reconnected to the trunk when the operator disconnects. If, therefore, the source is reconnected to the trunk in such a manner as to cause current to flow in its normal direction, this will effectively result in a reversal of current in the subscriber's line causing his register to operate falsely.

According to the present invention, the objections above mentioned are overcome by means of a system in which the current

source associated with the operator's trunk is reconnected to the trunk in reversed direction if the operator disconnects before the subscriber replaces his receiver. This prevents reversal of current in the subscriber's line and the consequent false operation of his register.

A feature of the invention is a system in which the operator may elect to charge the subscriber for the conversation by throwing a charge key which disables the regular source of talking current and substitutes therefor a special source of current which is subject to periodic reversals. Since there is a substantial difference in the potentials of the regular source and the charging source of current, the circuits are so arranged that the operation of the operator's key also brings about the substitution of a special supervisory relay for the regular supervisory relay.

In the drawings, Fig. 1 discloses a subscriber's line terminating in an automatic office and also a line finder and a first selector switch, a portion only of the circuits for these switches being illustrated. This figure also illustrates diagrammatically a central office controlling sender. Fig. 2 illustrates in diagrammatic manner other selector switches to which the selector of Fig. 1 has access for the extension of a connection automatically. Fig. 2 also shows a trunk extending to an operator's position together with an operator's cord circuit by means of which connections may be extended over trunks to manual positions or lines, or over other trunks through automatic switches to subscribers' lines.

The finder and selector switches shown in this disclosure may be of the type usually known as panel switches, the detailed construction of which is shown and described in the patent to McQuarrie No. 1,177,044, granted March 28, 1916, and in the patent to Craft and Reynolds No. 1,123,696, granted January 5, 1915. The manner in which these switches are operated and controlled, the recording of the designations on the central office sender, and the operation of this sender to determine the selective operation

of the switches may be substantially the same as that shown and described in detail in the patent to Kopp No. 1,589,402, granted June 22, 1926, and in the patent to Stearn et al No. 1,395,977, granted November 1, 1921.

The charges for service in the system herein disclosed are made on the basis of the duration of the call. To this end, the subscribers' lines are equipped with registers located at the substations which respond to periodic reversals of current in the line during intervals of conversation to operate a registering train. The substation register is so designed that it remains in either of its extreme positions until current is again reversed in the subscriber's line. One of these registers is illustrated in connection with the subscriber's line 100, Fig. 1, and it will be understood, of course, that other subscribers' lines in the system may be similarly equipped. Devices of this character are illustrated in the patents to Thomson No. 1,121,953, granted December 22, 1914; Babcock No. 1,594,587, granted August 3, 1926; and Babcock No. 1,747,210, granted February 18, 1930.

At the central office, the selector switch S is equipped with a reversing circuit RV, which is rendered effective in case the call is to be charged and periodically reverses the direction of talking current over the tip and ring conductors of the subscriber's line to actuate the substation register 102 once for each reversal. In case the call is a free one, the reversing mechanism RV remains inert, and talking current is supplied to the calling line continuously in a given direction so that the substation register 102 does not actuate during the conversation. The subscriber may choose to call an operator, either to obtain a connection to which he is entitled without charge, or to ask her assistance in obtaining a connection for which a charge should be made. In such a case, she dials a designation which causes the selector switch S to seize the operator's trunk 202 terminating in the jack 203 at the operator's position. On such a call to the operator, it is desirable to supply talking current to the calling line from the operator's cord circuit C, in which case it is necessary to exclude the repeating coil and current source at the selector S and to extend the tip and ring conductors directly through to the trunk circuit 202 and cord C. It is also desirable that the calling subscriber should have control of the release of the connection as well as the operator. For this purpose it is necessary to supply current to the tip and ring conductors of the subscriber's line through relays associated with the trunk 202. When, therefore, the switch S seizes the trunk 202, current is supplied to the tip and ring conductors extending back to the

polarized control relay 126 associated with the said switch. The relay 126 should not be operated at this time but should only operate when the operator responds. Accordingly, the direction of current flow supplied over the trunk 202 is such as not to operate the relay 126. When the operator responds by inserting the plug 214 in the pack 203, relay 126 is caused to operate to advance the sequence switch 130 associated with the selector S to exclude the repeating coil 117 and extend the subscriber's line directly through to the cord circuit. To accomplish this, it is necessary first to remove the source of current from the trunk 202 and then to substitute therefor a source of current in the operator's cord circuit connected in the opposite direction. Since the subscriber's line is now connected directly through to the source of current in the operator's trunk, the register 102 will assume a position, or will maintain it if already in that position, determined by the direction of current flow from the source in the operator's cord circuit.

If the call is a free one, the register does not change its position throughout the duration of the conversation, and, when the call has been completed, the operator may withdraw the cord before the calling subscriber replaces his receiver to open the line loop. In this event, the current source must be reconnected to the trunk 202 in order that the connection will not be released until the subscriber replaces his receiver, thereby permitting him to recall the operator if he so desires. Since the register 102 is now in the position corresponding to the direction of current flow from the cord circuit, and since the source at the trunk 202 is normally connected in the opposite direction, the reconnection of this source in its normal direction would cause the register 102 to make an operation, thus falsely charging the subscriber. This is avoided by so arranging the circuits that the source of current at the trunk 202 is reconnected in a direction which is the reverse of its normal direction and is therefore the same as the direction in which the cord circuit source is connected. Accordingly, the subscriber's meter is not operated falsely. Should the call be one for which the calling subscriber is to be charged, the calling subscriber's register might also be left, following the last charging operation, in such a position that the reconnection of the source to the trunk 202 in its normal direction would cause a false operation of the said register.

A detailed description will now be given of the operation of the system. It will first be assumed for this purpose that the subscriber of line 100 wishes to converse with the subscriber of line 201. In response to the initiation of the call, the allotted line

finder F responds and operates to place its brushes 103, 104 and 105 on the terminals of the calling line 100. Following this, the subscriber's line is extended over the springs 115 and 116 of sequence switch 130, which has been driven to some position between positions 3 and 11, to the register sender 131. The subscriber thereupon proceeds to manipulate his impulse transmitter 101 to send the necessary impulses to the sender 131 representing the wanted designation. Thereafter brush and group selection at the switch S take place under control of the sender 131, and the switch S automatically trunk hunts to seize with its brushes 120, 121 and 122 the terminals of a trunk 200 extending to an idle incoming selector switch S—1. The sender next proceeds to selectively control the operation of the incoming switch S—1 and the final selector switch S—2 to seize the called subscriber's line 201. During this time, the sequence switch 130 moves through successive positions and into some position such as position 12. In this position, the relay 128 is operated in a circuit from battery through its lower winding, upper left contact of spring 133, contact of spring 132, conductor 141 to ground in the sender 131. Relay 128 closes a circuit from battery through the winding of sequence switch magnet 130, contact of sequence switch spring 142, upper contact of relay 128, conductor 143, upper left contact of spring 127, lower left contact of spring 125 to ground. The sequence switch 130 moves out of position 12 and, according to the nature of the call, will stop either in position 12, 13, 14 or 15. In the present case it will be assumed that the sequence switch stops in position 14. As the sequence switch moves into position 12 $\frac{3}{4}$ a circuit is closed from ground, through the lower contacts of spring 125, conductor 144, through the lower contact of relay 128 and thence is parallel through the lower winding of said relay to battery and through springs 133 and 132 and conductor 141 to the sender. Examining spring 125, it will be noted that a similar circuit is closed in positions 13 $\frac{3}{4}$ and 14 $\frac{3}{4}$. These impulses hold the relay 128 energized and also affect the sender. When the proper number of these impulses have been sent to satisfy the sender, the circuit over conductor 141 is opened and relay 128 is permitted to release, stopping the sequence switch 130. As assumed, the sequence switch 130 in this case stops in position 14.

As the sequence switch 130 moves out of position 11 $\frac{1}{4}$ and into position 14, the sender 131 is disconnected from the tip and ring conductors 145 and 146 and these conductors are extended to the left windings of repeating coil 117. The circuit over conductor 145 may be traced through the lower left and

upper right contacts of spring 115, upper left winding of repeating coil 117 to ground through the upper contacts of relay 112. A circuit over conductor 146 may be traced through the upper left and lower right contacts of spring 116, lower left winding of coil 117, through the lower contacts of relay 112 to battery. The right windings of the repeating coil 117 are connected respectively to the tip and ring conductors 258 and 259 of the trunk 200. The circuit over conductor 258 may be traced through the brush 120, upper contacts of spring 118, upper right winding of coil 117, winding of the polarized supervisory relay 126, contacts of spring 124, lower right winding of the coil 117, lower contacts of spring 119, brush 121 to the conductor 259. This circuit extends to a source of current in the incoming selector S—1, the direction, however, being such that relay 126 does not operate.

When the called subscriber answers, the direction of current in the trunk 200 is reversed at the selector switch S—1 causing the operation of the polarized relay 126. As soon after relay 126 has operated as the interrupter 140 closes its right contacts, a circuit is completed from battery, through the winding of relay 139, right contacts of said interrupter, upper contacts of spring 137, conductor 148, contact of relay 126, upper right contact of spring 127 to ground at spring 125. Relay 139 operates and locks through its winding and inner contact, contact of spring 138 to ground over spring 137 and conductor 148. As soon thereafter as interrupter 140 closes its left contacts, a circuit is completed from battery, through resistance 134, winding of the charge relay 129, upper contacts of spring 136, upper front contact of relay 139, left contacts of interrupter 140 and thence to ground over conductor 148 as above traced. Relay 129 operates and locks in a circuit from its winding and upper contact thence over conductor 143 to ground at sequence switch spring 125. The foregoing operations, including the operation of the line finder F, the sender 131, and the switches S—1 and S—2 may all take place in the manner described in detail in the above-mentioned patents to Kopp and Stearn et al., and particularly in the patent to Kopp.

The called subscriber having answered, the connection is now ready for conversation, and preparation should be made to cause the periodic operation of the calling subscriber's register 102. This is accomplished by substituting the reversing mechanism RV for the direct source of talking current at the back contacts of relay 112. With the relays 129 and 139 actuated, a circuit is closed from battery, through the lower winding of relay 112, contacts of spring 123, conductor 149, lower contacts of relays

129 and 139, springs 138 and 137 and thence to ground over conductor 148 as above traced. The relay 112 energizes and connects the tip and ring conductors 145 and 146 through the impedance coils 108 and 109 and contacts of the reversing relay 107 to battery. This circuit may be traced from conductor 145, through contacts of spring 115, upper left winding of repeating coil 117, upper front contact of relay 112 to the impedance coil 108. The circuit over conductor 146 may be similarly traced through the contacts of spring 116, lower left winding of coil 117, lowermost front contact of relay 112 to the impedance coil 109. The armatures of relay 112 are so adjusted that ground and battery are connected to the calling subscriber's line through resistances 113 and 114 respectively during the brief interval that the uppermost and lowermost armatures of the relay are shifting from their back to their front contacts. This prevents a sudden change of current in the subscriber's line; consequently disagreeable sounds in his telephone receiver are avoided. Relay 107 is periodically operated and released by the constantly-driven interrupter 110 to reverse the direction of current over the line at regular intervals.

When conversation is over, the subscribers replace their receivers on the switch-hooks, and the finder switch F and selector switches S, S-1 and S-2 will restore to their normal positions in the manner described in the above mentioned patents to Kopp and Stearn et al. Should the called party hang up his receiver first and while relay 107 is operated, relay 112 is held operated although its operating circuit is opened by relay 126. The holding circuit may be traced from battery, upper front contact of relay 107, upper contacts and upper winding of relay 112, spring 125 to ground. This prevents false operation of meter 102 should relay 126 be repeatedly operated by the called subscriber's switch-hook or for any other reason.

It will next be assumed that the subscriber of line 100 calls the operator to assist him in establishing a connection with a subscriber whose line must be reached over automatic switches. It will also be assumed that the call is one to which the subscriber is entitled free of charge. The initiation of the call on the line 100 results in the operation of the line finder F and the association of the sender 131 as hereinbefore explained. The subscriber sets up the record of the wanted designation on the sender, and the selector switch S hunts and seizes an idle trunk 202 extending to the operator's position. During the foregoing operations, the sequence switch 130 moves into position 12, and, due to the nature of the designation recorded in the sender, the sequence switch

130 is now driven through positions 13 and 14 and into position 15, which is the position relating to an operator's call. With the sequence switch 130 in position 15, a circuit may be traced from battery, through the winding of relay 206, middle left contacts of relays 205 and 204, brush 120, contacts of spring 118, upper right winding of repeating coil 117, winding of relay 126, contacts of spring 124, lower right winding of coil 117, contacts of spring 119, brush 121, outer left contacts of relays 204 and 205 to ground. The direction of current flow in this circuit is such that the polarized relay 126 does not operate. Relay 206, however, operates and closes a circuit from battery, through its outer contact and the signal lamp 211 to ground. The lamp 211 illuminates to advise the operator that a call is waiting on the trunk 202. Relay 206 also completes a circuit from battery, through its inner contact, winding of slow-release relay 207 to ground. Relay 207 applies ground potential through resistance 212 to the sleeve conductor 260 to maintain the selector switch S busy. Relay 207 also closes a circuit from the tone source 210, interrupter 209, lamp 208, condenser 213, left contact of relay 207, right contact of relay 205 and thence to the tip conductor of the trunk 202. Current flowing over the line from this circuit produces a tone at the subscriber's station to advise him that the operator is being signalled.

The operator responds to the signal by inserting the plug 214 of the cord circuit C in the jack 203. The insertion of the plug closes a circuit from battery through the winding of relay 216, sleeve of the plug and jack, cut-off relay 205 to ground. Relay 205 operates and opens the battery and ground connections to the trunk 202, permitting the relay 206 to release. Relay 206 extinguishes the lamp 211 and opens the circuit of slow-releasing relay 207. Relay 207, however, does not retract its armatures since a substitute holding circuit is provided as will be presently described. Relay 205 operates the relay 204 in a circuit from battery, through the inner left contact of relay 205, winding of relay 204 to ground. Relay 204 operates and locks in a circuit from battery, through its inner left contact and left-hand winding to the grounded conductor 260. Relay 204 closes a holding circuit for relay 207 traceable from battery, through the inner left contact of relay 205, right contact of relay 204, to ground through the winding of relay 207. Relay 205 in operating disconnects the tone source 210 from the trunk 202 notifying the calling subscriber that the operator has answered. The purpose of the relay 204 is to maintain the direction of current flow over the trunk 202 when the relay 206 is subsequently connected

to the trunk and thus avoid false operation of the register 102 as hereinafter explained.

Relay 216 also operates in series with the cut-off relay 205 and in so doing completes the tip conductor through to the repeating coil 217 to include a source of current in the cord circuit in the loop extending to the selector switch S. The circuit for this purpose may be traced from battery, through the resistance 261, supervisory relay 242, outer right back contact of relay 235, lower left winding of repeating coil 217, contacts of key 215, ring of the plug 214 and jack 203, thence over the brush 121 and as previously traced through the winding of the polarized relay 126 and returning over brush 120, through the tip contacts of the jack and plug, contacts of key 215, inner contact of relay 216, upper left winding of repeating coil 217, inner right back contact of relay 235, resistance 262 to ground. The polarized relay 126 operates in this circuit and completes a circuit from battery, through the upper winding of relay 128, right contacts of sequence switch spring 137, closed in position 15, conductor 148, contact of relay 126, through the contacts of springs 127 and 125 to ground. Relay 128 operates and drives the sequence switch 113 out of position 15 and into position 16 by means of the circuit traceable from battery, through the winding of sequence switch magnet 130, spring 142, upper contact of relay 128 to the grounded conductor 143. Relay 128 locks in a circuit from battery, through its lower winding and lower contact, conductor 144, right contacts of sequence switch spring 125, test brush 122 to the grounded sleeve conductor 260. In position 16, the polarized relay 126 and the repeating coil 117 are excluded from the circuit, and the tip and ring conductors of the subscriber's line 100 are extended through the left contacts of springs 115 and 116 respectively, directly through to the tip and ring conductors of the trunk 202. The circuit previously traced for the supervisory relay 242 is thus modified to include the subscriber's loop, and relay 242 remains energized.

When relay 216 operates as above described, it closes a circuit from battery, through the supervisory lamp 227, resistance 228 to ground at the lower contact of said relay. The lamp 227, however, is prevented from illuminating by means of a shunt circuit traceable from ground at the lower contact of relay 216, through the resistances 228 and 229, right contact of supervisory relay 242, right back contact of slow-release relay 241, left normal contact of relay 246 to battery through the right winding of relay 248. The purpose of relays 241, 246 and 248 will be described more in detail hereinafter.

When the operator is ready to converse with the calling subscriber, she actuates the talking key 222, which associates her telephone circuit with the tip and ring conductors of the cord C. The actuation of key 222 also completes a circuit from battery, through the left winding of relay 241 to ground at the contacts of key 222. Relay 241 operates and locks in a circuit from ground, through its right winding and right front contact, right contact of relay 242 to battery through the left contact of relay 241. The operator challenges the calling subscriber and obtains from him the number of the wanted line 257, which, it has been assumed, is to be reached over the trunk 256 and succeeding automatic switches (not illustrated in this drawing). She thereupon inserts the calling plug 226 of her cord circuit in the jack 255 of an idle trunk 256 leading to automatic switches which have access to the called subscriber's line 257. The insertion of the plug in the jack 255 closes a circuit from battery, through the winding of relay 219, winding of relay 218, sleeve of the plug 226 and jack 255 to ground. It will be assumed that the sleeve circuit of the trunk 256 has a high resistance. Therefore, the marginal relay 219 does not operate. Relay 218, however, operates in this circuit and causes the operation of relay 225 in an obvious circuit. Relay 225 closes a break point in the tip conductor. Relay 225 also closes a circuit for the lamp 254 traceable from battery, through said lamp, resistance 252 to ground at the lower contact of said relay.

Next, the operator actuates the dial key 224 to connect the impulse contacts of the dial 250 to the tip and ring conductors of the trunk 256. She thereupon manipulates the dial 250 to send impulses in the well-known manner to set the succeeding switches to seize the called subscriber's line 257. The dial and talking keys having been released, the operator signals the called subscriber by means of her ringing key 223.

During the establishment of the connection, a loop circuit is completed extending over the tip conductor of the trunk 256, through the jack 255 and plug 226, through the inner front contact of relay 225, contacts of keys 224 and 223, upper right winding of repeating coil 217, upper back contact of relay 219, winding of the polarized supervisory relay 221, lower back contact of relay 219, lower right winding of repeating coil 217, thence over the ring side of the loop. The response of the called subscriber causes a reversal of current in this loop which operates the relay 221. The relay 221 closes a circuit from battery, through its contact, through resistances 253 and 252 to ground at the contact of relay 225. This circuit shunts the lamp 254, which extinguishes to advise

the operator that the called subscriber has answered the call.

At the end of conversation the called subscriber replaces his receiver on the switchhook, but it will be assumed that the calling subscriber delays the replacement of his receiver for an interval. The replacement of the called subscriber's receiver results in the release of supervisory relay 221. Relay 221 removes the shunt from lamp 254, and this lamp lights to notify the operator that the called subscriber has replaced his receiver. The operator disconnects by removing the plugs of the cord C from the respective jacks. The removal of the plug 226 opens the circuit of relay 218, and this relay in turn releases the relay 225. The removal of plug 214 from the jack 203 opens the circuit of relays 216 and 205, and these relays release. Relay 205 reconnects the relay 206 to the trunk 202, but in this case the circuit extends from battery, through the winding of relay 206, middle left contact of relay 205, middle left front contact of relay 204, over the ring conductor of the trunk 202, and thence over the calling subscriber's loop 100 and returning over the tip conductor, through the outer left front contact of relay 204 to ground at the outer left back contact of relay 205. The direction of flow of current in this circuit is the same as prevailed during the time the calling subscriber's line was connected to battery through the winding of the relay 242. Accordingly the subscriber's register 102 is not falsely operated. Relays 204 and 207 are now held by the relay 206 in a circuit traceable from battery, through the inner contact of relay 206 and thence in parallel through the winding of relay 207 and through the right contact and right-hand winding of relay 204 to ground. The removal of the plug 214 also results in the release of relays 242 and 241. When the calling subscriber finally replaces his receiver on the switchhook, the relay 206 releases, and after an interval relay 207 retracts its armatures to remove ground potential from the sleeve conductor 260 and to permit the release of relay 204. The removal of ground potential from the conductor 260 results in the release of the selector switch S and the finder switch F.

Assume next that the called line 257 is one that is reached over a trunk extending to a succeeding manual operator's position. Assume also that the sleeve circuit of the trunk extending to the succeeding operator's position, such as the trunk 256, has a relatively low resistance. When, therefore, the operator inserts the plug 226 of the cord C in the jack 255, a circuit is completed over the sleeve contacts for the relays 218 and 219 as hereinbefore described. In this case, however, the resistance of the sleeve circuit being low, the marginal relay 219 operates

with the relay 218. Relay 219 extends the tip and ring conductors of the cord circuit through the windings of relay 220 to battery and ground. Relay 220 operates and shunts the supervisory lamp 254 to extinguish it.

It will be assumed next that the call completed through the operator's cord C is one for which the calling subscriber should be charged. To effect this, the operator throws the charge key 244 after she has determined the nature of the call. Key 244 closes an obvious circuit for relay 243. Relay 243 operates and locks through its winding and left contact to ground at the lower contact of relay 216. When the called subscriber answers, either the relay 221 or the relay 220 operates as above explained, and a circuit is completed from battery, through the contact of the particular one of these relays which is operated, conductor 264, inner right contact of relay 243, winding of relay 245, conductor 265, resistance 252 to ground at the lower contact of relay 225. Relay 245 operates in this circuit. As soon thereafter as the interrupter 231 closes its contact, (said interrupter being constantly driven in synchronism with interrupter 232) a circuit is completed from battery, through the contact of said interrupter 231, lamp 230, normal contacts and winding of slow-release relay 266, inner contact of relay 245, normal contact of relay 235, resistance 262 to ground. Relay 266 operates and locks through its left-hand armature and makes contact. When the interrupter 232 subsequently closes its contact, a circuit is completed from battery, through said interrupter, lamp 267, outer right contact of relay 266, left winding of relay 235, outer contact of relay 245 to ground. Relay 235 operates and locks through its left contact and left winding to ground at the contact of relay 245. The purpose of relay 235 is to disconnect the normal source of talking current and the supervisory relay 242 from the calling subscriber's circuit and to substitute therefor the reversing circuit RV-1 and the auxiliary supervisory relay 236. The substitute circuit for supplying talking current may be traced from the free pole of battery, through the outer left back contact of relay 239, choke coil 237, winding of supervisory relay 236, outer right front contact of relay 235, thence through the lower left winding of the repeating coil 217, over the subscriber's line and returning through the upper left winding of said repeating coil, inner right front contact of relay 235, choke coil 238, right-hand armature and back contact of relay 239 to ground. The relay 239 is repeatedly operated and released at definite periods by the interrupter 240 to reverse the direction of current flow over the

calling subscriber's line to repeatedly operate the register 102 at the substation.

It has been found desirable to use a lower potential for the source of current associated with the reversing circuit than the source normally supplying current from the operator's cord circuit. In view of this difference of potential in the two sources of talking current, it is necessary to employ a separate supervisory relay for each source in order to secure a reliable performance for the supervisory relay under all conditions. This is accomplished by providing the relay 242 for use in series with the normal source of talking current and the auxiliary relay 236 for use in series with the source in the reversing circuit RV—1. The relay 235 in operating, as explained, removes the relay 242 and includes the relay 236 when the reversing battery is connected in circuit.

Should the calling subscriber wish to recall the operator, he may do so by momentarily depressing his switchhook and again releasing it. The depression of the switchhook at the calling station opens the line and releases the answering supervisory relay such as the relay 242. Relay 242 in turn releases the relay 241. When the switchhook is again released to close the line loop, the supervisory relay 242 reoperates and a circuit is closed from battery, through the right winding of relay 248, left normal contacts of relay 246, right back contact of relay 241, contact of relay 242, resistances 229 and 228 to ground at the contact of relay 216. This circuit shunts the lamp 227 and causes the relay 248 to operate. On the next closure of the interrupter 249, a circuit is completed to ground through said interrupter, contact of relay 248, winding of relay 246 to battery. Relay 246 operates and closes a holding circuit for the relay 248 traceable from battery, through the right winding of relay 248, left contacts of relay 246, left winding of relay 248 to ground. Relay 246 at its left contacts opens the previously traced circuit through the right winding of relay 248 in shunt of the lamp 227, allowing the lamp to illuminate. Relay 246 at its right contact closes a circuit for the buzzer 247. When the interrupter 249 opens its contacts, relays 246 and 248 release, and the shunt is again closed around the lamp 227 causing it to extinguish. This flashing of the lamp 227 will continue until the operator manipulates the talking key 222 to operate the relay 241 as hereinbefore explained.

What is claimed is:

1. In a telephone system, a subscriber's line, a message register at the substation responsive to the flow of current in said line, an operator's position, a trunk leading to said position, means for extending the subscriber's line to said trunk, a source normal-

ly connected to said trunk to cause the flow of current in a given direction therein, a cord circuit at the operator's position for making connection to said trunk, a source of current in said cord circuit, means responsive to the connection of said cord to the trunk for disconnecting said first source from the trunk and responsive to the disconnection of said cord for reconnecting said first source to said trunk, means responsive to the connection of said cord to said trunk for extending the talking conductors of said line through to the source of current in said cord, and means for reversing the connection of said first source to cause current to flow in the opposite direction in said trunk when said first source is reconnected thereto.

2. In a telephone system, a subscriber's line, a message register at the substation responsive to the flow of current in said line, an operator's position, a trunk circuit terminating in a jack at said position, a switch for extending the subscriber's line to said trunk, a source normally connected to said trunk to cause the flow of current in a given direction therein, a cord circuit for making connection with said trunk, a source of current in said cord circuit, means responsive to the insertion of the plug of said cord in said jack for disconnecting said first source from the trunk and responsive to the removal of said plug for reconnecting said first source to said trunk, means in said switch responsive to the insertion of said plug in the jack for extending the talking conductors of said line through said switch to the source of current in said cord circuit, and means for reversing the connections of said first source to cause current to flow in the opposite direction in said trunk circuit when said first source is reconnected thereto.

3. In a telephone system, a subscriber's line, a service register responsive to the flow of current in said line, an operator's position, a trunk circuit leading to said position, means for extending the subscriber's line to said trunk, a source normally connected to said trunk to cause the flow of current in a given direction therein, a cord circuit for making connection with said trunk, a source in said cord circuit for causing the flow of current in said trunk circuit in the opposite direction from that normally caused by said first source, means responsive to the connection of said cord with the trunk for disconnecting said first source from the trunk and responsive to the disconnection of said cord for reconnecting said first source to said trunk, means responsive to the connection of said cord to said trunk for extending the talking conductors of said line through to the source of current in said cord, and means for reversing the connections of said first source to cause current to flow in said trunk

in the same direction as that caused by the source in said cord circuit.

4. In a telephone system, a telephone line, a service register responsive to the flow of talking current in said line, a trunk circuit, an automatic switch for extending said line to said trunk circuit, a source normally connected to said trunk to cause the flow of current in a given direction therein, switching means for making connection to said trunk, a source of current in said switching means, means responsive to the connection of said switching means to the trunk for disconnecting said first source from the trunk and responsive to the disconnection of said switching means for reconnecting said first source to said trunk, means effective in response to the connection of said switching means to said trunk for extending the conductors of said telephone line through said automatic switch to the source of current in said switching means, and means for reversing the connection to said first source to said trunk to cause current to flow in the opposite direction in said trunk, when said first source is reconnected thereto.

5. In a telephone system, a telephone line, a message register at the substation responsive to the flow of talking current in said line, an operator's position, a trunk leading to said position, means for extending the telephone line to said trunk, a source normally connected to said trunk to cause the flow of current in a given direction therein, a cord for making connection to said trunk, a source of current in said cord, a circuit established by the extension of said connection to the trunk for the flow of current from said first source, said circuit including said trunk and excluding said telephone line, means responsive to the flow of current in said circuit for signaling the operator, means responsive to the connection of said cord to the trunk for disconnecting said first source from the trunk and responsive to the disconnection of said cord for reconnecting said first source to said trunk, means responsive to the connection of said cord to said trunk for extending the talking conductors of said line through to the source of current in said cord, and means for reversing the connections of said first source to cause current to flow in said line in the same direction as that caused by the source in said cord when said first source is reconnected to the trunk.

6. In a telephone system, a subscriber's line, a message register at the substation responsive to the flow of talking current in said line, an operator's position, a trunk leading to said position, an automatic switch for extending the subscriber's line to said trunk, a source normally connected to said trunk to cause the flow of current in a given direction therein, means responsive to the

normal flow of current in said trunk for holding said automatic switch against release, means responsive to the connection of said cord to said trunk for disconnecting said first source from the trunk and responsive to the disconnection of the cord for reconnecting said first source to said trunk, means responsive to the connection of said cord to said trunk for extending the conductors of said line through said automatic switch to said cord to cause the flow of current from the source in said cord over the conductors of said line, and means responsive to the connection of said cord to said trunk for reversing the connections of said first source to cause current to flow in the opposite direction over said trunk and line when said first source is reconnected to the trunk.

7. In a telephone system, a subscriber's line, a message register responsive to reversals of the flow of talking current in said line, an operator's position, a trunk leading to said position, an automatic switch for extending the subscriber's line to said trunk, a source of talking current associated with said switch, means for periodically reversing the direction of flow of current from said source to operate said message register, a source normally connected to said trunk to cause the flow of current in a given direction therein, a cord circuit for making connection with said trunk, a source of current in said cord circuit, means controlled by said cord circuit for connecting said second source to said trunk and for disconnecting the same from said trunk, means responsive to the connection of said cord to said trunk for extending the conductors of said line through said automatic switch to the source of current in said cord circuit, and means for reversing the connections of the source of current associated with said trunk for causing the flow of current in the opposite direction in said trunk when such source is reconnected thereto.

8. In a telephone system, a subscriber's line, a message register associated with said line and responsive to the flow of current therein, an operator's position, a trunk leading to said position, a cord circuit at said position for making connection with said trunk, a source in said cord circuit for supplying talking current to said line, a supervisory relay in circuit with said source for indicating the condition of the line, a second source associated with said cord for supplying talking current to said line, means for periodically controlling said second source to cause the operation of said message register, a supervisory relay in circuit with said second source, and means for substituting said second source and the associated supervisory relay for said first mentioned source and the associated supervisory relay.

9. In a telephone system, a subscriber's line, a message register at the substation responsive to reversals of current in said line, an operator's position, a trunk leading to said position, a cord circuit at said position
5 for making connection with said trunk, a source associated with said cord for supplying talking current to said line, a supervisory relay in circuit with said source for indicating the condition of said line, a second source
10 for supplying talking current to said line, means for periodically reversing the direction of current from said second source to cause the repeated operation of said message
15 register, a second supervisory relay in circuit with said second source for indicating the condition of said line, and a key at said position for substituting said second source of current and the associated supervisory relay
20 for said first-mentioned source and associated supervisory relay.

10. In a telephone system, a subscriber's line, a message register at the substation responsive to the flow of current in said line,
25 an automatic switch, means for extending the subscriber's line to said switch, a source associated with said switch for supplying current to said subscriber's line, a register sender for controlling the selective operation of
30 said switch to further extend the connection, and means controlled by said register sender in accordance with the nature of the connection being extended, for so controlling the flow of current from said source as to cause
35 the operation of said message register.

11. In a telephone system, a subscriber's line, a register at the substation responsive to reversals of current in said line, an automatic switch, trunks of different classes accessible to said switch, means for extending
40 the subscriber's line to said switch, a source of talking current for supplying said line, a register sender for variably controlling the selective operation of said switch to seize
45 trunks of different classes according to the nature of the call, and means controlled by said register sender in accordance with the nature of the call for causing the periodic reversal of said source of current to repeatedly operate said message register.
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In witness whereof, I hereunto subscribe my name this 18th day of August, 1930.

JOHN W. GOODERHAM.

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