

Oct. 17, 1933.

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1,930,612

TELEPHONE SYSTEM

Filed March 18, 1932

4 Sheets-Sheet 1

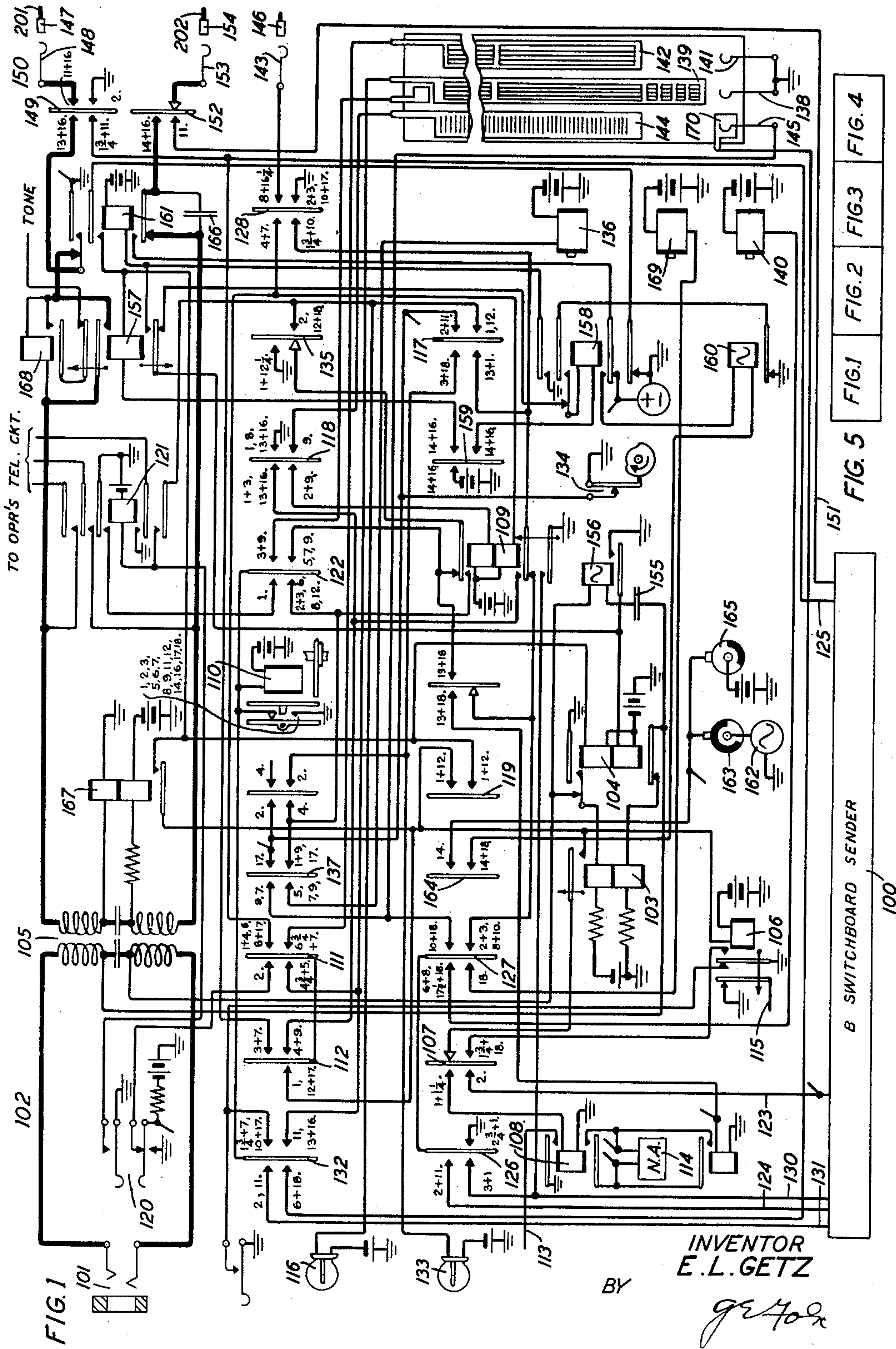


FIG. 1

FIG. 2 FIG. 3 FIG. 4

FIG. 5

B SWITCHBOARD SENDER

100

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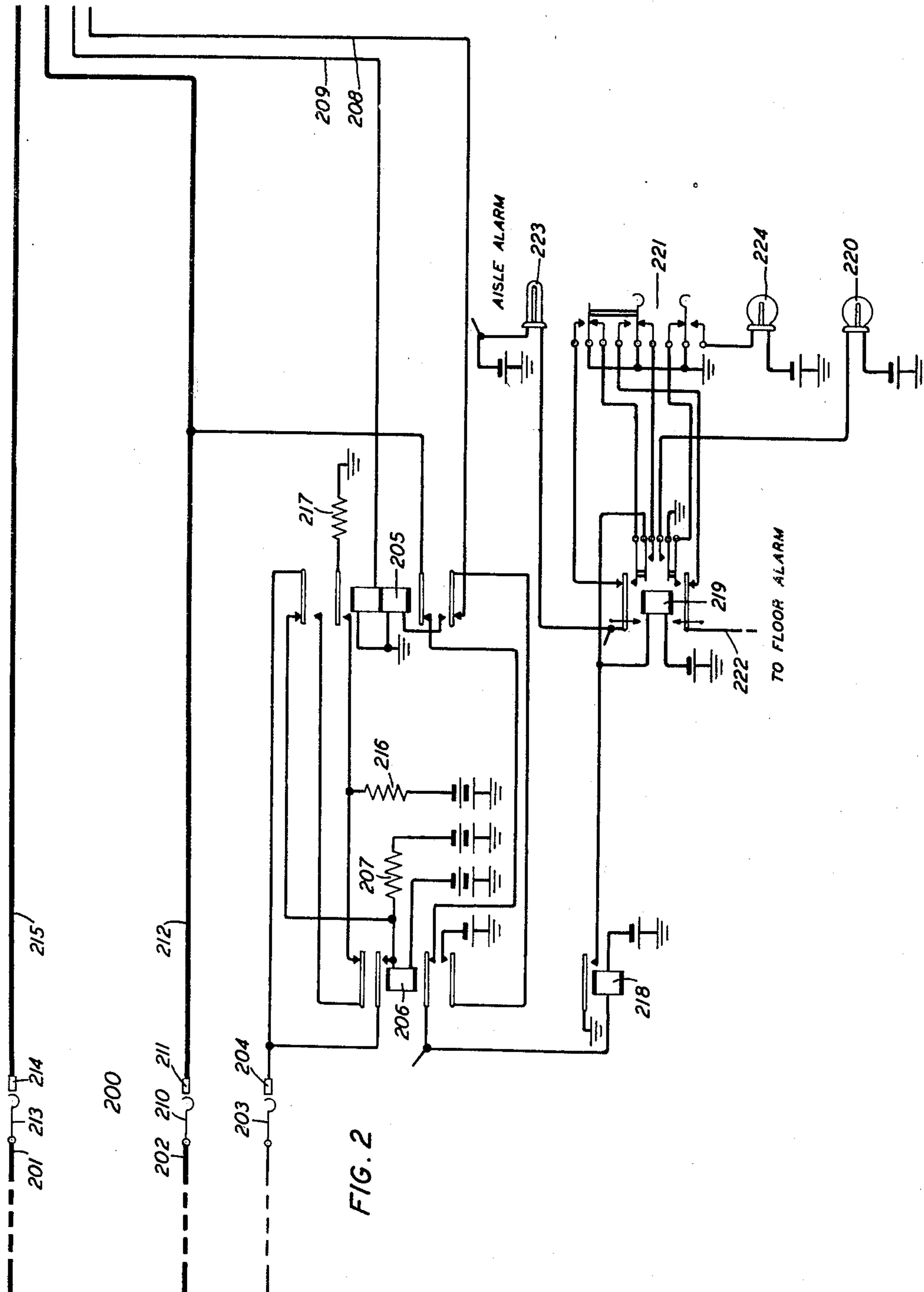
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

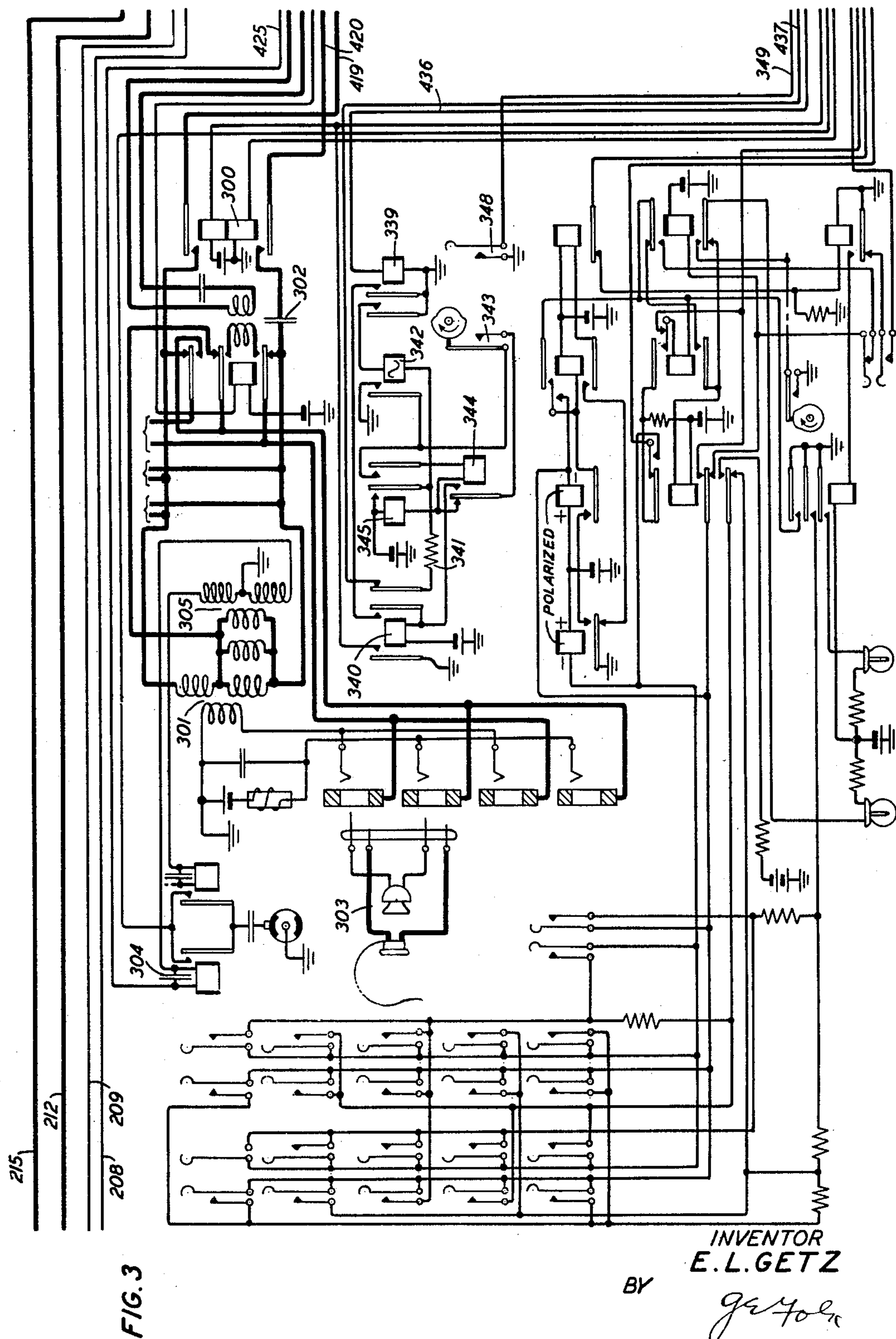


FIG. 3

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4 Sheets-Sheet 4

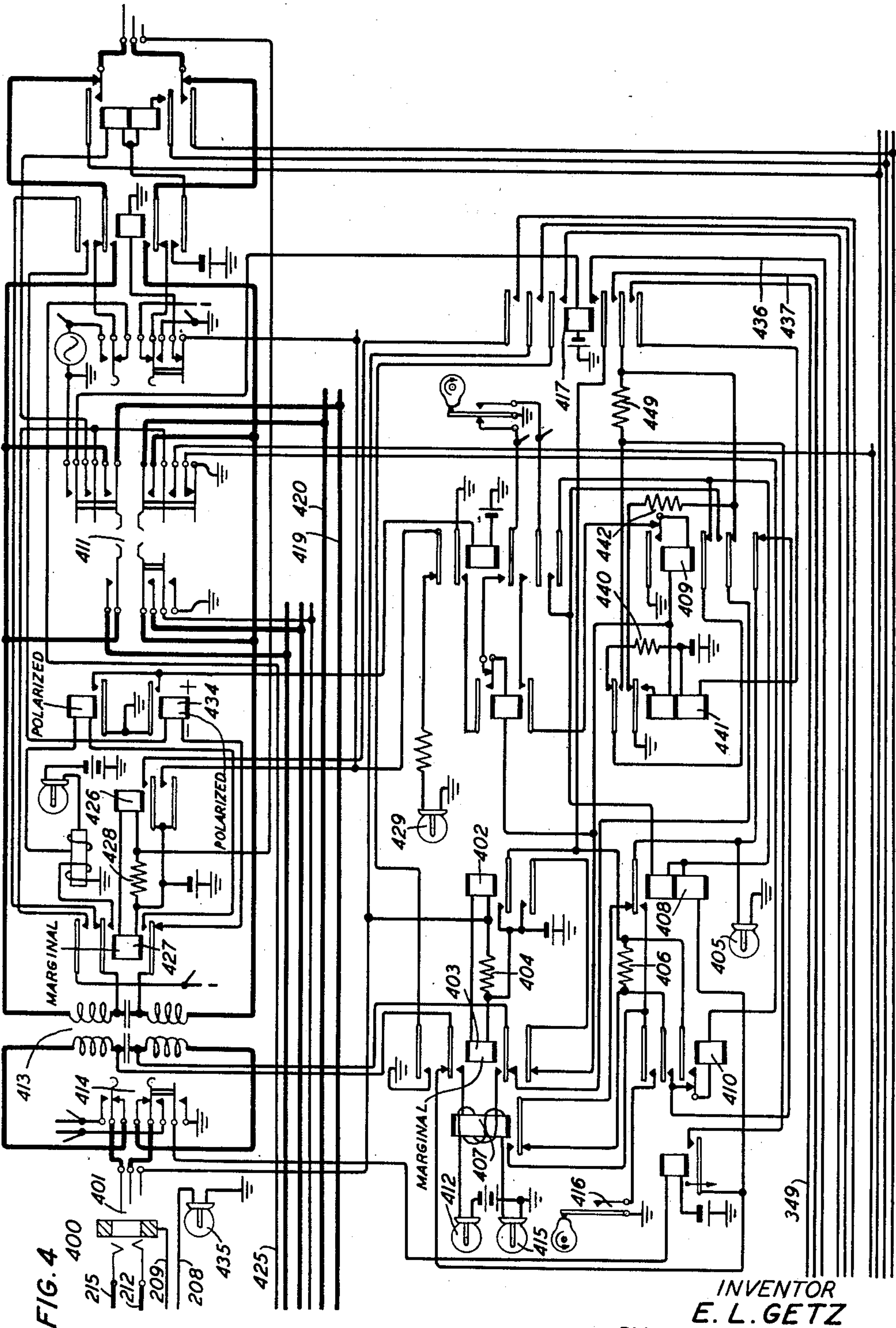


FIG. 4

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1,930,612

TELEPHONE SYSTEM

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Application March 18, 1932. Serial No. 599,732

6 Claims. (Cl. 179—27)

This invention relates to automatic telephone exchange systems and more particularly to circuits for enabling an operator to intercept calls which have been extended to blank terminals of selector switches in the establishment of either local or toll connections. The object of the invention is to simplify and improve the apparatus of an operator's position in a system of this type whereby an operator may answer all types of intercepting calls with the same cord circuit equipment and receive a discriminating signal when she answers an intercepted call over toll selectors.

In the installation of telephone exchanges in which mechanical switching mechanism is employed for extending connections between subscribers' lines, it is the usual practice to divide the exchange area into a plurality of offices and to make provision in each office for ultimately giving service to 10,000 subscribers' lines. The number of offices in the exchange is so selected that at the outset no office is required to function to its ultimate capacity and therefore, there must always be switching units which are not employed to their fullest extent. This is especially true of incoming selector switches which have access to small groups or divisions of trunk lines and to final selector switches which have access to the individual subscribers' lines. Thus, there will be a number of terminal sets in the banks of incoming selectors which are blank, or not connected to working trunk lines extending to final selector switches and terminal sets in the banks of final selector switches which are blank, or not connected to subscribers' lines.

If an incoming selector switch in response to dialing is positioned to extend a connection into a division of an office which has not yet been installed, or a final selector is positioned upon a blank terminal to which no subscriber's line has been connected, or upon the terminal of a line from which former service has been discontinued, the attempted connection is routed to a trunk terminating at an operator's position on a so-called "A" switchboard. This operator may also receive calls from subscribers who desire assistance and dial zero and receive calls from subscribers who wish to obtain toll connections.

It may also occur that in an attempt to terminate a toll connection over a toll incoming selector and final selector, such selectors may inadvertently be set upon a blank terminal. In this case also, the attempted connection will be routed to a trunk terminating at the operator's position. Thus, both local and toll calls intended

for a particular subscriber's line may be routed over a common group of trunks to an operator's position if either an incoming or final selector used in the establishment of such a connection is erroneously set upon a blank terminal.

In accordance with the present invention, the operator's position is equipped with cord circuits with which she may answer such intercepted calls and with which she may complete the calls which the subscribers fail to complete. When a call becomes routed to an intercepting trunk, the operator answers and ascertains from the calling subscriber the number of the desired subscriber. She then proceeds to complete the connection, if possible. If, however, a connection with a subscriber's line terminating in the office has been attempted from a distant toll point and has become routed to an intercepting trunk terminating at the operator's position, it becomes desirable to inform the operator of the character of the call when she answers it for the reason that it would not be advisable for the operator to attempt to complete such a toll connection.

In order that the operator may receive this special information when she answers an intercepted call from a toll point, the toll incoming selector used in establishing the connection is provided with a relay in addition to the usual battery bridge relay which operates when the operator plugs into the intercepted trunk and causes the application of tone current to the tip conductor of the operator's cord circuit and then to the operator's headset. The battery bridge relay in the incoming selector does not operate at this time. The operator hearing the tone recognizes that the call which she has intercepted is an attempted toll connection and she thereupon depresses a key in her position which operates a relay in the cord circuit to change the supervisory condition of the answering end of the cord circuit whereby the battery bridge relay of the incoming selector operates and the tone applying relay of the incoming selector becomes released to remove the tone current.

The operator then gives the toll operator the desired information, or advises the withdrawal of the toll cord circuit and the reorigination of the call.

The manner in which the invention functions will be more evident from the following detailed description taken in connection with the accompanying drawings in which:

Figure 1 shows a selector trunk circuit incoming from a toll operator's position and having access to final selector trunk circuits and to in-

intercepting trunk circuits together with the schematic disclosure of a sender at a "B" operator's position which may, in the well-known manner, be associated with the incoming trunk circuit;

5 Fig. 2 shows schematically the final selector switch to which the incoming selector of Fig. 1 has access and an intercepting trunk circuit accessible from the final selector switch and terminating at the operator's position of Fig. 4;

10 Fig. 3 shows the telephone and keyset circuits of an intercepting or special operator's position;

Fig. 4 shows one cord circuit of the intercepting or special operator's position by means of which the operator may render assistance or intercepting service to calling subscribers or to a toll operator; and

Fig. 5 is a diagram showing the manner in which the remaining figures should be arranged to show the complete circuits of the invention.

20 The cord circuit of Fig. 4, located at the intercepting operator's position, has access over the answering plug 401 to jacks of incoming trunks which may, for example, be intercepting trunks from final selector multiples as disclosed in Fig. 2, or from multiples of incoming selectors, as shown in Fig. 1, or to jacks of trunks incoming from district or office multiples over which calling subscribers have made calls for assistance in establishing connections. Over the calling plug of the cord circuit the operator may have access to different groups of trunk circuits for completing connections. These groups of outgoing trunk circuits may be of the type disclosed in the patent to W. B. Strickler, No. 1,897,083, Feb. 14, 1933, filed concurrently herewith. Since it is to be assumed in the following description that the operator is to receive an intercepted call extended from a toll operator's position, which call the operator is not to complete, no trunks outgoing from the operator's position have been disclosed. The keyset and operator's position equipment shown in Fig. 3 is common to all of the cord circuits such as shown in Fig. 4 of the operator's position. The keyset equipment may be employed by the operator to complete connections in the manner fully set forth in the aforementioned application of W. B. Strickler.

50 The sender shown schematically by the rectangle 100 of Fig. 1 may be of the general type disclosed in Patent No. 1,517,260, granted December 2, 1924 to F. A. Stearn and may be associated with the incoming selector trunk circuit following its seizure by a toll operator in the manner disclosed in such patent.

55 It will be assumed that a toll operator to complete a toll connection to a subscriber's line listed in the telephone directory as terminating in the terminal banks of final selector switch 200, plugs her cord circuit into the jack 101 of trunk circuit 102 which terminates in the incoming selector switch 150 thereby establishing a circuit extending from battery through the upper winding of relay 103, upper normal contacts of relay 104, lower left winding of repeating coil 105, rings of jack 101 and the toll operator's cord circuit plug, not shown, returning over the tips of the plug and jack 101, upper left winding of repeating coil 105, lower back contact of relay 104 to ground through the lower winding of relay 103. Upon the establishment of this circuit the calling supervisory lamp at the toll operator's cord circuit becomes lighted and relay 103 operates and closes a series circuit from battery, through the winding of relay 106, contact of relay 103, upper contacts of cam 107 to ground through the winding of re-

lay 108 and in parallel from battery, through the lower winding of relay 109, upper right contact of cam 111, lower left contact of cam 112, contact of relay 103, upper contacts of cam 107 to ground through the winding of relay 108. Relay 103 also closes a circuit extending from battery, through the upper winding of relay 104, contacts of cam 119, contact of relay 103, upper contacts of cam 107 to ground through the winding of relay 108. Relay 104 operates opening the initial operating circuit of relay 103 and closing a holding circuit for relay 103 from ground over the upper alternate contacts of relay 104 to battery through the upper winding of relay 103. With the windings of relay 104 disconnected from the circuit previously traced extending to the toll operator's cord circuit the supervisory lamp at such cord circuit becomes extinguished.

Relay 108 upon operating connects ground to conductor 113 for lighting a pilot lamp in the cordless "B" operator's telephone circuit and closes the night alarm circuit 114 for operating a night alarm bell thereat and for lighting a pilot lamp. Relay 106 upon operating removes ground at its back contact from conductor 115 extending to the group busy register. Relay 109 upon operating closes a circuit for the white-capped lamp 116, which circuit may be traced over the lower contacts of cam 117, inner lower front contact of relay 109 to ground over the upper contacts of cam 118. Lamp 116 lights as a signal to the "B" operator that the trunk circuit has been selected.

In response to the lighting of lamp 116 the operator depresses the assignment key 120 thereby closing an obvious circuit for relay 121 which locks over its lower front contact, the lower contacts of cam 117, inner lower front contact of relay 109 to ground over the upper contacts of cam 118, at its two upper front contacts connects the "B" operator's telephone circuit to the trunk circuit 102 through the right windings of repeating coil 105, closes a circuit over its inner lower contact to tone apparatus associated with the operator's telephone circuit for causing the transmission of two impulses of tone current to the toll operator's position as a signal to the toll operator that she may pass the call to the "B" operator, and closes a circuit extending from ground at its inner upper front contact over the upper left contact of cam 122, through the winding of sequence switch magnet 110 for advancing the sequence switch into position 2. With sequence switch 110 in position 2, relays 108 and 109 release and relays 104 and 106 are held operated by ground supplied over the front contact of relay 106, the right contacts of cam 107, the contact of relay 103 and thence as previously traced to battery through the winding of relay 106 and to battery through the upper winding of relay 104.

Ground is now connected to the start lead 123 from the front contact of relay 106, over the lower contacts of cam 107, to the holding lead 124 over the upper left contact of cam 126, lower right contact of cam 127, lower back contact of relay 109 and the lower contacts of cam 128, and to lead 125, over the lower contacts of cam 149, and ground is removed from the hunting lead 130 at the lower contacts of cam 126 which ground is applied to this lead in all positions of sequence switch 110 except position 2. A trunk finder, not shown, is now started through the grounding of start lead 123 to hunt for the calling incoming-selector trunk circuit and stops upon finding

this trunk circuit due to the ungrounded condition of hunting lead 130 and immediately grounds lead 130 making the trunk circuit busy to other trunk finders. When the sender 100 has been selected and the "B" operator in response to instructions from the toll operator has set up on her numerical keys the number of the desired line, ground is connected to conductor 131 thus closing a circuit over the upper left contact of cam 132 to battery through the winding of magnet 110 for advancing the sequence switch into position 3. As switch 110 leaves position 2, lamp 116 becomes extinguished and an interrupted circuit is established from battery through the green-capped lamp 133, over upper contacts of cam 117 to ground through the contacts of interrupter 134 and lamp 133 then flickers. Ground is also removed from leads 123 and 125 and ground is again applied to the holding lead 130.

When sequence switch 110 reaches position 3 and registration is completed, a circuit is established from battery through the lower winding of relay 109, upper right contact of cam 111, upper right contact of cam 112, lead 125, through the stepping relay, not shown, of sender 100 to ground. Relay 109 upon operating closes a circuit for advancing sequence switch 110 into position 5 which may be traced from battery through the winding of magnet 110, lower left contact of cam 122, upper front contact of relay 109 to ground at the left contacts of cam 135. After the sequence switch leaves position 4, relay 109 remains locked over its lower winding, the left contacts of cam 128, the inner lower front contact of relay 109, the right contacts of cam 112 to ground on lead 125. With relay 109 operated and the sequence switch in position 5, a circuit is established for the up-drive magnet 136 extending from battery, winding of magnet 136, lower contacts of cam 137, upper front contact of relay 109 to ground at the left contacts of cam 135. Magnet 136 advances the brush shaft of selector switch 150 in a brush selecting movement causing as it advances the intermittent application of ground over brush 138, commutator segment 139, the lower left contact of cam 111, the upper right contact of cam 112 to lead 125 thereby causing the intermittent shunting down of the sender stepping relay. Relay 109, however, is held energized. When the sender is satisfied with respect to the registration set up by the operator, the lead 125 is opened at the sender and as soon as brush 138 engages the next insulating portion of commutator segment 139, relay 109 releases opening the circuit of the up-drive magnet 136 to arrest further movement of the brush shaft and closing a circuit for advancing the sequence switch into position 6. This circuit may be traced from battery, through the winding of magnet 110, the lower right contact of cam 122, the upper back contact of relay 109 to ground at the left contacts of cam 135. In position 6 a circuit is established from battery, through the winding of trip magnet 140, the upper left contact of cam 127 to ground at the right contact of cam 126 for operating magnet 140 preparatory to tripping the set of brushes selected through the brush selection movement of switch 150.

With the sequence switch in position 6, relay 109 again operates over the circuit previously traced to lead 125 and closes the previously traced circuit for advancing the sequence switch into position 7. With the sequence switch in position 7 and relay 109 operated, the circuit of the

up-drive magnet 136 is again established for advancing the selector brush shaft in a group selection movement, relay 109 again locking itself to ground on lead 125 after the sequence switch leaves position 6. During the initial portion of the group selection movement with trip magnet 140 operated, the selected set of brushes is tripped and as the brush shaft further advances, ground is intermittently connected over brush 141, commutator segment 142, the lower right contact of cam 111, the upper right contact of cam 112 to lead 125 thus intermittently shunting down the sender stepping relay. Relay 109, however, remains operated. When the sender is satisfied the lead 125 is opened at the sender and as soon as brush 141 engages the next insulated portion of segment 142, relay 109 releases opening the circuit of the up-drive magnet 136 to arrest further group selection movement of the selector brush shaft and closing the previously traced circuit for advancing the sequence switch into position 8.

With the sequence switch in position 8, relay 109 operates in a local circuit extending from battery, through its upper winding to ground over the lower left and upper right contacts of cam 118 and closes the previously traced circuit for advancing the sequence switch into position 9. If the first trunk of the selected group is busy there will be ground on the test terminal thereof and a holding circuit will be established from such ground, over test brush 143, the upper right and lower left contacts of cam 128, the inner lower front contact of relay 109, the lower right contact of cam 112, the upper right contact of cam 111 to battery through the lower winding of relay 109. With relay 109 operated when the sequence switch reaches position 9, the previously traced circuit for the up-drive magnet 136 is closed for advancing the selector brush shaft in a trunk hunting movement. As soon as an idle trunk is found the test brush encounters an ungrounded test terminal and the previously traced holding circuit for relay 109 is opened. Relay 109, however, remains locked over a second holding circuit extending from battery, through its upper winding, the lower contacts of cam 118, centering commutator segment 144, brush 145, the upper left and lower right contacts of cam 137, the upper front contact of relay 109 to ground over the left contacts of cam 135 until the selector brushes become centered on the terminals of the idle trunk. Relay 109 then releases opening the circuit of the up-drive magnet 136 and closing the previously traced circuit for advancing the sequence switch into position 11 which is the selection beyond position. Until the sequence switch leaves position 10 with relay 109 released, busy ground potential is connected to the sleeve terminal 146 of the selected trunk over the upper right and lower left contacts of cam 128, the inner lower back contact of relay 109, the lower right contact of cam 127 to ground at the right contact of cam 126. As soon as the sequence switch reaches position 10, ground is applied to terminal 146 over brush 143 and the right contacts of cam 128.

With the sequence switch in position 11 a fundamental control circuit is established from battery at the final selector 200 over trunk conductor 201, tip terminal 147 and brush 148, of selector 150, upper right and lower left contacts of cam 149, lead 125, through the winding of the sender stepping relay returning over lead 151, lower contacts of cam 152, ring brush 153

and terminal 154 of selector 150, trunk conductor 202 to ground at the final selector 200. In the well-known manner the final selector is now controlled from the sender over the fundamental circuit in its brush, tens and units selection movements. It will be assumed that the final selector is thus set upon the terminals of a subscriber's line which has been removed from service or transferred to another portion of the exchange and that the intercepting trunk shown in Fig. 2 has been connected to such terminals in lieu of the subscriber's line. When therefore, the brushes of the final selector engage the terminals of the intercepting trunk, ground is applied from the final selector over brush 203, terminal 204, upper back contact of relay 205, through the winding of relay 206 and resistance 207 in parallel to battery. Relay 206 operates lighting the trunk lamp 435 over a circuit extending from battery, over the lower contact of relay 206, lower back contact of relay 205, conductor 208 to ground through the lamp 435.

When the sender has completed the setting of the final selector, ground is applied at the sender to lead 131 and with the sequence switch in position 11, a circuit is completed over the upper left contact of cam 132 to battery through the winding of the sequence switch magnet 110 thereby advancing the sequence switch into position 12. Since relay 103 is still operated, a circuit is now established from battery, through the lower winding of relay 109, upper right contact of cam 111, lower left contact of cam 112, contact of relay 103, right contacts of cam 107 to ground at the front contact of relay 106 and relay 109 operates closing the previously traced circuit for advancing the sequence switch into position 14. As soon as the sequence switch leaves position 12, the previously traced circuit of relay 104 is opened at the contacts of cam 119 and relay 104 releases again connecting the windings of relay 103 to the toll operator's cord circuit thus again lighting the calling supervisory lamp at the cord circuit as a ringing signal.

The intercepting operator upon noting the illumination of the trunk lamp 435 inserts plug 401 into jack 400 thereby establishing a circuit from ground, through the upper winding of relay 205, conductor 209, sleeves of jack 400 and plug 401 to battery through the winding of relay 402 and the winding of marginal relay 403 in series and to battery in parallel therewith through the noninductive winding 404 of relay 403. Relay 205 operates in this circuit locking over its lower winding and lower front contact to battery at the lower front contact of relay 206 and at its lower back contact opens the previously traced circuit for lamp 435 thereby extinguishing the lamp. At the cord circuit relay 402 operates, but due to the high resistance of the upper winding of relay 205, marginal relay 403 does not operate. Relay 402 upon operating closes a circuit for the supervisory lamp 405 extending from battery, over the inner contact of relay 402, resistance 406, back contact of relay 407, back contact of relay 408 to ground through lamp 405 and in parallel therewith from battery over the inner contact of relay 402, resistance 406, back contact of relay 407, back contact of relay 408, lower back contact of relay 409, inner normal contacts and winding of relay 410 to ground at the lower right normal contact of key 411. Relay 410 locks in a circuit from battery at the inner contact of relay 402, inner upper alternate contacts and winding of relay

410 to ground at key 411. The operator now throws her talking key 411 to the right, opening the circuit of relay 410 which releases, and closing an obvious circuit for relay 417 which in turn establishes a circuit from battery, over the inner contact of relay 402, inner lower contact of relay 417, conductor 436 to ground through the winding of relay 339. Relay 339 operates and awaits the application of ringing current from the incoming selector 150.

The toll operator noting the relighting of her calling supervisory lamp as a ringing signal, depresses the ringing key of her cord circuit thereby applying ringing current to the incoming-selector trunk circuit over a path which may be traced in part over the tip of jack 101, upper left winding of repeating coil 105, condenser 155, ringing relay 156, lower left winding of repeating coil 105 to the ring of jack 101. Relay 156 responds to this ringing current and closes an obvious circuit through the lower winding of relay 104 and a circuit extending from ground at the contact of relay 156, back contact of relay 157, upper normal contacts and winding of relay 158 to battery over the lower right and left contacts of cam 159. Relays 104 and 158 both operate, relay 104 closing a holding circuit for relay 103 and disconnecting the windings of relay 103 from the toll operator's cord circuit to thereby extinguish the calling supervisory lamp at said cord circuit. Relay 158 upon operating locks over its inner upper alternate contacts to ground at the back contact of relay 160 and at its upper front contact closes an obvious circuit for relay 161. With relays 158 and 161 both operated, ringing current and battery are alternately connected from the ringing source 162 and from battery through interrupters 163 and 165, over the contacts of cam 164, winding of relay 160, inner lower front contact of relay 158, lower front contact of relay 161, upper left and right contacts of cam 152, brush 153, terminal 154, ring brush 210 and terminal 211 of final selector 200, trunk conductor 212, rings of jack 400 and plug 401, lower normal contact of key 414, lower left winding of repeating coil 413, inner lower back contact of relay 403, middle lower back contact of relay 409, middle lower contact of relay 417, conductor 437, back contact of relay 340, resistance 341, winding of relay 342 to ground at the outer contact of relay 339.

Relay 342 responds to the ringing current but due to the high resistance of relay 342, relay 160 at the incoming selector does not operate at this time. Relay 342 upon operating closes a circuit from ground at its contact through the contacts of interrupter 343, back contact of relay 344 to battery through the winding of relay 345. Relay 345 operates and locks through its winding, the winding of relay 344, the outer front contact of relay 345 to ground at the contact of relay 342, but relay 344 being shunted does not operate until the interrupter 343 opens its contacts. Relay 345 at its inner contact closes an obvious holding circuit for relay 342 and thereby increases the current flowing over the ringing circuit extending to the incoming selector 150 to such an extent as to cause the operation of relay 160 thereat. During the application of ringing current from the source 162, as previously described, an audible ringing signal is passed back to the toll operator from the source 162 through interrupter 163, the contacts of cam 164, winding of relay 160, lower front contact of relay 158, lower front contact of relay 161, condenser 166, lower right winding of

repeating coil 105, lower winding of relay 167 to battery and thence inductively to the toll operator's telephone set over the left windings of repeating coil 105.

5 When the relay 345 operates as previously described in response to the operation of relay 342 and reduces the resistance of the ringing circuit through the winding of relay 160, relay 160 operates, opening the locking circuit of relay 158 which
10 in turn releases relay 161 and opens the ringing circuit from the source 162. A supervisory circuit is now closed from ground through the upper winding of supervisory relay 167, upper right winding of repeating coil 105, winding of relay
15 168, upper normal contacts of relay 161, upper contacts of cam 149, brush 148 and terminal 147, brush 213 and terminal 214, trunk conductor 215, tips of jack 400 and plug 401, upper normal contact of key 414, upper left winding of repeating
20 coil 413, upper back contact of relay 403, lower low resistance winding of relay 408, inner lower back contact of relay 409, upper back contact of relay 441, to battery through resistance 440 and, from battery through the lower winding of relay 167,
25 the lower right winding of repeating coil 105, lower back contact of relay 161, upper left and right contacts of cam 152 brush 153 and terminal 154, brush 210 and terminal 211, trunk conductor 212, rings of jack 400 and brush 401, lower normal contact of key 414, lower left winding of re-
30 peating coil 413, lower back contact of relay 403, intermediate lower back contact of relay 409, resistance 442 to ground at the inner upper back contact of relay 441. Relay 168 at the incoming selector and supervisory relay 408 at the inter-
35 cepting operator's position operate in the circuit just traced, but supervisory relay 167 at the incoming selector does not operate at this time. Relay 408 upon operating, opens the circuit of the
40 supervisory lamp 405 at its back contact thereby extinguishing the lamp.

When relay 344 operates and the interrupter contacts 343 again close, relay 340 operates in a circuit extending from battery through its wind-
45 ing, the front contact of relay 344, contacts of interrupter 343 to ground at the front contact of relay 342. Relay 340 upon operating locks to ground at the front contact of relay 339, opens the initial operating circuit of relay 342 and closes a
50 circuit extending from ground at its left contact through the upper winding of relay 300 to battery. Relay 300 operates and a talking path is thereupon established from the upper right winding of repeating coil 413, inner upper right con-
55 tact of key 411, conductor 419, upper contact of relay 300, right windings of repeating coil 301, condenser 302, lower contact of relay 300, conductor 420, inner lower right contact of key 411 to the lower right winding of repeating coil 413.
60 Assuming that the operator's telephone set 303 is plugged up, the talking path just traced is inductively associated therewith through the left windings of repeating coil 301.

With relay 168 at the incoming selector now
65 operated, tone current is now applied from a source of tone over the upper back contact of relay 157, the contact of relay 168, the upper normal contacts of relay 161, the upper contacts of cam 149 and thence as traced through the upper
70 left winding of repeating coil 413 to battery through resistance 440. This tone current is induced into the right windings of repeating coil 413 and then reaches the intercepting operator's headset 303, over the circuit previously traced.
75 The operator upon hearing this tone knows that

the call is an intercepted call originated at a toll operator's position and that she is not to complete it. She then depresses key 348 thereby establishing a circuit from ground over conductor 349, lower front contact of relay 417 to battery through
80 the lower winding of relay 441. Relay 441 operates and locks from battery at the lower front contact of relay 402, lower back contact of relay 403, upper winding and inner upper front contact of relay 441 to ground, removes battery through
85 resistance 440 from the circuit previously traced through the winding of relay 168 and the upper winding of relay 167 to ground, removes ground through resistance 442 from the circuit previously traced through the lower winding of relay 167
90 to battery, and establishes a loop supervisory circuit extending from ground through the upper winding of relay 167, the winding of relay 168, thence as traced through the lower winding of relay 408, inner lower back contact of relay 409,
95 upper front contact of relay 441, resistance 449, lower back contact of relay 409 and thence as previously traced to battery through the lower winding of relay 167.

Supervisory relay 408 at the cord circuit re-
100 mains operated over this circuit and supervisory relay 167 now operates closing a circuit for relay 157 extending from battery, over the upper contacts of cam 159, winding of relay 157, contact of relay 167, contact of relay 103, right contacts
105 of cam 107 to ground at the front contact of relay 106. Relay 157 operates closing an obvious shunt around the winding of relay 168 which now releases to disconnect the source of tone current. Relay 167 upon operating also establishes a cir-
110 cuit for reoperating relay 104, which relay released as soon as the toll operator released the ringing key and reconnected the windings of relay 103 to the toll operator's cord circuit for again lighting the calling supervisory lamp of the toll
115 cord circuit. The circuit for relay 104 may be traced from battery, through the upper winding of relay 104, contact of relay 167, contact of relay 103, right contacts of cam 107 to ground at the front contact of relay 106. Relay 104
120 upon reoperating disconnects the windings of relay 103 from connection with the toll cord circuit thereby extinguishing the cord lamp as a signal that the intercepting operator is connected for talking. The toll operator and the
125 intercepting operator may now converse and the intercepting operator may give the toll operator any necessary information for reaching the subscriber's line to which a connection has been attempted.
130

Should the intercepting operator desire to recall the toll operator after the toll operator has disconnected her headset from the toll cord circuit, she may do so by depressing the key 414. The operation of key 414 opens the supervisory
135 circuit previously traced through the windings of relay 167 thereby releasing relay 167 which in turn releases relay 104. Relay 104 upon releasing reconnects the windings of relay 103 to the toll cord circuit and thereby causes the lighting of the calling supervisory lamp thereat. When key 414 is released, relays 167 and 104 again operate and the cord circuit lamp is extinguished. Thus, by intermittently operating
140 key 414 the toll cord supervisory lamp may be flashed to signal the toll operator.
145

After having given the necessary information, the intercepting operator removes plug 401 from jack 400 thereby releasing all operated relays of her cord circuit, releasing relay 205 of the inter-
150

cepting trunk circuit and opening the circuit of supervisory relay 167 at the incoming selector 150. Relay 167 releases in turn releasing relays 157 and 104, relay 104 again connecting the wind-
 5 ings of relay 103 to the toll operator's cord circuit thereby causing the lighting of the calling supervisory lamp thereof as a disconnect signal. The toll operator noting the signal withdraws her cord plug from jack 101 thereby releasing
 10 relay 103 which in turn releases relay 106. A circuit is now established from ground over the back contact of relay 106, upper right contact of cam 132 to battery through the winding of magnet 110 for advancing the sequence switch
 15 out of position 14 into position 18.

With the sequence switch in position 18 a circuit is established from battery, through the winding of down-drive magnet 169, lower left contact of cam 127 to ground at the right con-
 20 tact of cam 126 for driving the incoming selector brush shaft into normal position. Upon reaching normal a circuit is established from ground over the right contact of cam 126, upper right contact of cam 127, brush 145, normal commu-
 25 tator segment 170, lower left contact of cam 132 to battery through the winding of magnet 110 for advancing the sequence switch into normal position. When the sequence switch leaves po-
 30 sition 16 1/4 ground is removed from the test brush 143 at the upper right contact of cam 128 and the final selector then restores in the well-known manner releasing relay 206 of the intercepting trunk circuit and restoring the intercepting trunk circuit to normal condition. All apparatus
 35 employed in the connection between the toll and intercepted operator's positions is now in normal condition.

Should the final selector 200 be released while the intercepting operator's cord circuit plug 401
 40 is still in the jack 400 and relay 205 is thus held operated after relay 206 releases, the intercepting trunk circuit is held busy until the intercepting operator disconnects from the intercepting trunk circuit, by busy battery potential applied
 45 to the final sleeve multiple 204 over the upper front contact of relay 205, the upper back contact of relay 206, resistance 216 to battery and over the inner upper front contact of relay 205 through resistance 217 to ground.

Should the ring conductor 212 of the intercepting trunk become grounded indicating an unstandard condition, a circuit will be established over the inner lower back contact of relay 205, the lower back contact of relay 206 to battery
 55 through the winding of relay 218. Relay 218 will thus operate closing an obvious circuit for relay 219. Relay 219 upon operating locks over its inner upper front contacts to ground over normal contacts of key 221, closes an obvious circuit
 60 for lamp 220 which indicates that the particular trunk circuit is in an unstandard condition, closes a circuit from ground over the lower normal contact of key 221 and the lower front con-
 65 tact of relay 219 to the floor alarm circuit 222, and closes a circuit from ground over the upper normal contact of key 221 and the upper front contact of relay 219 for the aisle pilot signal 223. The maintenance man upon hearing the alarm and noting the signal 223 operates key 221 there-
 70 by lighting lamp 224, opening the locking circuit of relay 219 and opening the circuits of the floor alarm and aisle alarm signals. Lamps 220 and 224 are now both lighted until the trouble condition is removed when relays 218 and 219 will
 75 release. The floor and aisle alarm signals are

now again operated over back contacts of relay 219 and alternate contacts of key 221. Noting the reoperation of the alarm signals with lamp 224 operated, the maintenance man restores key 221 extinguishing lamp 224 and the floor and
 80 aisle alarm signals.

What is claimed is:

1. In a telephone exchange system, automatic switching mechanism for extending a connec-
 85 tion to a desired subscriber's line, terminals in the terminal banks of said switching mechanism to which no subscribers' lines are connected, an operator's position, trunk lines extending from said terminals to said operator's position, means for controlling said mechanism to connect with
 90 one of said trunk lines, a source of tone current in said switching mechanism, a cord circuit at said operator's position for connection with said trunk line, means operable upon the connection of said cord circuit with said trunk
 95 line for causing the transmission of a tone signal from said source to said operator's position, and means in said switching mechanism controlled by said operator for disconnecting said source of tone.

2. In a telephone exchange system, selector switches, a trunk circuit selectable by said switches and terminating at an operator's position, a cord
 100 circuit at said position for connection with said trunk circuit, a source of tone current associated with one of said selector switches, a relay in said switch responsive to the connection of said cord circuit with said trunk circuit for connect-
 105 ing said source of tone current to said operator's position, a key in said cord circuit, a second relay in said switch, and means controlled by said key for operating said second relay to disconnect said source of tone current.

3. In a telephone exchange system, selector switches, a trunk circuit selectable by said switches
 115 terminating at an operator's position, a cord circuit at said position for connection with said trunk circuit, a source of tone current associated with one of said selector switches, a first relay connected in series with one of the talking con-
 120 ductors of said switch and operable from a source of operating current normally connected to one of the talking conductors of said cord circuit upon the connection of said cord circuit to said trunk circuit for applying said source of tone cur-
 125 rent to said operator's position, a battery bridge relay in said switch, a key in said cord circuit, a relay in said cord circuit controlled by said key for disconnecting said source of operating current at said cord circuit and for establishing
 130 a low resistance bridge across the talking conductors of said cord circuit for operating said battery bridge relay in said switch, and means controlled by said latter relay for disconnecting said source of tone current.

4. In a telephone exchange system, selector switches, a trunk circuit selectable by said switches and terminating at an operator's position, a cord
 140 circuit at said position for connection with said trunk circuit, a source of tone current associated with one of said selector switches, a first relay connected in series with one of the talking con-
 145 ductors of said switch and operable from a source of operating current normally connected to one of the talking conductors of said cord circuit upon the connection of said cord circuit to said trunk circuit for applying said source of tone current to said operator's position, a battery bridge relay in said switch, a key in said cord circuit, a relay in
 150 said cord circuit controlled by said key for dis-

connecting said source of operating current at said cord circuit and for establishing a low resistance bridge across the talking conductors of said cord circuit for operating said battery bridge relay in said switch, and a relay controlled by said latter relay for disconnecting said source of tone current and for shunting said first relay.

5. In a telephone exchange system, selector switches, a trunk circuit selectable by said switches terminating at an operator's position, a cord circuit at said position for connection with said trunk circuit, a source of tone current associated with one of said selector switches, a first relay connected in series with one of the talking conductors of said switch and operable from a source of operating current normally connected to one of the talking conductors of said cord circuit upon the connection of said cord circuit to said trunk circuit for applying said source of tone current to said operator's position, a battery bridge relay in said switch, a key in said cord circuit, a relay in said cord circuit controlled by said key for disconnecting said source of operating current at said cord circuit and for establishing a low resistance circuit extending through the battery bridge relay in said switch, and means controlled

by said latter relay for disconnecting said source of tone current.

6. In a telephone exchange system, selector switches, a trunk circuit selectable by said switches and terminating at an operator's position, a cord circuit at said position for connection with said trunk circuit, a source of tone current associated with one of said selector switches, a first relay connected in series with one of the talking conductors of said switch and operable from a source of operating current normally connected to one of the talking conductors of said cord circuit upon the connection of said cord circuit to said trunk circuit for applying said source of tone current to said operator's position, a battery bridge relay in said switch, a key in said cord circuit, a relay in said cord circuit controlled by said key for disconnecting said source of operating current at said cord circuit and for establishing a low resistance circuit extending through the battery bridge relay in said switch, and a relay controlled by said latter relay for disconnecting said source of tone current and for shunting said first relay.

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