

Sept. 15, 1931.

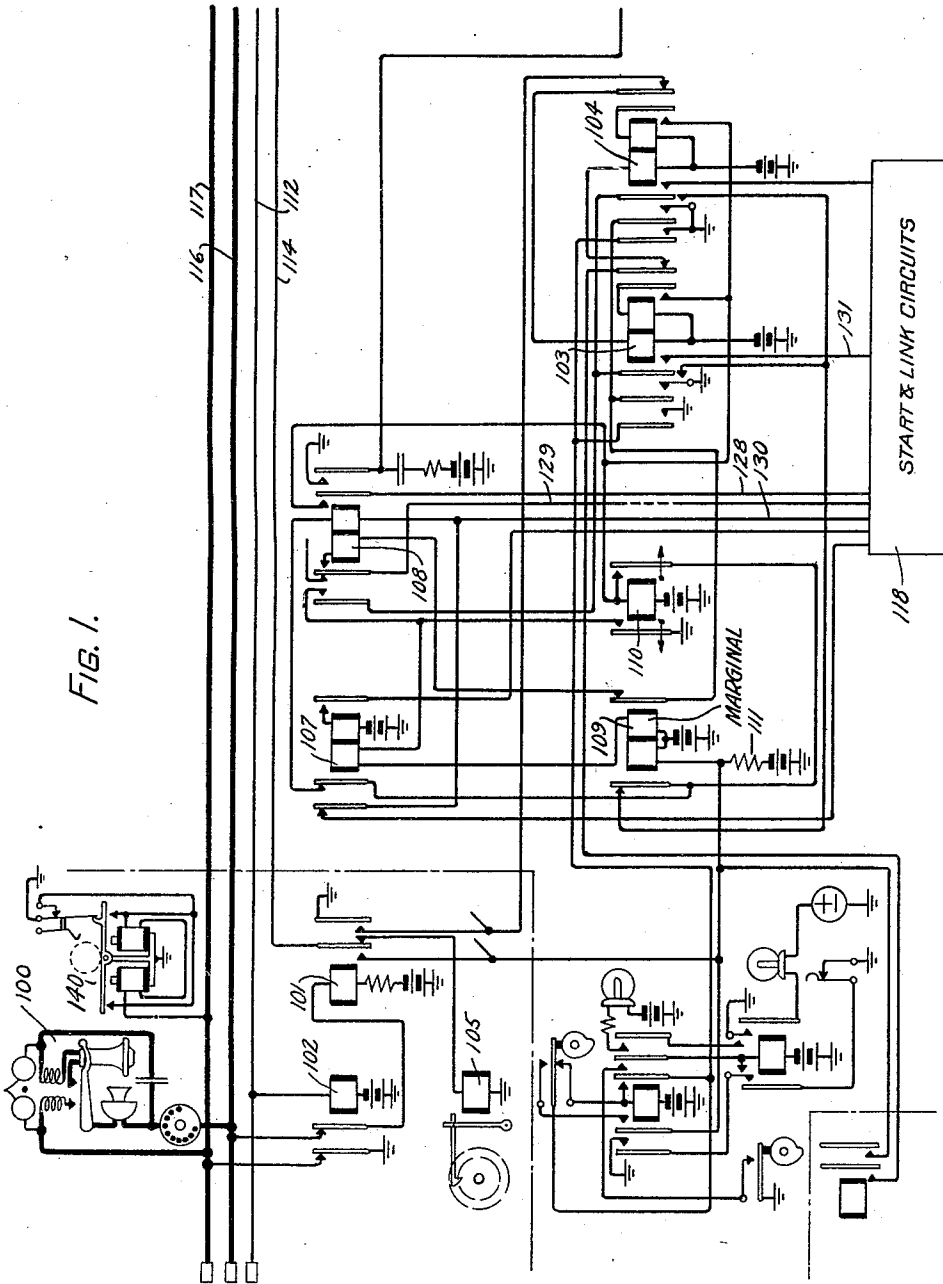
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1,823,679

CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed July 29, 1930

6 Sheets-Sheet 1



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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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6 Sheets-Sheet 2

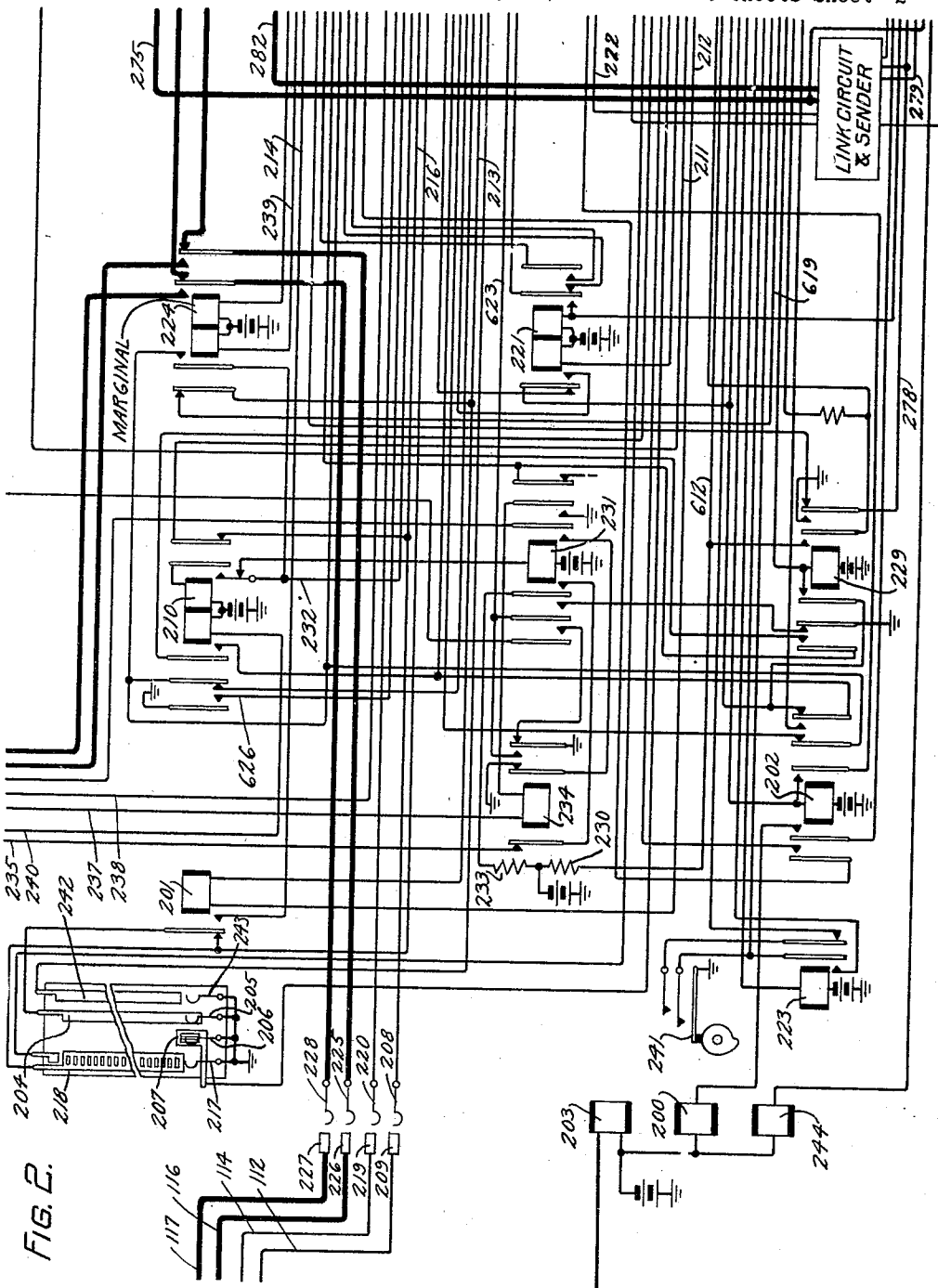


FIG. 2.

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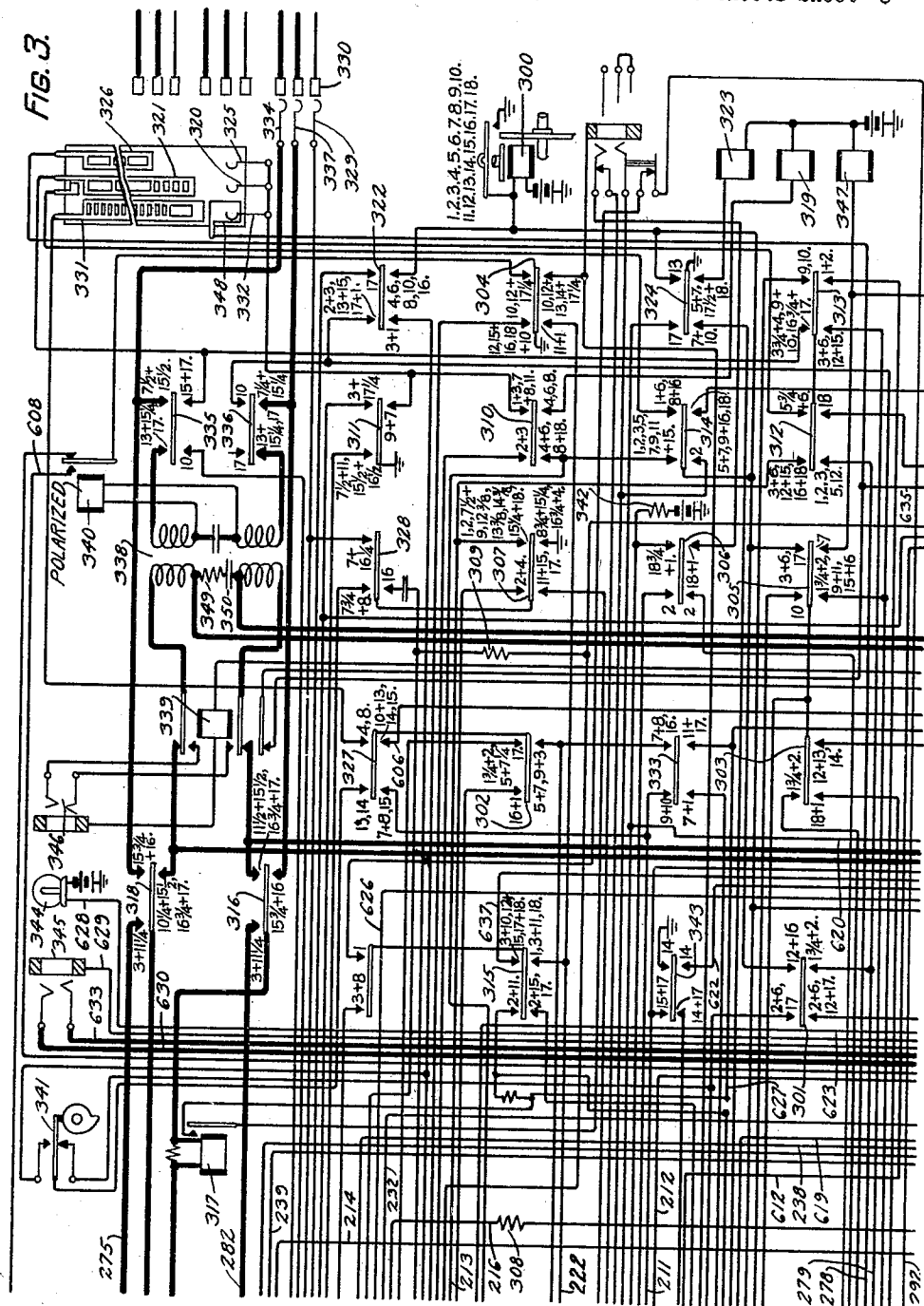
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6 Sheets-Sheet 3



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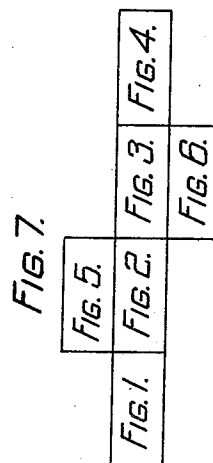
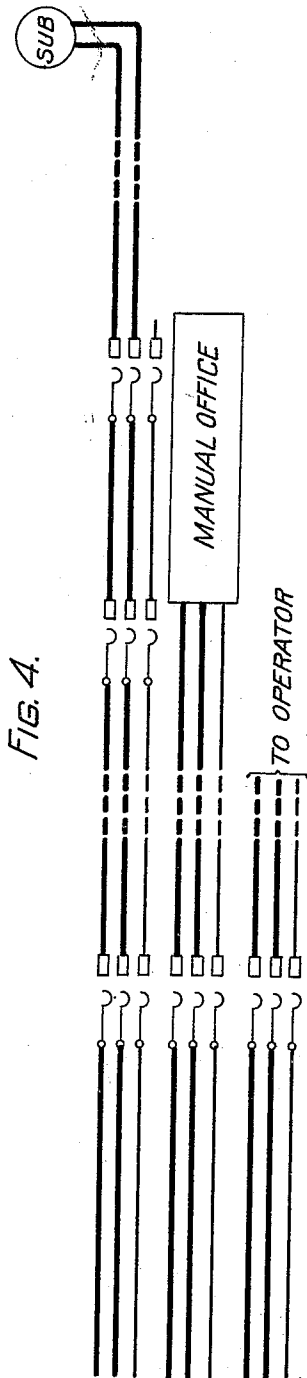
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6 Sheets-Sheet 4



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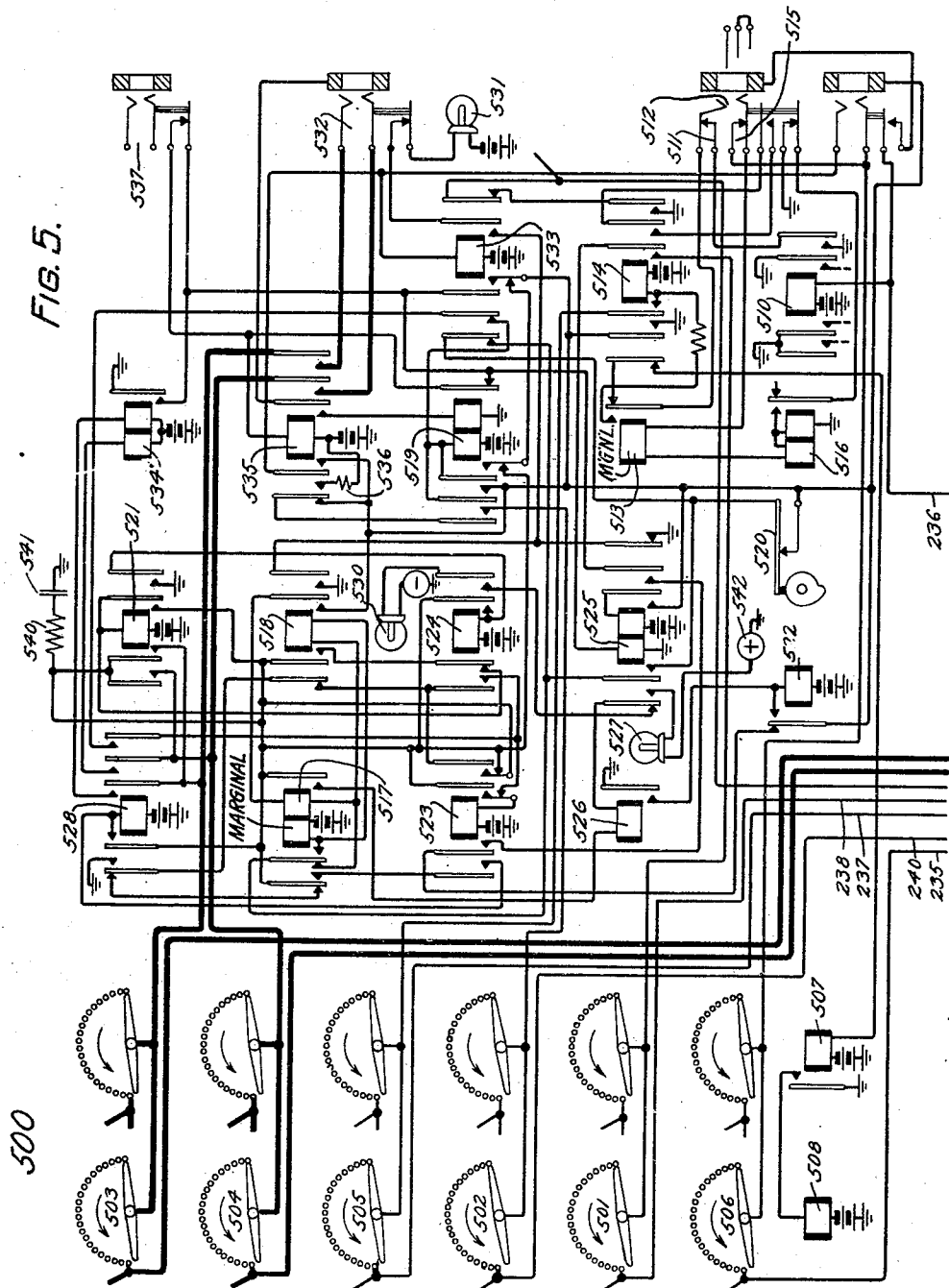
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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Filed July 29, 1930

6 Sheets-Sheet 5



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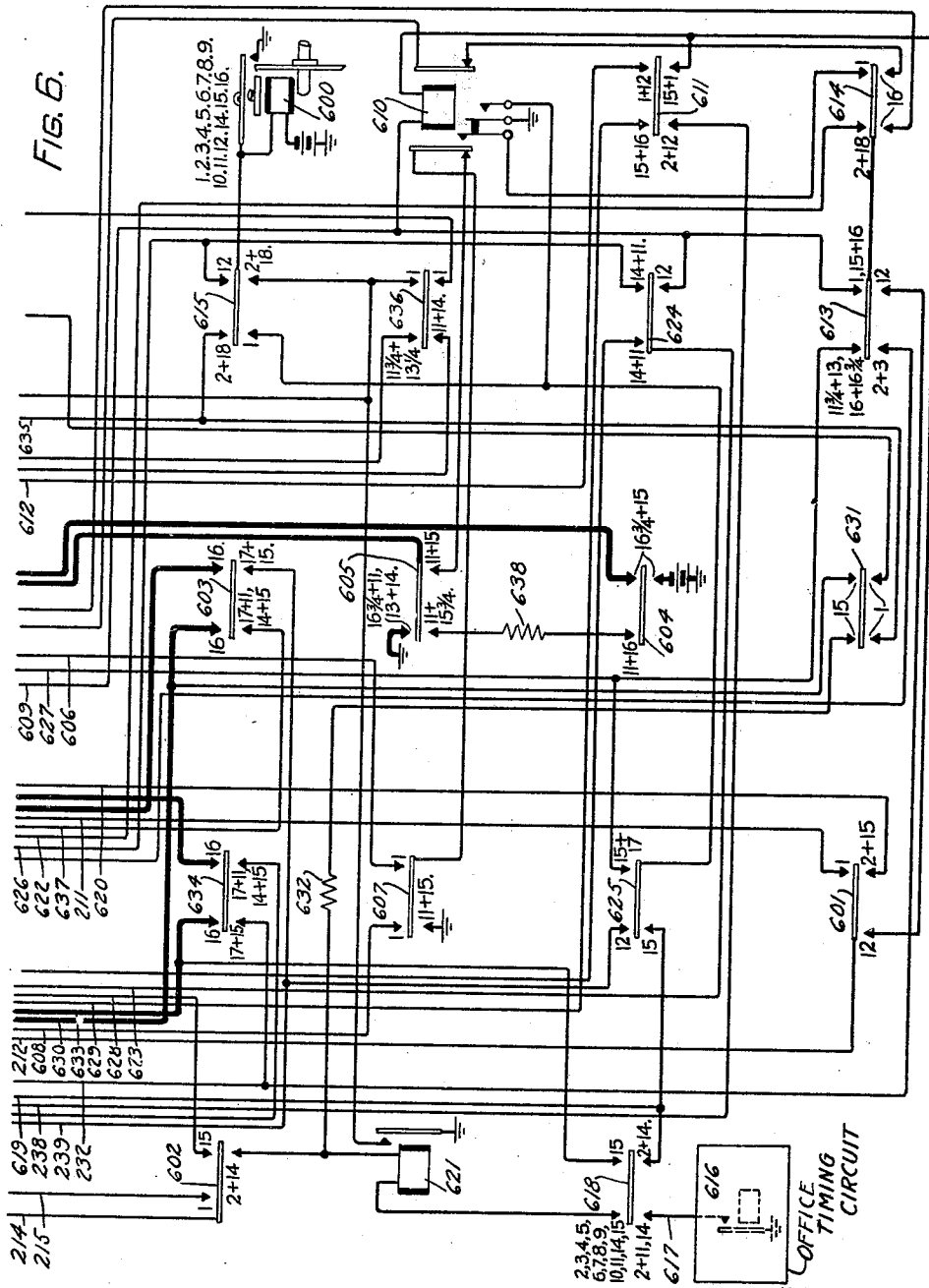
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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

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6 Sheets-Sheet 6



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CALL CHARGING TELEPHONE EXCHANGE SYSTEM

Application filed July 29, 1930. Serial No. 471,447.

This invention relates to telephone exchange systems and more particularly to systems in which automatic switches are employed in the establishment of connections and in which charges are assessed for calls by means of coin boxes associated with the substations of calling lines. The object of the invention is to enable the operation of the coin box of a calling line for collecting deposited coins at intervals during the continuance of a conversation with little annoyance to the connected subscribers and without destroying the connection.

In the panel type system calling lines are connected to the switches of the first selection stage, commonly called district selectors, over line finders which are paired in links with such district selectors. Talking battery is supplied to the calling line through the primary windings of a repeating coil in the link, the secondary windings of the coil being connected over the brushes of the district selector and a trunk circuit to the primary windings of a second repeating coil associated with an incoming selector at a subsequent switching stage.

When the calling lines are equipped with coin boxes and it is desired to charge for successive periods of conversation during the duration of a conversation, it becomes necessary at intervals to open the talking path between the calling line and the repeating coil of the district link and to connect a source of coin collecting battery to both sides of the calling line in parallel for the purpose of collecting deposited coins. It has been found from experimentation that if the circuit between the calling substation and the source of talking battery at the repeating coil of the district link is broken abruptly, that a very annoying click is produced in the receiver of the calling subscriber and that a surge of current is induced through the secondary windings of the repeating coil, which not only produces an annoying click in the called subscriber's receiver, but also in some cases causes the release of the incoming selector and thereby the disruption of the established connection.

In addition it is desirable to connect an

operator to the district link after the collection of the coin for any unit period of conversation to enable the operator to ascertain if the calling subscriber desires to continue the conversation for an additional unit period and to instruct him to deposit an additional coin if he desires to continue the conversation. The connection of the operator also tends to establish current surges which produce clicks in the operator's headset of an annoying character.

In accordance with the present invention means have been provided to lessen these clicks to such a degree that they do not annoy the subscribers or the operator and do not interfere with the maintenance of the established connection. The invention, one embodiment of which has been disclosed by way of illustration, is incorporated in a system which provides a timing switch individual to the district link which is started upon the response of the called subscriber and advances through a cycle to measure the prescribed unit period of conversation. A plurality of coin box control circuits common to a group of links is provided each equipped with apparatus for applying coin box operating current to the coin box of a calling line and each having individual thereto a hunting switch for associating the control circuit with a link.

The timing circuit is arranged to close a start circuit for all idle coin control circuit switches just prior to the completion of its timing cycle for causing the association of an idle control circuit with the link. The first idle control circuit switch to find the link is arrested and the hunting switches of other control circuits are stopped. Upon the association of the control circuit with the link, the calling line is disconnected from the repeating coil of the district link and connected to the control circuit whereby coin collecting current is transmitted from the control circuit to the coin box of the calling line for collecting the deposited coin. As soon as the coin has been collected the control circuit is dismissed and as the timing switch of the link continues its cycle a lamp is lighted at an operator's position to inform

her that the initial period of conversation is about completed.

The operator thereupon plugs a cord circuit of her position into a jack of the link for the purpose of determining if the calling subscriber desires to continue the conversation for an overtime period. If the subscriber intimates that he desires to so continue by depositing an additional coin, the operator then disconnects and the timing switch advances through another cycle, again causing the association of a control circuit with the link for the collection of the deposited coin. The circuits then continue to function in this manner as long as the calling subscriber desires to maintain the connection and deposits a coin for each overtime period of conversation.

In order that the dissociation of the calling line from the talking battery source and the connection of the line to the source of coin collecting current in the control circuit may not create annoying disturbances, the timing device is arranged to cause the sequential insertion of a resistance into the talking circuit extending through the primary windings of the repeating coil and the source of talking current between the primary windings of the repeating coil, the disconnection of the ground terminal of the talking battery from the repeating coil, the opening of both conductors of the calling line from the terminals of the repeating coil and the connection of both line conductors to the source of coin collecting current. By thus sequentially changing the character of the connection between the calling substation and the district link, the connected subscribers are not annoyed and no surges of a character to destroy the established connection are produced.

The timing switch is also arranged to perform a similar sequence of operations at the time the operator is connected to the link, that is, the resistance is first connected into the talking circuit between the primary windings of the repeating coil, the operator is signaled and after she plugs her headset into the monitoring jack the ground terminal of the talking battery is disconnected from the repeating coil of the link, the talking battery is disconnected and then her headset is connected to the calling line on the calling side of the repeating coil whereby the operator is connected to the calling line without receiving any annoying clicks at the time such connection is made, and no surges of current of a character to destroy the established connection are produced.

A clearer understanding of the purpose and scope of the invention will be obtained from a consideration of the following description in connection with the attached drawings in which:

Fig. 1 shows one of a group of subscri-

ers' lines together with the trip circuit serving the group and a start and link circuit serving the group indicated by the rectangle in the lower right portion of the figure;

Figs. 2 and 3 taken together show a line finder-district selector link circuit for extending a connection from a calling line, Fig. 2 showing the line finder and the representation of a link circuit and sender shown diagrammatically by the small rectangle, and Fig. 3 showing the district selector together with a sequence switch for controlling the circuits of the line finder and district selector;

Fig. 4 shows in diagrammatic form the switches necessary to establish connections from the district selector;

Fig. 5 shows one of a plurality of coin box control circuits;

Fig. 6 shows a timing circuit individual to the line finder district selector link circuit of Figs. 2 and 3; and

Fig. 7 is a diagram showing the manner in which the several figures of the drawings should be arranged to show the complete circuits of the invention.

Subscribers' lines, such as line 100, are connected to multiple terminals appearing before a plurality of line finders. These multiple terminals are arranged in a plurality of groups, each group being served by a separate brush set on each line finder and each group being divided into two subgroups. A trip circuit is provided individual to each group, a start circuit for all the groups of lines served by the group of line finders and a plurality of link circuits for each group of lines and line finders. Inasmuch as the operation of the start circuit and a link circuit is well known in the art and a disclosure thereof is not essential to a complete understanding of the present invention, the circuits of the start circuit and link have not been disclosed therein but have been indicated by small rectangles in Figs. 1 and 2. For a detailed description of these circuits, reference may be had to Patent No. 1,690,206, granted to A. Raynsford on November 6, 1928.

In general, when a call is initiated by a subscriber in a particular group, the trip circuit individual to the group and the start circuit are taken for use by that line and means are provided for preventing the extension of a call in the other subgroup of the group or in any other group until the line finder has been started in search of this calling line. Means are also provided for preventing the extension of a second call in this group until after simultaneous call in other groups have been taken care of. The operation of the start circuit causes the line finder associated with the link circuit allotted for use to hunt for the calling line and also causes the link circuit to hunt for an idle

sender. As soon as a particular link is taken for use with a call, the next link is allotted to serve the next initiated call in the particular subgroup which it serves. As soon as a brush set on the line finder has been tripped, the start circuit will be freed to permit the extension of calls in other groups. As soon as the line has been found, the trip circuit of the group is freed by the line finder to extend another call in the same group provided no call is awaiting extension in another group. When selections are completed the sender and link circuit are released by the district selector circuit and the link circuit immediately hunts for another idle district selector.

Inasmuch as the sender performs no functions in connection with the present invention which are not well known in the art, the detailed circuits of the sender have not been disclosed herein but have been indicated by the small rectangle in Fig. 2. For a complete disclosure of a sender which may be employed, reference may be had to the patent to O. H. Kopp No. 1,589,402, granted June 22, 1926, or to the application of A. E. Hague, Serial No. 472,998, filed Aug. 4, 1930, in which a sender of the type disclosed in the patent to O. H. Kopp has been disclosed in connection with circuits of the same character as are disclosed herein.

Extension of a local connection

When the subscriber at substation 100 moves his receiver from the switchhook, a circuit is closed for line relay 101 extending from battery through that relay, inner contact of relay 102, over the line loop to ground at the outer contact of relay 102. Relay 101 operates and closes a circuit from battery, through the left winding of relay 103, right back contact of relay 104 to ground at the outer contact of relay 101 and at its inner front contact connects battery through resistance 111 and the left winding of relay 109 in parallel to conductor 114 to mark the line as calling.

The operation of relay 103 opens at its right back contact the operating circuit of relay 104 which serves the second subgroup of the group to which line 100 belongs, thus preventing the extension of a connection from that subgroup, while the trip circuit is being used with line 100. At its middle left front contact relay 103 establishes a circuit for the trip relay 108 extending from battery in the start circuit 118 over conductor 130, right winding of relay 108, inner left back contact of relay 107, left back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 108 operates and locks to battery through the winding of a relay (not shown) in the start circuit 118 over conductor 129, back contacts of relays similar to relay 108 individual to

other subgroups of lines appearing before the same line finder, inner left front contact and left winding of relay 108, right back contact of relay 109 to ground at the middle left front contact of relay 103. Relay 108 at its outer right front contact establishes a circuit for operating the trip magnet 203 of the line finder of Fig. 2. The relay in the start circuit operates in the locking circuit of relay 108 and in combination therewith closes a circuit from ground over conductor 123, the inner right front contact of relay 108 to battery through the winding of relay 110. Relay 110 operates and locks over its right front contact, the left back contact of relay 109 to ground at the middle left contact of relay 103 and at its left front contact establishes a circuit for starting an allotted line finder.

Assuming that the link circuit 118 and the line finder of Fig. 2 are to be used next, sequence switch 300 will be standing in position 2. The operation of relay 110 will therefore close a circuit from ground at its left contact, outer left contact of relay 108, the inner left front contact of relay 103, conductor 131, thence through the link circuit to conductor 278, the lower right and upper left contacts of cam 301 to battery through the winding of relay 202. Relay 202 in operating closes a holding circuit for itself over its inner right front contact, the lower and upper right contacts of cam 302, the back contact of relay 201 to ground over commutator segment 204 and brush 205, and at its inner left front contact establishes a circuit for the updrive magnet 200 of the line finder extending over the upper contact of cam 303, outer right front contact of relay 202 to ground at the upper left contact of cam 304. The line finder moves upwardly under the control of magnet 200 and since trip magnet 203 is operated, the proper set of brushes is tripped. As soon as commutator brush 206 engages segment 207 a circuit is established from ground on brush 206, left contacts of cam 306, through the link circuit to conductor 129. This circuit shunts the winding of relay 108 and causes that relay to release, in turn, releasing the trip magnet 203. When the line finder brush 208 makes contact with terminal 209 which is connected to conductor 114 and therefore to battery, a circuit is completed from this battery over conductor 216, outer right back contact of relay 210, conductor 211, upper contact of cam 601, conductor 212, winding of relay 201, conductor 213, upper left and lower right contacts of cam 307 to ground. Relay 201 operates in this circuit and closes a shunt around its winding from ground on brush 205, segment 204, front contact of relay 201, conductor 214, left contact of cam 602, conductor 215, resistance 308, conductor 216 to brush 208.

This reduces the resistance in series with the winding of marginal relay 109 sufficiently to cause that relay to operate and to open the locking circuit of relay 110. The operation of relay 201 also opens the locking circuit previously traced for relay 202 and relay 202 releases as soon as the line finder brushes are centered on the calling line terminals when commutator brush 217 will be in engagement with an insulating portion of segment 218. The release of relay 202 opens the circuit of updrive magnet 200 and establishes the circuit of cutoff relay 102 from battery, through the winding of relay 102, conductor 112, terminal 219, brush 220, resistance 309, outer left back contact of relay 210, middle right back contact of relay 202, upper contacts of cam 310 to ground at the lower contact of cam 311. The operation of cutoff relay 102 opens the circuit of line relay 101 removing battery from conductor 114, thereby releasing relays 109 and 201.

At the time relay 202 operated it closed a circuit from ground at the upper left contact of cam 304, over the outer right front contact of relay 202, lower left contact of cam 305, conductor 279, to the link circuit for advancing the link circuit sequence switch into position 2 for causing the sender selector of the link circuit to hunt for an idle sender. After an idle sender is found, the link circuit sequence switch advances to position 3 and connects the selected sender with the line finder-district selector link circuit of Figs. 2 and 3. With the sequence switch of the link circuit in position 2, ground is connected to conductor 275, thereby establishing a circuit for relay 221 from battery through the right winding of relay 221, lower left contact of cam 312, lower right contact of cam 313 to grounded conductor 275. When relay 202 releases as above described, with relay 221 operated, a circuit is closed for advancing sequence switch 300 into position 3 which may be traced from battery, winding of magnet 300, upper left contact of cam 314, left front contact of relay 221, outer right back contact of relay 202 to ground at the upper left contact of cam 304. As sequence switch 300 advances from positions 2 to 3, relay 221 releases. From positions 3 to 17¼ the calling line cut-off relay 102 is maintained operated over terminal 219, brush 220, resistance 309, the left back contact of relay 210 to ground at the upper right contact of cam 311.

When the link sequence switch reaches position 3 a circuit is closed from ground through a relay in the sender over conductor 222, lower right and upper left contacts of cam 315 to battery through the winding of relay 223 and in parallel therewith over the upper right contact of cam 315, lower con-

tacts of cam 603, conductor 239 to battery through the left winding of relay 224. Relay 224 is marginal and does not operate and relay 223 although operating is not effective at this time. The relay in the sender prepares the circuits of the sender for receiving impulses to be dialed by the calling subscriber and advances the link sequence switch to position 5, in which position it remains until the sender has completely established the desired connection.

As soon as the link sequence switch arrives in position 2¾ a dialing circuit is established from the calling substation 100 to the selected sender which may be traced in part from battery through the impulse receiving relay of the sender (not shown) over conductor 282, left contact of cam 316, winding of relay 317, outer right back contact of relay 224, brush 225, terminal 226, line conductor 116, substation 100 of the calling line, line conductor 117, terminal 227, brush 228, inner right back contact of relay 224, left contact of cam 318, conductor 275 to ground at the sender. The calling substation receives the usual dial tone over this circuit from the sender to indicate that the sender is ready to receive dial impulses. The subscriber now dials the number of the wanted subscriber and the sender registers are set thereby to register the digits of the wanted line number. As soon as the first two or office code digits are registered, the translator of the sender is set and a fundamental switch controlling circuit is established from the sender to the district selector of Fig 3. This circuit may be traced in part from battery through the right winding of relay 221, lower left contact of cam 312, lower left contact of cam 313, conductor 278 to the sender through the impulse control relay (not shown) of the sender to ground.

Relay 221 and the sender control relay operate in this circuit, relay 221 locking over its inner right front contact, the upper left contact of cam 312 to the fundamental circuit and closing a circuit from battery, winding of sequence switch magnet 300, upper left contact of cam 314, left front contact of relay 221, the outer right back contact of relay 202 to ground at the upper left contact of cam 304. Magnet 300 operates and advances the sequence switch into position 4 in which position the energizing circuit of relay 221 is opened but the locking circuit is maintained closed. In position 4 with relay 221 operated, a circuit is closed from battery through the winding of updrive magnet 319 of the district selector, lower contacts of cam 310, left front contact of relay 221, outer right back contact of relay 202 to ground at the upper left contact of cam 304. The updrive magnet energizes in this circuit and causes the

district selector switch shaft to move upwardly in a brush selecting movement. Each time that commutator brush 320 makes contact with a conducting segment of commutator strip 321, a circuit is established from ground at the lower contact of cam 311, brush 320, segment 321, upper left contact of cam 313, thence to the fundamental circuit, holding relay 221 operated and shunting the sender control relay. When the sender is satisfied as to its district brush selection setting, the fundamental circuit is opened at the sender in the well-known manner, releasing relay 221 as soon as brush 320 leaves the next conducting segment 321 of the district selector commutator. At the sender, circuits are prepared for controlling district group selection. The release of relay 221 opens the circuit of updrive magnet 319 and closes a circuit from battery, winding of sequence switch magnet 300, lower contacts of cam 322, outer left back contact of relay 221, back contact of relay 202 to ground, in which circuit sequence switch 300 is advanced to position 5.

With sequence switch 300 in position 5 the fundamental circuit previously traced is extended to the sender and relay 221 again operates in series with the control relay of the sender. Relay 221 locks as previously described to the fundamental circuit and advances sequence switch 300 into position 6 over the previously traced circuit. In positions 5 to 7, inclusive, of sequence switch 300 trip magnet 323 is energized in a circuit extending from battery through its winding to ground at the lower right contact of cam 324. When the sequence switch arrives in position 6, updrive magnet 319 is again energized and the district selector switch shaft is moved upwardly in a group selecting movement. Due to the energization of trip magnet 323 and the positioning of the district selector in accordance with the brush selecting operation, just described, the proper set of brushes is tripped and moved over the associated bank of terminals.

As in the case of brush selection a shunt is prepared extending from ground over the lower contact of cam 311, brush 325, commutator segment 326, upper right contact of cam 312 to the fundamental circuit previously traced. As the district selector moves upwardly the control relay of the sender is intermittently shunted until the sender is satisfied in accordance with its district group selection setting when relay 321 is released, bringing the district selector to rest with its tripped brush set engaging the first terminal of the selected group. The release of relay 221 also closes a circuit from battery through the winding of sequence switch magnet 300, lower contacts of cam 322, left back contact of relay 221 to ground over the back contact of relay 202

for advancing the sequence switch to position 7.

In position 7 of sequence switch 300, relay 221 is operated over its left winding, lower left contact of cam 327, right contact of cam 302, back contact of relay 201, line finder commutator segment 204 and brush 205 to ground. The operation of relay 221 closes a circuit from battery through the winding of sequence switch magnet 300, upper left contact of cam 314, left front contact of relay 221 to ground over the back contact of relay 202, thus advancing sequence switch 300 into position 8. From positions 7½ to 9, relay 221 locks over its right winding and inner right front contact, upper right contact of cam 307, right contact of cam 328 to sleeve brush 329 and ground on sleeve terminal 330 provided that this trunk is busy. The energizing circuit of relay 221 is opened in position 8. If the first trunk of the group is busy and relay 221 is held energized in position 8, a circuit is completed for updrive magnet 319 from battery, through the winding of magnet 319, lower contacts of cam 310, left front contact of relay 221 to ground over the back contact of relay 202. The updrive magnet is energized and causes the district selector shaft to move upwardly in search of an idle outgoing trunk. Relay 221 is held operated between terminals over a circuit extending from battery, left winding of relay 221, lower left and upper right contacts of cam 327, commutator segment 331, brush 332, upper right and lower left contacts of cam 310, left front contact of relay 221, back contact of relay 202 to ground. As soon as an idle trunk is reached, characterized by the absence of ground on its sleeve terminal, the locking circuit of relay 221 is opened and the relay releases, in turn releasing the updrive magnet, bringing the district selector to rest on the first idle outgoing trunk of the group. The release of relay 221 closes a circuit from battery, through the winding of sequence switch magnet 300, lower contacts of cam 322, left back contact of relay 221, back contact of relay 202 to ground for advancing sequence switch 300 into position 9.

As soon as relay 221 releases ground is connected to sleeve terminal 330, over brush 329, the right contact of cam 328, the upper right contact of cam 307, the right back contact of relay 221 to ground at the left contact of cam 311 for holding the trunk busy while sequence switch 300 is passing from position 8 to position 9. In position 9 ground is connected to brush 329 over the right contact of cam 328, and the lower right contact of cam 307. With sequence switch 300 in position 9 relay 221 operates over a circuit extending from battery, left winding of relay 221, left contacts of cam

333, right contact of relay 223 to ground at the lower left contact of cam 324 and closes a circuit from battery, winding of sequence switch magnet 300, upper left contact of cam 314, left front contact of relay 221, right back contact of relay 202 to ground for advancing sequence switch 300 into the selection beyond position 10. In position 10 relay 221 remains energized over the circuit previously traced.

A fundamental switch controlling circuit may now be traced in part from brush 334, upper right and lower left contacts of cam 335, right back contact of relay 229, conductor 278, thence through the sender control relay, returning over conductor 279, right contacts of cam 336 to brush 337. Subsequent selections now take place as described in the above identified patent of O. H. Kopp and a test is made in the sender in the manner described in Patent No. 1,575,336, granted to I. H. Henry, March 2, 1926 and is described in the application of A. E. Hague, above referred to, to determine if the calling subscriber has deposited a coin in the coin box 140 of his line. If, as assumed a coin has been deposited at the time the sender has advanced preparatory to controlling the final units selection, the final units selection is made and the sender is advanced preparatory to controlling the talking selection movement of the district selector sequence switch.

Talking selection

Assuming that this is a call for which a charge is to be made. District selector sequence switch 300 should be advanced either to position 13 or 14. When selections beyond are completed the current flowing over conductor 222 through the windings of relays 223 and 224 is decreased to such an extent that relay 223 releases, in turn, releasing relay 221. Upon the release of relay 221 the district sequence switch 300 is advanced into position 11 over a circuit extending from battery, winding of magnet 300, lower contacts of cam 322, left back contact of relay 221, back contact of relay 202 to ground. As the sequence switch enters position 11, ground is connected to conductor 222 at the lower left contact of cam 304 for the purpose of advancing the sender to the talking selection position. After leaving position 10 relays 223 and 224 are both disconnected from conductor 222. Sequence switch 300 is then advanced into position 12 over a circuit extending from battery through magnet 300, the upper left contact of cam 314, lower left and upper right contacts of cam 310 to ground at the lower contact of cam 311. In passing into position 12 the subscriber's line becomes disconnected from the sender at contacts of cams 316 and 318 and

becomes connected to the left windings of repeating coil 338.

With sequence switch 300 in position 12, relay 221 is energized in a circuit from battery, through its right winding, the lower left contact of cam 312, the lower left contact of cam 313, conductor 278, thence through the winding of the control relay of the sender to ground. Relay 221 operates closing a circuit extending from battery through sequence switch magnet 300, upper left contact of cam 314, left front contact of relay 221 to ground at the lower right contact of cam 304. Relay 221, upon energizing, locks to the fundamental circuit over its inner right front contact and the upper left contact of cam 312. As sequence switch 300 rotates out of position 12 toward position 16, ground is intermittently applied to the fundamental circuit in shunt of the sender control relay at the right contacts of cam 307. When the sender is satisfied as to its talking selection setting, the fundamental circuit is opened at the sender and relay 221 deenergizes, arresting sequence switch 300 in its next stopping position. The sequence switch may be arrested in one of three positions, 13 or 14 which are charge positions, and position 15 for connections to an operator's position. If sequence switch 300 stops in position 13 it immediately advances into position 14 over a circuit closed over the upper right contact of cam 324.

As soon as sequence switch 300 advanced out of position 10 relay 317 operated over the calling line loop from battery at the right contacts of cam 604, lower left winding of repeating coil 338, inner lower back contact of relay 339, upper right contact of cam 316, through the winding of relay 317, thence as previously traced over the calling line loop to the lower contact of cam 318, upper back contact of relay 339, upper left winding of repeating coil 338, upper contact of cam 605 to ground. Relay 317 operates and holds relay 223 operated after sequence switch 300 leaves position 11 over a circuit through the winding of relay 223, front contact of relay 317 to ground at the lower contacts of cam 307. At the sender after talking selection is completed, a circuit is closed to advance the link sequence switch out of position 5 thereby dismissing the sender, whereupon the sender is restored in the manner described in the aforementioned patent to O. H. Kopp. The link circuit then functions in the manner fully set forth in the aforementioned patent to A. Raynsford to allot another line finder-district selector circuit and to prepare the link circuit for use on the next call.

Response of the called subscriber

When the called subscriber responds a circuit is established for relay 340 which

may be traced in part from brush 334, upper contacts of cam 335, upper right winding of repeating coil 338, winding of polarized relay 340, lower right winding of coil 338, 5 lower contacts of cam 336 to brush 337. Relay 340 operates and closes a circuit which may be traced from battery, winding of relay 202, lower contact of interrupter 341, upper left and lower right contacts of cam 327, conductor 606, upper contacts of cam 10 607, conductor 608, front contact of relay 340 to ground at the upper right contact of cam 304. Relay 202 operates and locks over its inner right front contact the lower contact of cam 302, lower right contact of cam 15 327, thence as traced to ground at the upper right contact of cam 304 and as soon as interrupter 341 closes its upper contact, establishes a circuit for relay 610 extending 20 from ground as traced to conductor 606, thence over the lower right and upper left contacts of cam 327, upper contacts of interrupter 341, outer right front contact of relay 202, lower right contact of cam 303, 25 conductor 609, winding of relay 610, right contacts of cam 611, conductor 612, resistance 230 to battery. Relay 610 operates and locks over a circuit extending from battery, conductor 612, right contacts of cam 611, 30 winding of relay 610, upper right contact of cam 613, upper right contact of cam 614, outer left front contacts of relay 610, upper left contact of cam 607, conductor 608, front contact of relay 340 to ground at the upper 35 right contact of cam 304 and establishes a circuit for advancing sequence switch 600 to position 2. This circuit may be traced from battery, winding of magnet 600, lower left contact of cam 615 to ground at the inner 40 left contacts of relay 610. When sequence switch 600 leaves position 1, relay 610 releases and the locking circuit of relay 202 is opened at the right contact of cam 607. With sequence switch 600 in position 2 a 45 circuit is established from battery, winding of relay 229, lower left contact of cam 613, upper left contact of cam 614, conductor 622 to ground over the right contacts of cam 343. Relay 229 locks over its inner left contact to ground at the lower right contact of 50 cam 304 preparatory to operating the message register of the calling line if the line is so equipped.

As soon thereafter as office timing circuit 5 616 connects ground to conductor 617, relay 201 operates over a circuit extending from ground, conductor 617, lower contacts of cam 618, conductor 619, left back contact of relay 224, conductor 213, winding of relay 201, conductor 212, lower right contact 10 of cam 601, conductor 620 to battery, to battery through resistance 342. Relay 201 upon operating locks from battery, over conductor 620, the lower right contact of cam 15 601, conductor 212, winding of relay 201, conductor 213, left back contact of relay 224, conductor 619, lower right and upper left contacts of cam 618, winding of relay 621, lower contact of cam 602, conductor 214, front contact of relay 201 to ground over 20 commutator segment 204 and brush 205. Relay 621 being shunted does not operate in this locking circuit. At the end of thirty seconds ground is removed from conductor 617 at the office timing circuit and relay 25 621 operates, closing a circuit from ground at its contact, over the lower right contact of cam 615 to battery through the winding of magnet 600, thus advancing sequence switch 600 to position 3. 30

Upon leaving position 2 the locking circuit of relays 201 and 621 is opened at the upper left contact of cam 618 and these relays release. When the sequence switch 600 reaches position 3 relay 201 again operates, 35 locking as before through the winding of relay 621 as soon as ground is connected to conductor 617 by the office timing circuit. As soon as ground is removed again by the office timing circuit, relay 621 operates in 40 the locking circuit of relay 301 to advance sequence switch 600 to position 3. In this manner sequence switch 600 is advanced at thirty second intervals through the operation of office timing circuit 616 and relays 45 621 and 201 into position 12, thus measuring off a complete interval of five minutes for conversation.

As sequence switch 600 enters position 11 a shunt is established from ground over the 50 left contacts of cam 605 through resistance 638, the left and lower contacts of cam 604 to battery around resistance 349 and condenser 350 connected between the left windings of repeating coil 338. When sequence 55 switch 600 advances into position 12, this shunt is maintained from ground over the lower contact of cam 607, the left back contact of relay 610, the lower contacts of cam 605, resistance 638, to battery over the left 60 and lower contacts of cam 604. With sequence switch 600 in position 12 a circuit is established from battery, winding of relay 231, right normal contacts of relay 210, conductor 232, lower right contact of cam 613, 65 upper left contact of cam 614, conductor 622, right contacts of cam 343 to ground. Relay 231 operates connecting battery through resistance 233, inner left contact of relay 231, left back contact of relay 234, 70 conductor 235 to multiple terminals associated with brushes 506 of all hunting switches 500 of coin control circuits having access to the line finder-district selector link circuit of Figs. 2 and 3, and closes a circuit for 75 operating start relay 510, which relay is common to said coin control circuits. The circuit of relay 510 extends from ground at the outer right back contact of relay 234, outer left contact of relay 231, conductor 130

236 to battery, through the winding of relay 510. Relay 510, upon operating, closes the start circuit of the coin control circuit of Fig. 5 extending from ground at the front contact of relay 510, upper normal contacts 511 of make busy jack 512, back contact of relay 513, left back contact of relay 514, winding of magnet 507 to battery. Magnet 507 operates and closes an obvious circuit for magnet 508 which causes switch 500 to rotate in search of the terminal to which battery has been connected over conductor 235. All idle control circuits, such as is shown in Fig. 5, are started in search of the line finder-district selector link shown in Figs. 2 and 3. Busy coin control circuits have the above traced circuits for their magnets open at the contacts of relays corresponding to relay 514 and hence are not moved out of their rest positions.

When switch 500 encounters the terminal connected to battery a circuit is completed from battery on conductor 235 over the terminal served by brush 506, contact 515 of jack 512, winding relay 513, windings of relay 516 to ground. Relay 516 operates in this circuit and closes a shunt around its high resistance winding over its front contact and the lower contacts of jack 512, thus reducing the resistance of the circuit through the winding of relay 513 sufficiently to permit the operation of relay 513. The operation of relay 513 opens the circuit of magnet 507 in turn releasing magnet 508 and bringing the switch 500 to rest in connection with terminals connected to the line finder district selector link of Figs. 2 and 3. A circuit is also completed from battery through the winding of relay 514, front contact of relay 513, contact 511 of jack 512 to ground at the front contact of relay 510, relay 514 locking over its inner left front contact, brush 505 and the terminal upon which it is resting, conductor 237, winding of relay 234 to ground at the outer right front contact of relay 231. Relay 514 also opens at its left back contact another point in the circuit of magnet 507.

Relay 234 upon operating opens the circuit of start relay 510 to arrest the hunting movement of the started hunting switches, removes battery from conductor 235 and also establishes a circuit for relay 610 which may be traced from ground over the outer right front contact of relay 234, conductor 623, lower contact of cam 624, winding of relay 610, lower contacts of cam 601, conductor 620 to battery through resistance 342. Relay 610 operates opening at its left back contact, the ground side of the talking circuit extending to the calling line. With the ground side of the talking current supply circuit to the calling line opened the talking current flowing over the calling line is gradually dissipated over a circuit extend-

ing from the calling substation, conductor 117, terminal 227, brush 228, the inner right back contact of relay 224, the lower contact of cam 318, the upper back contact of relay 339, the upper left winding of repeating coil 338, the lower left contact of cam 605, resistance 638, the upper contacts of cam 604, the lower left winding of repeating coil 338, the inner lower back contact of relay 339, the upper right contact of cam 316, winding of relay 317, outer right back contact of relay 224, brush 225, terminal 226 to line conductor 116. Due to the resistance 638 the talking current over the calling line and through the left windings of repeating coil 338 is attenuated gradually so that no surge of current is induced into the right windings of repeating coil 338 and thence over the outgoing trunk circuit to the incoming selector which would cause the release of the incoming selector, and no objectionable click is produced in the calling subscriber's receiver which might otherwise occur if the talking current were cut off abruptly.

A holding circuit for relay 223 to prevent the release of the connection after the circuit of relay 317 is opened through the later operation of relay 224 is also closed, which circuit may be traced from battery, winding of relay 223, conductor 627, the upper left contact of cam 613, the upper right contact of cam 614, to ground at the right contacts of cam 343. Relay 610 establishes a circuit from battery through the left winding of relay 224, conductor 239, upper left contact of cam 625 to ground at the inner left front contacts of relay 610. Relay 234 also opens the operating circuit of relays 513 and 516 and these relays release. Relay 224 upon operating transfers the tip and ring conductors of the calling line from their connection with the left windings of repeating coil 338 and resistance 638 to the coin control circuit.

The operation of relay 514 also extends a circuit from ground through the left winding of relay 525, inner right front contact of relay 514, brush 501 and the terminal upon which it is standing, conductor 238, lower left and upper right contacts of cam 611, conductor 612 to battery through resistance 230. Relay 525 upon operating locks from battery through its right winding and inner right front contact to ground at the outer left front contact of relay 514. Relay 525 being operated indicates to the coin control circuit that the call should be charged for through the collection of the deposited coin. The operation of relay 514 also closes a circuit from battery through the left winding of relay 517, winding of relay 518, inner left contact of relay 517, outer left back contact of relay 533, contacts of interrupter 520 to ground at the outer left front contact of relay 514. Relay 518 operates in this circuit

upon the closure of interrupter 520 but relay 517 being marginal does not operate. Relay 518 upon operating closes a locking circuit for itself from battery through the left winding of relay 517, winding of relay 518, right winding of relay 517, inner right front contact of relay 518 to ground at the outer left front contact of relay 514. Relay 517 does not operate in this circuit since its right winding is shunted by the energizing circuit of relay 518. The operation of relay 518 also closes a circuit from battery through the winding of relay 521, left back contact of relay 524, left front contact of relay 518, outer right normal contacts of relay 523, left normal contacts of relays 519 and 533 to ground at the outer left front contact of relay 514. Relay 521 operates and locks over its inner right contact, the outer right normal contacts of relay 523, thence as traced to ground at the outer left front contact of relay 514 and closes an obvious circuit for relay 524 which operates and locks over the left normal contacts of relays 519 and 533 to ground at the outer left front contact of relay 514.

The operation of relay 521 establishes a short circuit of the conductors of the calling line extending from conductor 117, terminal 227, brush 228, inner right front contact of relay 224, brush 503 and the terminal upon which it is resting, left contacts of relay 521, brush 504, and the terminal upon which it is resting, outer right front contact of relay 224, brush 225, terminal 226 to conductor 116, and connects both conductors 116 and 117 over the circuit previously traced to the right armature of relay 517 and over a discharge path to ground through a resistance 540 and condenser 541. The operation of relay 524 opens the operating circuit of relay 521. On the next opening of interrupter 520 the shunt around the windings of relay 517 is opened and relay 517 operates. Since relay 525 was operated positive coin collection current of 110 volts is now connected to the conductors of the calling line over the right front contact of relay 517, winding of relay 526, outer left front contact of relay 525, ballast lamp 527 to the source 542 of coin collection current. Relay 526 operates in this circuit if a coin is present in the coin box as it should be, and closes an obvious circuit for relay 522. Relay 522 operates and locks in a circuit from battery through its winding and left front contact to ground at the outer left front contact of relay 514 and performs a function which will hereinafter be described.

When the interrupter 520 again closes it shunts the winding of relay 518 from ground at the outer left front contact of relay 514, contact of interrupter 520, outer left back contact of relay 533, inner left front contact of relay 517, winding of relay 518, right winding of relay 517, inner right front con-

tact of relay 518 to ground at the outer left front contact of relay 514 and relay 518 releases, but relay 517 remains locked to ground over its inner left front contact. When interrupter 520 again opens, the locking circuit of relay 517 is opened and relay 517 releases, closing the energizing circuit of relay 523 from battery, inner right normal contacts of relay 523, left front contact of relay 524, left back contact of relay 518, left back contact of relay 528, outer left back contact of relay 517, left normal contacts of relays 519 and 533 to ground at the outer left front contact of relay 514. Relay 523 locks over its inner right front contact to ground at the front contact of relay 514, opening its operating circuit and at its outer right transfer contact transfers the holding circuit of relay 521 over the left back contact of relay 518, the left back contact of relay 528, the outer left back contact of relay 517 to ground at the outer left front contact of relay 514. At the next closure of interrupter 520, relay 518 again operates over the circuit previously traced, locks over the circuit previously traced through the windings of relay 517 and opens the holding circuit of relay 521 which releases. When the interrupter 520 again opens its contacts relay 517 operates and establishes a circuit for relay 528 extending from battery, winding of relay 528, outer left front contacts of relay 523, outer left front contacts of relay 517 to ground at the outer left front contact of relay 514. Relay 528 upon operating locks directly to ground at the front contact of relay 514 and at its right contacts connects the tip and ring conductors of the calling line to battery through the windings of relay 534. Relay 534 remains connected for the remainder of the open period of interrupter 520 and if the coin has been collected and consequently ground has been removed at the coin box 140 it does not operate.

As soon as the interrupter 520 closes its contacts again relay 518 becomes shunted in the manner previously described and releases closing a circuit from battery, left winding of relay 519, middle left back contact of relay 533, outer right front contact of relay 528, left front contact of relay 524, left back contact of relay 518 to ground at the outer left front contact of relay 528. At its inner left front contact relay 519 opens the holding circuit of relays 528, 523 and 524, causing their release, and locks over the left normal contact of relay 533 to ground at the outer left front contact of relay 514. With relay 519 operated a circuit is established from ground left winding of relay 210, conductor 240, terminal and brush 502, outer left front contact of relay 519, left back contact of relay 535 to ground at the outer left front contact of relay 514. Relay 210 operates and locks

over its right winding and right front contact, inner left front contact of relay 224 to ground at the upper right contact of cam 311 and opens the circuit of relay 231 which releases, in turn releasing relays 234, 610 and 514. Relay 210 at its outer left front contact also closes a circuit extending over conductor 626, upper right contact of cam 615 to battery through the winding of sequence switch magnet 600 for advancing the sequence switch into position 14. Upon leaving position 12 the holding circuit of relay 224 is opened and relay 224 releases in turn releasing relay 210. Relay 514 upon releasing releases all operated relays of the coin control circuit, thereby preparing the coin control circuit for use on another connection.

With sequence switch 600 in position 14 and relay 224 released, relays 201 and 621 again operate under the control of timing circuit 616 for advancing sequence switch 600 into position 15 whereby relays 201 and 621 release. If at this time the calling subscriber has not disconnected, relay 317 is operated over the circuit previously traced including resistance 638 and relay 201 operates in a circuit extending from battery, resistance 342, conductor 620, the lower right contact of cam 607, conductor 212, winding of relay 201, left back contact of relay 224, conductor 619, lower left and upper right contacts of cam 625, conductor 627, front contact of relay 317, to ground at the lower contacts of cam 307. A circuit is now established for lamp 344, extending from battery through lamp 344, conductor 628, the upper right contact of cam 602, conductor 214, front contact of relay 201 to ground over commutator segment 204 and brush 205. This is a signal to the operator that the allotted period for conversation for the initial deposit has elapsed.

The operator then proceeds to plug a cord circuit into the overtime monitoring jack 345 for the purpose of requesting the deposit of an additional coin by the calling subscriber if he desires to continue the conversation. With the plug of the cord circuit (not shown) in jack 345 a circuit is established from battery over the sleeve of the plug and sleeve of jack 345, conductor 629, upper left and lower right contacts of cam 611, winding of relay 610, upper right contact of cam 613, upper left contact of cam 614, conductor 622 to ground at the right contacts of cam 343. A circuit is also closed from the cord circuit over the tip of jack 345, conductor 630, upper contacts of cam 631, resistance 632, winding of relay 621, upper contacts of cam 618, conductor 633, the ring of jack 345 to the cord circuit, thereby operating relay 621 from battery supplied from the cord circuit. Relay 621 upon operating advances sequence switch

600 to position 16 thereupon releasing relays 201 and 621 and extinguishing the lamp 344. Relay 610 upon operating removes at its left back contact the talking ground supplied to the calling line over the upper left winding of repeating coil 338, the right contact of cam 605, left back contact of relay 610 and the lower contact of cam 607, whereby the current flowing over the calling line and through the left windings of repeating coil 338 is attenuated in the manner previously described.

As sequence switch 600 advances from position 15 to 16 a connection is established from the calling line over the lower contact of cam 318, the upper contacts of cam 603, conductor 630, tip of jack 345 to the operator's cord circuit, thence to the ring of jack 345, conductor 633, upper contacts of cam 634, upper right contact of cam 316, winding of relay 317, thence to the calling line, the calling subscriber being supplied with talking battery from the operator's cord circuit. Since at the time the operator's position is connected to the calling line the talking current flowing over the calling line from battery supplied from the timing switch has been attenuated through resistance 638, the operator receives no annoying click in her headset.

If the calling subscriber elects to continue the conversation and deposits another coin, the operator removes the cord from jack 345 thus causing the release of relay 610. Relay 610 upon releasing advances sequence switch 600 to normal over a circuit from battery, winding of magnet 600, upper left contact of cam 615, conductor 635, lower back contact of relay 339, right back contact of relay 610, lower right and upper left contacts of cam 614, conductor 622 to ground over the right contacts of cam 343. In the normal position 1 the subscriber's line loop is extended through the winding of relay 317 and the left winding of repeating coil 338 to battery and ground at contacts of cams 604 and 605 and since the calling subscriber has elected to continue the conversation relay 317 remains operated. A circuit is now established from battery through the winding of relay 202, lower contacts of interrupter 341, upper left and lower right contacts of cam 327, conductor 606, upper contacts of cam 607, conductor 608, front contact of relay 340 to ground at the upper right contact of cam 304. Relay 202 operates and locks over its inner right front contact, the lower contact of cam 302 and thence to ground as traced at the upper right contact of cam 304 and closes a circuit for relay 610 extending from ground as traced to conductor 606, thence over the lower right and upper left contacts of cam 327, upper contact of interrupter 341, outer right front contact of relay 202, lower right

contact of cam 303, conductor 609, winding of relay 610, right contacts of cam 611, conductor 612, resistance 230 to battery. Relay 610 operates, locking over a circuit extending from battery, conductor 612, right contacts of cam 611, winding of relay 610, upper right contact of cam 613, upper right contact of cam 614, left front contact of relay 610, upper left contact of cam 607, conductor 608, front contact of relay 340 to ground at the upper right contact of cam 304 and establishes a circuit for advancing sequence switch 600 to position 2 which may be traced from battery through the winding of magnet 600, lower left contact of cam 615 to ground at the inner left contacts of relay 610. When sequence switch 600 leaves position 1 relay 610 releases and the locking circuit of relay 202 is opened at the right contact of cam 607. Sequence switch 600 is thereupon advanced into position 12 under the control of timing circuit 616 and relays 201 and 621 to measure off an additional five minutes for conversation. The coin control circuit is again taken for use, the deposited coin is collected and after its collection the operator is again signalled in the manner previously described. These functions are thereafter repeated so long as the calling subscriber signifies that he wishes to continue the conversation by depositing additional coins.

If when the operator requests the calling subscriber to either deposit an additional coin or to hang up, he does neither the operator may then plug a second cord circuit into the splitting jack 346. As soon as sequence switch 600 advances to position 16 when the operator connected a first cord circuit with jack 345, a circuit is established from battery over the sleeve of jack 346, winding of relay 339, left contacts of cam 614, conductor 622, to ground over the left contacts of cam 343. With relay 339 operated, the talking circuit between the subscribers is interrupted and the called subscriber is connected over front contacts of relay 339 and jack 346 with the operator's cord circuit. The operator may then instruct the called subscriber to wait on the connection while an attempt is being made to obtain a second deposit from the calling subscriber. If the calling subscriber, however, disconnects, the operator will then inform the called subscriber accordingly and remove the cord plug from the splitting jack 346 and the other cord plug from the monitoring jack 345. With both plugs removed, the sequence switch 600 will advance in the manner described to position 1. As soon as the subscribers have both hung up and relays 317 and 340 have both deenergized, relay 223 releases as soon after the release of relay 317 as interrupter 241 opens its lower contact, and opens the hold-

ing circuit of relay 223 which extends from battery through the winding of relay 223, lower contacts of cam 333, right contact of relay 223 to ground at the lower contacts of interrupter 241. As soon as interrupter 241 again closes its contacts with relay 223 released, a circuit is established from ground at interrupter 241, left back contact of relay 223, lower left and upper right contacts of cam 315, conductor 637, lower contacts of cam 603, conductor 239 to battery through the left winding of relay 224. Relay 224 upon operating transfers the talking conductors of the calling line to conductors extending to terminals of coin control circuits and locks in a circuit extending from battery through its right winding, lower contacts of cam 634, conductor 232, left front contact of relay 224, to ground at the upper right contact of cam 304. This locking circuit is extended over the right normal contacts of relay 210 to battery through the winding of relay 231. Relay 231 functions in the manner previously described to cause an idle coin control circuit to become associated with the line finder district selector link, whereupon relays 234 and 514 operate in the manner previously described. Relay 234 upon operating performs the functions previously described and in addition establishes a circuit from ground at its right front contact, conductor 623, upper left contact of relay 624, lower left and upper right contacts of cam 301, to battery through the winding of sequence switch magnet 300 thereby advancing sequence switch 300 into position 17. With sequence switch 300 in position 17 and relay 234 operated, a circuit is closed for relay 202 extending from battery, winding of relay 202 left contacts of cam 301, conductor 625, left contact of cam 624, conductor 623 to ground at the outer right front contact of relay 234. Relay 202 upon operating locks over its inner right front contact, the lower and left contacts of cam 302, to ground over line finder commutator segment 242 and brush 243.

Since the sequence switch 600 is in normal position at this time, when relay 514 operates, upon the connection of the coin circuit with the line finder district link, the circuit previously traced for relay 525 is not closed and when thereafter relays 517, 518, 521 and 524 function in the manner previously described, current is applied to the conductors of the calling line from the 110 volt source of negative coin refunding potential through ballast lamp 530, outer right front contact of relay 524, left back contact of relay 525, winding of relay 526, right contact of relay 517, left front contacts of relay 521, over the calling line, thence to ground through the coin box 140 if a coin is present in the coin box. This application of refunding potential will

thereupon cause any deposited coin to be refunded. The coin circuit then functions as previously described to operate relay 519 in turn operating relay 210. Relay 210 upon operating locks over its right winding and right inner front contact, inner left contact of relay 224 to ground at the upper right contact of cam 311, and releases relays 221 and 514 thereby releasing the coin circuit and also releases the calling line cut off relay 102.

As the calling line is equipped with a message register 105, a circuit is established with sequence switch 300 in position 17 and sequence switch 600 in position 1, from ground through register 105, left back contact of relay 101, conductor 114, terminal 209, brush 208, right back contact of relay 210, left contacts of cam 343, inner right front contact of relay 229 to battery through resistance 230. With relays 202 and 210 operated, a circuit is established for advancing sequence switch 300 to position 18 which may be traced from battery, winding of magnet 300, upper right contact of cam 305, outer right front contact of relay 202, inner left front contact of relay 210 to ground at the upper left contact of cam 324. In position 18 the locking circuit of relay 210 is opened in turn releasing relay 224 and a circuit is established for the down drive magnet 244 of the line finder extending from battery through the winding of magnet 244, lower left contact of cam 303, outer right front contact of relay 202 to ground at the upper left contact of cam 304 for restoring the shaft of the line finder to normal. When the line finder reaches its normal position the locking circuit of relay 202 is opened at commutator brush 243 and segment 242 and relay 202 releases opening the circuit of the down drive magnet. A circuit is also closed from battery through winding of down drive magnet 347 of the district selector, right contacts of cam 636, lower right and upper left contacts of cam 312 to ground over the right contacts of cam 307 for driving the district selector shaft to normal. When it reaches normal, sequence switch 300 is advanced to normal over a circuit extending through the winding of magnet 300, lower right contact of cam 314, lower contacts of cam 631, conductor 635, normal commutator segment 348, brush 332 to ground at the lower contact of cam 311. Upon leaving position 16 1/4 ground is removed from test terminal 330 at the right contact of cam 328 and the release of all selector switches beyond the district selector is thus initiated. All apparatus used in the establishment of the connection is now restored to normal.

Failure to collect or refund a deposited coin

It will be recalled that following the application of coin collecting current or coin

refunding current from the coin control circuit of Fig. 5 to the coin box 140 of the calling line, relay 528 in the coin circuit connected the windings of relay 534 to the conductors of the calling line for the purpose of testing to determine if the coin has been released from the coin chute of the box either into the collection till or into the return chute. If the coin is not properly released and the calling subscriber has not hung up ground will be connected at the coin box 140 to the conductors of the calling line for operating relay 534. Relay 534 upon operating closes a circuit for relay 535 extending from ground, the front contact of relay 534, over the normal contacts of release jack 537 to battery through the winding of relay 535 and relay 535 in turn closes a circuit from ground at the outer left front contact of relay 514 over the inner left front contact of relay 535 to battery through the winding of relay 533. Relay 533 upon operating closes a holding circuit for relay 535 extending from battery through the winding of relay 535, right back contact of relay 519, inner left front contact of relay 533 to ground at the outer left front contact of relay 514 and establishes an operating circuit for signal lamp 531 extending either from ground at the right back contact of relay 525, right front contact of relay 533, normal contacts of monitoring jack 532 to battery through lamp 537 or from ground at the outer right front contact of relay 518, thence as traced to battery through lamp 531, whereby the lamp burns steadily if the coin sticks when refund current is applied to the coin box or flashes during the operation and release of relays 517 and 518 if the coin sticks when the coin collection current is applied to the coin box. Relay 533 also opens the locking circuits of relays 517, 518 and 524. When the monitoring operator answers in response to the stuck coin signal given by the lamp 531, relay 519 operates over a circuit from ground through its right winding, inner right contact of relay 535, sleeve of jack 532 to battery on the sleeve of the operator's cord circuit. Relay 519 upon operating locks over its left winding and middle left front contact to ground at the outer left front contact of relay 514 and connects battery through resistance 536 through left front contact of relay 535, outer left front contact of relay 519 to test brush 502 for test purposes. The operator may now talk to the calling subscriber for the purpose of having the subscriber attempt to dislodge the stuck coin. If the operator is successful in clearing the coin and desires to release the coin control circuit and associated district selector she may do so by removing the plug of the cord circuit from the monitoring jack and inserting it in the release jack 537 thereby releasing relays 535 and 533. With

relay 535 normal and relay 519 operated ground is connected from the outer left front contact of relay 514, left back contact of relay 535, outer left front contact of relay 519, brush 502, conductor 240 to battery through the right winding of relay 210, whereupon the connection is released in the manner previously described.

Charge call with no coin present

If relay 526 fails to operate when relay 525 is operated and coin collection current is applied to the coin box 140 through the winding of relay 526, and consequently relay 522 does not operate, a circuit is established from ground at the outer left front contact of relay 514, back contact of relay 522, inner left front contact of relay 523, outer right front contact of relay 525, normal contacts of release jack 537 to battery through the winding of relay 535. Relay 535 operates causing relay 533 to operate, thereby locking relay 535, releasing relays 517, 518 and 524 and closing the flashing circuit for lamp 531 in the manner previously described. The release of the connection then proceeds in the manner described in the preceding paragraph.

What is claimed is:

1. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over the conductors of said line through the primary windings of said repeating coil and a source of current, a resistance, and means for sequentially inserting said resistance into said supply circuit between the primary windings of said coil, rendering said source of current ineffective to supply talking current to said line and finally opening the connection between the conductors of said line and the primary windings of said coil.

2. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over one conductor of said line through one primary winding of said repeating coil to ground and extending over the other conductor of said line through a second primary winding of said coil to battery, a resistance, and means for sequentially inserting said resistance into said supply circuit between the ground and battery terminals of said primary windings, disconnecting said ground and finally opening the connection between the conductors of said line and the primary windings of said coil.

3. In a telephone exchange system, a calling line, a coin box on said calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talk-

ing current supply circuit for said calling line extending over the conductors of said line through the primary windings of said repeating coil and a source of talking current, a source of coin box operating current, a resistance, and means for sequentially inserting said resistance into said supply circuit between the primary windings of said coil, rendering said source of talking current ineffective to supply talking current to said line, opening the connection between the conductors of said line and the primary windings of said coil and finally connecting said source of coin box operating current to said line.

4. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over the conductors of said line through the primary windings of said repeating coil and a source of current, a first resistance and a condenser interposed between the primary windings of said coil, a second resistance, and means for sequentially inserting said second resistance between the primary windings of said coil in shunt of said first resistance and condenser, rendering said source of current ineffective to supply talking current to said line and finally opening the connection between the conductors of said line and the primary windings of said coil.

5. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over one conductor of said line through one primary winding of said repeating coil to ground and extending over the other conductor of said line through a second primary winding of said coil to battery, a first resistance and a condenser interposed between the primary windings of said coil, a second resistance, and means for sequentially inserting said second resistance between the primary windings of said coil in shunt of said first resistance and condenser, disconnecting said ground and finally opening the connection between the conductors of said line and the primary windings of said coil.

6. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over the conductors of said line through the primary windings of said repeating coil and a source of current, a resistance, and a switch for sequentially inserting said resistance into said supply circuit between the primary windings of said coil, rendering said source of current ineffective to supply talking current to said line and finally opening the connec-

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tion between the conductors of said line and the primary windings of said coil.

7. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over one conductor of said line through one primary winding of said repeating coil to ground and extending over the other conductor of said line through a second primary winding of said coil to battery, a resistance, and a switch for sequentially inserting said resistance into said supply circuit between the ground and battery terminals of said primary windings, disconnecting said ground and finally opening the connection between the conductors of said line and the primary windings of said coil.

8. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over the conductors of said line through the primary windings of said repeating coil and a source of current, an operator's position having a headset, a signal for signalling said operator, a resistance, and means for sequentially inserting said resistance into said supply circuit between the primary windings of said coil, signalling said operator, rendering said source of current ineffective to supply talking current to said line, disconnecting said source of current and finally connecting said operator's headset with said calling line.

9. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a repeating coil in said link circuit, a talking current supply circuit for said calling line extending over one conductor of said line through one primary winding of said repeating coil to ground and extending over the other conductor of said line through a second primary winding of said coil to battery, an operator's position having a headset, a signal for signalling said operator, a resistance, and means for sequentially inserting said resistance into said supply circuit between the primary windings of said coil, signalling said operator, disconnecting said ground, disconnecting said battery and finally connecting said operator's headset with said calling line.

10. In a telephone exchange system, a calling line, a link circuit for extending said calling line, a monitoring jack for said link circuit, a repeating coil in said link circuit, a talking supply circuit for said calling line extending over conductors of said line through the primary windings of said repeating coil and a source of current, an operator's cord circuit, a signal, a resistance, a switching device, means for advancing said

switching device to first insert said resistance into said talking supply circuit between the primary windings of said coil, and to then operate said signal, and means responsive to the connection of said cord circuit with said jack to render said source of current ineffective to supply talking current to said line and to further advance said switching device to disconnect said source of current and to connect said cord circuit over said jack and link circuit into a talking connection with said line.

In witness whereof, I hereunto subscribe my name this 25th day of July, 1930.

ALOYSIUS J. BUSCH.

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