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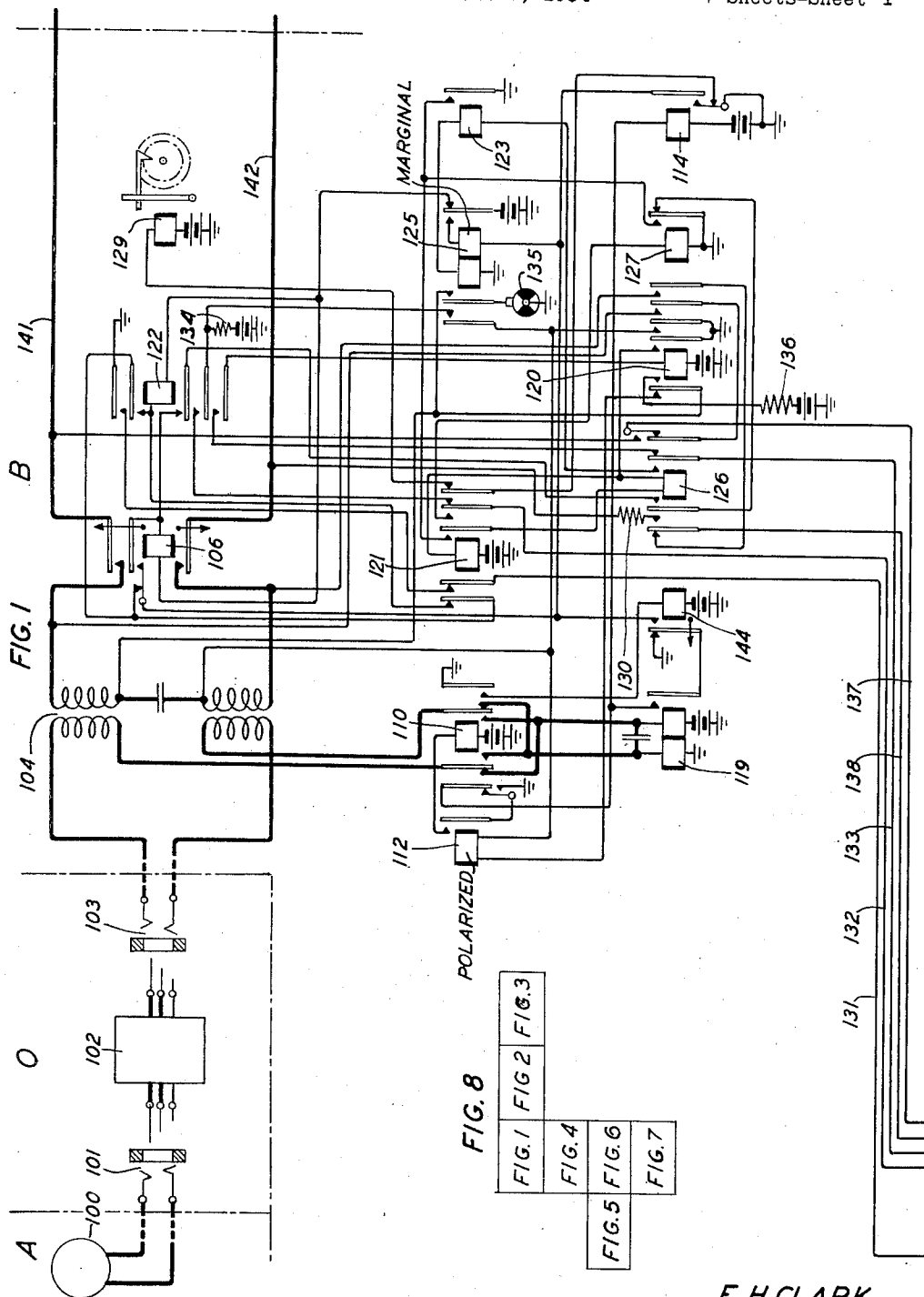
E. H. CLARK ET AL

2,021,291

TELEPHONE SYSTEM

Filed June 9, 1934

7 Sheets-Sheet 1



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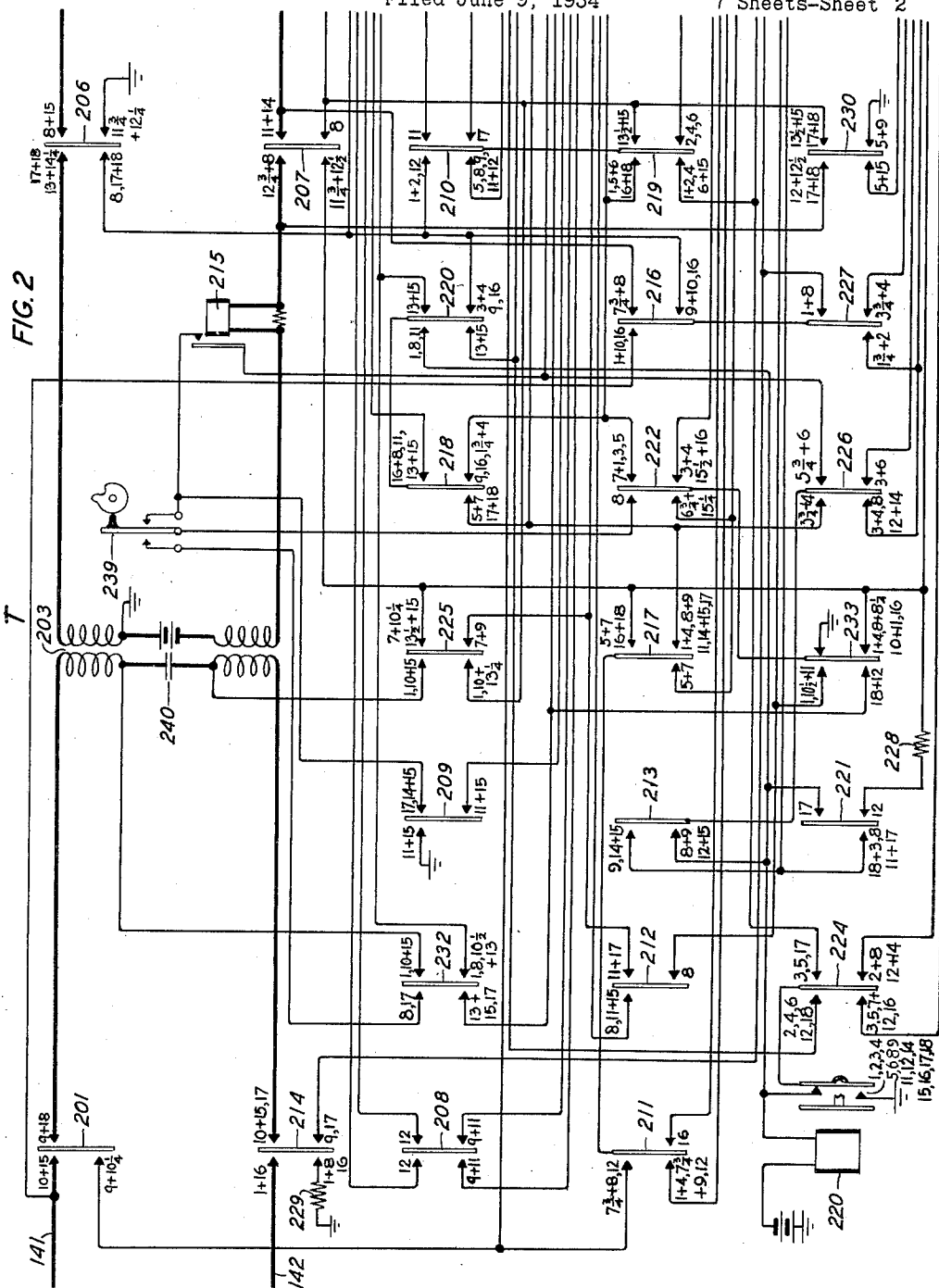
E. H. CLARK ET AL

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TELEPHONE SYSTEM

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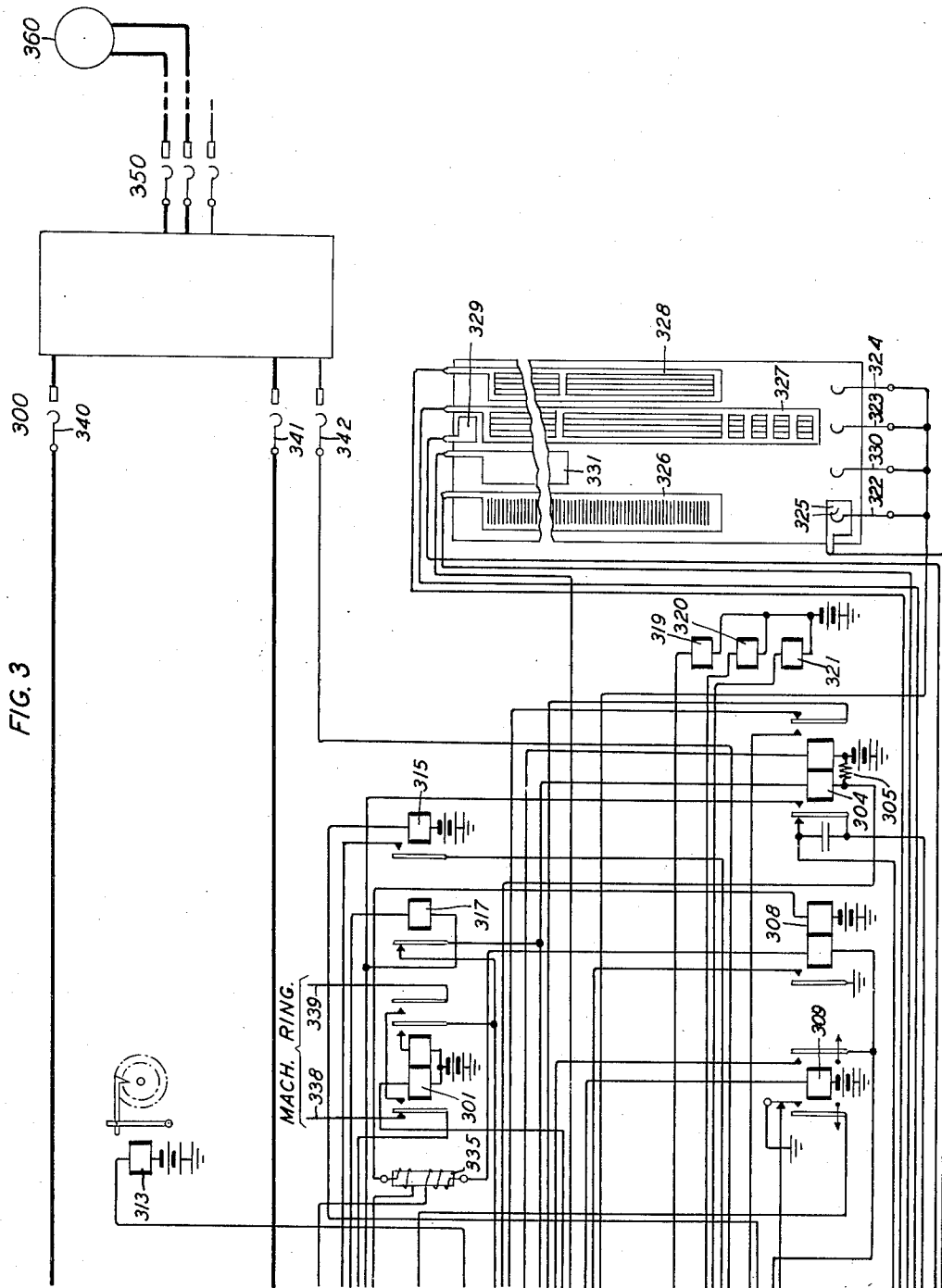
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TELEPHONE SYSTEM

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7 Sheets-Sheet 3



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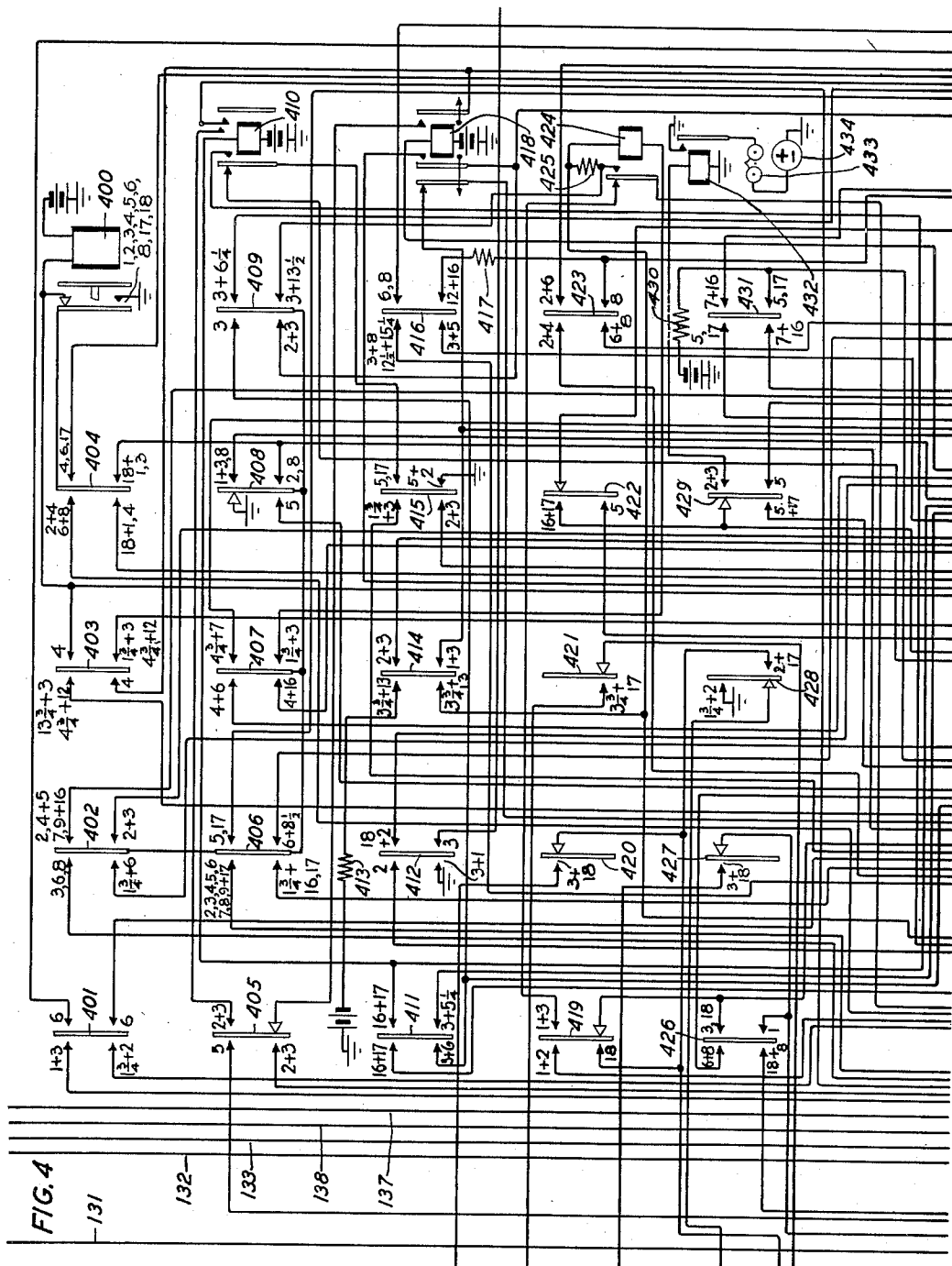
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TELEPHONE SYSTEM

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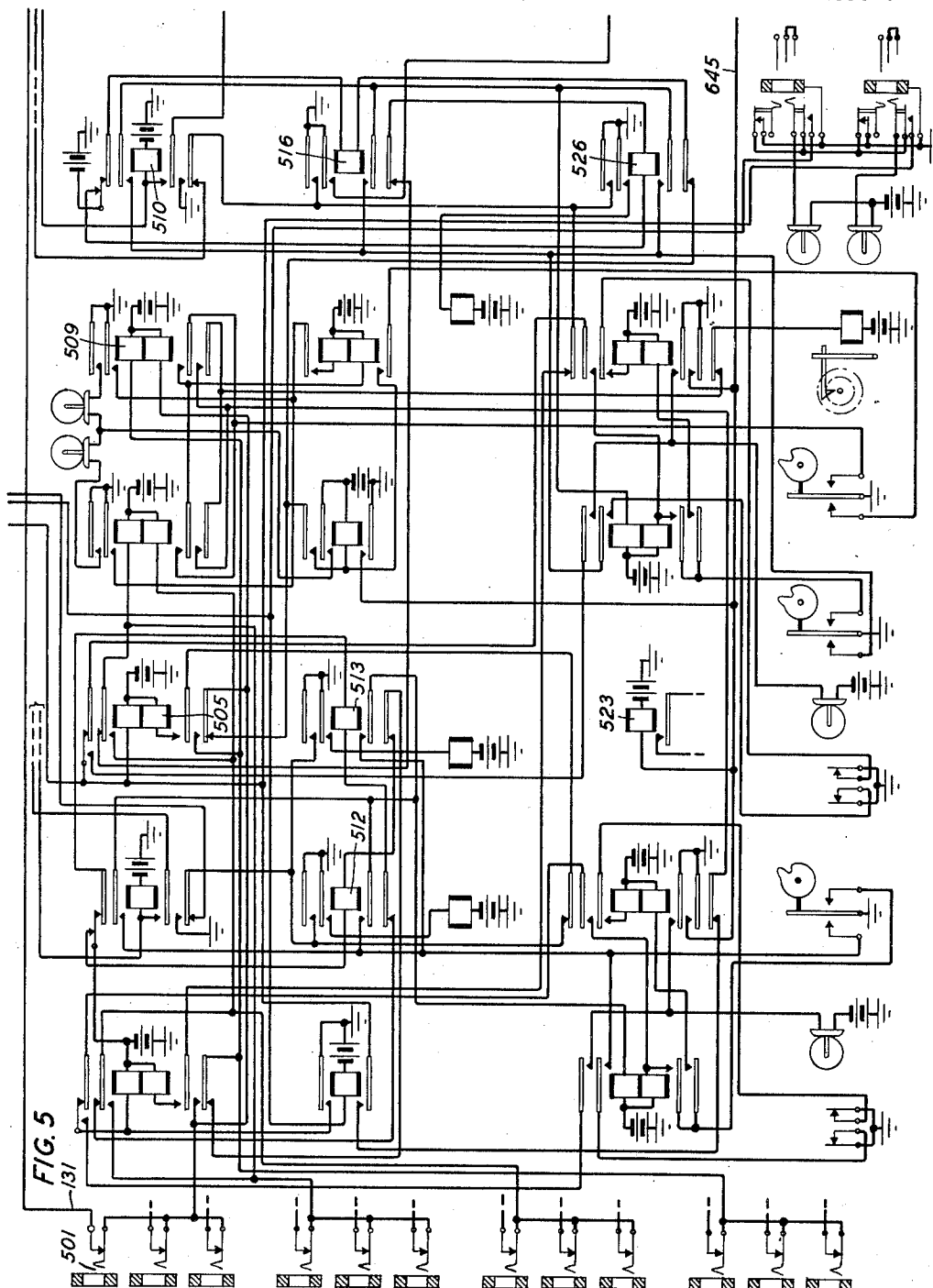
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TELEPHONE SYSTEM

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7 Sheets-Sheet 5



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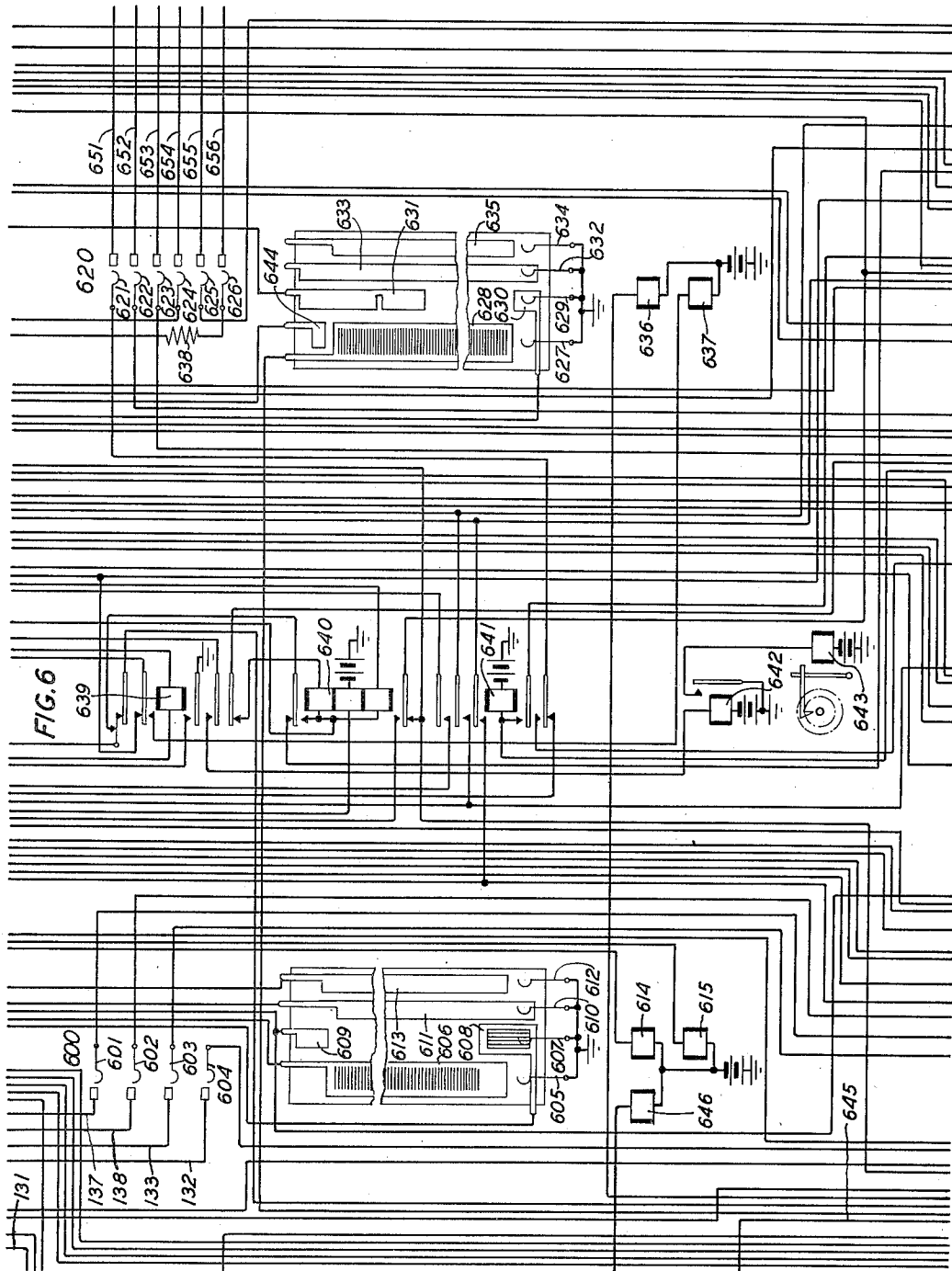
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TELEPHONE SYSTEM

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7 Sheets-Sheet 6



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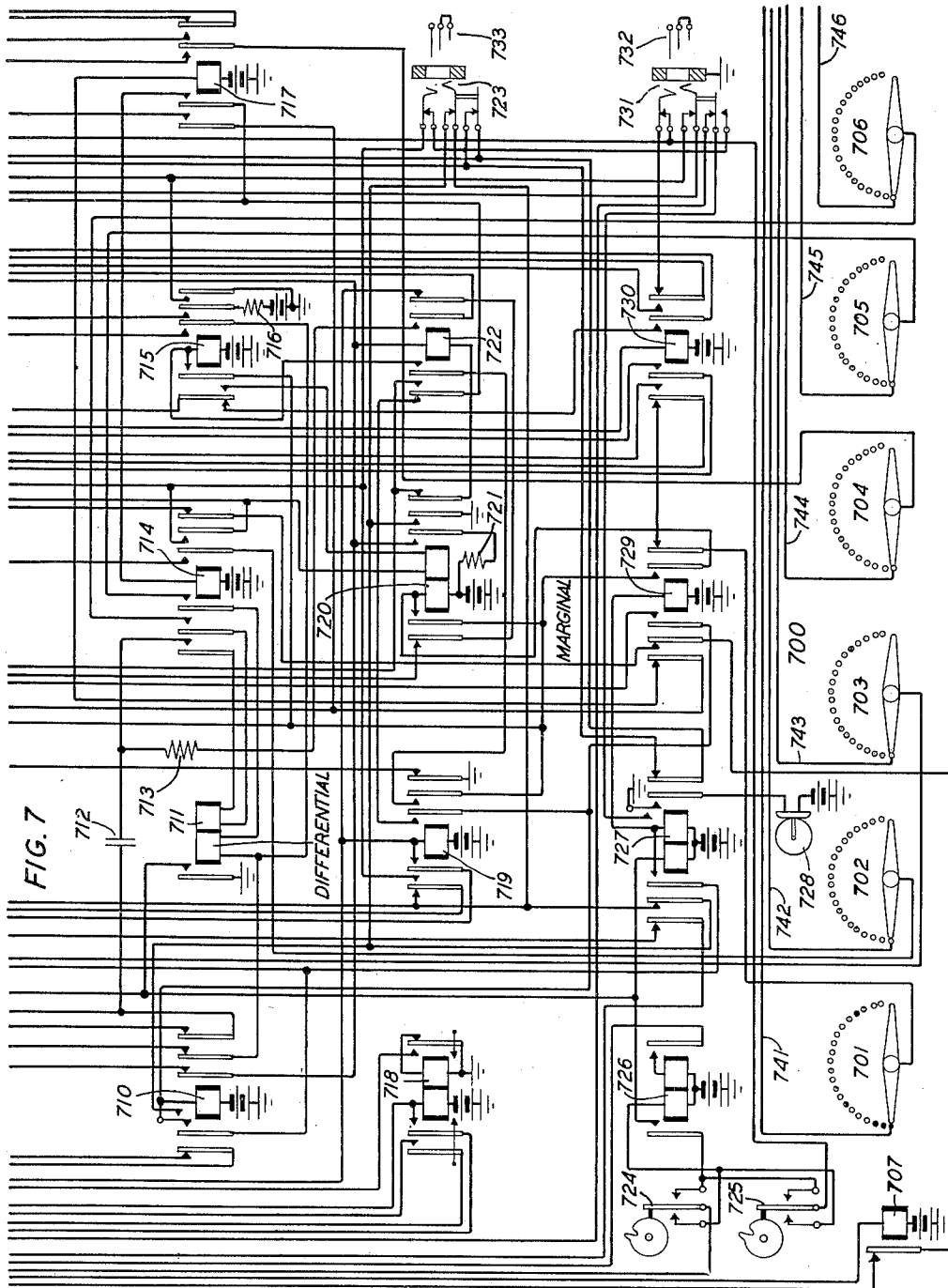
E. H. CLARK ET AL

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TELEPHONE SYSTEM

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7 Sheets-Sheet 7



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2,021,291

TELEPHONE SYSTEM

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Application June 9, 1934, Serial No. 729,772

12 Claims. (Cl. 179-27)

This application relates to telephone systems and more particularly to telephone systems in which the establishment of connections involves more than one operator.

5 More specifically, the invention relates to an improvement on the operator's equipment disclosed in Patent No. 1,753,348 granted to J. B. Newsom, April 8, 1930. The equipment of that patent is arranged for use where the operator's equipment and the automatic switches controlled thereby are located in the same office. Small offices in a territory serving a metropolitan area may very conveniently be served by dial equipment but the presence of one or two operators is usually necessary to assist in the completion of calls. That small groups of operators are uneconomical is well known and the circuits forming the subject matter of the present invention have been designed to permit the grouping of operators to control the completion of calls from manual to dial offices in one central office at which no switching takes place.

In the previous arrangement where control equipment was connected directly with the incoming selector switch, the holding circuit for the switch is available throughout the establishment of the connection. In the present case, however, since the trunk conductors must be used in controlling the operation of the selector switches, the holding circuit can only be established after selections have been completed. A relay is therefore connected to the trunk at the selector switch following the completion of selections and the operation of this relay is necessary both to establish the talking condition and to permit the release of the connection. In the control equipment, therefore, means is provided to cause the preparation of a holding circuit by the trunk, but to reduce the interval before the completion of this holding circuit, a temporary holding circuit is provided in the control circuit which overlaps the closure of the holding circuit by the trunk circuit. Means is also provided to cause the closure of this temporary holding circuit in case of trouble so that the selector may be released.

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

Fig. 1 shows the relay equipment of a trunk circuit;

Figs. 2 and 3 show the incoming selector in which the trunk of Fig. 1 terminates;

55 Figs. 4 to 7 show the link circuit for connect-

ing the operator's position and sender with the trunk equipment; and

Fig. 8 shows the manner in which the remaining figures are to be arranged.

Equipment at four telephone offices is disclosed, that is, equipment at a local office A, at a manual tandem office O, a centralized office B and a terminating office T. The centralized equipment at office B may be employed in the completion of calls, which have been extended from the calling substation 100 to an operator's position at the office O and by means of jack 101, cord 102 and jack 103 to the trunk circuit at the centralized office B. The establishment of a connection with the trunk circuit causes the link circuit of Figs. 4 to 7 to associate itself with the trunk and with a position circuit and a sender. The link circuit first connects the incoming end of the trunk with the position circuit so that the manual operator may give the wanted number 20 to the B operator. It then connects the position circuit with the sender to permit the registration of the number in the sender and finally connects the sender with the outgoing end of the trunk so that the sender may control the incoming selector of Figs. 2 and 3 and the final selector 350 in the selection of the wanted line 350. The centralized equipment may also be used for the completion of calls from a toll operator's position. Certain features of the circuits embodying the present invention are disclosed and claimed in the application of J. F. Dahl, Serial No. 729,782 filed June 9, 1934. Since the sender and position circuits have been disclosed and described in detail in the Dahl application, they have been omitted from the present disclosure and reference is made to the Dahl application for such details.

The subscriber at substation 100 in originating a call for a subscriber at substation 360 will be connected by jack 101 with the manual tandem A operator's position having access through the centralized B office with the office at which substation 360 is located.

When the tandem operator inserts the calling plug of her cord 102 in the jack 103 leading to the trunk circuit of Fig. 1, a circuit is closed from battery through the right winding of relay 119, inner left back contact of relay 110, upper left winding of repeating coil 104, over the tip conductor of the incoming inter-office trunk and through the repeating coil and supervisory relay (not shown) in the tandem operator's cord, back over the ring conductor to the lower left winding of repeating coil 104, right back contact of

relay 110, to ground through the left winding of relay 119. Relay 119 closes a circuit for relay 114, from ground at the back contact of relay 144. Relay 114 connects ground over its front contact, upper normal contact of relay 106, outer left back contact of relay 121, winding of relay 122 to battery at the right back contact of relay 125. Relay 122 locks over its inner upper front contact to its operating ground independent of relay 121.

The operation of relay 122 initiates the association of the trunk circuit with the B operator's equipment. It therefore connects ground over its outer upper contact and the inner left back contact of relay 121 to the start conductor 131. It also connects battery through resistance 134 over its middle lower front contact and the inner right back contact of relay 121 to conductor 132 which terminates in the test terminal of trunk finder 600. In addition, relay 122 closes a circuit from battery through the winding of relay 120 over the outer lower contact of relay 122, inner right back contact of relay 126 to conductor 133 which likewise terminates in the bank of finder 600. The connection of ground to conductor 131 completes a circuit which extends over the normal contact of jack 501, lower back contact of relay 505, lower back contact of relay 526 through the winding of relay 516 to battery over the upper back contacts of relay 510. Relay 516 operates in this circuit, closing an obvious circuit for the trip magnet 646 of the trunk finder 600. It also closes a circuit from ground over its outer upper front contact, lower back contact of relay 513, and thence over the lower contacts of cam 426 to the winding of relay 719 and battery to initiate the operation of the link circuit.

The start circuit of Fig. 5 closely resembles that disclosed in the above identified Newsom patent and serves to prevent interference between calls originating in close succession and acts in case of trouble to delay the handling of a call, to sound an alarm and automatically disable the group of link circuits on which the trouble occurred.

When relay 719 is operated, it locks in a circuit from battery through its winding, over its inner left front contact, right contacts of cam 419, back contact of relay 424 to ground over commutator strip 611 and brush 610. Another holding circuit is also closed for relay 719 over the lower right and upper left contacts of cam 419 which extends to ground over the commutator strip 606 and brush 605 after the selector moves off-normal for the purpose of centering the brushes of the finder properly. With relay 719 operated, a circuit is closed from battery through the winding of sequence switch magnet 400, lower right contact of cam 404, outer left front contact of relay 719, upper right and lower left contacts of cam 412 to ground, advancing sequence switch 400 from position 1. With sequence switch 400 in position 2, a circuit is closed from battery through the winding of the updrive magnet 614, upper contacts of cam 412, outer left front contact of relay 719, over the lower right and upper left contacts of cam 408 to ground.

As the selector starts upward, ground is connected over brush 607 and commutator segment 608, left contacts of cam 401 to the winding of relay 510 and battery. Relay 510 locks over its inner lower front contact, left back contact of relay 727 to ground over the upper left and lower right contacts of cam 415 and is therefore held operated until after the trunk has been found.

Relay 510 in operating disconnects battery from the windings of relays 516 and 526, thereby rendering the start circuit unresponsive to calls over other trunks of this group. Calls over trunks of the groups served by relays 512 or 513 may be extended.

As the brushes of selector 600 move upward over the terminals leading to various trunk circuits, a test is made for the calling trunk which is marked by battery connected to conductor 132. When this is found, a circuit is completed from battery on conductor 132, brush 604, left back contact of relay 710, through the winding of relay 424 to ground over the lower right contact of cam 407. Relay 424 in operating opens one holding circuit for relay 719 and that relay releases when the brushes are properly centered, as indicated by the position of brush 605 on commutator strip 606. Relay 719 released, closes a circuit from battery, through the winding of sequence switch magnet 400, upper left contact of cam 404, left back contact of relay 719 to ground over the lower right and upper left contacts of cam 408, advancing sequence switch 400 to position 3. With sequence switch 400 in position 3 a circuit is closed from ground over the upper left contact of cam 409, right back contact of relay 720, winding of relay 722, over the inner right contact of relay 710 to brush 603, conductor 133, right back contact of relay 126, outer lower contact of relay 122 to the winding of relay 120 and battery. Relays 722 and 120 operate in this circuit.

The operation of relay 120 prepares the trunk circuit for the connection between the tandem operator's position and the B operator's position. For this purpose it closes a circuit from battery through resistance 136 over the left front contact of relay 120, upper right winding of repeating coil 104, middle right contact of relay 120, right normal contact of relay 126, conductor 137 to brush 601 of the trunk finder, and connects ground over its next to inner right contact through the lower right winding of repeating coil 104, outer right front contact of relay 120, left back contact of relay 126 to conductor 133 and brush 602. Relay 120 also opens the circuit of supervisory relay 112 to prevent its premature operation, and furthermore closes an obvious circuit for relay 121 which prepares a locking circuit for itself from battery through its winding and the winding of relay 126, inner right front contact of relay 121, to ground at either the front contact of relay 127 or the front contact of relay 123 depending upon which of these is operated, neither being operated at the present time. Relay 121 in operating, signals the link circuit that the operator's talking circuit has been established through the trunk circuit by transferring conductor 132 from battery through resistance 134, to ground through the winding of relay 127.

In the link circuit relay 722 which operates in series with relay 120 locks in a circuit from battery over conductor 133, brush 603, inner right back contact of relay 710, winding of relay 722, right back contact of relay 720, outer left front contact of relay 722 to ground over the upper right contact of cam 409. With sequence switch 400 in position 3, conductor 132 is extended over brush 604, left back contact of relay 710, through resistance 425 to ground at the lower right contact of cam 409 in parallel with the circuit previously traced through the winding of relay 424 to ground over the lower right contact of cam 407. Therefore, when relay 121 substitutes

ground for battery on conductor 132, relay 424 releases quickly, closing a circuit from battery through the winding of relay 719, lower left and upper right contacts of cam 426, right contacts of cam 419, back contact of relay 424 to ground over commutator strip 611 and brush 610. Relay 719 locks over its inner left front contact, right contacts of cam 419, back contact of relay 424 to ground on commutator strip 611.

As soon as sequence switch 403 arrived at position 2, a circuit was closed from battery through the winding of relay 418, lower back contact of relay 640, lower left contact of cam 409 to ground. Relay 418 in operating prepares the test circuit for the position finder by closing a circuit from battery through the middle winding of relay 640, upper left and lower right contacts of cam 403, lower winding of relay 640, left front contact of relay 418, lower left contact of cam 409 to ground. At the same time a branch of this circuit is extended from ground through the lower winding of relay 640, as traced, and thence through the upper winding of relay 640 over the lower back contact of relay 639, left back contact of relay 730, right back contact of relay 729, to brush 701 of switch 790 which has access to the operators' positions. Relay 418 also causes the operation of the position finder 700 by closing a circuit from ground over the lower left contact of cam 402, outermost upper contact of relay 639, upper back contact of relay 640, lower contact of jack 723, or the right back contact of relay 727, right front contact of relay 418, lower contacts of cam 405, back contact of stepping magnet 707, inner left back contact of relay 729, right back contact of relay 714 to the winding of relay 410 and battery. Relay 410 closes an operating circuit for magnet 707 which may be traced from battery through the winding of that magnet, over the right contacts of relay 410 to the upper right contact of cam 405 and thence over the operating circuit for relay 410 to ground. Magnet 707 opens the operating circuit for relay 410 which thereupon releases and in turn releases the magnet which advances position finder 700 to the next position. On the release of magnet 707, the circuit for relay 410 is reclosed and the magnet and relay operate alternately until an idle position is found.

An idle operator's position is indicated by the connection of battery through a resistance to conductor 741. When the idle position is found, the battery connected over conductor 741 to the terminal of brush 701 operates relay 640 which opens the operating circuits of relay 410 and magnet 707, bringing the position finder 700 to rest. Relay 640 locks in a circuit from battery on brush 701 through its upper winding as previously traced and thence over its upper front contact and the upper normal contact of relay 639 to ground at the lower left contact of cam 402. The operation of relay 640 opens the circuit of relay 418 which releases after an interval. When relay 418 closes its back contact, a circuit is completed from battery through the winding of relay 717, outer left back contact of relay 729, right contacts of cam 414, left back contact of relay 418, lower front contact of relay 640 to ground at the lower left contact of cam 409. Relay 717 locks in a circuit which extends through its winding over the left back contact of relay 729, outer left front contact of relay 717, over the lower contacts of cam 411, outer left front contact of relay 722 to ground at the upper right contact of cam 409. Relay 717 also closes a circuit from battery through the winding of relay

714, inner left front contact of relay 717, to ground over the upper right contact of cam 409. With relay 714 operated, a circuit is closed from battery through the winding of sequence switch magnet 400, lower right contact of cam 434, outer left front contact of relay 719, outer right front contact of relay 714 to ground over the upper contacts of cam 408 advancing sequence switch 400 to position 4.

As soon as the sequence switch reaches position 3 $\frac{3}{4}$, battery through resistance 413 is also connected to brush 604 over the left contacts of cam 414 and the left back contact of relay 710, and when sequence switch 400 leaves position 3, relay 424 is disconnected from brush 604, although ground through resistance 625 remains connected thereto. This potentiometer arrangement operates relay 127 and holds the terminal on which brush 604 is resting at such a potential that no other trunk selector will pick this trunk. Relay 127 completes the locking circuit for relays 121 and 126, previously traced. The advance of sequence switch 400 from position 3 also opens the locking circuit of relay 510 and permits the further extension of calls in this group.

With relay 714 operated, the tip and ring brushes of the trunk finder are connected through to the tip and ring brushes of the position finder. The circuits may be traced from the tip brush 601, middle right back contact of relay 710, left winding of relay 711, inner left front contact of relay 714 to brush 705 and from ring brush 602, outer right back contact of relay 710, left contacts of cam 416, right front contact of relay 722, resistance 713, outer left front contact of relay 714, right winding of relay 711, middle left contact of relay 714 to brush 706. Condenser 712 is bridged across resistance 713 and the contacts of cam 416.

In the operator's position, this circuit extends from brush 705 through the winding of a relay (not shown) to brush 706. Since battery and ground are supplied to brushes 601 and 602, as previously described, a circuit is completed in which this relay operates but the windings of relay 711 are differentially arranged so that it does not operate at this time. The position circuit relay in operating establishes the order tone circuit from the trunk to the position, starts the generation of the tones and prepares the keyset for pulsing. Thereafter, battery is disconnected from brush 701 thereby releasing relay 640.

The release of relay 640 closes a circuit from battery through the winding of sequence switch magnet 400, upper right and lower left contacts of cam 403, lower contact of jack 723, upper back contact of relay 640, outer upper back contact of relay 639, to ground over the lower left contact of cam 402 advancing sequence switch 400 to position 5. In this position, a circuit is closed from battery through the winding of relay 739, upper right contact of cam 437 to ground. Relay 739 initiates the connection of the link circuit with an idle sender. It closes a circuit from battery through the winding of relay 418, lower back contact of relay 640, outer right front contact of relay 739, upper right contact of cam 405 to ground. With both relays 739 and 418 operated, the test relay 640 is again prepared and associated with the sender finder 620. A circuit is closed from battery through the middle winding of relay 640, upper left and lower right contacts of cam 433, lower winding of relay 640, left front contact of relay 419, outer right

front contact of relay 730 to ground at the upper right contact of cam 406. A circuit also extends from ground through the lower winding of relay 540 as traced and from there through the upper winding of relay 640, lower back contact of relay 638, outer left front contact of relay 730 to brush 623 of the sender selector. An idle sender is characterized by the connection of battery through a resistance to conductor 653 and the terminal to which brush 623 has access. If the sender selector 620 is resting on the terminal of a busy sender when the circuits for relay 640 are closed, relay 540 will remain unoperated and a circuit will be closed from battery through the left winding of relay 718, upper left and lower right contacts of cam 405, right front contact of relay 418, lower contact of jack 723, upper back contact of relay 640, upper back contact of relay 639 to ground at the lower left contact of cam 402. Relay 718 is made slow-to-operate by its short-circuited right winding to prevent its operating prematurely when an idle sender is encountered. When relay 718 closes its right contact, a circuit is closed from ground over that contact to the winding of relay 418 to hold that relay energized. A circuit is also closed from battery through the winding of updrive magnet 636 of the sender selector, outer left front contact of relay 718, upper back contact of relay 639 to ground at the lower left contact of cam 402, causing the sender selector to move upward in search of an idle sender. Relay 718 is held operated over its inner left front contact to ground over the commutator strip 628 and brush 627 to insure that the brushes will be centered.

When an idle sender is found, relay 640 operates and when the brushes of the sender selector are centered, relay 718 releases, in turn releasing the updrive magnet 636 and bringing the selector to rest. With relay 718 released and relay 640 operated, the circuit of relay 418 is opened and that relay releases after an interval. When relay 418 closes its back contact, a circuit is closed from battery through the winding of relay 641, inner left front contact of relay 730, left back contact of relay 418, lower front contact of relay 640, outer right front contact of relay 730 to ground at the upper right contact of cam 406. Relay 641 locks over its inner lower front contact and the inner right front contact of relay 730, back contact of relay 715 to brush 622 which is connected over conductor 652 to ground in the sender. Relay 641 closes a circuit from battery through the winding of sequence switch magnet 400, outer upper front contact of relay 641 to ground over the left contacts of cam 408, advancing sequence switch 400 to position 6. Relay 641, in operating, closes a new holding circuit for relay 717 which extends as previously traced to the outer left contact of relay 717 and thence over the middle upper front contact of relay 641, outer left front contact of relay 722, upper right contact of cam 409 to ground.

With sequence switch 400 in position 6, a circuit is closed from ground over the lower right contact of cam 406 through resistance 638 to brush 626 to mark the sender busy. In the sender this circuit extends through the winding of a relay which, in operating, disconnects battery from the terminal of brush 623 thereby releasing relay 640. It also closes an off-normal ground to provide locking circuits for the sender relays.

With both sender and position circuits connected to the link circuit, a circuit is established

from battery in the position circuit over conductor 744, brush 704, inner right front contact of relay 717, upper right and lower left contacts of cam 423, brush 624, conductor 654 through the winding of a relay in the sender to ground. A similar circuit is closed from battery over conductor 743, brush 703, right contacts of cam 491, outer right front contact of relay 717, brush 625, conductor 655 through the winding of a second relay to ground. The joint operation of the sender relays causes the operation of the transfer relays to prepare the sender for registration.

With the transfer relays operated, a signal is transmitted to the position to indicate that the sender is ready to receive the wanted number by closing a circuit from battery over the contacts of the transfer relays to conductor 651, brush 621, lower front contact of relay 641, inner right front contact of relay 714, brush 702, conductor 742 through the winding of a relay in the position.

This relay causes the removal of battery from conductors 743 and 744, releasing the sender relays and completing the preparation for registration after which battery is removed from conductor 651. Registration takes place as described in detail in the Dahl application hereinbefore referred to.

At the completion of registration, ground is disconnected from conductor 652, opening the locking circuit of relay 641 and releasing that relay. Conductors 654 and 655 are disconnected from the recording relays and are connected together thereby preparing the fundamental circuit for selections. At this time battery is also connected to the fundamental circuit in the sender.

The release of relay 641 opens the locking circuit for relay 717 which also releases, in turn releasing relay 714. With relay 714 released, the position circuit is restored to normal. With relay 717 released, the tip conductor of the fundamental circuit is opened at the inner right contact of that relay but the ring conductor is extended from conductor 655, brush 625, right back contact of relay 717, upper contacts of cam 416, outer right back contact of relay 710, brush 602 to conductor 138. Since relay 120 is still operated, a circuit is closed from ground over the next to inner right front contact of relay 120, lower right winding of repeating coil 104, outer right front contact of relay 120, outer left back contact of relay 126 to conductor 138, over the ring conductor of the fundamental circuit as above traced to conductor 655 and through the winding of a sender relay to battery. This relay causes the connection of ground over conductor 651, brush 621, lower back contact of relay 641, left contacts of cam 426, to the winding of relay 719 and battery. Relay 719, in operating, closes a circuit from battery through the winding of relay 715, inner left front contact of relay 722, middle right contact of relay 719, lower left contact of cam 407 to ground. Relay 715 locks over its inner right front contact directly to this same ground and closes a circuit from ground over its outer right front contact, upper right contact of cam 404 to the winding of sequence switch magnet 400 and battery, advancing the sequence switch to position 7 from which position it is advanced to position 8 over its local cam. Relay 715 also connects battery through resistance 716 over the middle right contact of relay 715, upper right and lower left contacts of cam 431, inner right back contact of relay 75

710, brush 603, conductor 133, inner right back contact of relay 126, outer lower contact of relay 122 to the winding of relay 120 and battery. This releases relay 120, permitting relay 126 to operate in the locking circuit of relay 121. The release of relay 120 disconnects battery and ground from the right windings of repeating coil 104, opens the talking conductors extending from the repeating coil to the link circuit and reconnects relay 112 to the right windings of repeating coil 104. The disconnection of ground from the repeating coil permits the closure of the fundamental circuit in the sender.

Relay 126, in operating, disconnects the incoming end of the trunk from the link circuit and connects the link circuit with the outgoing trunk, transferring conductor 137 from association with the repeating coil 104 into direct connection with the tip conductor 141 of the outgoing trunk and conductor 138 from the connection with the repeating coil 104 into connection with the ring conductor 142 of the outgoing trunk through resistance 130. Relay 126 disconnects relay 120 from conductor 133 and connects that conductor to ground through the left winding of relay 125 and the winding of relay 123. Since battery is connected to conductor 133 through resistance 716 over the circuit previously traced, relay 123 operates but relay 125 which is marginal does not. The operation of relay 123 closes a circuit from ground over the right contact of relay 123 to the locking circuit of relays 121 and 126 in parallel with the front contact of relay 127.

With relay 126 operated and sequence switch 400 in position 8, the fundamental circuit may be traced from battery through the winding of relay 315 of the incoming selector circuit, upper right contact of cam 227, upper left contact of cam 216, over the tip conductor 141 of the outgoing trunk, outer right front contact of relay 126, conductor 137, brush 601, middle right back contact of relay 710, inner right front contact of relay 715, lower contacts of cam 423, brush 624, conductor 654 through the polarized relay and stepping relay (not shown) of the sender, conductor 655, brush 625, right back contact of relay 717, upper contacts of cam 416, outer right back contact of relay 710, brush 602, conductor 138, outer left front contact of relay 126, resistance 130, over the ring conductor 142 extending between the two offices to ground over the left contacts of cam 214 and resistance 229 at the incoming selector. Relay 315 operates in the fundamental circuit, closing a circuit from battery through the right winding of relay 304, lower right contact of cam 217, lower left contact of cam 211, front contact of relay 315, upper left contacts of cams 210 and 219, upper right contact of cam 222 to ground. Relay 304 locks in a circuit which may be traced over its operating circuit as far as the upper left contact of cam 210 and thence over the lower left contact of cam 219, right front contact of relay 304 to ground over the lower left contact of cam 233. Relay 304, in operating, closes a circuit from battery through the winding of sequence switch magnet 200, upper left contact of cam 220, upper contact of cam 218, left front contact of relay 304, to ground over the lower right contact of cam 233 advancing sequence switch 200 to position 2. When sequence switch 200 reaches position 2, a circuit is closed from battery through the winding of updrive magnet 319 over the lower contacts of cam 219, right front con-

tact of relay 304 to ground over the lower left contact of cam 233, advancing the incoming selector in its brush selecting movement. As the selector moves upward a circuit is closed intermittently from ground over the lower right contact of cam 233, left front contact of relay 304, right contacts of cam 218, brush 323, commutator strip 327, lower left contact of cam 227 to the fundamental circuit, holding relay 315 and shunting the stepping relay of the sender. When the sender is satisfied it opens the fundamental circuit causing relay 315 to release. A series of operations are performed by the sender as described in the above mentioned Dahl application after which the fundamental circuit is reestablished.

In the incoming selector, the release of relay 315 at the termination of brush selection also releases relay 304 which opens the circuit for the updrive magnet 319, bringing the selector to rest in position to trip the proper set of brushes. The release of relay 304 also closes a circuit from battery through the winding of sequence switch magnet 200 over the upper left contact of cam 224, right back contact of relay 304 to ground over the lower left contact of cam 233. When sequence switch 200 advances to position 3 and the fundamental circuit is reestablished in the sender, relay 315 again operates, in turn operating relay 304 over the circuit previously traced to the front contact of relay 315 thence over the lower right contacts of cams 220 and 218, the upper right contact of cam 222 to ground. In position 3 of sequence switch 200, the locking circuit of relay 304 extends as previously traced to the front contact of relay 315 and from thence over the lower right contact of cam 220, upper right contact of cam 218, left front contact of relay 304 to ground over the lower right contact of cam 233. Relay 304, in operating, advances sequence switch 200 to position 4 in a circuit over the upper right contact of cam 224, right front contact of relay 304 to ground at the lower left contact of cam 233. In position 4, the updrive magnet 319 is reenergized and the selector advances in a group selecting operation. When sequence switch 200 reached position 3, a circuit was closed for trip magnet 320 extending from battery through the winding of that magnet over the lower right contact of cam 222 to ground and this circuit is maintained through position 4 so that the proper brush set is tripped as the selector moves upward. For group selection, ground is connected to the commutator brushes over the front contact of relay 304 the same as for brush selection and ground is intermittently connected over brush 324, commutator strip 328, the lower right contact of cam 227 to the tip conductor in shunt of the winding of the stepping relay.

The stepping relay functions in the usual manner and when the condition set up on the counting relays by the registers is satisfied, the fundamental circuit is opened for a measured interval after which it is reclosed.

At the incoming selector, the opening of the fundamental circuit releases relay 315 which, in turn, releases relay 304. Relay 304 advances sequence switch 200 to position 5 in a circuit over the upper left contact of cam 224, right back contact of relay 304 to ground as previously traced. In position 5, a circuit is closed from battery through resistance 305, left winding of relay 304, back contact of relay 317, lower left contact of cam 210, upper left contact of cam 219, upper right contact of cam 222 to ground. Relay 304

closes a circuit from battery through its right winding, lower left and upper right contacts of cam 218, left front contact of relay 304, upper right and lower left contacts of cam 217 to sleeve brush 342 to test whether the first final selector of the group on which the brushes of the incoming selector is now resting is busy or idle. Relay 304 also closes a circuit from battery through the winding of sequence switch magnet 200, upper right contact of cam 224, right front contact of relay 304 to ground over cam 233 to advance the sequence switch 200 to position 6. In this position, the operating circuit of relay 304 is opened, but the holding circuit is maintained if the final selector is busy. Assuming that it is busy, a circuit will be closed from battery through the winding of updrive magnet 319, over the lower contacts of cam 219, right front contact of relay 304 to ground, advancing the selector in search of an idle final selector. During trunk hunting, ground is connected to the commutator brushes over the front contact of relay 304 as previously traced and commutator strip 326 is connected over the right contacts of cam 226 to the left winding of relay 304. When an idle finder selector is found, the circuit over brush 342 for relay 304 is opened and when the brushes are properly centered the circuit over the commutator strip 326 is also opened and relay 304 releases, releasing magnet 319 and bringing the selector to rest with its brushes engaging an idle final selector. As soon as relay 304 releases, ground is connected to the sleeve brush 342 to mark the final selector busy to other incoming selectors. This circuit may be traced from ground over the lower contacts of cam 230, left back contact of relay 304, upper right and lower left contacts of cam 217, to brush 342. With relay 304 released, a circuit is closed from battery through the winding of sequence switch magnet 200, upper left contact of cam 224, right back contact of relay 304 to ground over cam 233, advancing sequence switch 200 to position 7 from which position the sequence switch is advanced to position 8 over its local cam. When sequence switch 200 reaches position 6¾, ground is connected to brush 342 over the lower left contact of cam 222.

During trunk hunting, relay 315 is held operated over the fundamental circuit and when sequence switch 200 reaches position 8, closes a circuit from battery through the right winding of relay 304, lower right contact of cam 217, lower left contact of cam 211, front contact of relay 315, lower left and upper right contacts of cam 206 to brush 340 and thence over the tip conductor to the final selector. A circuit is also closed from battery through resistance 305 and the left contacts of cam 211 over the front contact of relay 315 and the contacts of cam 206 to brush 340. Under these conditions, relay 304 does not operate but a relay in the final selector does operate to prepare that circuit for functioning. During final selections, commutator pulses are connected over brush 341 and the upper right contact of cam 216 to the winding of relay 315 in shunt of the winding of the stepping relay and relay 315 is held operated.

When the final selector completes the selection of the wanted line, it connects ground to both brushes 340 and 341. The connection of ground to brush 341 holds relay 315 operated which holds closed the previously traced circuit for relay 304 to brush 340. The connection of ground to that brush therefore operates relay 304. Relay 304 closes a locking circuit for itself from battery

through resistance 305, left winding of relay 304, back contact of relay 317, lower left contacts of cams 210 and 219, right front contact of relay 304 to ground over the lower left contact of cam 233. It also closes a circuit from battery through the winding of sequence switch magnet 200, upper left contact of cam 220, upper right contact of cam 218, left front contact of relay 304 to ground over the lower right contact of cam 233, advancing sequence switch 200 to position 9 in which position relay 304 releases. While sequence switch 200 is in position 8+8¼, a circuit is closed from ground over the right contacts of cams 233 and 225 to the winding of relay 309. When the sequence switch leaves position 8¼ this circuit is opened but relay 309 which is slow-to-release is held operated in a circuit over the right contacts of cam 225, left back contact of relay 304 which releases quickly, lower contacts of cam 230 to ground.

In this position reverse battery is connected to the fundamental circuit which extends from the tip conductor 141 of the interoffice trunk over the upper left and lower right contacts of cam 216, lower right contacts of cams 220 and 218, upper right contact of cam 222 to ground, and from the ring conductor 142 of the interoffice trunk over the upper left and lower right contacts of cam 214 to battery through the winding of relay 315.

After the completion of final selections, the fundamental circuit is reestablished in the sender and the connection of reverse battery to the circuit is a signal for the sender dismissal.

When relay 315 operates in the reverse battery fundamental circuit it closes a circuit from battery through the right winding of relay 304, lower right contact of cam 217, lower left contact of cam 211, front contact of relay 315, lower right contacts of cams 220 and 218 to ground over the upper right contact of cam 222. With relay 304 operated in position 9 of sequence switch 200 it opens the holding circuit of relay 309 which releases after an interval to prolong the reverse battery closure and a circuit is closed from battery through the winding of sequence switch magnet 200 over the contacts of cam 213, left normal contact of relay 309 to ground, advancing sequence switch 200 to position 10 and thence to position 11 over its normal cam. When sequence switch 200 leaves position 9, relays 315 and 304 release.

When sequence switch 200 passes through positions 10+10¼ battery through the resistance 305 is connected over the contacts of cam 201 to the upper left winding of repeating coil 203 and the upper terminal of condenser 240 while the lower terminal of the condenser and the lower left winding of repeating coil 203 are connected to ground over the upper contacts of cam 225 and the lower right contact of cam 233.

When sequence switch 200 reaches position 11, battery through the right winding of relay 308 is extended through the upper winding of retard coil 335, right contacts of cam 232, upper left winding of repeating coil 203 over the upper contacts of cam 201 to the tip conductor 141 of the interoffice trunk. As the sequence switch 200 leaves position 9, the ground above traced is disconnected and when the sequence switch reaches position 11, the ring conductor 142 of the interoffice trunk is extended over the upper contacts of cam 214, lower left winding of repeating coil 203, left contacts of cam 225, lower winding of retard coil 335, left winding of relay 308

to ground over the upper contacts of cam 233. The incoming selector now awaits trunk closure by the link or trunk circuit.

In the sender when the reverse battery circuit is opened, ground is disconnected from conductor 651 indicating that the sender has completed its functions and opening the circuit of relay 719 which now releases closing a circuit from battery through the winding of sequence switch magnet 400, upper left contact of cam 404, left back contact of relay 719 to ground over the lower right contact of cam 408, advancing sequence switch 400 to position 9 from whence it is advanced to position 17 over its local cam. As soon as sequence switch 400 leaves position 8½ ground is disconnected from conductor 656 causing the disconnection of off-normal ground in the sender thereby releasing all sender relays and putting the sender in condition to control another call.

As sequence switch 400 passes through positions 12½ to 15¼ a circuit is closed from the tip-conductor 141 of the interoffice trunk which was connected as previously traced to battery through the right winding of relay 308 over the right alternate contact of relay 126, conductor 127, brush 601, middle right contact of relay 710, inner right front contact of relay 715, through resistance 417, lower right and upper left contacts of cam 416, outer right back contact of relay 710, brush 602, conductor 138 over the outer left front contact of relay 126, through resistance 130 to the ring conductor 142 and thence to ground through the left winding of relay 308 as above traced.

When sequence switch 400 reaches position 13 battery through resistance 413 is removed from conductor 132 thereby releasing relay 127 but since relay 123 is still operated, the locking circuit of relays 121 and 126 is maintained and a circuit is closed from ground over the back contact of relay 127, inner left front contact of relay 126, inner lower front contact of relay 122, through the winding of relay 106, right back contact of relay 125 to battery. Relay 106, in operating, closes a locking circuit for itself from battery over the back contact of relay 125, winding of relay 106, inner upper front contact of relay 106 to ground at the front contact of relay 114. Relay 106 disconnects ground from the holding circuit of relay 122 which now releases. Relay 106 also connects the tip conductor 141 of the interoffice trunk over its outer upper front contact, upper right winding of repeating coil 104, back contact of relay 126, winding of relay 112, lower right winding of repeating coil 104, outer lower front contact of relay 106 to the ring conductor 142 of the interoffice trunk and thereby making a second trunk closure which overlaps the trunk closure made by the link circuit. Since relay 112 is polarized it does not operate in series with relay 308 at this time.

When sequence switch 400 leaves position 16, battery through resistance 716 is disconnected from conductor 133 thereby releasing relay 123 which, in turn, releases relays 121 and 126. The link circuit is thereby completely disconnected from the trunk circuit.

When sequence switch 400 reaches position 16, a circuit is closed from battery through the winding of relay 410, upper contacts of cam 411, commutator strip 613, brush 612 to ground. When sequence switch 400 reaches position 17, relay 410 closes a circuit from battery through the winding of downdrive magnet 615 of the trunk

finder 600, left front contact of relay 410, right contacts of cam 415 to ground, restoring the trunk finder to normal. When the trunk finder reaches the bottom of its bank, brush 612 leaves commutator strip 613 and relay 410 releases, in turn releasing downdrive magnet 615.

With sequence switch 400 in position 16, a test is made to determine the location of the sender selector by means of a circuit from ground over brush 629, commutator strip 631, upper contacts of cam 422, winding of relay 639, resistance 430 to battery. If the selector is not engaging one of the predetermined top groups, relay 639 is not operated and when relay 410 releases sequence switch 400 is advanced to position 18 over the upper right contact of cam 404, inner lower normal contact of jack 731, inner upper back contact of relay 639 to ground over the back contact of relay 410 and the right contacts of cam 415. If the selector is engaging a sender in such a top group, relay 639 will operate and lock over its inner lower front contact and the left contacts of cam 429. When relay 410 releases with sequence switch 400 in position 17, a circuit is closed from battery through the winding of downdrive magnet 637, inner upper front contact of relay 639, back contact of relay 410 to ground over the right contacts of cam 415. The sender selector 620 is restored to the bottom of its bank in this circuit and when it reaches this position, a circuit is closed from ground over brush 629, commutator strip 639, upper left and lower right contacts of cam 431 to resistance 430 and battery in shunt of the winding of relay 639 which now releases. With relay 639 released, the circuit above traced is closed through the winding of sequence switch magnet 400 and sequence switch 400 is advanced to position 10, in which position it remains until it is assigned for use by the advance of the next link to position 2.

Relay 308 operates in response to the trunk closures by the link and trunk circuits, completing a circuit from ground over the front contact of relay 308, upper contacts of cam 212, through the winding of relay 309 to battery. Relay 309 closes a substitute ground to the left winding of relay 308 from the upper left and lower right contacts of cam 209. It also connects ground over its left front contact, upper right and lower left contacts of cam 210, back contact of relay 317, left winding of relay 304, resistance 305 to battery, operating relay 304. Relay 304 locks in a circuit from battery, resistance 305, left winding of relay 304, back contact of relay 317, lower left contacts of cams 210 and 219, right front contact of relay 304 to ground at the lower left contact of cam 233. Relay 304 also closes a circuit from ground over the right contacts of cam 233, left front contact of relay 304, upper right contact of cam 218 and upper left contact of cam 220 to battery through the winding of sequence switch magnet 209 advancing the sequence switch to position 12. In this position ringing takes place.

The polarity of the ringing current to be used in signaling a called line is determined by the group of final selectors having access to that line. As sequence switch 200 passes through positions 9 to 11, a circuit is prepared from battery through the left winding of relay 301, lower contacts of cam 209 to commutator segments 331. Assuming that final selector 350 lies within group 1 or group 3, brush 330 will be engaging segment 331 and the circuit of relay 301 will be completed to ground over the upper right contact

of cam 222. Relay 301 locks in positions 11 and 12 over its right winding and inner right contact, lower left contact of cam 219, lower left contact of cam 219, right front contact of relay 304 to ground at the lower left contact of cam 233.

With relay 301 operated, the ringing circuit is closed in position 12 from positive superimposed ringing current applied to conductor 339, outer right front and left front contacts of relay 301, upper contacts of cam 208, winding of relay 317, left front contact of relay 304, lower left and upper right contacts of cam 207, brush 341, through the final selector and over called line 360 to brush 345, right contacts of cam 206 to ground.

This ringing continues intermittently until the called subscriber answers. When the called subscriber answers, relay 317 operates over the subscriber's line thereby opening the circuit of relay 304. Relay 304 connects battery through the lower right winding of repeating coil 293, winding of relay 215, left contacts of cam 230, left back contact of relay 304, lower left and upper right contacts of cam 207 to ring brush 341 to supply talking battery until cam 207 closes in position 12 3/4. Relay 304 also closes a circuit from battery through the winding of sequence switch magnet 290, upper left contact of cam 224, right back contact of relay 304 to ground over the lower left contact of cam 233. Sequence switch 290 advances to position 14 in which talking may take place. Relay 215 operates over the called subscriber's line and closes a circuit from battery through resistance 395, left winding of relay 304, front contact of relay 215, upper contacts of cam 209 to ground. With relay 304 operated and sequence switch 290 in position 14, the circuit of relay 303 may be traced from battery through its right winding, upper winding of retard coil 335, upper right contacts of cams 229 and 218, left front contact of relay 304, upper contacts of cam 225, lower left winding of repeating coil 293, upper contacts of cam 214 and thence as traced through the winding of relay 112 back to the upper contacts of cam 201, upper left winding of repeating coil 293, upper right and lower left contacts of cam 232, right front contact of relay 304, lower left and upper right contacts of cam 219, lower winding of retard coil 335, left winding of relay 303 to ground over the right front contact of relay 303 and the lower right and upper left contacts of cam 209.

The reversal of battery and ground over the tip and ring interoffice leads, operates relay 112. Relay 112 closes a circuit from battery, winding of relay 110, front contact of relay 112, left back contact of relay 110, front contact of relay 119 to ground at the back contact of relay 144. Relay 110 reverses the connection of battery and ground through the winding of relay 119 to the incoming trunk as a signal to the operator at office O that the called subscriber has answered. Relay 110 at its outer left contact closes a locking circuit for itself under the control of relay 112. It also closes an obvious circuit for relay 144 which opens the operating circuit of relay 114 but closes a holding circuit for that relay to ground over the front contacts of relays 119, 144 and 114.

When the called subscriber restores his receiver to the switchhook, relay 215 releases, in turn releasing relay 304 and restoring the connection of battery and ground through relay 308 to the interoffice trunk, releasing relay 112

which reverses the connection of battery and ground to the trunk conductors leading to the manual office and causing the lamp at that office to light as a disconnect signal. Relay 112 also releases relays 110 and 144 in turn. When the tandem operator removes the plug of cord 102 from jack 103, relay 119 releases, in turn releasing relay 114. Relay 114 in releasing disconnects ground from the locking circuit of relay 106, thereby causing the release of relay 106.

The release of relay 106 disconnects relay 112 from the windings of relay 308 and that relay, in turn, releases, releasing relay 309. With relay 309 released, relay 308 can not reoperate. A circuit is closed from battery through the winding of sequence switch magnet 200, left contacts of cam 213 over the normal contact of relay 309 to ground, advancing sequence switch 200 to position 16. In position 16 a circuit is closed from battery through the winding of 20 downdrive magnet 321, lower right contact of cam 211, upper right contact of cam 217, lower right contact of cam 233, to ground, restoring the incoming selector to normal. When the selector reaches its lowermost position, a circuit is 25 closed from battery through the winding of sequence switch magnet 290, lower left contact of cam 224, normal commutator segment 325, brush 322, upper right contact of cam 222 to ground, advancing sequence switch 200 to position 17. Sequence switch 200 is advanced to position 18 over the upper right and lower left contacts of cam 221 and the normal contact of relay 309 and to position 1 over the upper left contact of cam 224, right back contact of relay 304, and the lower left contact of cam 233. The advance of sequence switch 200 from position 15 1/4 removes ground from the sleeve brush 342 thereby permitting the final selector to restore to normal.

Trouble conditions

Relay 727 controls the release of the link circuit in case of trouble and is operated under a variety of conditions.

The link circuit is provided with a time alarm arrangement under the control of interrupters 724 and 725. With sequence switch 400 in positions 3, 6 and 8, ground is connected to interrupter 724 which has a comparatively slow period, while in positions 2, 4, 5, 7 and 9 to 16, inclusive, ground is connected to interrupter 725 which has a period of somewhat less than half that of interrupter 724. It may be noted that the right and left contacts of these interrupters are connected in parallel so that the effect of the operation of the interrupters is the same except for the speed at which they operate. The first closure of the left contact of either interrupter completes the circuit for relay 726 which locks in a circuit from battery through its right winding and inner right contact to ground at the upper left contact of cam 406, this locking circuit being closed irrespective of which interrupter is functioning and opened as the sequence switch passes from position to position. If relay 726 remains operated until the right contact of the same interrupter closes, a circuit is completed over the left contact of relay 726 through the left winding of relay 727 to battery.

The position circuit is normally disconnected from the link circuit by the advance of the link circuit. However, if the position is held because of trouble in the link circuit, the position may also be released by operating the position dis-

connect key or reorder key. Before the trunk is connected through to the position, the operation of the position disconnect key will connect ground to conductor 744, operating relay 727 to bring about the forced release of the link.

After the trunk and position have been connected the operation of the disconnect key connects ground to conductors 745 and 746. This ground shunts the left winding of relay 711 while maintaining the circuit through the right winding. Since relay 711 is differentially wound, it now operates and closes an obvious circuit for relay 727.

If the operator removes her headset from the position jack just as the position has been seized by a link, a circuit is closed from ground to conductors 745 and 746 operating relays 711 and 727.

If relay 727 operates in positions 2 or 3 of sequence switch 400, it locks in a circuit from battery through its right winding and inner left front contact to ground over the lower left contact of cam 406. Relay 727 also extends this locking ground through the winding of relay 729 to battery. In addition it closes a circuit from battery through lamp 728 to ground at its middle right contact. It also closes a circuit from ground over its inner right contact, lower normal contact of jack 731, to conductor 645 which extends through the winding of relay 523 which controls the time alarm circuit. Furthermore, it opens the locking circuit of relay 510. Relay 729 opens the circuit of relay 410 and also opens the circuit by which the position finder tests for an idle position.

Relay 729 closes a circuit from battery through the winding of relay 710, inner left contact of relay 729 to ground over the lower right contact of cam 402. Relay 710 locks over its outer left front contact to ground at the lower left contact of cam 406 and disconnects brushes 601 to 604, inclusive, from the link equipment, thereby releasing trunk relays such as relays 120 and 121 which may be operated under the control of the link. Since the wanted number has not been given to the B operator, the connection is maintained at the originating office and, with relay 510 released, another link may be assigned to handle the call. Relay 710 also closes a circuit from ground over its locking circuit and its inner left contact, middle normal contact of jack 723, upper left contact of cam 404 to battery through the winding of sequence switch magnet 400, advancing the sequence switch to position 5 where the sender finder hunts for an idle sender, after which the sequence switch is advanced to position 6. Relay 710 advances the sequence switch from position 6 to position 9 after which it advances to position 17 under the control of its local cam and restores to normal in the usual manner.

If relay 727 is operated in position 4 to 6 of sequence switch 400, it operates relay 729 as above. Relay 729 also opens the circuit by which relays 714 and 717 are held if these relays have been operated, and relay 714 permits the position circuit to restore to normal. It also closes a circuit from battery through the left winding of relay 720, right front contact of relay 729 to ground over the lower left contact of cam 407. Relay 720 locks in a circuit from battery through its left winding and the inner left front contact to this ground, independent of relay 729 and opens the locking circuit of relay 722 and that relay releases. In addition, relay 720 closes a circuit from battery through resistance 721, inner

right front contact of relay 720, inner right back contact of relay 710, brush 603, conductor 133, inner right front contact of relay 126, through the windings of relays 123 and 125 to ground. Relay 123 operates in this circuit and relay 125 also operates due to the low value of resistance 721.

Relay 125 in operating closes a locking circuit for itself from battery over its right front contact and right winding to ground at the front contact of relay 114. Relay 125 in operating disconnects battery from the winding of relay 122 and that relay releases. It also disconnects battery from the operating circuit of relay 106 to prevent its premature operation and to disconnect relay 112 from the outgoing trunk conductors. It also closes a circuit from battery through resistance 134 over the outer left front contact of relay 125 through the winding of relay 112, left back contact of relay 120, inner left front contact of relay 125 to ground through interrupter 135 thereby causing relay 112 to intermittently operate and release, these interruptions causing the cord supervisory lamp at the tandem office to flash. Relay 720 in operating also closes a circuit from battery through the winding of sequence switch magnet 400, upper left contact of cam 404, middle contact of jack 723, middle right front contact of relay 720 to ground, advancing sequence switch 400 to position 5 from which position the selection of a sender advances it to position 6, relay 720 advances it to position 9 and the local cam advances it to position 17. The restoration of the trunk finder and advance to position 18 take place in the usual manner.

If during selection, the incoming selector 300 finds all of the trunks in the selected group busy, the selector is driven to the overflow terminal to the sleeve of which no ground is connected. Therefore, relay 304 releases when this terminal is reached in turn releasing the updrive magnet 319 and advancing sequence switch 200 to position 8. A circuit is thereupon closed from battery through the winding of sequence switch magnet 200, lower left contacts of cams 213 and 226, commutator strip 327, brush 323, upper right contact of cam 222 to ground, advancing sequence switch 200 to position 9. In this position reverse battery is connected to the interoffice trunk in the manner previously described. Reverse battery is also supplied to the interoffice trunk if, in making any selection, the selector goes to the top of the bank, in which case a circuit is closed from battery through the winding of sequence switch magnet 200, lower right contact of cam 224, commutator segment 329, brush 323 and thence to ground as just traced.

Premature reverse battery is also closed to the sender if the incoming selector is not in its normal position when the fundamental circuit is first established. This is apparent since it will take fewer than the normal number of selections to advance the incoming selector sequence switch to the reverse battery position.

When the sender receives premature reverse battery a circuit is closed from battery to conductor 652 over brush 622, left front contact of relay 715, right winding of relay 720, to ground over the upper contacts of cam 408. Relay 720 in operating connects battery through resistance 721 to brush 603 as previously described to give a reorder signal to the trunk circuit. Relay 720 also advances sequence switch 400 to position 9 whence it is advanced to position 17 over its local

cam. When the sequence switch leaves position 16, relay 720 releases.

When sequence switch 400 passes through positions $12\frac{1}{2}$ to $15\frac{1}{4}$, the trunk closure previously described, is completed in order to operate relay 308 if the sequence switch 200 is standing in position 11. The operation of relay 308 operates relay 309 which in turn operates relay 304 which locks under the control of relay 317 and advances sequence switch 200 to position 12.

As soon as the trunk closure is removed by the link circuit relay 308 releases since no closure is made by the trunk circuit. The release of relay 309 releases relay 309 which closes a circuit from ground at its left normal contact, lower contacts of cam 221, resistance 228, left front contact of relay 304, winding of relay 317, upper contacts of cam 208 to the ringing machine over conductor 338 or 339 depending on the operative condition of relay 301. Relay 317 operates in this circuit, releasing relay 304. Relay 304 advances sequence switch 200 to position 14 as previously described. Since relay 309 is released, the sequence switch is immediately advanced to position 16 where the selector switch is restored to normal, after which the sequence switch is restored to position 1.

What is claimed is:

1. In a telephone system, an originating office, an intermediate office, a terminating office, a trunk circuit extending from a manual terminal at said originating office through said intermediate office to an automatic switch at said terminating office, and means at said intermediate office for recording wanted line numbers and for controlling said automatic switch.

2. In a telephone system, a trunk circuit extending from an originating office through an intermediate office to switching equipment at a terminating office, and means in said intermediate office for receiving line designations from said originating office and for controlling the switching equipment in said terminating office, no switching operations being performed at said intermediate office.

3. In a telephone system, an originating office, an intermediate office, a terminating office, a trunk circuit extending from said originating office through said intermediate office to switching equipment at said terminating office, control equipment at said intermediate office, means for successively connecting said control equipment with the originating office and with the terminating office over said trunk circuit to control the completion of a connection thereover, and means responsive to the completion of said connection to render said trunk circuit independent of said control equipment.

4. In a telephone system, a trunk circuit connecting an originating and a terminating office, an intermediate office through which said trunk circuit passes, an operator's equipment at said intermediate office for controlling the completion of connections over said trunk circuit at said distant office, no switching operation being performed at said intermediate office.

5. In a telephone system, a plurality of originating offices, a plurality of terminating offices, trunk circuits connecting said originating offices and said terminating offices, an intermediate office through which said trunk circuits pass, but in which no switching takes place, and an operator's equipment at said intermediate office for controlling the completion of connections over said trunk circuits.

6. In a telephone system, a first plurality of

offices, a second plurality of offices, trunk circuits connecting said first offices with said second offices terminating in switches in said second offices, an intermediate non-switching office through which said trunk circuits pass, and an operator's equipment at said intermediate office for receiving instructions from said first offices and for controlling the operation of said switches.

7. In a telephone system, an originating office, an intermediate office, a terminating office, a trunk circuit extending from said originating office through said intermediate office to switching equipment at said terminating office, control equipment at said intermediate office, means associated with said trunk circuit to connect said control equipment with said originating office to receive a wanted line designation, means responsive to the completed recording of said designation to transfer the connection of said control equipment at said trunk circuit to said terminating office to control said switching equipment to complete a connection to said wanted line, and means responsive to the completion of said connection to disconnect said trunk circuit from said control equipment.

8. In a telephone system, a selector switch, a trunk circuit terminating in said selector switch, a link circuit, control equipment, means including said link circuit for connecting said control equipment with said selector switch over said trunk circuit, a relay associated with said selector switch, means responsive to the operation and release of said relay for causing the release of said switch, means effective after said selector switch has been operated for connecting said relay with said trunk circuit, means in said trunk circuit normally effective for operating said relay, and means in said link circuit effective in case of trouble to operate said relay.

9. In a telephone system, a selector switch, a trunk circuit terminating in said selector switch, a link circuit, control equipment, means including said link circuit for connecting said control equipment with said selector switch over said trunk circuit, a relay associated with said selector switch, means responsive to the operation and release of said relay for causing the release of said switch, means effective after said selector switch has been operated for connecting said relay with said trunk circuit, means in said trunk circuit normally effective for operating said relay, means in said link circuit effective in case of trouble to prevent said trunk circuit from operating said relay, and means in said link circuit for closing a substitute circuit for operating said relay.

10. In a telephone system, a trunk circuit terminating in an automatic selector switch at one office, a link circuit and a register sender at a second office, means to cause said link circuit to connect said sender with said trunk circuit at said second office, means in said sender to control the operation of said selector switch, a holding relay associated with said selector switch, means to connect said holding relay with said trunk circuit, means in said sender responsive to the completion of selections to initiate the release of said link circuit, means in said link circuit for causing said trunk circuit to prepare a holding circuit at said second office for said holding relay, and means in said link circuit for establishing an overlapping holding circuit for said holding relay.

11. In a telephone system, a trunk circuit extending from a first office and terminating in an

- automatic selector switch at a second office, a link circuit having an associated sequence switch, and a register sender at said first office, means to cause said link circuit to connect said sender with said trunk circuit, means in said sender to control the operation of said selector switch, a holding relay associated with said selector switch, means effective following the completion of selections to connect said holding relay with said trunk circuit, means in said sender responsive to the completion of selections to initiate the release of said link circuit by advancing said sequence switch, means controlled by said sequence switch in its advance to sequentially establish a holding circuit for said holding relay in said link circuit, to cause the closure of a holding circuit for said holding relay by said trunk circuit and to disconnect said link circuit from said trunk circuit.
12. In a telephone system, a trunk circuit terminating in an automatic selector switch at one office, a link circuit and a register sender at a second office, means to cause said link circuit to connect said sender with said trunk circuit at said second office, means in said sender to control the operation of said selector switch, a holding relay associated with said selector switch, means to connect said holding relay with said trunk circuit, means in said sender to initiate the release of said link circuit, means in said link circuit for causing said trunk circuit to prepare a holding circuit at said second office for said holding relay, means in said link circuit for establishing a holding circuit for said holding relay, means to prevent the completion of the holding circuit by said trunk circuit, and means to establish the holding circuit in said link circuit whether or not the holding circuit in said trunk circuit is completed.
12. In a telephone system, a trunk circuit terminating in an automatic selector switch at

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