

Aug. 10, 1937.

W. W. CARPENTER ET AL

2,089,338

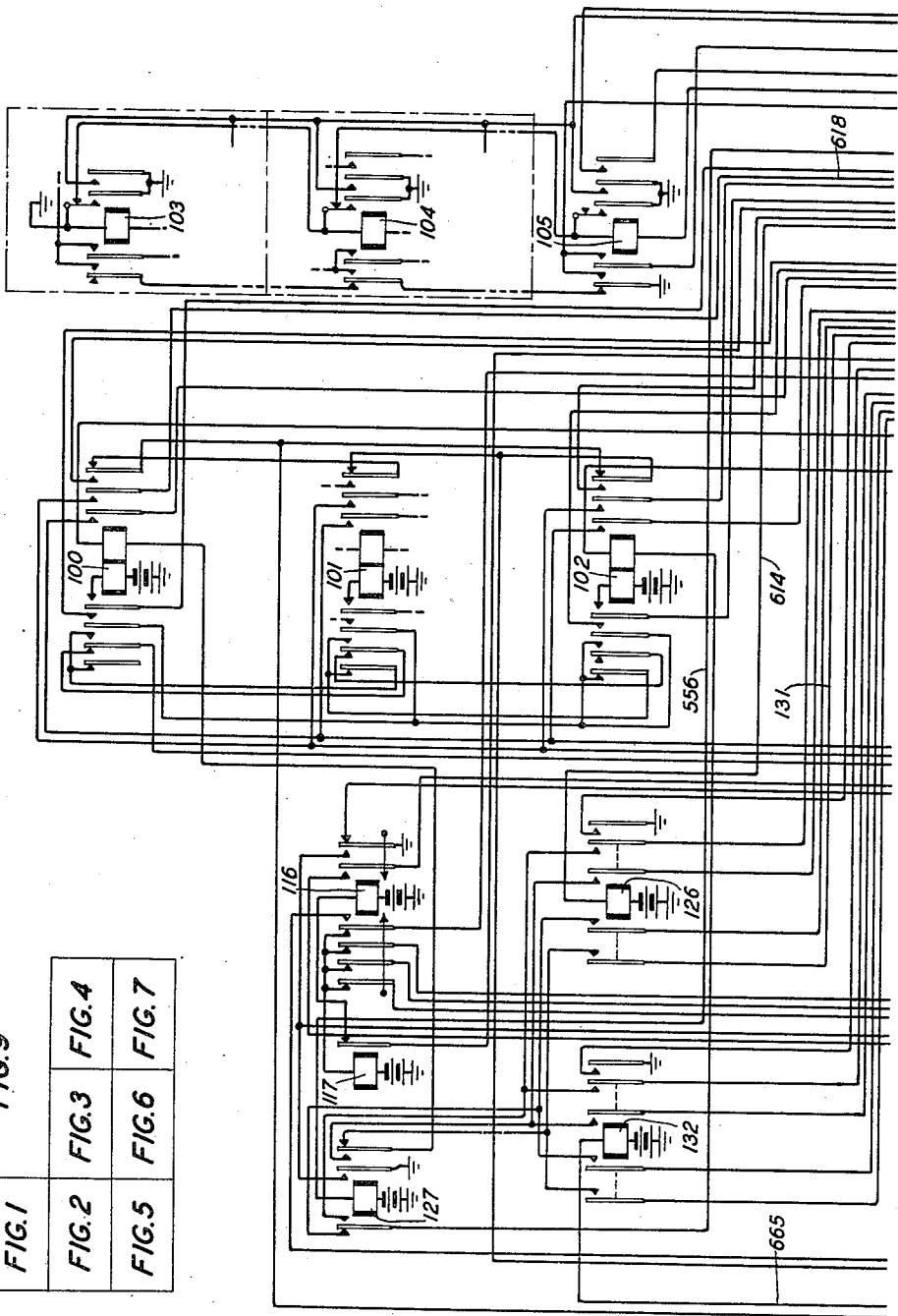
TELEPHONE SYSTEM

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8 Sheets-Sheet 1

FIG. 1

FIG. 9			
FIG. 1	FIG. 2	FIG. 3	FIG. 4
	FIG. 5	FIG. 6	FIG. 7



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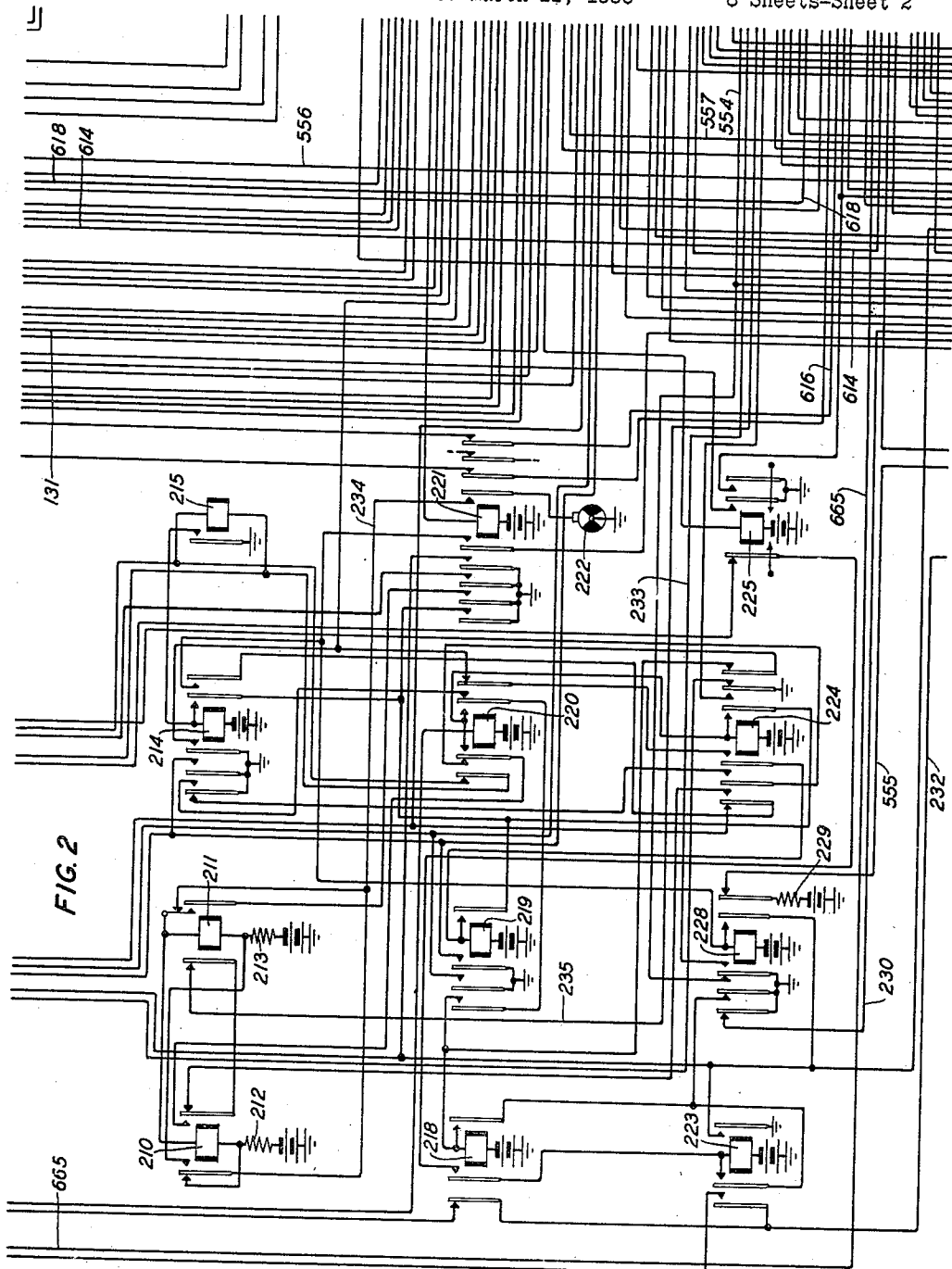
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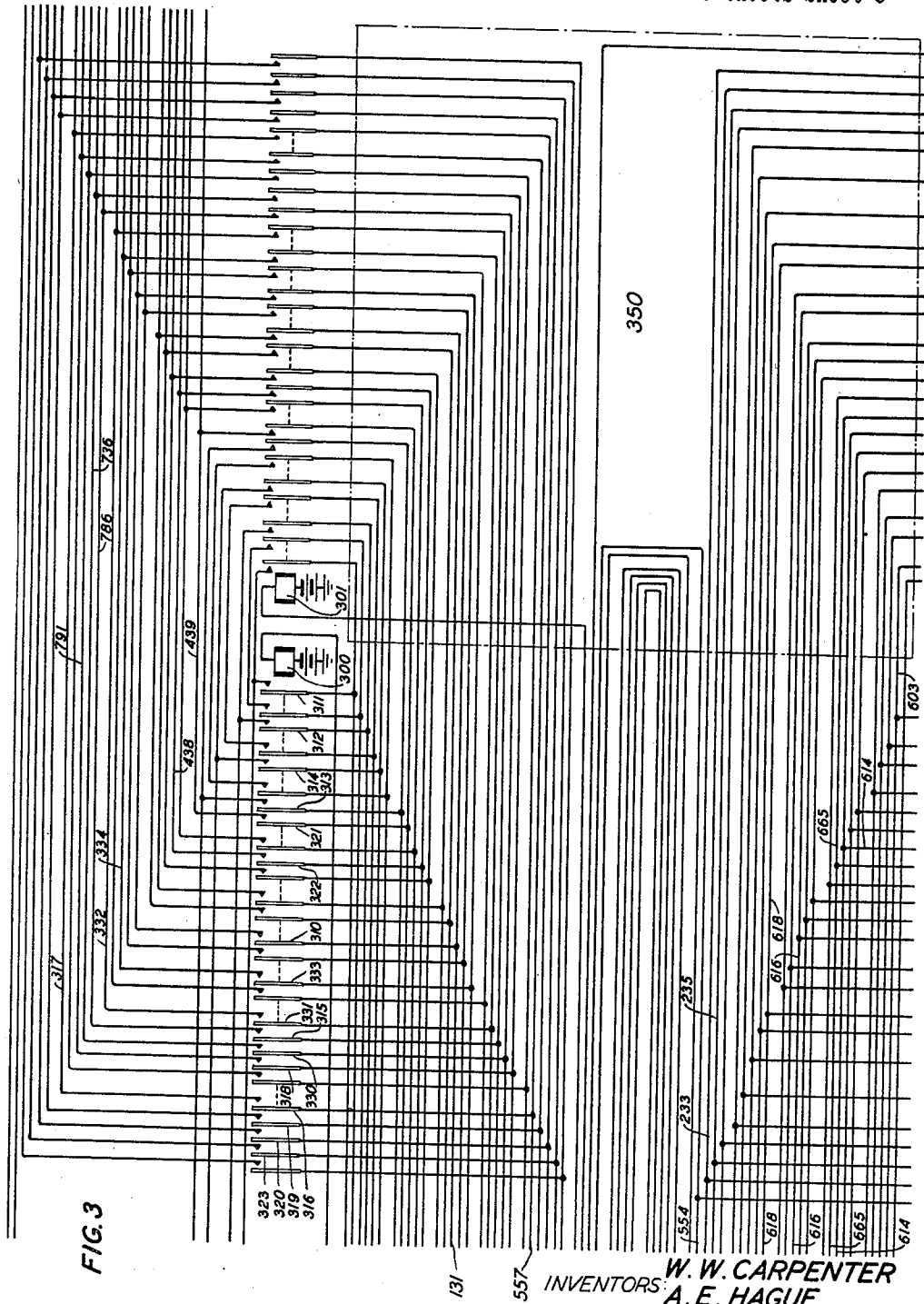


FIG. 3

131

557

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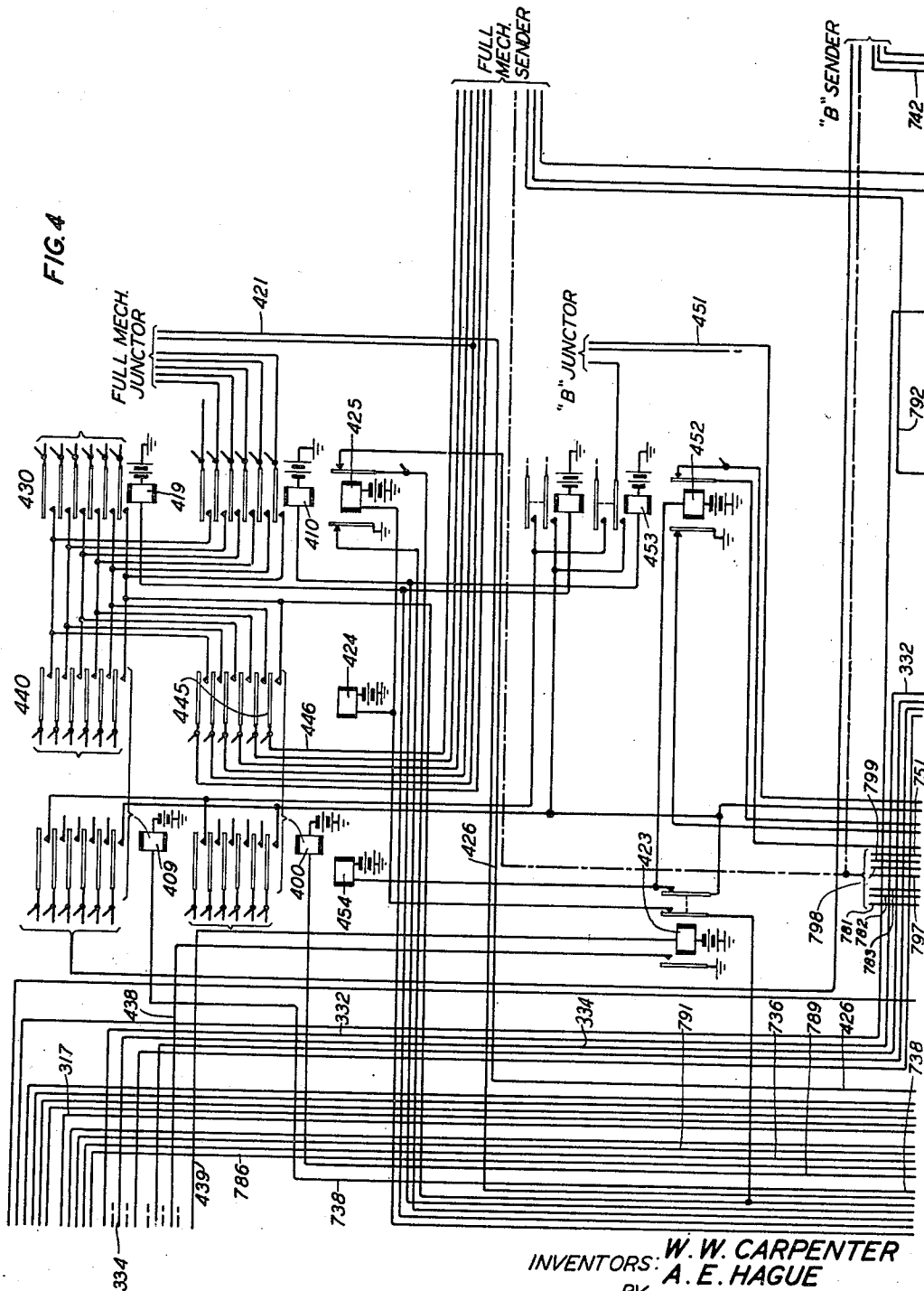
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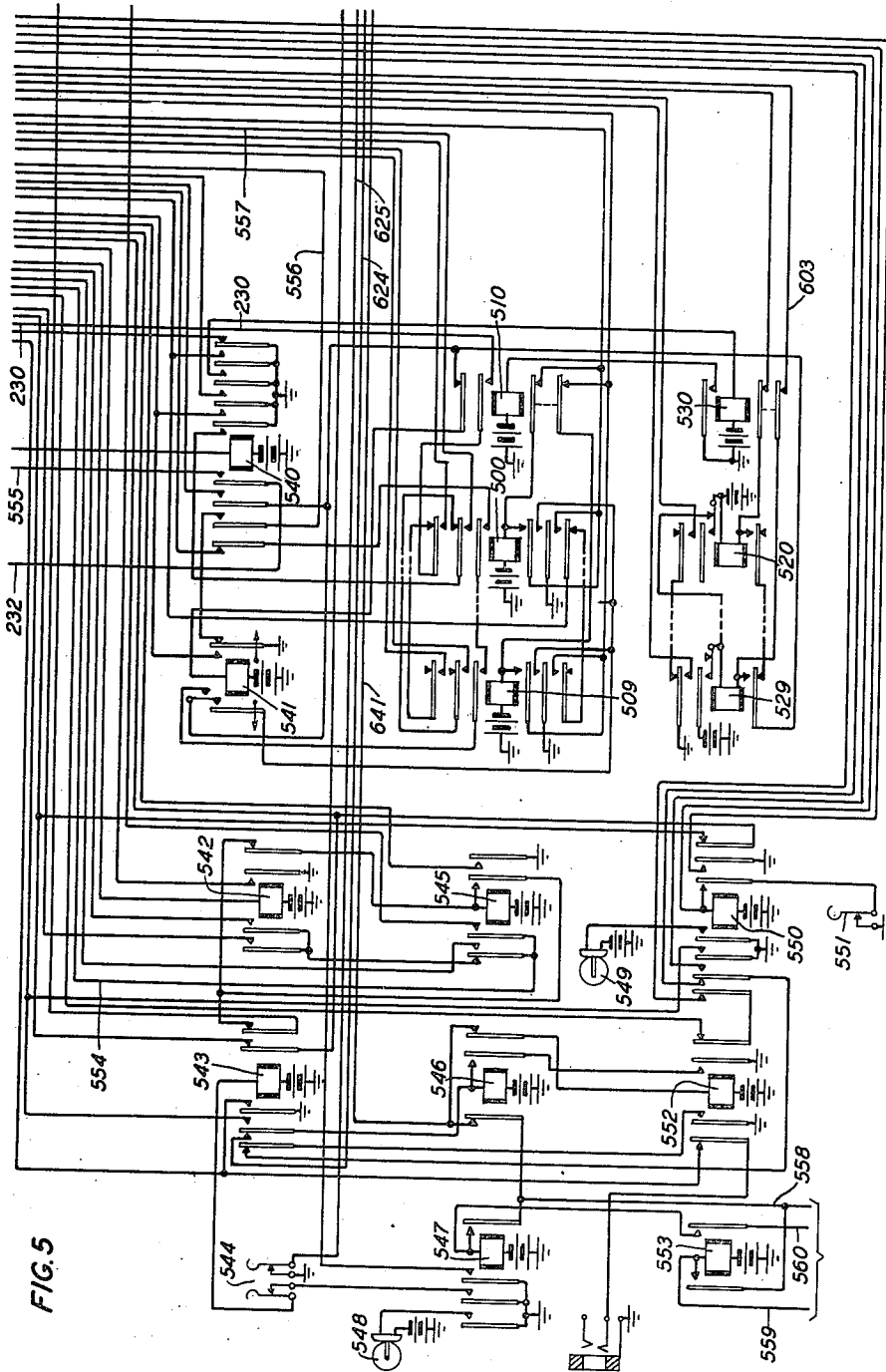


FIG. 5

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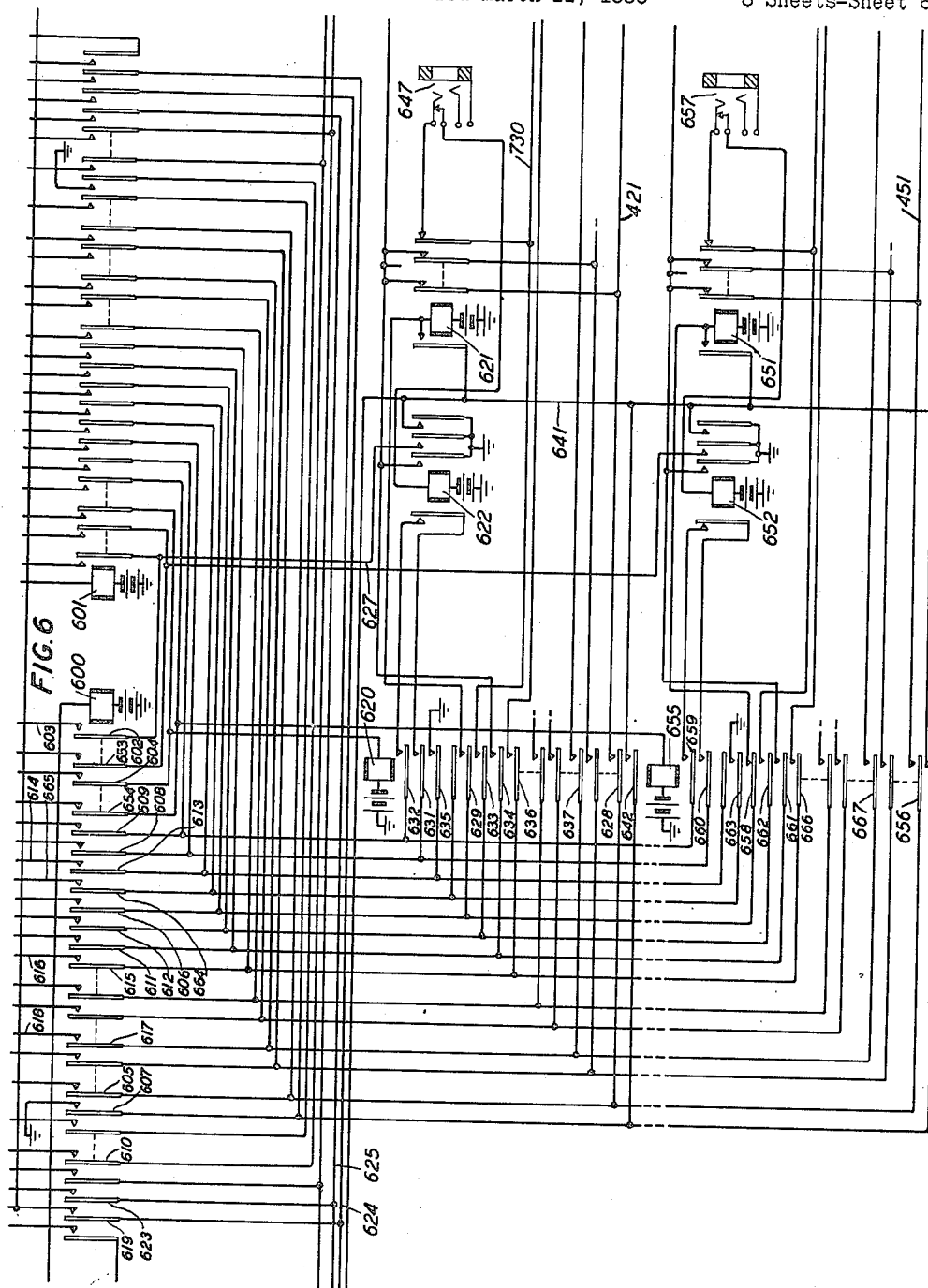
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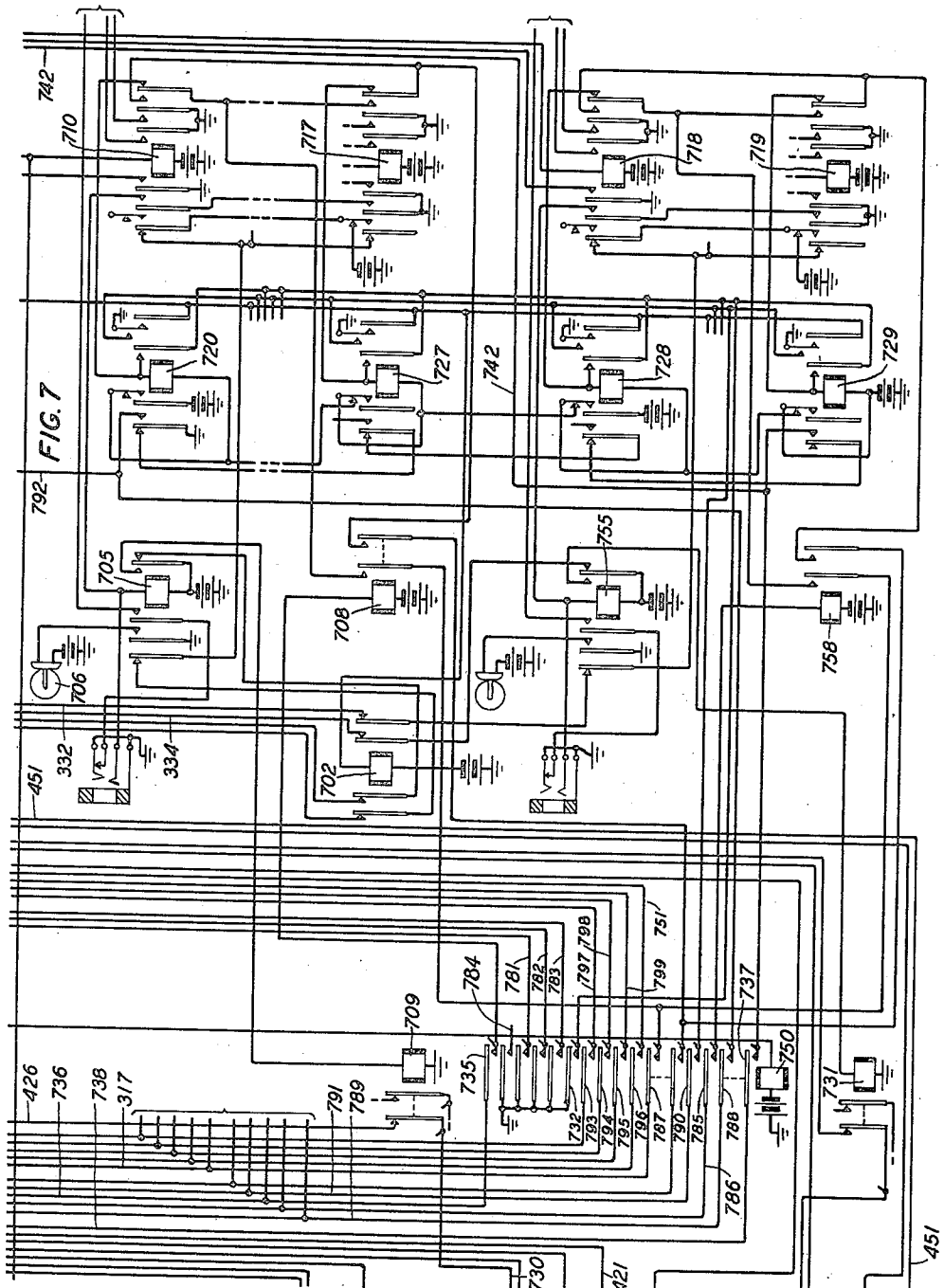
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8 Sheets-Sheet 7



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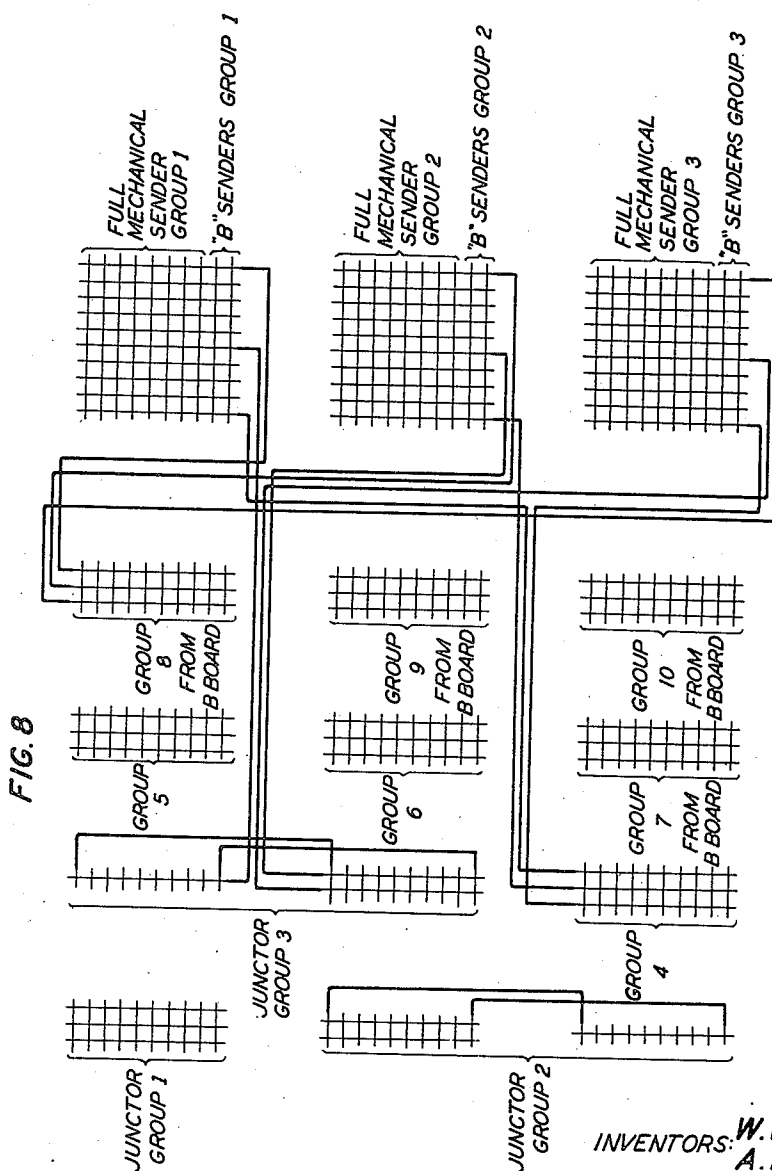
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TELEPHONE SYSTEM

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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

2,089,338

TELEPHONE SYSTEM

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Application March 11, 1936, Serial No. 68,263

10 Claims. (Cl. 179-16)

This invention relates to telephone systems and has for its object to reduce the amount of equipment necessary for certain kinds of connections.

In the cross-bar system, at the terminating office, registering devices are employed which are associated with the incoming trunk circuit. In the case of trunk circuits incoming from dial offices, the registering devices are positioned by means of reveritive impulses under the control of the originating sender. In the case of trunk circuits incoming from manual offices, the registering device is also associated with an operator's position and receives its setting under the control of the operator.

Heretofore, separate switching arrangements have been employed in connecting dial and manual trunk circuits with their respective registering devices. If either group of registering devices is small, this separation requires an unnecessary duplication of equipment. In accordance with the present invention, a unitary switching device is provided for connecting the trunk circuits and registering devices together with means for permitting connections between corresponding equipment only.

More specifically, the switching device comprises primary and secondary cross-bar switches with interconnecting links in which primary contacts and links are individual to the trunk types and secondary contacts are individual to register types, the links having access to both register types. Means is provided to record the type of trunk seizing the switching device and responsive to this record, only the corresponding type of register may be tested and connected with.

The present disclosure forms a part of the complete system disclosed in the application of W. W. Carpenter, Serial No. 68,262, filed March 11, 1936.

The invention will be more clearly understood from a consideration of the following description in association with the drawings in which:

Fig. 1 shows the sender group testing and link lock-out relays;

Fig. 2 shows a number of control relays;

Figs. 3 and 6 show the multicontact connecting relays;

Fig. 4 shows a part of the sender link switches;

Fig. 5 shows the junctor group and selecting relays;

Fig. 7 shows the sender selecting relays;

Fig. 8 is a skeleton showing of the sender connector; and

Fig. 9 shows the manner in which Figs. 1 to 7 are to be arranged.

Referring first to Fig. 8, the sender connector

consists of three primary cross-bar switches and three secondary cross-bar switches. The junctors are connected to contacts appearing in the horizontals of the primary switches; the senders are connected to the horizontals of the secondary switches; while the links connect verticals of the primary switches to verticals of the secondary switches. The primary switches are split vertically to divide the links into groups of three, and ten junctors are connected to the horizontals served by each group of three links, being multiplied between switches where necessary. Therefore the primary switches provide thirty links for serving one hundred junctors. The three links of one group are connected one to each of the three secondary switches, thereby giving each incoming junctor access to all of the thirty senders. As will be pointed out in the description of the circuits, assuming that certain groups of junctors, for example groups 7 to 10, are incoming from manual offices, they will be served only by the "B" senders. Such junctors are grouped by themselves and are therefore served by links individual to that purpose. However, the links have physical access to all senders so that regrouping of the junctors may take place without rewiring the switches themselves. It is, of course, to be understood that the grouping shown is merely illustrative.

Detailed description

This link control circuit, like the line group and control circuit described in the application of W. W. Carpenter, above-identified, is arranged to act as an emergency control circuit for an adjacent or mate frame. The dotted rectangle 350 of Fig. 3 has been used as a convenient means of indicating the relationship between the two control circuits and all conductors entering the rectangle are considered to emerge at the mate frame.

Test for presence of idle link and sender

Turning now to Figs. 1 to 7, when a full mechanical junctor has been seized, it grounds conductor 421 completing a circuit over the inner back contact individual to that junctor on relay 621, back contact of primary hold magnet 425, conductor 426, outer back contact of relay 709, conductor 730, outer right back contact of relay 621, contact of jack 647 to the winding of group relay 622 and battery. The circuit of relay 622, which is individual to the group of ten junctors including the calling junctor, also extends in parallel over the back contacts of the hold mag-

nets individual to the other two sender links which serve this group of junctors and over the back contacts of the corresponding sender group busy relays. Relay 621 is operated if the control circuit is busy, hold magnet 425 is operated if the corresponding sender link is in use with another junctor and relay 709 is operated if all of the full-mechanical senders in the corresponding group are busy. Therefore, relay 622 can only operate if the control circuit is idle and an idle link to an idle sender is available.

Connecting junctor group to control circuit

Assuming that relay 622 operates, at its inner right contact, it closes a holding ground for itself over the contacts of magnet 425, relay 709 and relay 621. It also connects ground over its outer right contact, conductor 641, and the right back contact of relay 546 to the winding of relay 552 and battery, to start the control circuit functioning. With relay 552 operated, a circuit is closed from battery through the winding of relay 542, through rectangle 350, over the right back contact of relay 550 or the inner right back contact of relay 543 of the mate control circuit, indicating that the mate control circuit is functioning, back through rectangle 350, inner left back contact of relay 550 and the outer left back contact of relay 543 of the home control circuit to ground at the left front contact of relay 552. Relay 542 in turn closes circuits from battery through the windings of relays 300 and 600, over its left contacts in parallel, over the left back contact of relay 545, conductor 554 to ground at the inner left back contact of relay 228. Relays 300 and 600 connect the junctor group circuits and the sender group circuits to the home control circuit. Relay 542 also opens the circuit of relay 545 to prevent interference from the mate frame until the control circuit has completed its function. It also connects ground over the outermost front contact of relay 600 to conductor 554 to hold relays 600 and 300 operated.

Choosing junctor group to be served

With relay 600 operated, an indication of the group within which the calling junctor lies is given to the control circuit. Ground from the middle right contact of relay 622 extends over conductor 627, armature 602 of relay 600, conductor 603, outer back contact of relay 530 to the winding of relay 529 and over the normal contacts of the lower numbered group test relays to battery at the back contact of relay 520. Relay 529 closes a holding circuit to battery at its inner upper front contact. If junctors in other groups were calling, their relays might also operate, but preference is given to the highest numbered group by reason of the chain wiring of relays 520 to 529. Assuming relay 529 operates, it extends its operating ground over its lower front contact, over the upper back contact of relay 510 to the winding of relay 541 and battery. Relay 529 also closes a circuit from ground over its outer upper front contact, armature 604 of relay 600, winding of relay 620 to battery. Relay 620 connects the individual group circuit serving the calling group of junctors to the control circuit.

Choosing junctor to be served

Relay 620 in operating connects the ten start leads such as conductor 421, from the ten junctors of the group, through to the ten trunk test relays 500 to 509, conductor 421 extending over armature 628 of relay 620, armature 605 of relay

600, inner lower back contact of relay 510 to the winding of relay 500 and battery. It will be noted that the start conductors of the ten trunks of the group are connected together at the contacts of relay 621. Therefore the ground from conductor 421 also extends over other back contacts of relay 621 and front contacts of relays 620 and 600 to the windings of relay 509 and the rest of the trunk test relays. Each relay locks to its operating ground, independent of relay 510. With all of the relays 500 to 509 operated, a circuit is closed from battery through the winding of relay 621, armature 629 of relay 620, armature 606 of relay 600, left back contact of relay 540, inner upper front contacts of relays 500 to 509, inner left contact of relay 541 to ground at the middle lower front contacts of all of the relays 500 to 509. Relay 621 in operating locks over its right front contact, conductor 641, armature 642 of relay 620, armature 607 of relay 600 to ground. It also disconnects the multiple ground from the trunk relays and releases relay 622. Those relays, such as relay 500 which correspond to calling trunks remain locked, but the remaining relays release.

The release of relay 622 closes a circuit from battery through the winding of relay 540, armature 608 of relay 600, armature 631 of relay 620, back contact of relay 622, armature 632 of relay 620, armature 609 of relay 600, outer lower front contact of relay 500 to ground over the operating circuit of that relay. Relay 540 locks in a circuit from battery through its winding, armature 608 of relay 600, armature 631 of relay 620, back contact of relay 622, armature 632 of relay 620, armature 609 of relay 600, to ground at the fifth right contact of relay 540. With relay 540 operated, a circuit is closed at its fourth right contact for relay 530. Relay 530 opens the operating circuits of the group relays 520 to 529, leaving the highest numbered operated relay, in this case relay 529, locked over the inner front contacts of relay 529, outer left contact of relay 541 to ground at the middle lower contacts of the operated trunk test relays. When relay 540 operates, it closes a substitute holding circuit for relay 529 which may be traced from battery over the inner upper front contact, winding and lower front contact of relay 529, middle left front contact of relay 540, armature 611 of relay 600, armature 634 of relay 620, back contact of hold magnet 425, conductor 426, outer back contact of relay 709, conductor 730, armature 633 of relay 620, armature 612 of relay 600, to ground at the third right contact of relay 540. Parallel holding circuits extend over the other hold magnets and sender group relays serving the group. Therefore, if all links or all sender groups become busy, relay 529 releases, in turn releasing the group relay 620 to normal so that other calling junctors may be served.

Relay 540 also closes a locking circuit for the preferred trunk relay 500 which extends over the inner and outer lower front contacts of relay 500 to ground at the outer right front contact of relay 540. This locking circuit prefers the lowest numbered relay, the higher numbered relays locking only over the back contacts of the lower numbered relays. However, if higher numbered relays were operated at this time, they would remain locked to ground on the corresponding start lead.

Relay 530 also closes an obvious circuit for relay 510 which opens the operating circuits of the trunk test relays. Relay 510 also opens the

circuit of relay 541 which releases, but due to its slow-to-release characteristic, only after an interval. Relays 530 and 510 in operating prevent the operation of any further group and 5 trunk relays should additional calls be received.

Operating select magnet of primary sender selector

Relay 510 also closes a circuit for the select magnet corresponding to the preferred junctor in the primary sender selector. This circuit may be traced from ground at the outer left back contact of relay 228, conductor 230, upper front contact of relay 510, outer upper front contact of relay 590, armature 610 of relay 600, winding of primary select magnet 410 to battery, and in parallel to the select magnets of correspondingly positioned junctors in the other primary switches.

Test for idle sender group and link

In the meantime the control circuit has been testing for a sender group and sender. Since this is a full mechanical incoming junctor, group relay 620 connects ground over its armature 635 and armature 613 of relay 600 to conductor 614 and the winding of relay 126, which is individual to this junctor type and connects the group test relays to the circuits controlled by full mechanical senders only.

Assuming an arrangement similar to that shown in Fig. 8, each group of ten senders includes eight full mechanical senders grouped in the top horizontals of the switch and two B senders grouped in the bottom two contacts of the switch. Each group of senders has a circuit such as shown in Fig. 7, relays 710 to 719 being individual busy relays for the senders and relays 720 to 729 serving to test the condition set up on the sender busy relays 710 to 719. Relays 708, 705 and 709 serve the full mechanical senders, while relays 755, 758 and 731 serve the B senders. With relay 126 operated, the three sender groups are tested to determine whether the link serving the calling trunk group is idle and whether there are two or more full mechanical senders idle in the group. One sender group test circuit may be traced from ground at the left back contact of the link hold magnet 425, armature 636 of relay 620, armature 615 of relay 600, conductor 616, outer right back contact of relay 221, right winding of relay 100, right back contact of relay 127, outer left front contact of relay 126, conductor 131, armature 310 of relay 300, left back contacts of relays 702 and 705, outer left back contact of relay 710 to battery over the left normal contact of the next lower unoperated relay in the chain. A similar circuit is closed over the outer back contact of each unoperated relay except relay 717, which belongs to the last full mechanical sender of the group, to battery over the inner left contact of the next unoperated relay in the chain. Where operated relays intervene, the chain is extended to the following relay. This relay arrangement is disclosed and claimed in the application of A. J. Busch, Serial No. 68,240, filed March 11, 1936.

Circuits similar to the one traced for relay 100 are closed for relays 101 and 102 if the corresponding link and two full mechanical senders of the group are available. Assuming that relay 100 is operated, a circuit is closed from ground over the normal contacts of relays 103 and 104 through the winding of relay 105, armature 312 of relay 300, outer right front contact of relay

100, right back contact of relay 102, left back contact of relay 218, conductor 232, inner left front contact of relay 540, conductor 555, right back contact of relay 228, resistance 229 to battery.

Seizing sender group

Relay 105 is individual to the group of senders represented by relay 100 in this link circuit. A similar relay (not shown) is provided for each of the other sender groups. Relays 103 and 104 belong to the same sender group as relay 105 but are a part of other link circuits. These relays are arranged in a lock-out chain in order to individualize the sender group to a particular link circuit and to prevent interference from other link circuits. In this case the link circuit shown has the last preference for the sender group shown and relay 105 can only operate if no other link control circuit is attempting to connect with this group of senders. Relay 105 when operated locks to ground at its own front contact and renders relays 103 and 104 ineffective by disconnecting ground from their left armatures. With relay 105 operated, a locking circuit is closed for relay 100 which may be traced from battery through the left winding and over the inner left front contact of relay 100, armature 311 of relay 300, outer left front contact of relay 105, to ground. This same ground is extended over the inner left front contact of relay 105, armature 313 of relay 300, to the winding of relay 221 and battery. A circuit is also closed from ground at the middle right contact of relay 105 to the winding of relay 702 and battery. Relay 221 opens the operating circuits of relays 100, 101 and 102 causing relays 101 and 102, for which no locking circuits have been provided, to release.

Reserve sender group test

When relay 541 closes its back contact, a circuit is closed from ground at the right back contact of relay 541, outer left front contact of relay 540, conductor 556, winding of relay 127 to battery. If none of the relays 100, 101 or 102 has operated by this time, relay 127 transfers their circuits from the regular test over back contacts of the sender relays 710 to 717, to the reserve test to battery over the back contacts of relays 702 and 705 and the similar relays of the other sender group circuits. Relay 705 is operated over the outer left front contacts of relays 710 to 717 when all of the full mechanical senders of the group are busy, thereby opening the circuit of the corresponding sender group relay. Therefore for groups having a single idle sender, relay 705 will be unoperated and such a group may be selected. The operation of relay 702 from relay 105, when the regular test is satisfied, cancels this reserve test, although relay 127 is operated.

Selection of idle sender

With relays 100 and 105 operated and locked, the control circuit is ready to select an idle sender in the selected group. A circuit is first closed from ground over the middle left contact of relay 221, outer left front contact of relay 100, outer left back contacts of relays 101 and 102, middle left front contact of relay 100, armature 314 of relay 300, outer right contact of relay 105, winding of relay 750 to battery. Relay 750 connects the circuits of the selected group of senders to the control circuit.

Relay 750 connects ground to conductors 781, 75

782, 783 and 784. These conductors extend in multiple to the ten senders of the group but are ineffective until a sender has been seized. Conductor 781 controls a relay which reverses the direction of current flow over the contact of the stepping relay for calls received over part of the link circuits in order to save wear on the contact. Conductor 782 supplies holding ground to the sender until after the off-normal relay has operated. Conductors 783 and 784 carry the identity of the trunk group to the sender for transmission to the marker.

Operating select magnet of secondary sender selector

Relay 750 also closes a circuit from battery through the winding of relay 708, armature 735 of relay 750, conductor 736, armature 330 of relay 300, to ground at the outer right contact of relay 126. With relay 708 operated, the circuits for selecting a sender are closed. Each trunk normally prefers a different sender but in this case, with only eight senders available the preference of two pairs of trunks would be the same. Therefore relays 300 and 708 connect eight preference leads from the trunk relays 500 to 509 through the windings of the eight sender selecting relays 720 to 727 over contacts of the sender busy relays 710 to 717. Since trunk relay 500 was operated, the circuit closed at this time extends from ground at the inner right front contact of relay 540, middle upper front contact of relay 500, conductor 557, armature 316 of relay 300, conductor 317, armature 787 of relay 750, inner right contact of relay 708, right back contact of relay 710, assuming this sender to be idle, winding of relay 720, left normal contacts of relays 727, 728, 729, etc., to battery. Relay 720 operates and locks to battery at its inner left contact and to ground over its inner right contact and armature 732 of relay 750. It connects ground over its outer right contact to the winding of relay 702 to hold that relay operated. At its outer left contact it closes a circuit from ground over armature 783 of relay 750, conductor 789 to the winding of the secondary select magnet 400 individual to the selected sender. At the same contact it connects ground to conductor 792 to inform the sender that it has been selected. Relay 720 also connects ground over its middle right contact, armature 790 of relay 750, conductor 791, armature 318 of relay 300, to the winding of relay 225 and battery.

When relay 750 operated, relay 117 was connected in parallel over the four left back contacts of relay 116, the four outermost armatures of relay 300, armatures 793 to 796 of relay 750 to conductors 797 to 799 and 751 leading in multiple to the group of senders to test them for the presence of false ground. If any one of these conductors is grounded falsely, relay 117 operates, opening the circuit of relay 116 and blocking the progress of the call.

Operating link hold magnets

If relay 117 does not operate, the operation of relay 225 closes a circuit from ground at its inner right contact over the back contact of relay 117 for relay 116 which disconnects relay 117 from conductors 797 to 799 and 751. With relay 116 operated, a circuit is closed for hold magnets 424 and 425, belonging to the link circuit connecting the calling trunk and selected sender, extending over the inner back contact of relay 423, armature 637 of relay 620, armature 617 of relay 600, conductor 618, middle right front contact of relay

100, through the winding of relay 215 shunted by the outer left back contact of relay 220, inner right front contact of relay 116, to ground at the inner right back contact of relay 224. Magnets 424 and 425 operate, closing the cross-points prepared by select magnets 400 and 410. When magnet 424 closes its cross-point, the operating ground for the magnets is extended over contact 445 of the secondary selector, conductor 446, to the sender.

Test of sender holding circuit

When relay 720 connects ground to conductor 792, it causes the operation of a sender relay which connects conductor 446 to conductor 751, armature 796 of relay 750, armature 319 of relay 300, inner left front contact of relay 116, winding of relay 220 and battery. Relay 220 opens the shunt around the winding of relay 215 and relay 215 operates, provided there is no false ground on the sleeve conductor of the sender link. Such a ground, while holding the hold magnets and relay 220 would be in shunt of the winding of relay 215, preventing its operation and blocking the call.

Assuming relay 215 operated, it closes an obvious circuit for relay 214 which locks under the control of relay 221. Relay 214 connects ground over its middle left contact, outermost contact of relay 300, armature 793 of relay 750, conductor 797, to the sender where it operates a relay which in turn connects ground to the winding of relay 710, marking this sender busy to this and other link circuits.

Frame registration

In the meantime, the incoming frame is identified to the sender by ground connected to conductors 783 and 784 as previously described. In response to the completion of the frame registration ground is closed over conductor 799, armature 795 of relay 750, armature 320 of relay 300, left back contact of relay 224, outer right contact of relay 214, winding of release relay 223 and battery. This same ground is also extended to conductor 446 to hold the magnets 424 and 425 operated, independent of the control circuit.

Release of control circuit

Release relay 228 locks under the control of relays 223, 127, 221, 116, 540 and 541 if operated, to insure that it remain operated until the control circuit has restored to normal. It also connects ground over its left front contact, conductor 233, armature 619 of relay 600, conductor 624, inner left back contact of relay 543, winding of relay 546 and battery. Relay 546 locks to ground at the right front contact of relay 552, opens the circuit of relay 552 and disconnects ground from conductor 558, thereby terminating the timing operation. Relay 552 releases relay 542 which in turn releases relays 600 and 300, disconnecting the sender and group circuits from the control circuit. The release of relay 600 in turn releases group relay 620, select magnet 410, relay 540, the group test relay 529 and trunk test relay 500, as well as relays 510 and 530. Relay 300, in releasing, restores the link lock-out relay 195, sender group connect relay 750, sender test relay 720, sender select magnet 400, relay 702 and relay 708, also sender group test relay 100, and the remaining operated relays of Figs. 1 and 2, relay 228 releasing last.

Relay 621 releases following the release of relay 620 if no calls are waiting in other groups. When

calls are waiting in other groups, the corresponding group start relay, for example relay 652, is operated, grounding conductor 641, which is common to all groups, and thereby holding relay 621 operated and preventing the extension of a new call in this group until other waiting groups have been served.

The junctor is now connected over the primary sender selector 430 and secondary sender selector 440 to the terminating sender.

Emergency operation of control circuit

Before proceeding to a description of a call involving a B junctor, the operation of the link control circuit in connection with a mate frame will be described. When conductor 641 is grounded, this ground extends over the left back contact of relay 546 to conductor 558 and an interrupter (not shown). After an interval the interrupter grounds conductor 559, operating relay 553 which locks to conductor 558. After a further interval of about 6 seconds the interrupter connects ground to conductor 560, completing a circuit over the right contact of relay 553 to the winding of relay 547 and battery. Relay 547 also locks to conductor 558, lights lamp 548, and operates relay 543 over the left contact of key 544. Relay 543 opens the operating circuits for relays 542 in both the home and mate control circuits and the circuit of relay 545 and transfers the circuit of relay 546 from control by the sender relay and the release relay 228 to the transfer relays 550 of the home and mate frames. In addition, relay 543 closes a circuit for relay 550 which is effective if the transfer relay 550 and start relay 552 of the mate control circuit are idle. The circuit may be traced from battery through the winding of relay 550, through rectangle 350, over the outer left back contact of the mate relay 550, right back contact of mate relay 552, back through rectangle 350, to ground at the inner right contact of home relay 543. Relay 550 locks over its inner right contact to ground over key 551 and therefore remains operated until released manually by the operation of the key. Relay 550 further opens the circuit for mate relay 542, operates relay 546, lights lamp 549, extends the start circuit from the front contact of relay 552 to the winding of mate relay 545, and opens the circuit of mate relay 550.

Relay 542, if operated, releases, in turn releasing relays 600 and 300. The operation of relay 546 disconnects ground from conductor 558, releasing relays 553, 547 and 543. When relay 543 releases, mate relay 545 operates, locking independent of mate relay 542, opening the circuits of mate relays 300 and 600 and closing circuits from battery through the windings of relays 601 and 301, over the left front contacts of mate relay 545, mate conductor 554, to ground at mate relay 228. Relays 601 and 301 connect this group circuit to the mate control circuit. If, in the meantime, a call comes in on the mate frame, relay 542 of that frame will be operated and when relay 545 is released at the completion of the previous call, immediately seizes the control circuit for that frame.

Timing for sender connection

In the control circuit, relay 221 operates as soon as the control circuit is associated with a group of senders. Relay 221 at its inner right contact connects interrupter 222 to conductor 234, thereby grounding that conductor at half second intervals. Relays 210 and 211 function in the

well-known manner, relay 211 operating at the beginning of the first pulse and relay 210 operating when ground is removed. Relay 211 releases at the beginning of the second pulse and relay 210 at the end, the cycle repeating as long as the ground pulses continue. If the control circuit has not released when relays 211 and 210 have operated and relay 211 has released, a circuit is closed from battery through the winding of relay 218, outer right back contact of relay 224, inner left back contact of relay 220, right front contact of relay 210, left back contact of relay 211, conductor 235, armature 623 of relay 600, conductor 625 to ground over the right contact of key 544. Relay 218 locks under the control of release relay 228. Relay 218 opens the circuit of relay 105, releasing the selected group of senders. Relay 218 also closes a circuit from battery through the winding of relay 223, left front contact of relay 218, left contact of relay 225, to ground at the right back contact of relay 116. Relay 223 also locks to the back contact of relay 228. In selecting a sender group, the preference lead coming into the control circuit over conductor 232, normally extends over the back contact of relay 218 to the armature of relay 102. With relays 218 and 223 operated this preference lead is extended over the front contact of relay 223 to the armature of relay 100, thus endeavoring to seize a different sender group.

Relays 210, 211, 218 and 223 are permitted to function if because of false grounds relay 117 operates as previously described, or if because the cross-points fail to close properly, relay 220 does not operate. If relay 220 operates, but because of double connections relay 215 does not operate, when relay 211 falls back, the circuit above traced to relay 218 extends over the left front contact of relay 220 to the winding of relay 224, which locks under the control of relay 221. Relay 224 closes a circuit from battery through the winding of relay 423, conductor 439, armature 321 of relay 300, inner right front contact of relay 100, middle left front contact of relay 224, to ground at the left back contact of relay 214. Relay 423 opens the circuits of hold magnets 424 and 425 opening the corresponding cross-points and disconnecting ground from relay 220, which releases. It also connects ground over its left contact, conductor 438, armature 322 of relay 300, outer right back contact of relay 220, inner left front contact of relay 224, to the winding of relay 219 and battery. Relay 219 operates and locks under the control of relay 221.

Relay 219 connects ground over its middle left contact, armature 323 of relay 300, armature 794 of relay 750 to conductor 798 to release the sender. It also connects ground over its inner left contact, outermost armature of relay 300, armature 793 of relay 750 to conductor 797, which ground is passed back over conductor 751 and thence as previously traced to the winding of relay 220 and battery. Relay 220 closes a circuit for relay 218 over the outer left contact of relay 219, inner right and left contacts of relay 220 to the right front contact of relay 210 and thence to ground as described above when relays 210 and 211 reach the proper point in their cycle. Relay 218 functions as previously described to release the sender group selection relays and to bring about a second trial.

If the sender is selected and otherwise operates correctly but fails to send a release signal to the link within the prescribed length of time, the functioning of relays 210 and 211 will bring 75

about the operation of relay 224 as described. If relays 220, 215 and 214 have been operated, when relay 210 releases after operating relay 224 it closes ground over its back contact, outer left front contact of relay 224, outer right front contact of relay 214, winding of relay 228 and battery. Relay 228 functions in the usual manner to release the link control circuit. If relays 220, 215 and 214 do not operate, the call is transferred to the mate control circuit.

Operation in connection with B junctor

When a call is originated on a junctor to be served by a B operator, the group start conductor is grounded in the same manner as by a full mechanical junctor. As above mentioned the B junctors are grouped together and will be served by individual links. Assuming the B junctor indicated in Fig. 4 is seized, conductor 451 is grounded, operating the individual group relay 652. The circuit for relay 652 may be traced from grounded conductor 451, back contact of relay 651, back contact of hold magnet 452, back contact of relay 731, outer right back contact of relay 651, contact of jack 657 to the winding of relay 652 and battery. Parallel circuits are closed over the back contacts of the hold magnets of the other two links serving this group of junctors and the corresponding sender group busy relays. Relay 731 operates from relay 755 which, in turn, operates over the front contacts of relays 718 and 719 if the two B senders of this group are both busy.

Relay 652 grounds conductor 641 to start the operation of the control circuit in the usual manner. Relay 542 is operated, in turn, operating relays 600 and 300. Relay 652 now indicates the identity of the calling group of junctors to the group relays 520 to 529 by closing a circuit from ground at its middle right contact, armature 653 of relay 600, inner lower back contact of relay 530 to the winding of relay 520 and battery. Assuming relay 520 is operated alone, it removes the operating battery from the higher numbered relays to prevent interference. It also extends its operating ground over its lower front contact and the back contacts of the higher numbered group relays including relay 529, upper back contact of relay 510 to the winding of relay 541 and battery. Relay 520 also closes a circuit from ground over the upper back contacts of relays 529 and the intermediate group relays, outer upper front contact of relay 520, armature 654 of relay 600, to the winding of relay 655 and battery. Relay 655 performs the same functions for this group of junctors that relay 620 performed for its group. Since this B junctor is also the first in its group, relay 655 connects start lead 451 over armature 656 of relay 655, armature 605 of relay 600, inner lower back contact of relay 510 to battery through the winding of relay 500.

All of the trunk relays operate and lock temporarily as above described. With relays 500 to 509 operated a circuit is closed from battery through the winding of relay 651, armature 658 of relay 655, armature 606 of relay 600, left back contact of relay 540, inner upper front contacts of relays 500 to 509, inner left contact of relay 541 to ground at the middle lower front contacts of relays 500 to 509. Relay 651 locks under the control of relay 600 and opens the multiple ground allowing all relays but relay 500 to release. Relay 651 also releases relay 652 which closes the circuit of relay 540 over armature 608 of relay 600, armature 660 of relay 655,

left back contact of relay 652, armature 659 of relay 655, armature 609 of relay 600, outer lower front contact of relay 500 to ground over the operating circuit of that relay. Relay 540 supplies locking ground at its outer right contact in place of the ground supplied by relay 500.

Relay 540 operates relay 530, which in turn operates relay 510. Relay 540 also provides a holding circuit for relay 520, which extends over the lower front contact of relay 520 and the lower back contacts of the other group test relays, back contact of relay 529, middle left front contact of relay 540, armature 611 of relay 600, armature 661 of relay 655, back contact of magnet 452, back contact of relay 731, armature 662 of relay 655, armature 612 of relay 600 to ground at the third right contact of relay 540. As in the operating circuit of relay 652 there are parallel circuits over contacts of the hold magnets and sender group busy relays of other sender groups. In addition relay 540 also locks relay 509 as before.

With relay 510 operated the select magnets corresponding to relay 500 are operated as above described.

In the meantime the sender test is taking place. Since this is a B junctor, group relay 655 connects ground over armature 663, armature 664 of relay 600, conductor 665 to the winding of relay 132 and battery. With relay 132 operated the three sender groups are tested to determine whether the links are idle and B senders are available. The test circuit for the group shown extends from ground at the left back contact of magnet 452, armature 666 of relay 655, armature 615 of relay 600, conductor 616, outer right back contact of relay 221, right winding of relay 190, right back contact of relay 127, outer left contact of relay 132, armature 331 of relay 300, conductor 332, outer right contact of relay 702, left back contacts of relays 755, 718 and 719 to battery. This is under the assumption that the two B senders of the group to which relays 718 and 719 belong are idle. If one of the senders were busy and the corresponding sender busy relay operated, this circuit could not be completed. If both senders were busy relay 755 would be operated over the middle left front contacts of relays 718 and 719, in turn, operating relay 731.

Similar test circuits are closed for relays 101 and 102. With at least one sender busy in each group, the regular test would fail and the reserve test be made under the control of relay 127. The reserve test circuit for relay 100 extends over the outer right front contact of relay 127, inner right contact of relay 132, armature 333 of relay 300, conductor 334, inner right back contact of relay 702, to battery at the right back contact of relay 755. If both senders are busy so that both tests fail, this group of senders cannot be used.

Assuming, however, that the reserve test is successful, relay 718 being operated but relay 719 idle, relay 100 will operate, in turn, operating relay 105, which provides a locking circuit for relay 100, and an operating circuit for relay 221. Relay 105 also operates relay 702.

With relays 100 and 105 operated, relay 750 is operated as previously described. Relay 750 closes a circuit from battery through the winding of relay 758, armature 785 of relay 750, conductor 786, armature 315 of relay 300, outer right contact of relay 132 to ground. Relay 758 closes a sender selecting circuit from ground at the inner right front contact of relay 540, middle upper front contact of relay 500, conductor 557, armature 316 of relay 300, conductor 317, armature 787 of relay

750, inner right contact of relay 758 to the outer right armature of relay 718. Since it was assumed that relay 718 is operated, the circuit extends over the outer right front contact of relay 718, right back contact of relay 719, winding of relay 729 and battery.

Relay 729 locks to ground on armature 732 of relay 750, and connects ground to the winding of relay 702. It also closes a circuit from ground over the left back contacts of relays 720 to 728, outer left front contact of relay 729, armature 737 of relay 750, conductor 738, winding of sender select magnet 409 and battery. A branch of this circuit extends over conductor 742 to the sender.

At its middle right contact relay 729 connects ground to the circuit of relay 225, which operates relay 116 as previously described. With relay 116 operated, a circuit is closed from ground at the inner right back contact of relay 224, inner right front contact of relay 116, through the winding of relay 215 shunted by the outer left back contact of relay 220, middle right front contact of relay 100, conductor 618, armature 617 of relay 600, armature 667 of relay 655, outer right back contact of relay 423 to the windings of hold magnets 452 and 454. These magnets close the cross-points prepared by select magnets 453 and 409, completing the connection between the junctor and sender.

The testing of this connection and the release of the control circuit take place in the same manner as for a full mechanical junctor.

What is claimed is:

1. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits, and a unitary switching device for connecting any one of said trunk circuits with one of the corresponding registering devices.

2. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits, and a unitary switching device responsive to seizure by any one of said trunk circuits to connect said trunk circuit with one of the corresponding registering devices.

3. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits, a unitary switching device, means for seizing said switching device by any one of said trunk circuits, means associated with said switching device to record the type of said trunk circuit, means for testing said registering devices, and means under the control of said recording means to cause said testing means to test only those registering devices corresponding to said trunk circuit.

4. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, trunk circuits incoming to said office from dial offices, first registering devices for association with said manual trunk circuits, other registering devices for association with said dial trunk circuits, said registering devices being arranged in groups containing both said first registering devices and said other registering devices,

a unitary switching device, means for seizing said switching device by any one of said trunk circuits, means associated with said switching device to record the type of said seizing trunk circuit, a testing circuit associated with said switching device for testing each of the registering devices of a group, and means under the control of said recording means for rendering only those testing circuits effective which test registering devices associable with the seizing trunk.

5. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, trunk circuits incoming to said office from dial offices, first registering devices for association with said manual trunk circuits, other registering devices for association with said dial trunk circuits, said registering devices being arranged in groups containing both said first registering devices and said other registering devices, a unitary switching device, means for seizing said switching device by any one of said trunk circuits, means associated with said switching device to record the type of said seizing trunk circuit, means for testing said registering devices comprising a set of relays one for each registering device in the group, and means under the control of said recording means for rendering only those relays effective which test registering devices associable with the seizing trunk.

6. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, trunk circuits incoming to said office from dial offices, first registering devices for association with said manual trunk circuits, other registering devices for association with said dial trunk circuits, said registering devices being arranged in groups containing both said first registering devices and said other registering devices, a unitary switching device, means for seizing said switching device by any one of said trunk circuits, means associated with said switching device to record the type of said seizing trunk circuit, means for testing said registering devices comprising a set of relays one for each registering device in a group, and means for operating one of said relays under the joint control of said recording means and the registering devices under test.

7. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, trunk circuits incoming to said office from dial offices, first registering devices for association with said manual trunk circuits, other registering devices for association with said dial trunk circuits, said registering devices being arranged in groups containing both said first registering devices and said other registering devices, a unitary switching device, means for seizing said switching device by any one of said trunk circuits, means associated with said switching device to record the type of said seizing trunk circuit, means for testing said registering devices comprising a set of relays one for each registering device in a group, and means for operating a particular one of said relays under the joint control of said seizing trunk, said recording means and the registering device under test.

8. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits, a unitary switching device, comprising primary and secondary cross-bar switches and links inter-

connecting them, sets of contacts in said primary switches and links individual to each type of trunk, sets of contacts in said secondary switches individual to each type of registering device and
 5 accessible to both types of link, and means for preventing links of one type from engaging contacts belonging to registering devices of the other type.

9. In a telephone system, a terminating office,
 10 trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits,
 15 a unitary switching device, comprising primary and secondary cross-bar switches and links interconnecting them, sets of contacts in said primary switches and links individual to each type of trunk, sets of contacts in said secondary
 20 switches individual to each type of registering device and accessible to both types of link, and means for permitting links of one type to engage only contacts belonging to registering devices of the same type comprising means for recording
 25 the type of an incoming trunk, means under the control of said recording means for testing only the corresponding type of registering device, and means under the control of said testing means to prepare a set of secondary switch contacts.

10. In a telephone system, a terminating office, trunk circuits incoming to said office from manual offices, registering devices for association with said manual trunk circuits, trunk circuits incoming to said office from dial offices, registering devices for association with said dial trunk circuits,
 5 a unitary switching device, comprising primary and secondary cross-bar switches and links interconnecting them, sets of contacts in said primary switches and links individual to each type of trunk, sets of contacts in said secondary switches individual to each type of registering device and accessible to both types of link, and means for
 10 permitting links of one type to engage only contacts belonging to registering devices of the same type comprising means for recording the type of an incoming trunk, a set of relays for testing each group of registering devices, means under control of said recording means for preparing the
 15 circuits of those test relays only which test the corresponding type of registering device and means under the control of said test relays to prepare a set of secondary switch contacts individual to a registering device of corresponding
 20 type.
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