

Aug. 10, 1943.

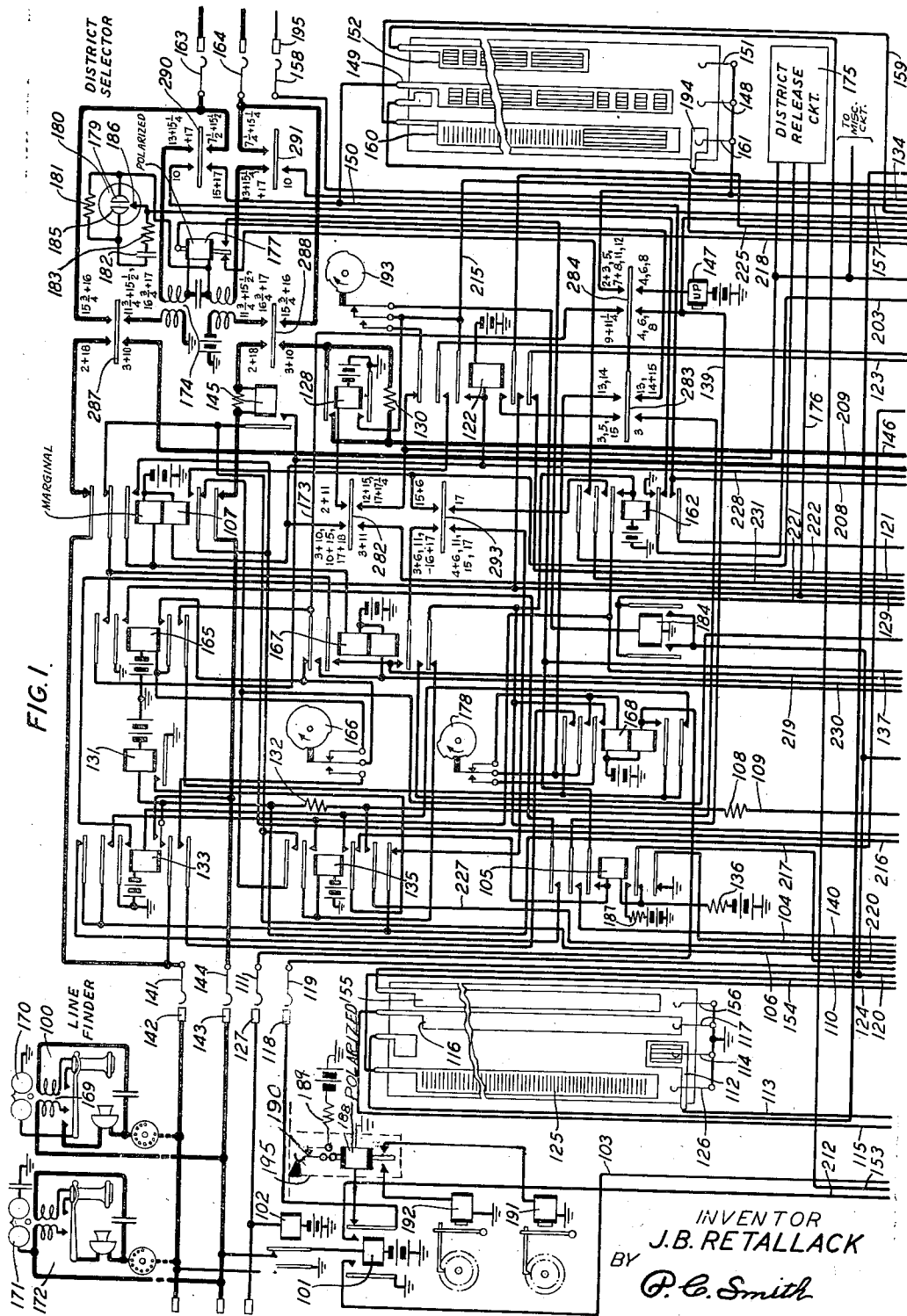
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2,326,679

PARTY LINE TELEPHONE SYSTEM

Filed July 11, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

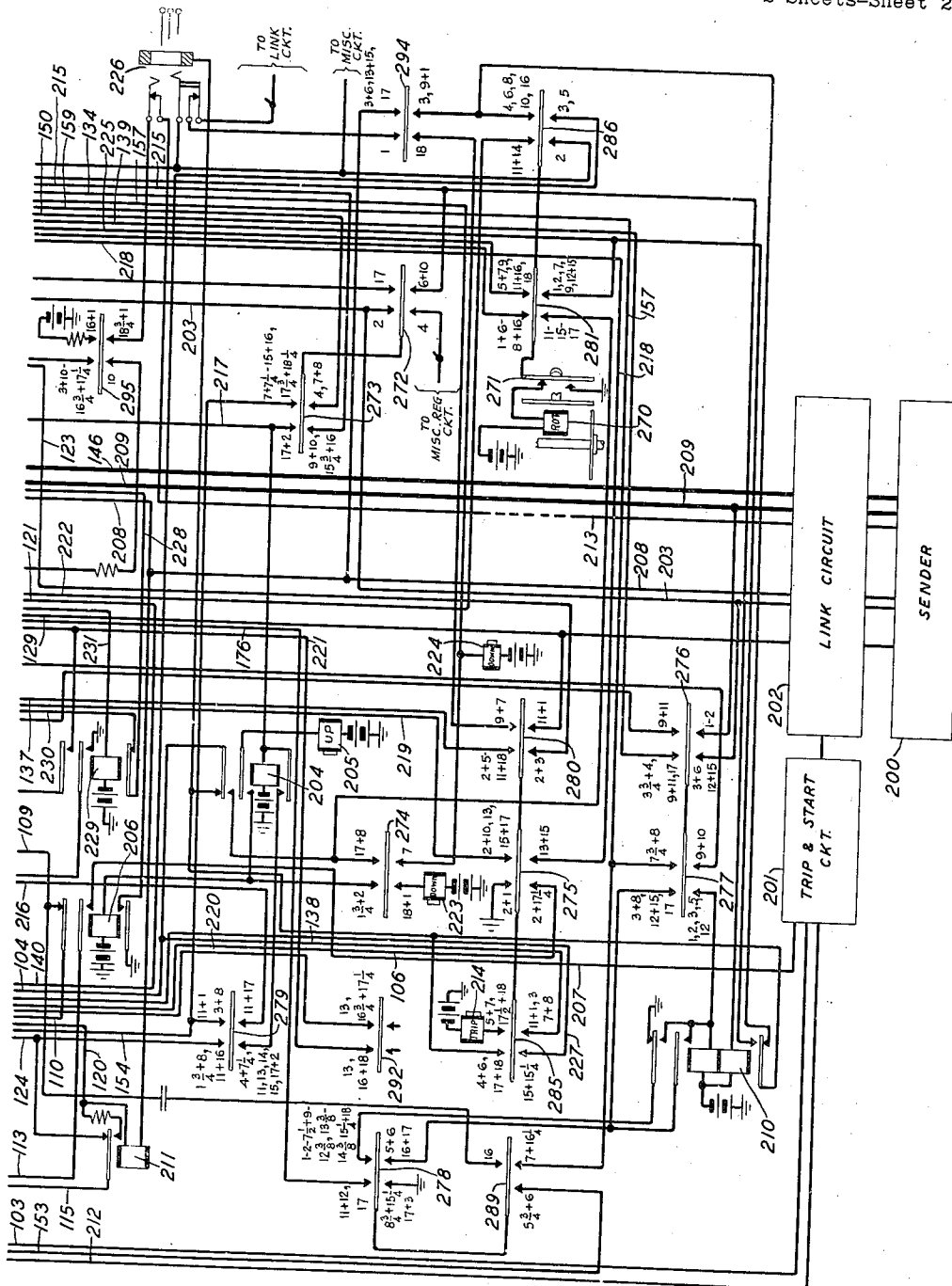


FIG. 2

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2,326,679

PARTY LINE TELEPHONE SYSTEM

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Application July 11, 1940, Serial No. 344,896

5 Claims. (Cl. 179-8.5)

This invention relates to a telephone system and more particularly to a system having party lines in which one or more charges are automatically assessed against the calling subscriber for each completed call.

The object of the invention is to simplify the means whereby the message registers allocated to party line subscribers may be selectively operated in accordance with which subscriber on the party line has initiated a call.

It has heretofore been the usual practice as disclosed, for example, in Patent No. 1,696,275 granted December 25, 1928, to L. H. Johnson and A. E. Hague to select one or the other of two message registers allocated to the subscribers' substations on a two-party line for operation, dependent upon whether the cut-off relay of the line is held operated or is released at the time metering takes place. In systems of this type since the metering takes place only upon the termination of the call, the release of the cut-off relay to enable the selective operation of one of the message registers does not result in any undesirable operating condition. If, however, metering is to be controlled at definite intervals during the continuance of the conversation as has been proposed and disclosed in Patent No. 2,214,809 of H. C. Caverly granted Sept. 17, 1940, it is necessary to maintain the cut-off relay operated until the connection is released at the termination of the conversation and it is therefore essential that a different means for selecting the message register allocated to the calling party be provided.

In accordance with the present invention message register selection is accomplished by the provision of a polarized relay for each two-party line which has two circuit controlling positions and a neutral position. This relay is operable over the usual meter control circuit extending over the metering brush of the line finder to one or the other of its circuit controlling positions, dependent upon the polarity of the metering current applied to such circuit as determined by the party line subscriber who initiated the connection. In one of its circuit controlling positions the relay closes the operating circuit of the message register allocated to one of the party line substations and in the other of its circuit controlling positions closes the operating circuit of the message register allocated to the other of the party line substations. Impulses for controlling this relay may be transmitted at any time during the continuance of the conversation or a single impulse may be transmitted upon the ter-

mination of the conversation depending upon the type of connection which is established.

To enable the message register selecting relay to be adjusted without danger of falsely operating one of the message registers controlled thereby, the relay is provided with a pair of contact springs included in the operating circuit of both registers which are normally closed when the usual dust cover is in position on the relay but which open when the dust cover is removed for the inspection or maintenance of the relay. A relay of this type is disclosed in Patent No. 2,275,145 granted March 3, 1942, to H. C. Harrison.

For a clearer understanding of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawings in which:

Figs. 1 and 2 when placed with Fig. 2 beneath Fig. 1 disclose a two-party subscriber's line, a line finder having access thereto, a district selector paired with such line finder by means of which connections may be extended from the subscriber's line and schematic representations of a trip and start circuit, a link circuit and a sender.

The invention has been embodied in a disclosure which is substantially like that of Patent No. 1,696,275 hereinbefore referred to. The trip and start circuit, schematically indicated by the box 201, and the link circuit, schematically indicated by the box 202, may be similar to the similar circuits disclosed in the patent above referred to and the sender, indicated by the box 200, may be of the type disclosed in Patent No. 1,862,549 granted June 14, 1932, to R. Raymond and W. J. Scully. The sequence switch cams disclosed in both figures of the drawings are positioned on the same shaft and are driven from a power shaft under the control of magnet 270 and for convenience of reference will be designated with numerals 271 to 295, inclusive. When the line finder is idle and preselected for use the sequence switch stands in a position to render circuits extending over its No. 2 contacts effective.

It will first be assumed that the subscriber at substation 100 removes his receiver from the switchhook to initiate a call thereby closing a circuit from battery through the winding of line relay 101, inner left contact of cut-off relay 102, over the line loop through substation 100 to ground at the outer left contact of relay 102. Relay 101 upon operating closes a circuit from ground over its left contact and conductor 103 for operating a relay (not shown) in the trip and start circuit 201 which, through a preselected idle link circuit 202 is effective in closing the

circuit of the start relay 204 of an idle preselected line finder assumed to be the line finder disclosed. This circuit may be traced in part over conductor 203, the upper left contact of cam 272 and the upper left contact of cam 273 through the winding of relay 204 to battery.

Relay 204 upon operating closes a circuit for the up-drive magnet 205 of the line finder which extends from battery through the winding thereof, the inner upper front contact of relay 204, the upper contacts of cam 274, the upper front contact of relay 204, conductor 104 to ground at the lower back contact of relay 105 and a circuit in parallel therewith through the winding of relay 206 to battery. Relay 206 upon operating disconnects ground applied over the left contacts of cam 275, over conductor 106, the inner lower back contact of relay 107, through resistance 103, over conductor 109, the upper back contact of relay 206 and conductor 110 to sleeve brush 111 of the line finder during the hunting movement of the line finder; connects the line-finder commutator segment 112 over conductor 113, the upper front contact of relay 206 and conductor 207 to the trip and start circuit 201, and at its lower front contact connects ground to the ring fundamental circuit conductor 208 extending to the link circuit for causing the link circuit to start hunting for an idle sender, assumed to be the sender 200, and to operate a relay in the start circuit 201 which opens the operating circuit of relay 204 and prevents the start circuit from operating on another call until the line-finder brushes have become tripped. When the link circuit advances into the position for hunting for an idle sender, it grounds conductor 209 thereby completing a circuit over the lower right contact of cam 276 and the lower left contact of cam 277 to battery through the upper winding of relay 210 whereupon relay 210 operates and locks from battery through its upper winding and upper front contact to ground over the upper right and lower left contacts of cam 278.

Up-drive magnet 205 upon operating causes the line-finder elevator rod to be driven upwardly and in the first part of its movement to trip the set of brushes of the line finder having access to the particular group of lines in which the calling line is located as determined by the trip and start circuit 201. After the brushes have been tripped, ground is applied over commutator brush 114 to commutator segment 112 and thence over the circuit previously traced to the trip and start circuit 201 which causes the release of the operated trip magnet. Relay 204 is now held operated in a circuit from battery through its winding and over its lower front contact, the left contacts of cam 279, the back contact of relay 211, conductor 115, commutator trip 116 and brush 117 to ground. When the line finder finds the calling line terminals, battery supplied from the trip and start circuit 201 and connected over conductor 212 and the right front contact of line relay 101 to bank terminal 118 individual to the calling line, becomes connected over brush 119 of the line finder and conductor 120 through the winding of relay 211, thence over conductor 121, the lower back contact of relay 122, conductor 123, the lower left contact of cam 280 and the upper left contact of cam 275 to ground, whereupon relay 211 operates opening the previously traced locking circuit of relay 204. Relay 204, however, remains operated over another locking circuit extending as previously traced over the

left contacts of cam 279, thence over conductor 124, the centering commutator strip 125 and brush 126 of the line finder to ground until the tripped brush set has been centered upon the terminals of the calling line, whereupon relay 204 releases in turn releasing relay 206 and the up-drive magnet 205. At the time relay 211 operated a relay in the trip and start circuit 201, also operated to release the trip and start circuit.

With relay 204 released and relay 210 operated a circuit is established for advancing the sequence switch out of position 2 into position 3 which circuit may be traced from ground on conductor 104, over the upper back contact of relay 204, the lower front contact of relay 210, over the lower right contact of cam 281 and the upper contact of cam 271 through the magnet winding 270 to battery. After the sequence switch advances from position 2 into position 3 the locking circuit of relay 210 is opened and this relay releases. With relay 206 released the previously traced circuit from ground over the left contacts of cam 275 through resistance 103 to sleeve brush 111 is closed at the upper back contact of relay 206 whereby busy ground potential is applied to sleeve terminal 127 of the calling line to mark the line as busy and to operate the calling line cut-off relay 102 thereby releasing line relay 101. The release of relay 101 releases relay 211 in the line finder.

With the sequence switch in position 3 battery is connected through the winding of relay 128 and the upper right contact of cam 282 and through the lower winding of relay 107, and the upper left contact of cam 282, thence over the lower left contact of cam 282 and conductor 129 through the link circuit to the sender 200 which causes the sender to function to remove battery from conductor 213. Relay 128 also operates but relay 107 being marginal does not operate at this time. Relay 128 upon operating short-circuits resistance 130 for a purpose to be later described and supplies a locking ground for relay 122 if such relay should be operated on an early disconnect. A circuit is also closed at this time from battery through the winding of relay 131, through resistance 132 which preferably is wound as a non-inductive winding on relay 133, lower left contact of cam 283, upper right contact of cam 284, conductor 134, upper right contact of cam 280 to ground at the upper left contact of cam 275. If relay 131 fails to operate the call is blocked and a stuck sender signal is given. If relay 131 operates it closes a circuit from ground over its contact, the inner lower back contact of relay 135 through the winding of relay 105 and resistance 136 to battery whereupon relay 105 operates and locks over its inner upper front contact, conductor 137, the upper left contact of 280 to ground at the upper left contact of cam 275 and prepares a circuit for advancing the sequence switch out of position 3 into position 4. Relay 210 now reoperates over a circuit from ground through the winding of the stepping relay of the sender 200, through the link circuit over the tip fundamental circuit conductor 203, the lower left contact of cam 276 and the lower left contact of cam 277 to battery through the upper winding of relay 210 and locks to conductor 203 over its inner upper front contact, the upper left contact of cam 277 and the lower left contact of cam 276. With relays 210 and 105 both operated the sequence switch is now advanced into position 4 over a circuit extending from ground over the upper left contact

of cam 275, the lower right contact of cam 285, conductor 138, upper back contact of relay 204, lower front contact of relay 210, conductor 139, middle upper front contact of relay 105, conductor 140, lower right contact of cam 286, upper contact of cam 271 to battery through sequence switch magnet 270. After the sequence switch leaves position 4, relay 210 remains locked to the tip fundamental circuit conductor 203.

In the meantime, following the advance of the sequence switch into position 3, the calling line has become associated with the sender over a dialing circuit, the subscriber has received the usual dialing tone from the sender and has proceeded to dial the digits of the wanted line number. The dialing circuit may be traced in part over conductor 209, left contacts of cam 287, upper back contact of relay 107, tip brush 141 of the line finder, tip terminal 142 of the calling line, through the substation 109, ring terminal 143 of the calling line, ring brush 144 of the line finder, lower back contact of relay 107 through the winding of supervisory relay 145, left contacts of cam 288, upper contact of relay 128 to conductor 146.

With relay 210 operated and the sequence switch in position 4, the circuit of the up-drive magnet 147 of the district selector is established from battery through the winding of magnet 147, over the lower contacts of cam 284, conductor 139, lower front contact of relay 210, upper left contact of cam 285 to ground at the upper left contact of cam 275 and the elevator rod of the district selector is driven upwardly in a brush selection movement whereby the sender stepping relay is intermittently shunted and the relay 210 is held operated in a circuit extending from ground, over the upper left contact of cam 275, the upper right contact of cam 280, conductor 134, commutator brush 148, conducting segments of commutator strip 149, conductor 150 and the upper left contact of cam 276 to a point between the winding of relay 210 and the winding of the sender stepping relay. As soon as the sender stepping relay has received sufficient shunting impulses to satisfy the sender for the district brush registration, the fundamental circuit is opened at the sender thereby releasing relay 210 as soon as brush 148 has advanced into engagement with the next insulating segment of commutator strip 149.

Relay 210 upon releasing opens the circuit of up-drive magnet 147 to arrest the brush selection movement of the district selector elevator rod and closes a circuit for advancing the sequence switch out of position 4 into position 5 which latter circuit may be traced from ground over the upper left contact of cam 275, the upper left contact of cam 285, the lower back contact of relay 210, the upper right contact of cam 286, the upper contact of cam 271 to battery through the winding of magnet 270. As soon as the sequence switch reaches position 5, the circuit of trip magnet 214 is established over the upper right contact of cam 285 and the upper left contact of cam 275 and the previously traced fundamental circuit is closed through the upper winding of relay 210 and the winding of the sender stepping relay. Relay 210 upon operating locks as previously described to the fundamental circuit and establishes the previously traced circuit for advancing the sequence switch out of position 5 into position 6.

With relay 210 operated and the sequence switch in position 6, the previously traced cir-

cuit of up-drive magnet 147 is closed whereby the elevator rod of the district selector is driven upwardly in a group selection movement. During the first part of the group selection movement, the selected set of brushes is tripped and thereafter as the commutator brush 151 engages successive conducting segments of commutator strip 152, the sender stepping relay is intermittently shunted down and relay 210 is held operated, over a circuit extending from ground over the upper left contact of cam 275, the upper right contact of cam 280, conductor 134, brush 151, commutator strip 152, conductor 153, left contact of cam 289, lower right contact of cam 273 to a point between the winding of relay 210 and the winding of the sender stepping relay. As soon as the sender stepping relay has received sufficient shunting impulses to satisfy the sender for the district group registration, the fundamental circuit is opened at the sender thereby releasing relay 210 as soon as brush 151 has advanced into engagement with the next insulating segment of commutator strip 152.

Relay 210 upon releasing opens the circuit of up-drive magnet 147 to arrest the group selection movement of the district selector elevator rod and closes the previously traced circuit for advancing the sequence switch out of position 6 into position 7. When the sequence switch reaches position 7 a circuit is established from battery through the lower winding of relay 210, lower right contact of cam 272, upper right contact of cam 273, conductor 154, commutator strip 155 of the line finder to ground over commutator brush 156 whereupon relay 210 operates and closes a circuit for advancing the sequence switch into position 8. This circuit may be traced from ground over the upper left contact of cam 275, the lower right contact of cam 285, conductor 138, the upper back contact of relay 204, the lower front contact of relay 210, the lower right contact of cam 281, and the upper contact of cam 271 to battery through the winding of magnet 270.

As soon as the sequence switch reaches position 7 3/4 a locking circuit is established for relay 210 if the first trunk of the selected group upon the terminals of which the district selector brushes are now standing is busy. This circuit may be traced from battery through the upper winding and inner upper front contact of relay 210, the upper contacts of cam 277, conductor 157 and the district selector sleeve brush 158 to busy ground on the sleeve terminal of the busy trunk. If the first trunk is busy and relay 210 is thus locked operated, when the sequence switch reaches position 8 the previously traced circuit for up-drive magnet 147 is established to drive the elevator rod of the district selector upwardly in a trunk hunting movement, relay 210 being held operated over the locking circuit just traced so long as the sleeve brush 158 encounters the sleeve terminals of busy trunks. During the intervals that sleeve brush 158 is passing between sleeve terminals, relay 210 is held operated in a circuit through its lower winding, the lower right contact of cam 272, the lower right contact of cam 273, conductor 159, centering commutator strip 160, brush 161, conductor 134, upper right contact of cam 280 to ground at the upper left contact of cam 275. When an idle trunk is found, relay 210 releases due to the absence of ground on the sleeve terminal of such trunk as soon as the brushes become centered upon the terminals of such trunk and commutator brush

164 leaves the next conducting segment of the centering commutator strip 160.

Relay 210, upon releasing, opens the circuit of up-drive magnet 147 to arrest the further hunting movement of the district selector and establishes the previously traced circuit for advancing the sequence switch from position 8 into position 9. As soon as relay 210 releases, the selected trunk is made busy by the application of busy ground to the sleeve terminal 195, thereof over a circuit from ground at the upper back contact of relay 210, the upper right contact of cam 278, the lower right contact of cam 289, and conductor 157, the sleeve brush 158 and terminal 195, and when the sequence switch reaches position 9 busy ground is applied to the circuit just traced over the lower left contact of cam 278. In position 9 of the sequence switch, relay 210 is reoperated in a circuit extending from battery through its lower winding, the lower right contact of cam 272, the lower left contact of cam 273, conductor 215 to ground at the lower front contact of relay 128 and establishes a circuit for advancing the sequence switch out of position 9 into position 10 which circuit may be traced from battery through the winding of magnet 270, the upper contact of cam 271, the lower right contact of cam 281, the lower front contact of relay 210, the upper back contact of relay 204, conductor 164 to ground at the lower back contact of relay 105, which relay released when the sequence switch advanced out of position 5. In position 10 of the sequence switch, relay 210 remains operated over the operating circuit therefor just traced.

With the sequence switch in position 10, the fundamental circuit conductors 203 and 208, extending through the link circuit 202 to the sender 200 are connected to the tip and ring conductors of the seized trunk, conductor 203 being connected over the lower back contact of relay 162, the upper left and lower right contacts of cam 290, and tip brush 163 to the tip conductor of the trunk and conductor 208 being connected over the lower and upper right contacts of cam 291 and ring brush 164 to the ring conductor of the trunk. Other selector switches are now controlled over the fundamental circuit to complete the connection to the wanted line in the well-known manner. When such selector switches have been completely set, the sender 200 increases the resistance on the conductor 129 in the circuit of relay 128 whereupon this relay releases in turn releasing relay 210. Relay 210, upon releasing now establishes a circuit for advancing the sequence switch out of position 10 into position 11, which may be traced from battery through the winding of magnet 270, the upper contact of cam 271, the upper right contact of cam 285, the lower back contact of relay 210, the upper back contact of relay 204, conductor 104 to ground at the lower back contact of relay 105. At its upper contact, relay 128 removes the short circuit from resistance 130 in the dialing loop extending to the sender, thereby reducing the current through the subscriber's loop to reduce the click received by the subscriber when battery is removed by the advance of the sequence switch out of position 10 and the loop is thereby opened at the left contacts of cams 287 and 288.

Party line station test

With the sequence switch in position 11, the circuit of relay 165 is closed from battery there-through over the right contacts of interrupter 166 as soon as such contacts close, the upper back

contact of relay 167, conductor 173, the upper contacts of cam 284, conductor 134, the upper right contact of cam 280 to ground at the upper left contact of cam 275. Relay 165 upon operating locks over its inner lower front contact, over the upper back contact of relay 167, and thence to ground on conductor 173; closes the circuit of relay 133, extending from battery through the winding thereof, the lower back contact of relay 168, the lower front contact of relay 165, to ground on conductor 173 and closes the circuit of relay 122, extending from battery through the winding thereof, the upper front contact of relay 165, the inner upper back contact of relay 107, conductor 216, the right contacts of cam 279, conductor 154, line-finder commutator strip 155 and brush 156 to ground. With relay 133 operated, the winding of relay 131 is connected over the inner lower front contacts of relay 133 and the tip and ring brushes 141 and 144, of the line finder to the tip and ring conductors of the calling line and, since the substation 100 has been assumed to be calling, the ring conductor is at this time connected through the left winding of induction coil 169, and a switchhook contact through the bell 170 to ground and the tip conductor is connected through the dial contacts, transmitter and a switchhook contact to ground through the bell 170. Relay 131 will therefore operate in turn causing the operation of relay 105 which locks over its inner upper front contact, conductor 137, the upper left contact of cam 280, and the upper left contact of cam 275 to ground. With relay 133 operated, when interrupter 166 closes its left contact, a circuit is closed from ground connected over conductor 173 and the upper back contact of relay 167 to the middle contact of interrupter 166, over the left contact thereof, the lower front contact of relay 133, to battery through the lower winding of relay 168 which relay thereupon operates and locks over its lower front contact and the lower front contact of relay 165 to ground on conductor 173. The time between the closure of the right and left contacts of interrupter 166 is sufficient to permit relay 131 to operate and in turn to cause the operation of relay 105 as previously described in case the substation 100 having a grounded ringer or bell is calling.

Relay 105 upon operating connects ground to the tip conductor of the calling line to prevent the inductive discharge from the substation bell 170 from causing the tapping of bell 171 of the substation 172 when the test battery through the winding of relay 131 is removed upon the subsequent release of relay 133. This ground is applied over the inner upper front contact of relay 165, the upper front contact of relay 105, the inner lower front contacts of relay 133, tip brush 141 and thence to the tip conductor of the line. Relay 168 upon operating opens the circuit of relay 133 at its lower back contact thereby disconnecting relay 131 from the calling line, whereupon relay 131 releases. With relays 165 and 168 operated and relay 133 released, a circuit is established from battery through the winding of relay 204, conductor 217, upper back contact of relay 133, upper front contact of relay 168 and the lower front contact of relay 165 to ground on conductor 173. Relay 204 upon operating closes a circuit for advancing the sequence switch out of position 11 into position 12 which may be traced from battery through the winding of magnet 270, upper contact of cam 271, lower

left contact of cam 281, upper front contact of relay 204, conductor 138, lower right contact of cam 285 to ground at the upper left contact of cam 275. As soon as the sequence switch leaves position 11 $\frac{1}{4}$, the circuit, over which ground was applied to conductor 173, is opened at the upper left contact of cam 284 thereby releasing relays 165 and 168 which were locked thereto and in turn releasing relay 204.

When the sequence switch reaches position 12, the tip conductor of the calling line is connected over tip brush 141, the upper back contact of relay 107 and the upper left and lower right contacts of cam 287 to ground through the upper left winding of repeating coil 174 and the ring conductor of the line is connected over ring brush 144, the lower back contact of relay 107, through the winding of supervisory relay 145 and over the upper contacts of cam 288 to battery through the lower left winding of repeating coil 174, whereby the calling line is supplied with talking current and the supervisory relay 145 is held operated. With relay 145 operated, a holding circuit is supplied for relay 122 over the front contact of relay 145, conductor 216, the right contacts of cam 279 to ground supplied to conductor 154 over the commutator strip 155 and brush 156 of the line finder to maintain relay 122 operated following the release of relay 165. If relay 133 should fail to release, or the sequence switch fail to advance out of position 11, a time alarm signal is given at the district release circuit 175 by the connection of ground over the inner upper front contact of relay 133 or the left contacts of cam 278 to conductor 176 extending to the release circuit.

In position 12 of the sequence switch a circuit is closed from battery through the upper winding of relay 210, the lower left contact of cam 277 and the lower left contact of cam 276 to ground over the tip fundamental circuit conductor 203 supplied through the winding of the stepping relay of the sender. Relay 210 upon operating locks over its inner upper front contact, the upper left contact of cam 277 and the lower left contact of cam 276 to the fundamental tip conductor after the sequence switch advances out of position 12 following the operation of relay 210 over a circuit extending from ground at the upper left contact of cam 275, the lower right contact of cam 285, conductor 138, upper back contact of relay 204, lower front contact of relay 210, lower right contact of cam 281, upper contact of cam 271 to battery through the winding of sequence switch magnet 270. As the sequence switch advances from position 12, ground is intermittently connected over the lower left and upper right contacts of cam 278 and the upper front contact of relay 210 to a point between the winding of relay 210 and the winding of the sender stepping relay whereby the sender stepping relay is intermittently shunted down and relay 210 is held operated. When the sender stepping relay has been shunted down a sufficient number of times to satisfy the sender with respect to its talking selection registration, the fundamental circuit is opened at the sender thereby releasing relay 210 and opening the circuit of magnet 270 of the sequence switch which will therefore be arrested in one of the talking selection positions 13, 14 or 15. It will be assumed that the sequence switch is stopped in position 13 which is the position employed on a call requiring remote control of registration.

Remote control registration

When the called subscriber answers, a circuit is established which may be traced in part over the tip brush 163 of the district selector, right contacts of cam 290, upper right winding of repeating coil 174, winding of polarized relay 177, lower right winding of repeating coil 174, upper contacts of cam 291 to the ring brush 164 whereupon relay 177 operates from talking battery supplied at the remote end of the called trunk and closes a circuit from ground over the upper left and lower right contacts of cam 275, conductor 216, right contact of relay 177, right contacts of cam 283, to the armature contact of interrupter 178 and thereafter when this contact makes with its right contact to battery through the upper winding of relay 168. Relay 168 thereupon operates and locks over its middle upper front contact to its operating circuit independent of the contacts of interrupter 178 and prepares a circuit which is effective as soon as the interrupter closes its left contact which may be traced from ground applied to the armature contact of the interrupter over the left contact thereof, the inner upper front contact of relay 168, through the winding of charge relay 162 to battery and in parallel therewith over the lower back contact of relay 167 to battery through the winding of auxiliary charge relay 135. Relay 162 operates and locks over its inner upper front contact, conductor 219 and the upper contacts of cam 275 to ground and relay 135 upon operating locks over its inner upper front contact to ground on conductor 219.

To cause the registration of a charge for the initial period of conversation or after a time interval in the case of an overtime charge, the remote control registration point, such as the tandem office to which the seized trunk may be extended and which tandem office may be of the type disclosed in the patent granted to H. C. Caverly, hereinbefore referred to, replaces the talking battery on the trunk by which polarized relay 177 has been operated with high voltage positive battery on both the tip and ring conductors of the trunk with a difference of potential between the tip and ring conductors so as to hold relay 177 operated during the control of registration. This battery is applied over tip wiper 163, the right contacts of cam 290, through the upper right winding of repeating coil 174, through the winding of relay 177 to the right cathode 179 of the gas-filled tube 180 and through resistance 181, condenser 182, resistance 183 to ground through the winding of relay 184 and also in parallel over ring wiper 164, the upper contacts of cam 291, the lower right winding of repeating coil 174, and thence as traced to ground through the winding of relay 184. This battery causes condenser 182 to charge and when it becomes fully charged, the potential on the left cathode 185 of the tube will be raised to such an extent that the tube will break down across its cathode gap and allow current to flow from its cathode 179 across its cathode-anode gap to the anode 186 and thence to ground through the winding of relay 184 thereby operating this relay. Since relay 185 is at this time operated to register the fact that substation 100 on the party line has initiated the call, when relay 184 operates a circuit is established from positive battery through resistance 187, the lower front contact of relay 105, conductor 220, the contacts of cam 292, conductor 221, the contacts of relay 184, conductor 120, brush 119, the back contact of line

relay 101 to ground through the winding of polarized relay 188.

Relay 188 in response to the energization of its winding will, with current of positive polarity, operate its armature to the right thereby closing a circuit from battery through resistance 189, dust cover contacts 190 normally closed when the dust cover 195 indicated by dotted lines is in place over the relay 188, right contact of relay 188 to ground through the winding of message register 191, allocated to substation 100. Removal of the positive battery from the trunk outgoing from the district selector and the reconnection of talking battery thereto at its distant end causes tube 180 to become extinguished thereby releasing relay 184 which in turn releases polarized relay 188 and releases the message register magnet 191 to charge a call unit against the party line subscriber at station 100. Subsequent operations of tube 180 and relays 184 and 188 will in the same manner cause the message register 191 to charge further units against the party line subscriber during the continuance of the conversation.

At the end of the conversation when the calling subscriber restores his receiver to the switch-hook, relay 145 releases followed by the release of relay 122 as soon as the contacts of interrupter 193 open and remove ground over conductor 137 from a holding circuit therefor. With relay 122 released, when interrupter 193 closes its outer contacts, a circuit is established for relay 107 from battery through its lower winding, the upper left and lower right contacts of cam 282, the upper back contact of relay 122, the contacts of interrupter 193 to ground on conductor 137. Relay 107 upon operating closes a locking circuit through its upper winding and the upper winding of relay 137 in parallel over the inner upper front contact of relay 107, conductor 136 to ground over the left contacts of cam 275 thereby causing relay 167 to operate, opens the talking circuit over its outer back contacts and closes a circuit for advancing the sequence from position 13 into position 15. This circuit may be traced from ground on conductor 106 over the lower front contact of relay 107, conductor 222, the upper left contact of cam 285 and the upper contact of cam 271 to battery through the winding of sequence switch magnet 270. Relays 135 and 152 release as soon as the sequence switch advances out of position 13 and disconnects locking ground from conductor 219 at the upper right contact of cam 275. Relay 135 upon releasing opens at its upper front contact the circuit over which busy potential was applied to the sleeve 127 of the calling line following the operation of relay 107 whereupon cut-off relay 102 releases restoring the calling line to its normal condition.

With relay 107 operated and relay 135 released, and the sequence switch in position 15, a circuit is established from battery through the winding of relay 204, conductor 217, the lower back contact of relay 135, the lower left and upper right contacts of cam 293, the lower front contact of relay 107 to ground on conductor 106 which causes relay 204 to operate and close the circuit extending from ground over the upper left contact of cam 275, the lower right contact of cam 285, conductor 133, the upper front contact of relay 204, the lower left contact of cam 281 and the upper contact of cam 271 to battery through the winding of magnet 270 for advancing the sequence switch out of position 15 into position 16. When the sequence switch leaves position 15, relay 204 releases and closes a circuit from ground

on conductor 133 over its upper back contact, the lower back contact of relay 210, the upper right contact of cam 296, the upper contact of cam 271 to battery through the winding of magnet 270 for advancing the sequence switch out of position 16 into position 17. Upon reaching position 17, relay 204 reoperates over conductor 217, the lower back contact of relay 135, the lower left and upper right contacts of cam 293, the lower front contact of relay 107 to ground on conductor 133, locks over its lower front contact, the lower left and upper right contacts of cam 279, conductor 154 to ground over commutator segment 155 and brush 158 of the line finder and closes a circuit for advancing the sequence switch from position 17 into position 18. This circuit may be traced from ground on conductor 133 over the upper front contact of relay 204, the lower left contact of cam 281, over the upper contact of cam 271 to battery through the winding of magnet 270.

In position 18 of the sequence switch and with relay 204 operated, a circuit is established from ground on conductor 133, over the upper front contact of relay 204 and the upper right and lower left contacts of cam 274 to battery through the winding of down-drive magnet 223 of the line finder. As soon as the line-finder elevator rod has been driven downwardly into its normal position, brush 156 leaves commutator strip 155 thereby releasing relay 204 to open the circuit of down-drive magnet 223. Also in position 18, a circuit is closed from ground over the upper left contact of cam 275, upper left contact of cam 285, lower back contact of relay 210, lower contacts of cam 294 to battery through the down-drive magnet 224 of the district selector whereby the district selector elevator rod is driven downwardly into its normal position. Upon reaching its normal position, brush 161 engages the normal commutator segment 194 thereby closing a circuit from ground over the upper left contact of cam 275, the upper right contact of cam 280, conductor 134, brush 161, segment 194, conductor 225, the upper right contact of cam 281 and the upper contact of cam 271 to battery through the winding of magnet 270, for advancing the sequence switch into position 1. When the sequence switch leaves position 18, operated relays 195, 107 and 167 release and the line finder and district selector are rendered selectable for another call. Other switching apparatus employed in the establishment of the connection is restored in the well-known manner. The line finder and district selector are now marked as idle by the connection of battery through a resistance over the right contacts of cam 295, the upper normal contacts of make busy jack 226, to test conductor 213.

Had the call been initiated by the subscriber at substation 172, then when relay 131 was connected to the tip and ring conductors by the operation of relay 133, with the sequence switch in positions 11 and 12 as previously described, it would not have been operated since the substation 172 has its bell 171 connected to ground through a condenser. Relay 105 is not therefore operated and consequently when relay 184 is thereafter operated to cause charges to be applied for the call, negative battery is connected through resistance 136 over the lower back contact of relay 105 and thence as previously traced to ground through the winding of polarized relay 188 to cause relay 188 to close its left contact

thereby causing the operation of message register 192 allocated to substation 172.

Local charge call

For a local charge call the circuit will function as previously described up to the time that the sequence switch is advanced out of position 12 for talking selection and relay 105 will be operated and locked up if the tip party at said station 100 has initiated the call or relay 105 will not be operated if the ring party at substation 172 has initiated the call. For a local charge call the sequence switch will be advanced into the talking position 14 in response to the talking selection control from the sender. When the called subscriber answers, relay 177 will operate causing the operation of relays 168, 162 and 135 under the control of interrupter 178 as previously described. Relay 168 locks under the control of relay 177 and relays 135 and 162 lock over conductor 219 and the upper contacts of cam 275 until the sequence switch has advanced out of position 17.

When the calling subscriber hangs up his receiver at the end of the conversation, relay 145 releases followed by the release of relay 122 whereupon relays 107 and 167 operate under the control of interrupter 193 as previously described, relay 107 upon operating advancing the sequence switch into position 15. With the sequence switch in position 15 and relay 135 operated a circuit is established from battery through the winding of relay 131, resistance 132, the lower front contact of relay 135, conductor 227, the lower left contact of cam 285 to ground at the upper left contact of cam 275. Relay 131 thereupon operates in turn closing a circuit extending from battery through the winding of relay 133 and the inner lower front contacts of relay 135 to ground at the contacts of relay 131. The winding of relay 131 is now connected over the inner lower contacts of relay 133 to the tip and ring conductors of the calling line to determine if the line is free from ground as it should be since the calling subscriber has restored his receiver to the switchhook. Relay 133 also closes a circuit for relay 204 extending from battery through the winding thereof, over conductor 217, the upper front contact of relay 133, conductor 219 to ground over the upper contacts of cam 275 and relay 204 thereupon operates and closes a circuit from ground on conductor 138 over its upper front contact, the lower left contact of cam 281 and the upper contact of cam 271 to battery through the winding of magnet 270 for advancing the sequence switch into position 16. When the sequence switch leaves position 15½, the circuit of relay 131 is opened at the lower left contact of cam 285 and relay 131 releases if no ground was found on the line, in turn releasing relay 133 followed by the release of relay 204. Relay 204 upon releasing establishes the previously traced circuit for advancing the sequence switch out of position 16 into position 17. In positions 16 and 17 of the sequence switch, relay 122 is operated in a circuit from battery through its winding, over conductor 228, the back contact of relay 229, conductor 229, inner lower front contact of relay 157, upper contacts of cam 293, inner lower front contact of relay 107 to ground on conductor 106.

It will be first assumed that the call was made from the tip substation 100 and that therefore relay 195 was operated and locked. When the sequence switch reaches position 17, a circuit is established from ground on conductor 106, inner

lower front contact of relay 107, right contacts of cam 293, middle upper front contact of relay 162, conductor 231 to battery through the winding of relay 229. Relay 229 operates and connects positive battery through resistance 187, the lower front contact of relay 105, conductor 220, the upper contacts of cam 292, the upper front contact of relay 229, conductor 120, brush 119, terminal 118, back contact of line relay 101 to ground through the winding of polarized relay 188, thereby operating message register 191. Relay 229 upon operating also releases relay 122. From this point the connection is released in the manner previously described.

Had the call been made from the ring party substation 172, the circuit would have functioned in the same manner except that on the party test made with the sequence switch in positions 11 and 12, relay 105 would not have been operated and consequently when the sequence switch reached position 17 and relay 229 operated, a circuit would have been completed from negative battery through resistance 136 over the lower back contact of relay 105, conductor 220, upper contacts of cam 292, upper front contact of relay 229, conductor 120, thence as traced to ground through the winding of polarized relay 188 whereby such relay would have been operated in such a direction as to close the circuit of message register 192.

What is claimed is:

1. In a telephone system, a line, two subscribers' stations connected thereto, a message register individual to each of said stations, an operating circuit for each of said message registers, a polarized relay selectively operable to close the circuit of either message register, a circuit for said relay and means for applying operating current of either polarity to said latter circuit for operating said relay, whereby the circuit of either one of said message registers is closed.

2. In a telephone system, a line, two subscribers' stations connected thereto, a message register individual to each of said stations, an operating circuit for each of said message registers, a polarized relay selectively operable to close the circuit of either message register, means operable following the initiation of a call from said line for testing said line to determine from which station the call was initiated, an operating circuit for said relay and means for applying operating current of either positive or negative polarity to said latter circuit under the control of said testing means for operating said relay whereby the circuit of the message register individual to the calling station is closed.

3. In a telephone system, a line, two subscribers' stations connected thereto, a message register individual to each of said stations, an operating circuit for each of said message registers, a polarized relay selectively operable to close the circuit of either message register, means for extending a connection from said line to a wanted line, means operable following the initiation of a call from said calling line for testing said calling line to determine from which station the call was initiated, an operating circuit for said relay and means operative following the response of the called subscriber for applying operating current of either positive or negative polarity to said latter circuit under the control of said testing means for operating said relay, whereby the circuit of the message register individual to the calling station is closed.

4. In a telephone system, two subscribers' sta-

tions, connected thereto, a message register individual to each of said stations, an operating circuit for each of said message registers, a polarized relay selectively operable to close the circuit of either message register, means for extending a connection from said line to a wanted line, means operable following the initiation of a call from said calling line for testing said calling line to determine from which station the call was initiated, an operating circuit for said relay, and means operative following the response of the called subscriber and upon the restoration of the calling subscriber's receiver to the switchhook for applying operating current of either positive or negative polarity to said latter circuit, under the control of said testing circuit for operating said relay, whereby the circuit of the message register individual to the calling station is closed.

5. In a telephone system, a line, two subscri-

ers' stations connected thereto, a message register individual to each of said stations, an operating circuit for each of said message registers, a polarized relay selectively operable to close the circuit of either message register, means for extending a connection from said line to a wanted line, means operable following the initiation of a call from said calling line for testing said calling line to determine from which station the call was initiated, an operating circuit for said relay, and means operative at predetermined intervals following the response of the called subscriber and during the continuation of the connection for applying operating current of either positive or negative polarity to said latter circuit, under the control of said testing means for operating said relay, whereby the circuit of the message register individual to the calling station is closed.

JOHN B. RETALLACK.