Aug. 6, 1946. B. D. HOLBROOK ET AL 2,405,214

CALL DISTRIBUTING SYSTEM

Filed April 10, 1945 9 Sheets-Sheet 1

FIG. 1

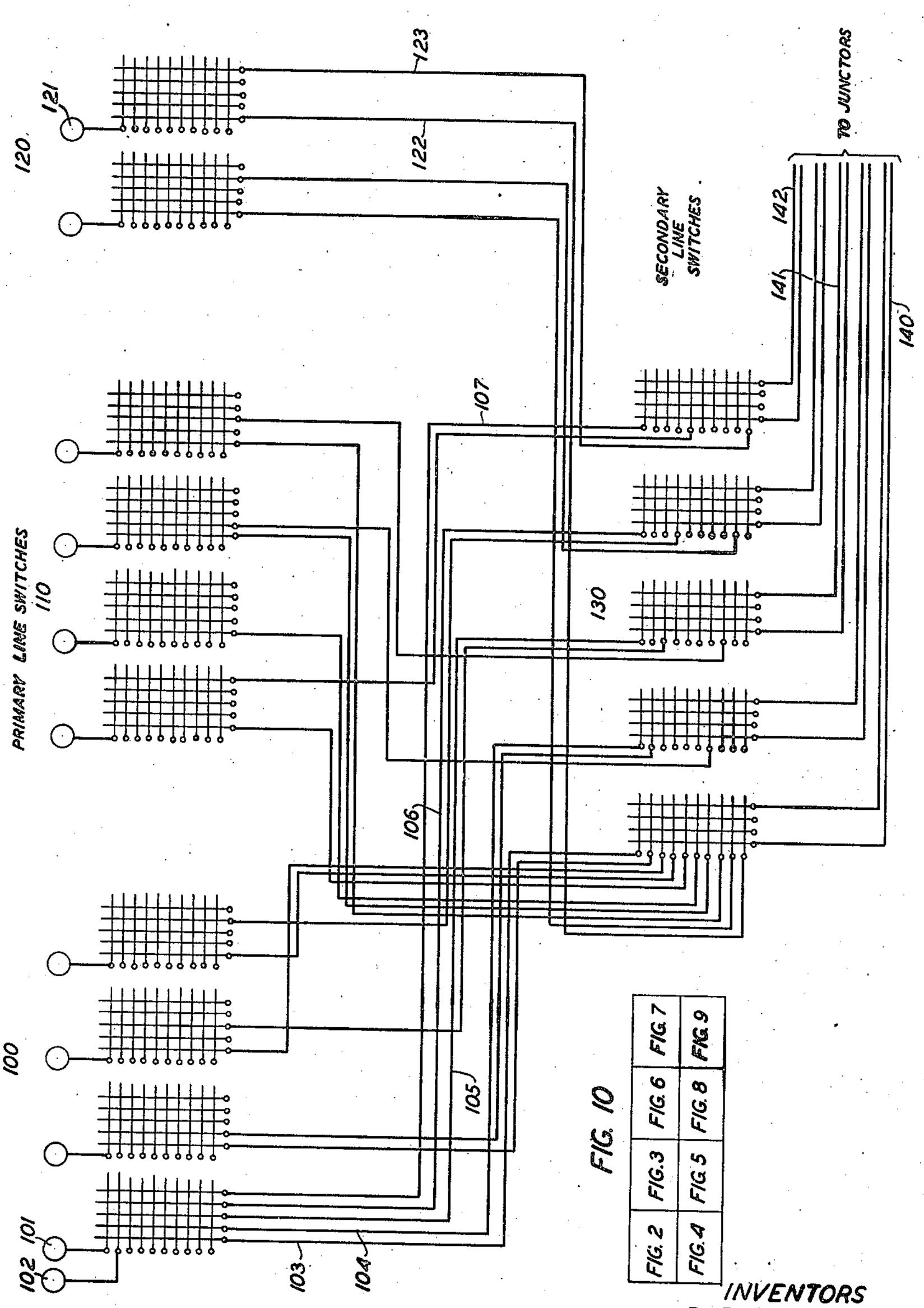

FIG. 10

FIG. 2	FIG. 3	FIG. 6	FIG. 7
FIG. 4	FIG. 5	FIG. 8	FIG. 9

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CALL DISTRIBUTING SYSTEM

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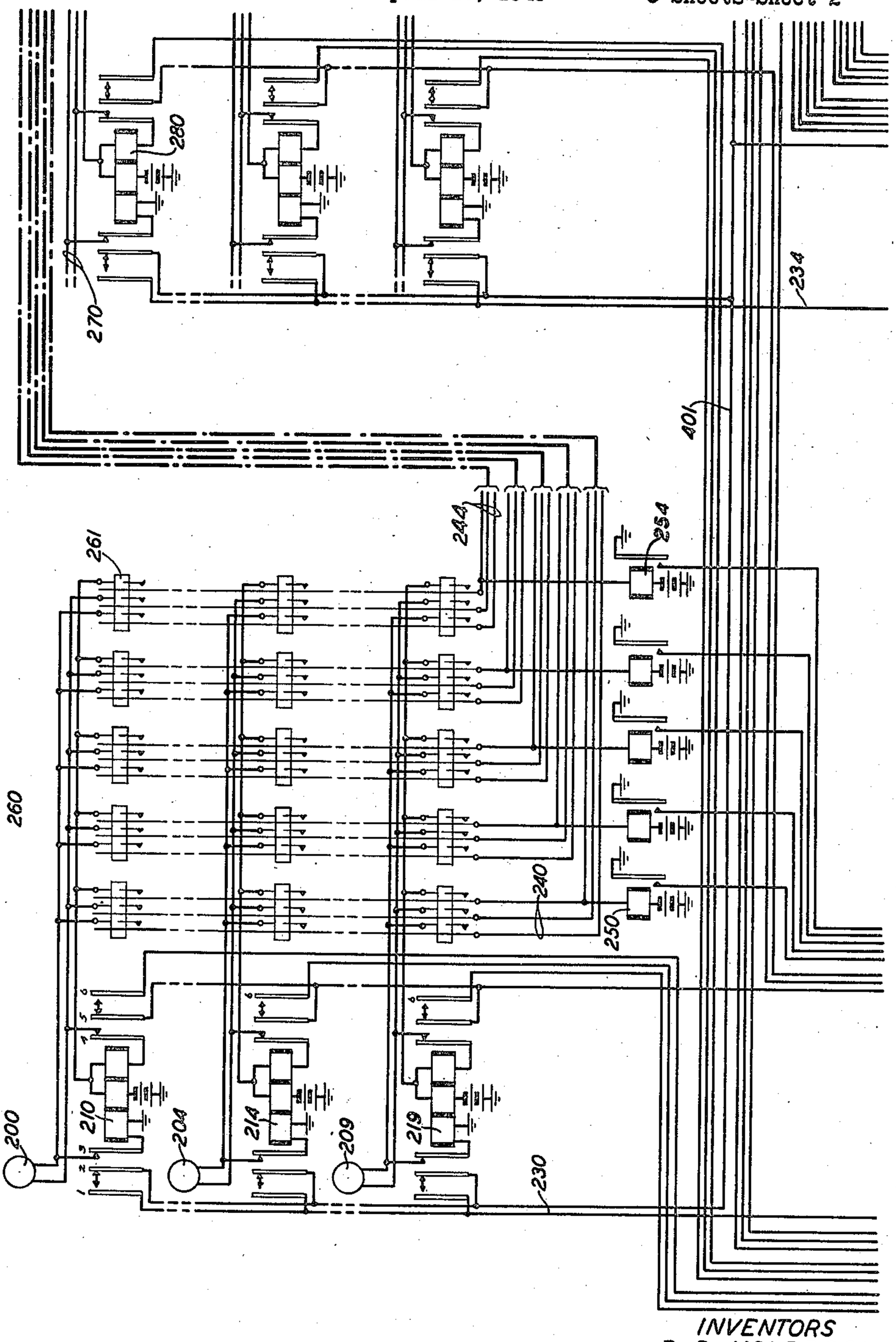
FIG. 2



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CALL DISTRIBUTING SYSTEM

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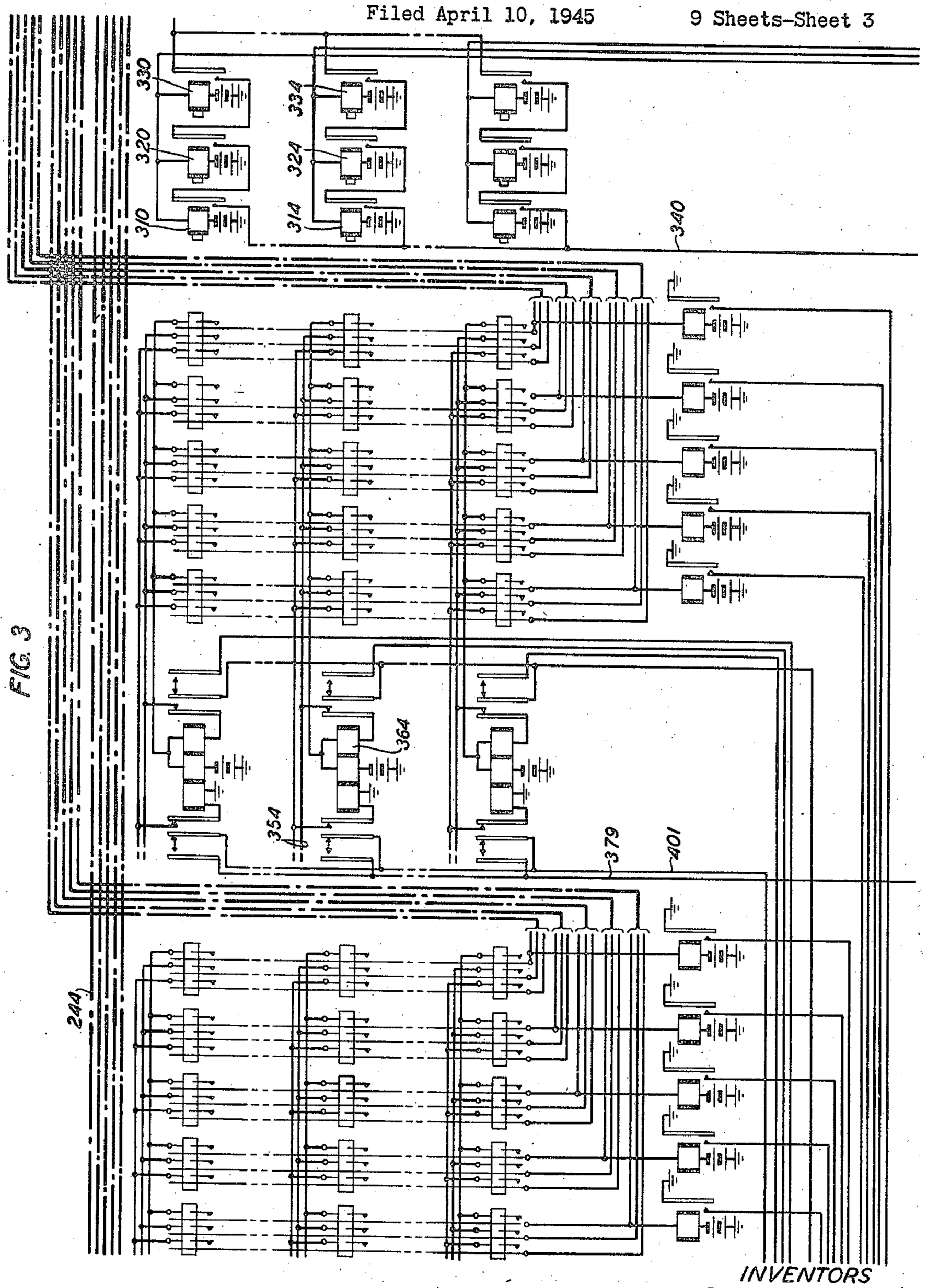

FIG. 3

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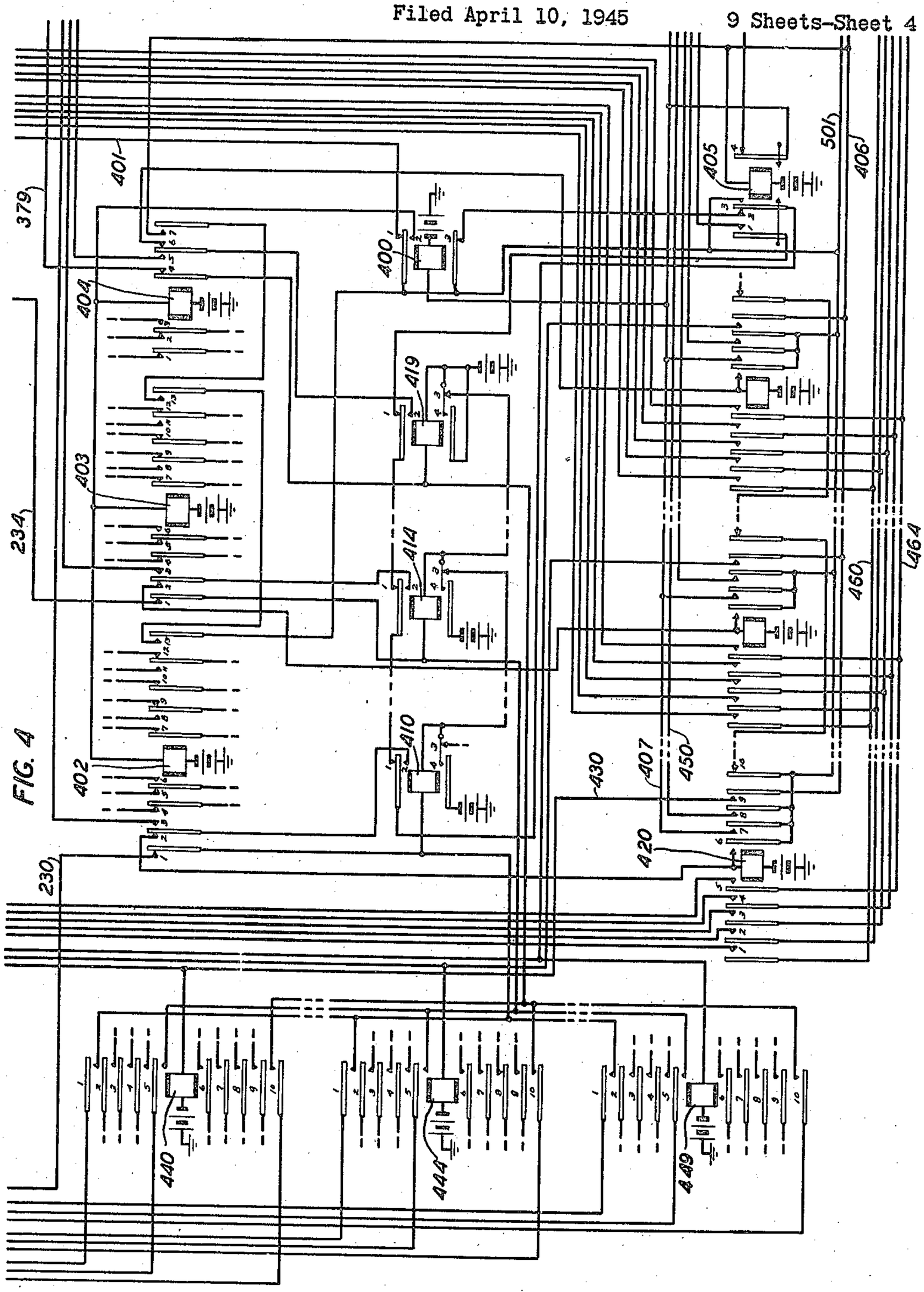

FIG. 4

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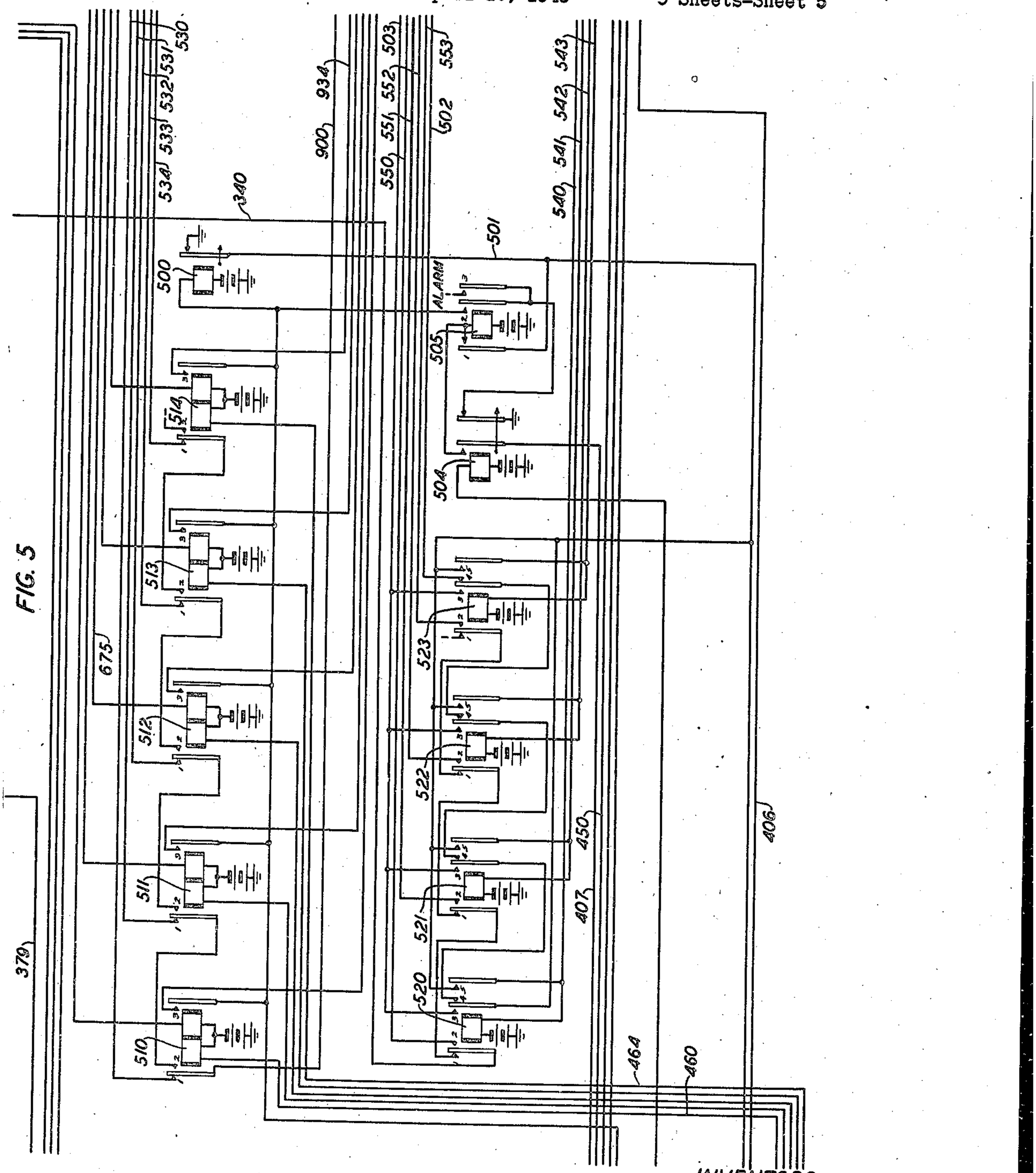

FIG. 5

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CALL DISTRIBUTING SYSTEM

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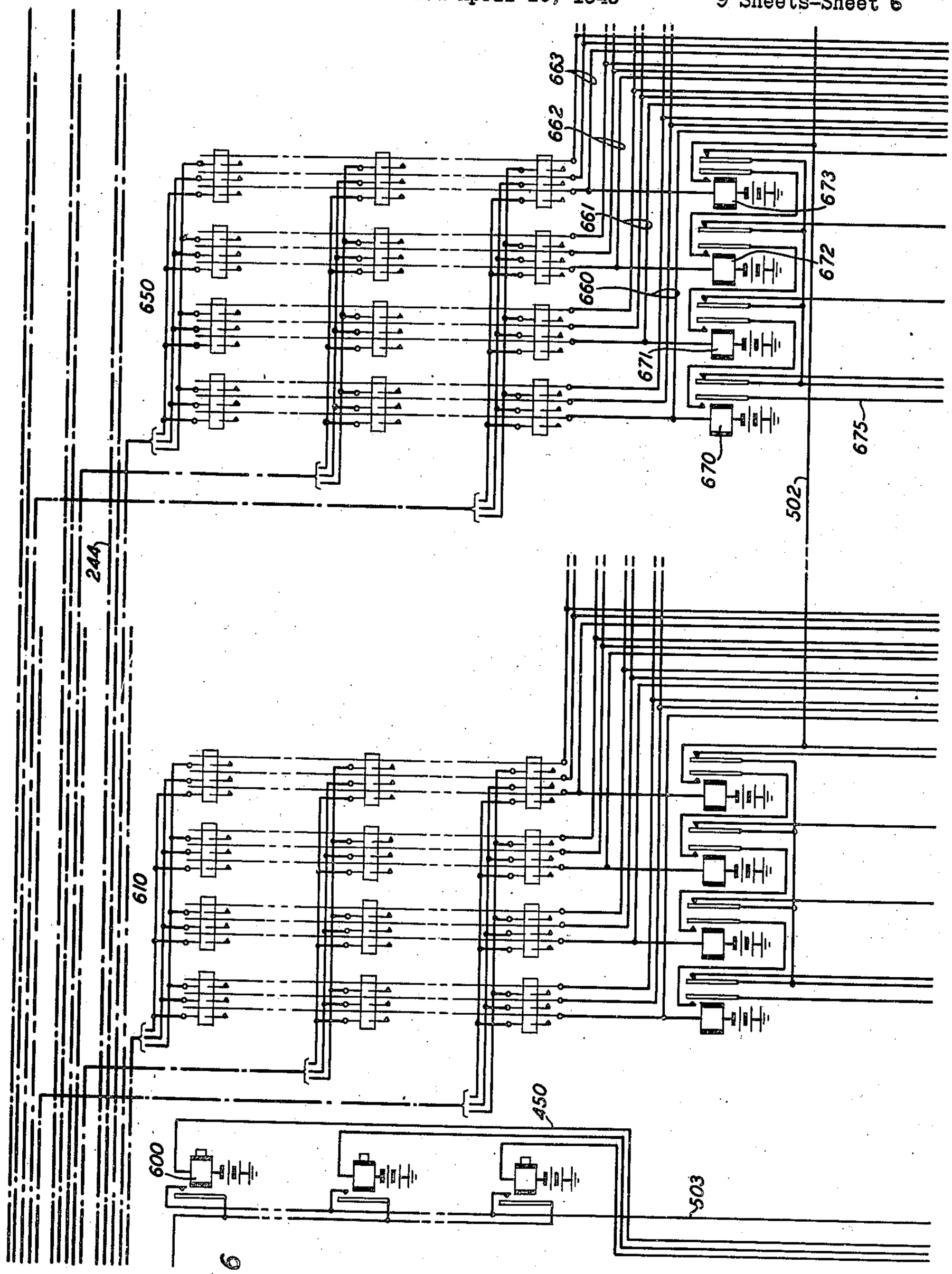

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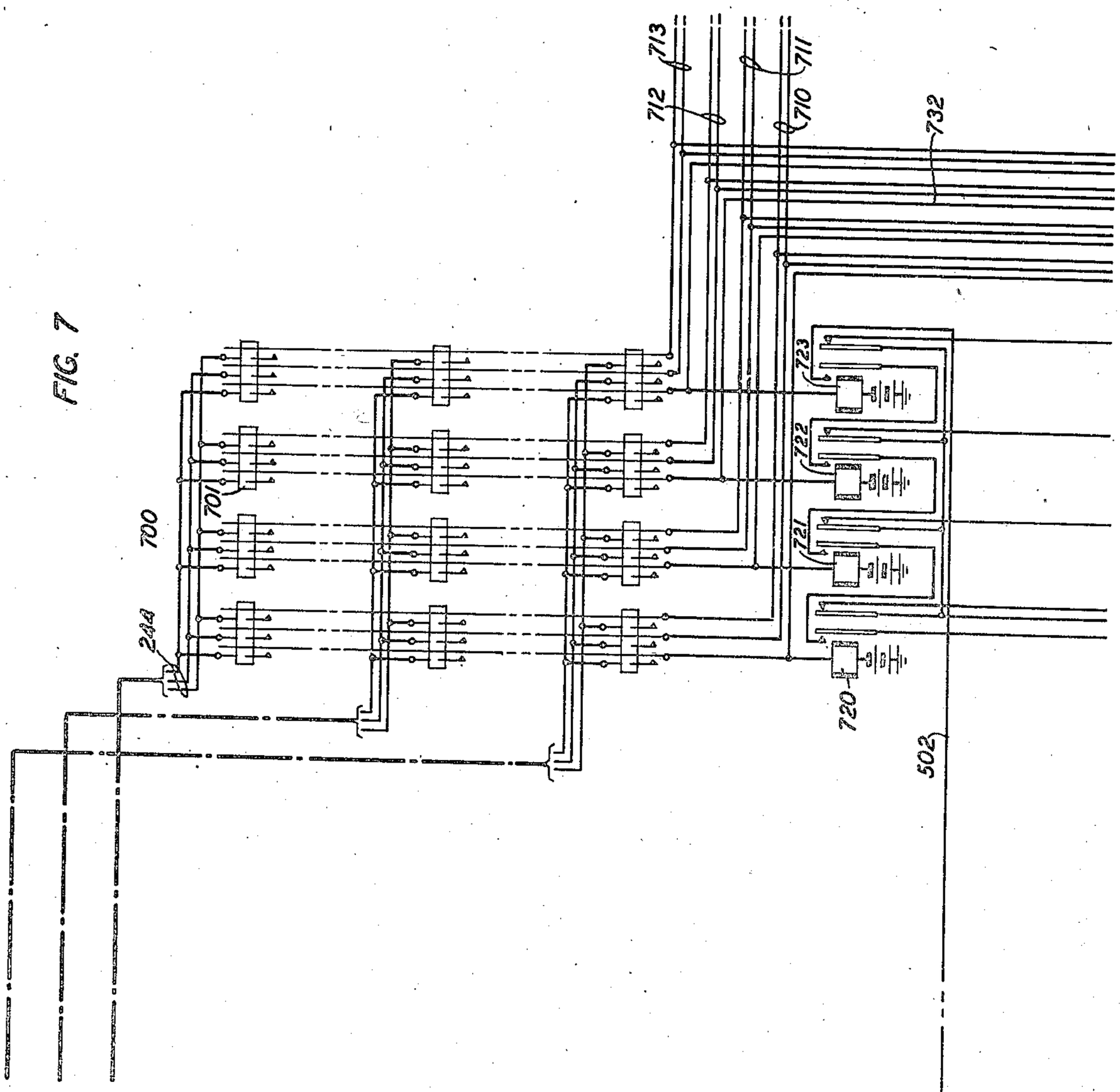

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CALL DISTRIBUTING SYSTEM

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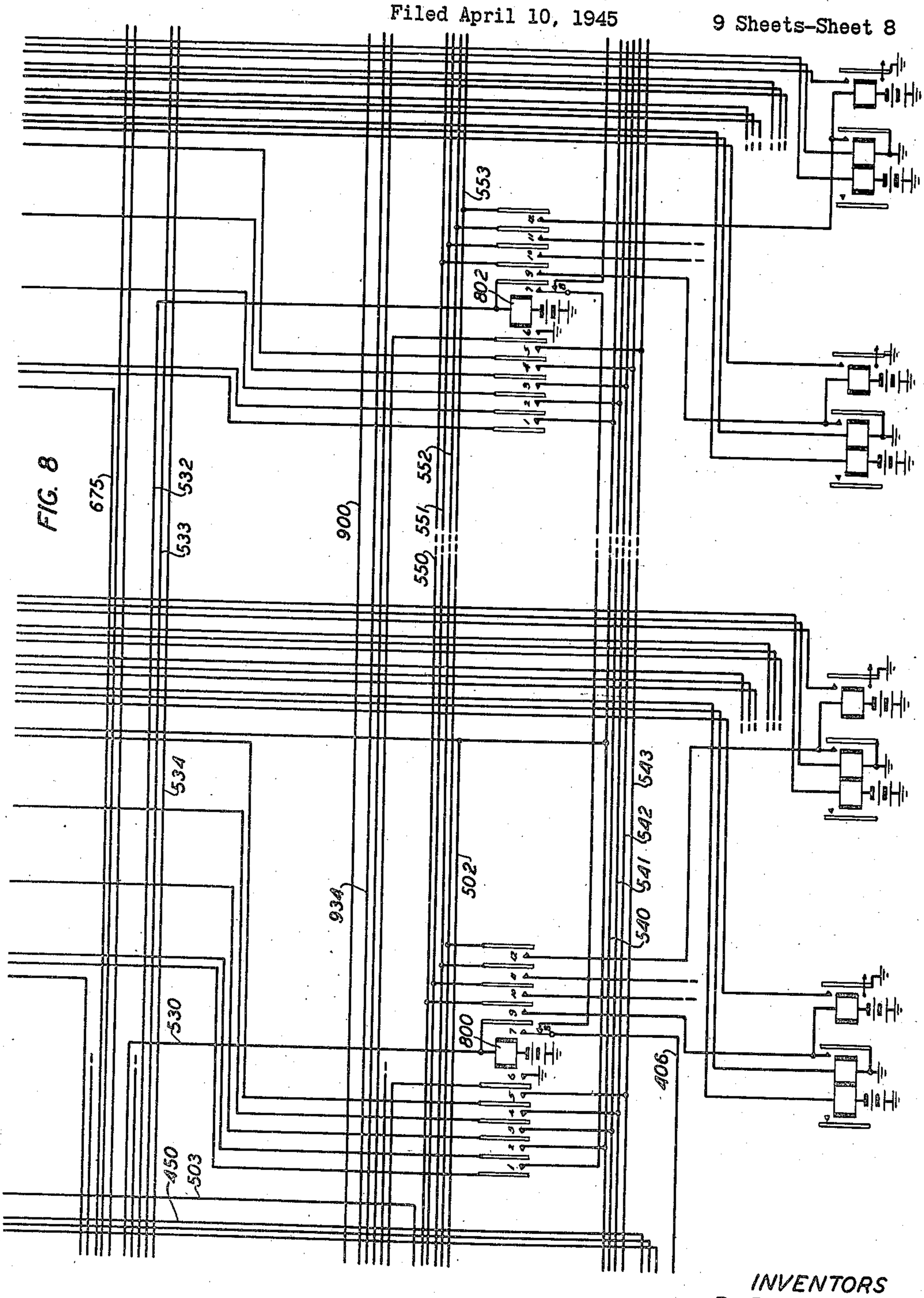

FIG. 8

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CALL DISTRIBUTING SYSTEM

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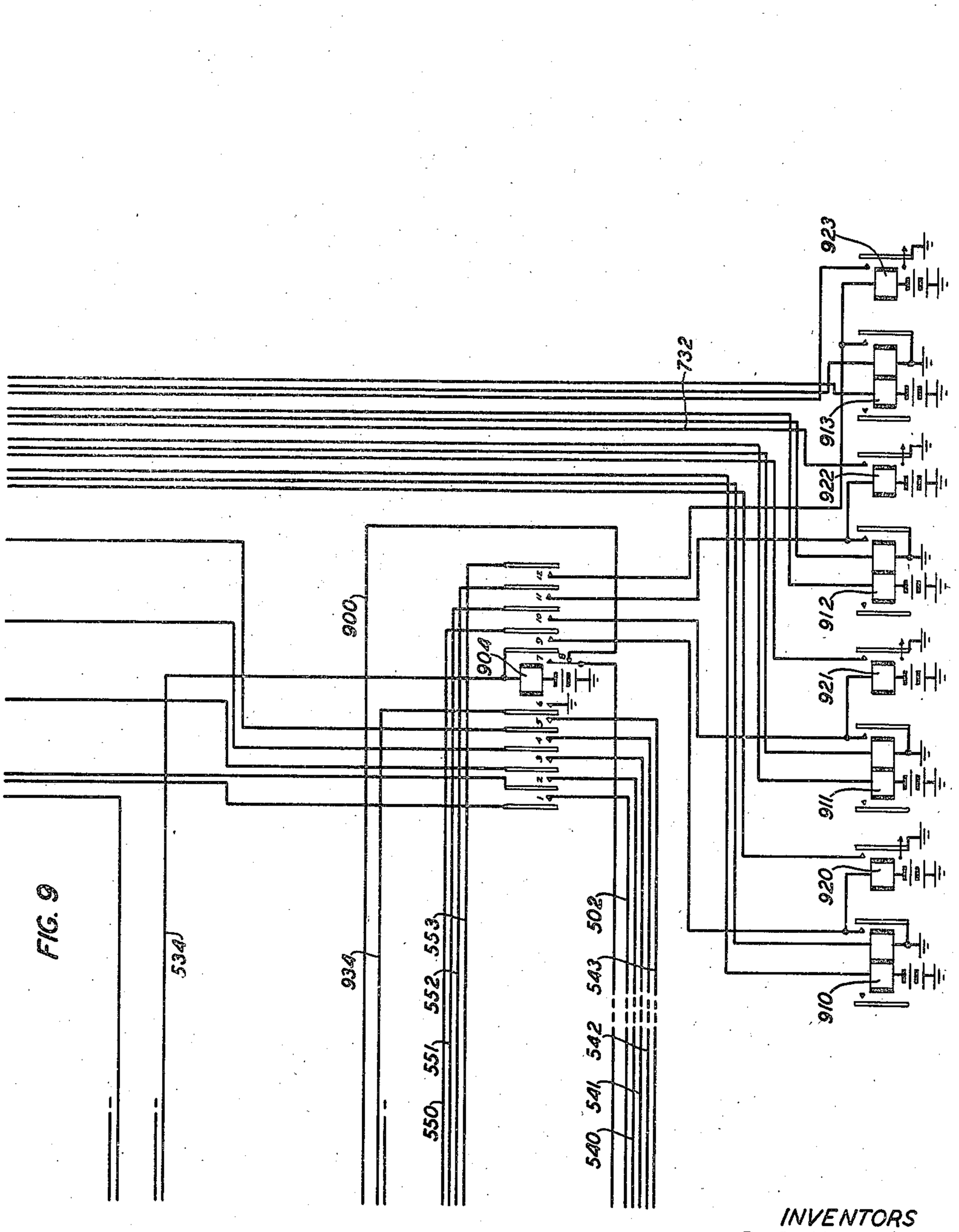

FIG. 9

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Patented Aug. 6, 1946

2,405,214

UNITED STATES PATENT OFFICE

2,405,214

CALL DISTRIBUTING SYSTEM

Bernard D. Holbrook, Madison, and Mason A. Logan, Summit, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application April 10, 1945, Serial No. 587,550

10 Claims. (Cl. 179—18)

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This invention relates to telephone systems and has for its object increased efficiency in call distribution.

More specifically, the invention concerns the use of cross bar switches in small telephone exchanges designed for use chiefly between members of a business organization and generally known as private branch exchanges.

Cross bar switches provide means for connecting any one of a plurality of incoming lines to any one of a plurality of outgoing lines and are therefore controlled by common control circuits which identify an individual incoming line to be served and an available outgoing line and cause the proper magnets to be operated for connecting the lines together. When the control circuit serves more than one group of incoming lines and a plurality of incoming lines in a plurality of groups desire service simultaneously, the control circuit first selects a group of lines and then an individual line to be served, selects an available outgoing line, completes that connection and then serves other lines according to a predetermined arrangement.

Heretofore control circuits serving a plurality of lines have included one means for identifying the group of lines including a calling line and other means for identifying the line in the group. In accordance with the present invention the same means, comprising a chain of relays, serves to identify the group of lines and the line within the group.

The call distributing system embodying the present invention employs primary and secondary switches, with the outgoing lines from one primary switch appearing as incoming lines at the same level of the secondary switch. Therefore after the group of lines, in which a calling line is located, has been determined the select magnet of the secondary switch may be operated and as soon as the calling line has been located, the select magnet of the primary switch may be operated. Thereafter an idle link between the primary and secondary switches and an idle outgoing line from the secondary switch may be selected. In accordance with another feature of the present invention, a check is made to determine that both primary and secondary switches are ready for operation before selecting an outgoing line, by including in the circuit, over which the idle outgoing trunk is seized, contacts on the select magnets of both switches.

In accordance with a further feature of the invention, the outgoing line or trunk is seized by operating the trunk busy relay in the trunk from

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the control circuit, the trunk busy relay then operating the switch hold magnets to close the switch contacts and connect the calling line with the line relay of the trunk, which upon operating provides an alternate energizing circuit for the trunk busy relay to place the switches under the control of the calling line.

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

Fig. 1 is a diagrammatic showing of the distributing arrangement;

Figs. 2 to 9 show the circuits employed in such distribution, Figs. 2 and 3 showing the primary line switch, Figs. 6 and 7 showing the secondary line switch, and Figs. 4, 5, 8 and 9 showing the control circuits; and

Fig. 10 shows the proper arrangement of Figs. 2 to 9.

Referring first to Fig. 1, the call distributing arrangement shown is designed to serve one hundred subscribers and to distribute calls from the one hundred lines to twenty trunks or junctors from which calls may be extended by any suitable means. Standard cross bar switches comprise ten horizontal rows of contacts and twenty vertical rows of contacts, the contacts in each row being connected in multiple. However, in the present case as shown in Fig. 1, the horizontal multiples are cut so that only five horizontal contacts are connected in multiple. The one hundred lines are divided into ten groups of ten lines each and the lines are so connected to the horizontal rows that each line has access to five verticals. To serve ten groups of lines, two and one-half standard switch structures are required to constitute the primary line switch. A single switch serves as a secondary switch, its horizontal multiple cut to form five sections, each having four verticals. The fifty verticals of the primary switch are connected by links to the horizontals of the seconary switch and the verticals of the secondary switch are connected to twenty junctors.

The arrangement shown in Fig. 1 gives each line access to any junctor. For example, lines **101**, **102**, etc. are connected to the horizontal rows of contacts of the first section of switch structure **100**, which may be called the first switch unit and therefore have access to links **103** to **107**. These links, since they come from the first switch unit, are connected to the first or top level of the units of secondary switch **130**, the first link **103** being connected to the first unit of switch **130**, the second link **104** connected to the second unit and

so on. Similarly, the links connected to the second unit of switch **100** are connected to the second level of the units of switch **130**, one to each unit.

As previously mentioned, each unit of switch **130** has four verticals, each connected to one of the junctors **140**, **141**, **142**, etc., any one of which may be connected to a calling line. For example line **101** may reach junctor **140** over the first unit of switch **100**, link **103**, and the first unit of switch **130**. It may reach junctor **141** over link **105** and the third unit of switch **130** and junctor **142** over link **107** and the fifth unit of switch **130**. Line **121** on the other hand may reach junctor **140** over the second unit of switch **120**, link **122** and the first unit of switch **130**, while it may reach junctor **142** over link **123** and the fifth unit of switch **130**.

The detailed circuits of Figs. 2 to 9 will now be described. The one hundred lines served by the distributing switches are divided into ten groups of ten lines each, of which three lines in each of these groups have been indicated, namely, the first, fifth and last lines of the first, fifth and last groups. The lines have access to fifty links through a primary line switch which, as pointed out in connection with Fig. 1, is built up from two and one-half standard twenty vertical switches. The horizontal multiple of the switch is divided to form ten small switch units, each having five sets of vertical contacts and ten sets of horizontal contacts, the groups of lines being connected to the horizontal sets of contacts and the links being connected to the vertical sets of contacts. However, the select magnets of the three basic switches are operated simultaneously, creating a unitary primary switch for serving the entire group of one hundred lines. Three of the small switch units are indicated, including all five verticals but only the three horizontals in which appear the three lines shown.

As in the case of the primary switch, the horizontal multiple of the single secondary switch structure is cut to provide five small switch units, each giving access by means of four verticals to four junctors and accommodating ten links on the ten horizontals. The first, third and fifth switch units are indicated, the first, fifth and tenth levels being shown in each case, thereby showing the termination of the first, third and fifth link outgoing from the first, fifth and tenth primary switch units. All four junctors of the first, third and fifth groups are indicated.

Assume now that line **200** initiates a call. When the subscriber removes his receiver from the hook, he establishes a circuit from battery through the middle and right windings and contact 4 of relay **210**, through substation **200**, contact 3 and left winding of relay **210** to ground. Relay **210** which is a two-step relay serves as a combined line and cut-off relay, but conventional line and cut-off relays might be employed instead. Relay **210** is energized in the circuit above traced sufficiently to take up its intermediate or "order" position in which it closes its front contacts 1 and 6 but does not open any of the back contacts 2, 3, 4 and 5. At contacts 1 and 2, relay **210** closes a circuit for identifying the group of lines to which line **200** belongs, while at contacts 5 and 6 relay **210** prepares a circuit for identifying the position of the line in the group.

For the purpose of locating the calling line, a lock-out chain of test relays **410** to **419** is provided which is first used to identify the group in which the calling line is located and then to locate the position of the line in the group. The group indicating circuit closed by relay **210** may be traced from ground at the back contact of release relay **500**, conductor **501**, contact 1 of relay **400**, conductor **401**, contacts 2 and 1 of relay **210**, group conductor **230**, contact 1 of relay **402**, winding of test relay **410**, contacts 3 of test relays **414**, **419** and the intermediate relays of the series to battery. Relay **410** operates in this circuit, indicating that the calling line is in the zero group, and locking to battery over its contact 4. At its contact 2 it closes a circuit from ground on conductor **501**, contact 3 of relay **400**, contact 2 of relay **405**, contact 2 of relay **410**, contact 2 of relay **402** to the winding of the zero line group relay **420** and battery. Relay **420** operates in this circuit and locks over contact 6 to grounded conductor **501**.

With the zero line group relay **420** operated, the zero switch unit **260** in which the calling line appears, has been identified and relay **420** at contacts 1 to 5 closes circuits to test for an idle vertical in that unit. Relay **420** also closes a circuit from grounded conductor **501**, contact 7 of relay **420**, winding of change-over relay **400** and battery.

Relay **400** at contact 1 opens the circuit of relay **410**, causing that relay to release and at contact 3 disconnects ground from the armature of relay **410**, thereby opening the operating circuit for relay **420**, which remains operated, being locked directly to conductor **501**. At contact 2, relay **400** closes a circuit from grounded conductor **501**, to battery through the windings of transfer relays **402**, **403** and **404** in parallel. Relay **402** at contacts 1 and 2 further opens the operating circuits of relays **410** and **420**. When relays **402**, **403** and **404** have all operated, a circuit is closed from grounded conductor **501**, contacts 13 of relays **402** and **403**, contact 7 of relay **404**, conductor **406** to the winding of relay **405** and battery, and over contact 9 of relay **420** and conductor **430**, to the winding of relay **440** and battery.

Relay **440** operates immediately, connecting contacts 6 of the line relays of the first or zero group of lines to the test relays **410** to **419**. Since line relay **210** is operated, the operation of relay **440** completes a circuit from ground on conductor **501**, extended as above traced to conductor **430**, contacts 5 and 6 of relay **210**, contact 1 of relay **440**, to the winding of test relay **410**, contact 3 of the remaining test relays and battery. Relay **410** operates and locks to battery over its contact **4**, identifying the calling line as the first or zero line in the group which has been previously identified as the zero group.

Relay **405** which is slow to operate, does not close its front contacts until after relay **410** has operated and locked. When relay **405** closes contact 3 it again connects ground to the armature of relay **410**, thereby completing a circuit from ground on conductor **501**, contact 3 of relay **405**, contact 2 of relay **410**, contact 3 of relay **402** to the windings of select magnets **310**, **320** and **330**, to prepare the zero level in all of the primary switch units.

As pointed out in connection with Fig. 1, all of the links outgoing from one primary switch unit appear in the same level in the secondary switch units. Therefore when line group relay **420** operates it identifies the level which will be used in the secondary switch and it closes a circuit from grounded conductor **501**, contact 8 of relay **420**, conductor **450** to the winding of select

magnet 600 and battery, preparing the zero horizontal in each of the secondary switch units.

It is now necessary to determine which of the links serving the calling line are idle and whether there is an idle trunk in any of the groups of trunks to which such idle links give access. As previously mentioned, relay 420, when it operated to identify the group of trunks and thereby the switch unit and the group of links serving that group of lines, closed a set of test circuits for that group of links. Whenever a link is busy, the corresponding hold magnet is operated as will be described hereinafter, connecting ground to the associated test circuit. Therefore, when the group relay operates, this grounded test circuit is extended to one of the junctor group test relays 510 to 514.

Relays 510 to 514 are two winding relays and provide a simultaneous test of a group of links and of the trunks to which those links have access. The left windings of relays 510 to 514 are connected by a line group relay individually to the five test conductors extending to the five primary hold magnets associated with the five links serving the corresponding group of lines. The right windings of each of the relays 510 to 514 are connected directly to a chain circuit extending over front contacts on the hold magnets of the secondary switch unit to which the link circuits tested by their left winding have access. Therefore a junctor group test relay is operated whenever all of the junctors of the associated group are busy or when it is connected to the test conductor of a busy link having access to that junctor group.

Assume now that the first link 240 is busy with some other line of the group and that all of the junctors 660 to 663 of the third group are busy. With hold magnet 250 operated, when relay 420 operates, a circuit is closed from ground over the contact of magnet 250, contact 1 of relay 420, conductor 460 to the left winding of relay 510 and battery causing relay 510 to operate. Whenever the control circuit has been restored to normal, circuits for testing the junctor groups are prepared. Ground on conductor 501 is extended over the normally closed contacts 4 of the junctor test relays 520 to 523 and conductor 502 to the front contacts of the hold magnets of the last junctors in each group. Whenever all of the junctors of a group become busy this ground is extended to the right winding of the corresponding junctor group test relay. Under the assumption that all of the junctors appearing in switch 650 are busy, a circuit will be completed from conductor 501 to conductor 502 as above traced and thence over the front contacts of secondary hold magnets 673, 672, 671 and 670, conductor 675 to the right winding of relay 512 and battery, causing relay 512 to operate. For convenience, assume that relays 511 and 513 are also operated but relay 514 is not operated.

With relays 510 to 513 operated and relay 514 not operated, when relays 402 to 404 are operated subsequent to the operation of relay 420, connecting ground from conductor 501 to conductor 406, a circuit is completed from ground on conductor 406, over the normally closed contacts 8 of the junctor choice relays 800, 802, 904 and the intermediate relays, conductor 900, contacts 2 of relays 510, 511, 512 and 513, contact 1 of relay 514, conductor 534 to the winding of junctor choice relay 904 and battery. Relay 904 closes a locking circuit for itself over its contact 7 and contacts 8 of relays 802 and 800 and the intermediate junctor choice relays to ground over conductor 406. Thereafter, at its contact 8, relay 904 disconnects the operating circuit for the junctor choice relays from the armature of relay 510 so that, if one of the junctor group relays 510 to 513 should release because the link or junctor group becomes available, it cannot be effective to operate another junctor choice relay. At contacts 1 to 5 relay 904 prepares test circuits for the individual junctors of the chosen group and at contacts 9 to 12 prepares circuits for seizing a chosen junctor.

Assuming that junctors 710 and 711 are busy and that junctors 712 and 713 are idle, secondary hold magnets 720 and 721 will be operated and magnets 722 and 723 will be unoperated. The operation of relay 904 therefore closes a circuit from ground, connected to conductor 502 over the back contacts of relays 520 to 523 as above traced, contact 1 of relay 904, to the outer armatures of magnets 720 to 723. Since magnets 720 and 721 are operated, no circuit will be closed at these magnets but the circuit will be extended over the back contact of magnet 722, contact 4 of relay 904, conductor 542 to the winding of relay 522 and battery and over the back contact of magnet 723, contact 5 of relay 904, conductor 543 to the winding of relay 523 and battery. Relays 522 and 523 lock over their contacts 5 to grounded conductor 501 and then disconnect conductor 501 from the above-traced operating circuit, thereby preventing the release of a busy junctor in the chosen group and its associated secondary hold magnet from operating a previously unoperated junctor test relay and interfering with the junctor selection. Relays 522 and 523 also open the junctor group busy circuit controlled by the secondary hold magnets for operating the junctor group relays so that, in the case where only one junctor in a group is idle, the operation of the hold magnet of that junctor will not operate the corresponding junctor group relay prematurely.

With the junctor test relays 522 and 523 operated, a circuit is closed for seizing the first idle junctor. This circuit may be traced from grounded conductor 501, contacts 4 of relays 520 and 521, contact 3 of relay 522, conductor 503, contact of operated secondary select magnet 600, contacts of primary select magnets 330, 320 and 310 in series, conductor 340, contacts 1 of relays 520 and 521, contact 2 of relay 522, conductor 552, contact 11 of relay 904, winding of relay 922 and battery.

Relay 922 is the slow-release, junctor busy relay belonging to junctor 712. If the select magnets of both the primary and the secondary switches are operated, or as soon as they do operate, the circuit above traced is completed and relay 922 operates. Relay 922 connects ground to the sleeve conductor 732 of junctor 712, in turn operating hold magnet 722. Hold magnet 722 in operating closes cross-point 701, connecting the tip, ring and sleeve conductors of junctor 712 to the corresponding conductors of link 244. The ground which operated secondary hold magnet 722 is extended through the cross-point 701 and over the sleeve conductor of link 244 to the winding of primary hold magnet 254 and battery. Hold magnet 254 operates, closing cross-point 261, thereby connecting the tip and ring conductors of the link to the calling line 200 and closing a circuit from battery through the left winding of the junctor line relay 912 over the tip conductor of the junctor 712, cross-point 701, link 244, and cross-point 261 to the substation 200 and back over the ring conductor of the line and contacts

of cross-point 261, link 244, cross-point 701 and junctor 712 to ground through the right winding of relay 912. Relay 912 closes an obvious holding circuit for relay 922 and originates any operations necessary for extending a connection to a wanted line.

The ground which operated primary hold magnet 254 is extended over cross-point 261 to the sleeve conductor associated with line 200, which is connected to the middle, low resistance, winding of the two-step line and cut-off relay 210. The closure of this circuit energizes relay 210 completely, causing it to perform its cut-off function and open its back contacts to disconnect itself from the line. Relay 210 is held operated from the junctor relay 912 which is now held operated under the control of the calling line, relay 912 in turn holding hold magnets 722 and 254 operated. The complete energization of relay 210 opens the circuit of relay 410 permitting that relay to release, in turn releasing select magnets 310, 320 and 330.

When primary hold magnet 254 operates it closes a circuit from ground at its front contact, contact 5 of relay 420, conductor 464, left winding of relay 514 to battery, since link 244 is now busy. Relay 514 now operates closing a circuit from ground at contact 6 of relay 904, conductor 934, contact 3 of relay 514, winding of release relay 500 to battery. Release relay 500 opens its back contact, removing ground from conductor 501, releasing select magnet 600, relays 420, 440, 400, 402, 403, 404, 405, 522, 523, 904 and finally relay 500, which is made slow to release to permit the remaining relays to completely release before reconnecting ground to release conductor 501. Relays 510 to 514 also release, but those which are associated with groups of junctors, all of which are busy, will reoperate as soon as relays 520 to 523 have released.

The foregoing description traced the operation of the control equipment when only a single call required attention. If a plurality of calls are originated at substantially the same time the control circuit will extend them to idle junctors one at a time in a predetermined sequence. For the purpose of describing this sequential operation, assume that calls are simultaneously originated by lines 204, 209, 270 and 354. Line relays 214, 219, 280 and 364 all operate, each of them closing their front contacts and attempting to complete group identification circuits. Relays 214 and 219 close parallel circuits from grounded conductor 401 to group conductor 230 and the winding of relay 410. Relay 280 connects ground from conductor 401 to group conductor 234 and the winding of relay 414 and relay 364 connects ground from conductor 401 to group conductor 379 and the winding of relay 419. It will be observed that the battery supply for relays 410 and 414 as well as the other intermediate relays is carried over normal contacts of each of the higher numbered relays. Therefore the operation of a higher numbered relay prevents the subsequent operation of any of the lower numbered relays in the chain, while the operation of a low numbered relay does not prevent the operation of a higher numbered relay. However, the circuit for operating any line group relay is carried over the back contacts of lower numbered relays so that the subsequent operation of a higher numbered relay does not interfere with the selection of a line group for service.

Assume then that the group conductors 230, 234 and 379 are grounded very nearly simultaneously

but with sufficient intervals to permit relays 410, 414 and 419 all to operate and lock. With relay 410 operated the circuit for relay 420 is closed and relay 420 operates and locks as above described, followed by the operation of relay 400 and relays 402, 403 and 404. The operation of relays 403 and 404 opens the circuits of relays 410, 414 and 419 and all of these relays release. When relay 440 operates to connect the corresponding group of lines to the test relays, relays 414 and 419 may operate over contacts 5 and 6 of line relays 214 and 219. The operation of relay 405, again connecting ground to the armature of relay 410 completes a circuit over contacts 1 of relay 410 and the intermediate relays, contact 2 of relay 414, contact 3 of relay 403 to the windings of select magnets 314, 324 and 334 in parallel and battery. The operation of selecting an idle link and junctor is the same as previously described after which the release relay 500 is operated and release takes place as previously described. As soon as relays 420, 400, 402, 403 and 404 release the line group test is repeated, resulting in the extension of line 209 to an idle junctor, after which lines 270 and 354 will also be served in turn.

If a subscriber, having initiated a call, abandons it before the line group relay has operated, the line relay and the test relay release and the circuit returns to normal. Since the line group relay locks to grounded conductor 501, means are provided to release the control circuit if the calling subscriber abandons the call after that relay has been operated and before the line has been extended to an idle junctor. For this purpose, when relay 405 operates it prepares a circuit from battery through the winding of release relay 500, contact 1 of relay 405 to contact 1 of relay 419. If, because the call has been abandoned, all of the test relays are in the released condition this circuit extends over contacts 1 of relays 419, 414, 410 and the intermediate relays, contact 3 of relay 405 to grounded conductor 501, completing an operating circuit for release relay 500 and restoring the control circuit to normal. If there had been two calls waiting in the group, the abandonment of the one call would permit the second call to be handled and the control circuit to be released in the normal manner.

In addition, means are provided to measure a time interval sufficient for the complete operation of the control circuit and to thereupon release the control circuit if necessary, for example, if no idle link and junctor could be found. When a line group relay, for example, relay 420, operates it closes a circuit from ground on conductor 501, contact 7 of relay 420, conductor 407, contact 4 of relay 405, winding of relay 504 to battery. Relay 504 operates in this circuit, in turn connecting conductor 407 to the winding of relay 505 and battery. Relay 505 operates and locks to grounded conductor 501. When relay 405 operates to initiate the test for an idle link and junctor, it opens the circuit of relay 504 which, however, remains operated for a time because of its slow-to-release character. Normally, relay 500 will be operated, releasing relay 505 before relay 504 closes its back contact. If, however, relay 500 is not operated by one of the above-described methods, relay 504 will finally release and connect ground over its back contact and a front contact of relay 505 to the winding of relay 500, causing that relay to operate and restore the control circuit to normal. A parallel circuit serves to sound an alarm.

What is claimed is:

1. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, a set of select magnets common to said primary switches and a set of hold magnets individual to said switches, a secondary cross bar switch, links connecting said primary switches with said secondary switch, a plurality of trunks outgoing from said secondary switch, said secondary switch having select magnets and hold magnets, a control circuit common to all said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, means to connect said relays to said unit conductors to identify the calling line and to operate the corresponding primary switch select magnets, means to select an idle link having access to an idle trunk, means to seize said trunk effective only if said select magnets are operated, and means under the control of said seized trunk to operate a hold magnet in said secondary switch and in said primary switch to complete a connection between said calling line and said trunk.

2. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, a set of select magnets common to said primary switches and a set of hold magnets individual to said switches, a secondary cross bar switch, links connecting said primary switches with said secondary switch, a plurality of trunks outgoing from said secondary switch, said secondary switch having select magnets and hold magnets, a control circuit common to all said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, means to connect said relays to said unit conductors to identify the calling line and to operate the corresponding primary switch select magnets, means to select an idle link having access to an idle trunk, means to seize said trunk effective only if said select magnets are operated, means under the control of said seized trunk to operate a hold magnet in said secondary switch and said primary switch to complete a connection between said calling line and said trunk, and means operated by said primary switch hold magnet to release said control circuit.

3. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch, a secondary cross bar switch, a set of select magnets and a set of hold magnets for each of said switches, links connecting said switches, trunks outgoing from said secondary switch, a control circuit common to said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, means to connect said relays to said unit conductors to identify the calling line, and means under the joint control of said group recording means and said set of relays for operating said switches to connect said calling line with a trunk.

4. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch, a secondary cross bar switch, a set of select magnets and a set of hold magnets for each of said switches, links connecting said switches, trunks outgoing from said secondary switch, a control circuit common to said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, said recording means effective to operate one of said secondary switch select magnets, means to connect said relays to said unit conductors to identify the calling line, said relays effective to operate one of said primary switch select magnets, and means under the control of said recording means for operating said switches to connect said calling line with a trunk.

5. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, a set of select magnets common to said primary switches and a set of hold magnets individual to said primary switches, a plurality of trunk circuits arranged in groups, a secondary cross bar switch for each group of trunks, a set of select magnets common to said secondary switches and a set of hold magnets individual to said secondary switches, links connecting each of said primary switches with each of said secondary switches, a control circuit common to all said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, said recording means operating one of said secondary select magnets, means to connect said relays to said unit conductors to identify the calling line and to operate the corresponding set of primary select magnets, said recording means also effective to control the operation of said switches to connect said calling line with an idle trunk.

6. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch, a secondary cross bar switch, a set of select magnets and a set of hold magnets for each of said switches, links connecting said switches, trunks outgoing from said secondary switch, a control circuit common to said switches, means responsive to the initiation of a call on one of said links to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, said recording means effective to operate one of said secondary switch select magnets, means to connect said relays to said unit conductors to identify the calling line, said relays effective to operate one of said primary switch select magnets, means to select an idle link having access to an idle trunk, and means to seize said trunk effective only if said select magnets are operated.

7. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, a set of select magnets common to said primary switches and a set of hold magnets individual to said primary switches, a plurality of trunk circuits arranged in groups, a secondary cross bar switch for each group of trunks, a set of select magnets common to said secondary

switches and a set of hold magnets individual to said secondary switches, links connecting each of said primary switches with each of said secondary switches, a control circuit common to all said switches, means responsive to the initiation of a call on one of said lines to mark a group conductor and a unit conductor, a set of relays in said control circuit, means to connect said relays to said group conductors to identify and record the group of the calling line, said recording means operating one of said secondary select magnets, means to connect said relays to said unit conductors to identify the calling line and to operate the corresponding set of primary switch select magnets, means to select an idle link having access to an idle trunk, and means to seize said trunk effective only if said select magnets are operated.

8. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, a set of select magnets common to said primary switches and a set of hold magnets individual to said primary switches, a plurality of trunk circuits arranged in groups, a secondary cross bar switch for each group of trunks, a set of select magnets common to said secondary switches, and a set of hold magnets individual to said secondary switches, a control circuit common to all said switches, means in said control circuit to identify a calling one of said lines, means to select an idle link having access to an idle trunk, means to seize said trunk, and means under the control of said seized trunk to operate a hold magnet in one of said secondary switches and in one of said primary switches to complete a connection between said calling line and said trunk.

9. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, sets of select magnets common to said primary switches and a set of hold magnets individual to said primary switches, a plurality of trunk circuits arranged in groups, a secondary cross bar switch for each group of trunks, a set of select magnets common to said secondary switches, and a set of hold magnets individual to said secondary switches, a control circuit common to all said switches, means in said control circuit to identify a calling one of said lines and to operate one of said sets of primary select magnets and one of said secondary select magnets, means to select an idle link having access to an idle trunk, means to seize said trunk effective only if said select magnets are operated, and means under the control of said seized trunk to operate a hold magnet in said secondary switch and in said primary switch to complete a connection between said calling line and said trunk.

10. In a telephone system, a plurality of subscribers' lines arranged in groups, a primary cross bar switch for each group of lines, sets of select magnets common to said primary switches and a set of hold magnets individual to said primary switches, a plurality of trunk circuits arranged in groups, a secondary cross bar switch for each group of trunks, a set of select magnets common to said secondary switches, and a set of hold magnets individual to said secondary switches, a control circuit common to all said switches, means in said control circuit to identify a calling one of said lines and to operate one of said sets of primary select magnets and one of said secondary select magnets, means to select an idle link having access to an idle trunk, means to seize said trunk effective only if said select magnets are operated, means under the control of said seized trunk to operate a hold magnet in said secondary switch and in said primary switch to complete a connection between said calling line and said trunk, and means operated by said primary switch hold magnet to release said control circuits.

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