Jan. 5, 1926. 1,568,306

S. B. WILLIAMS ET AL

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 1

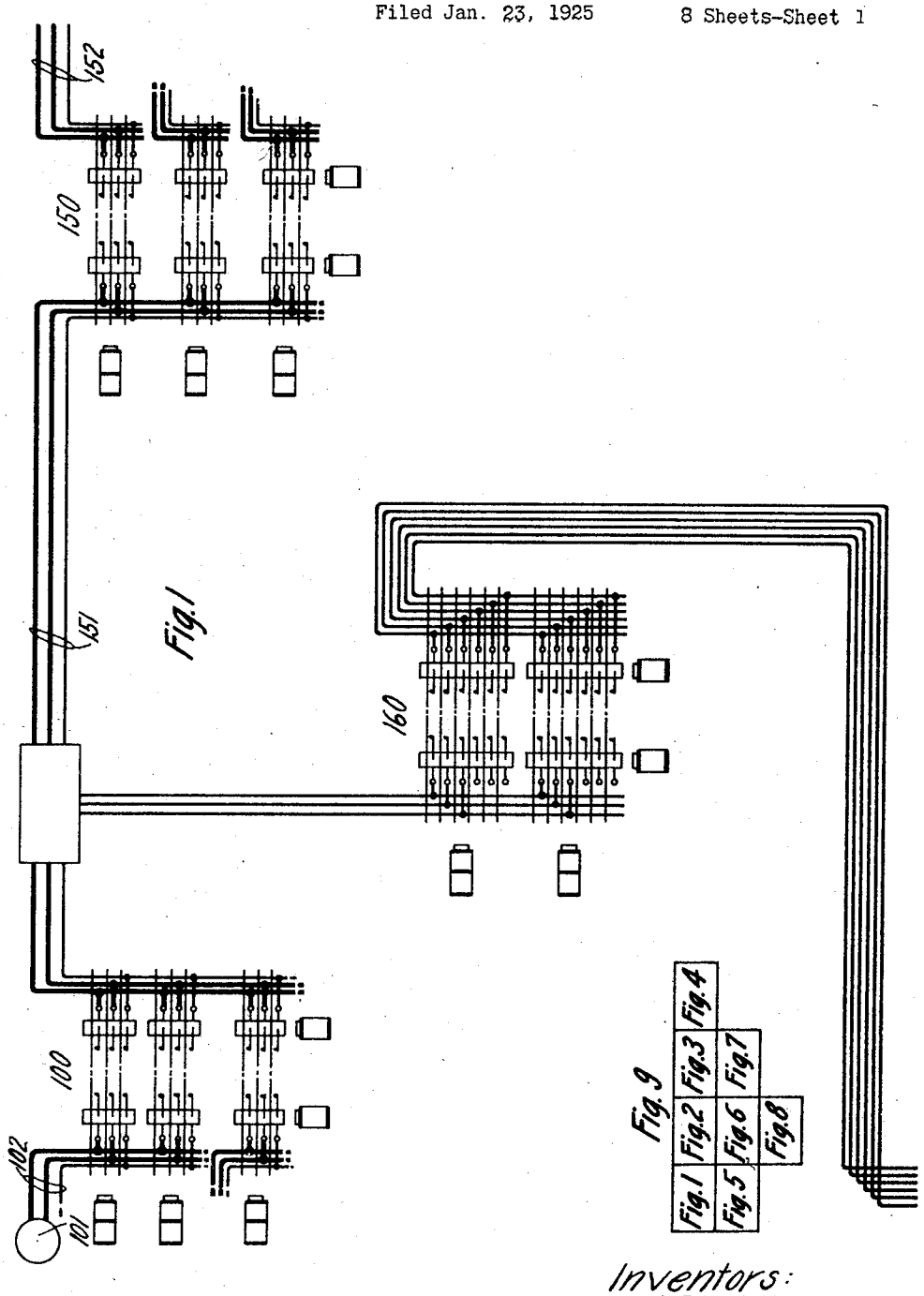


Fig. 1

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TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 2

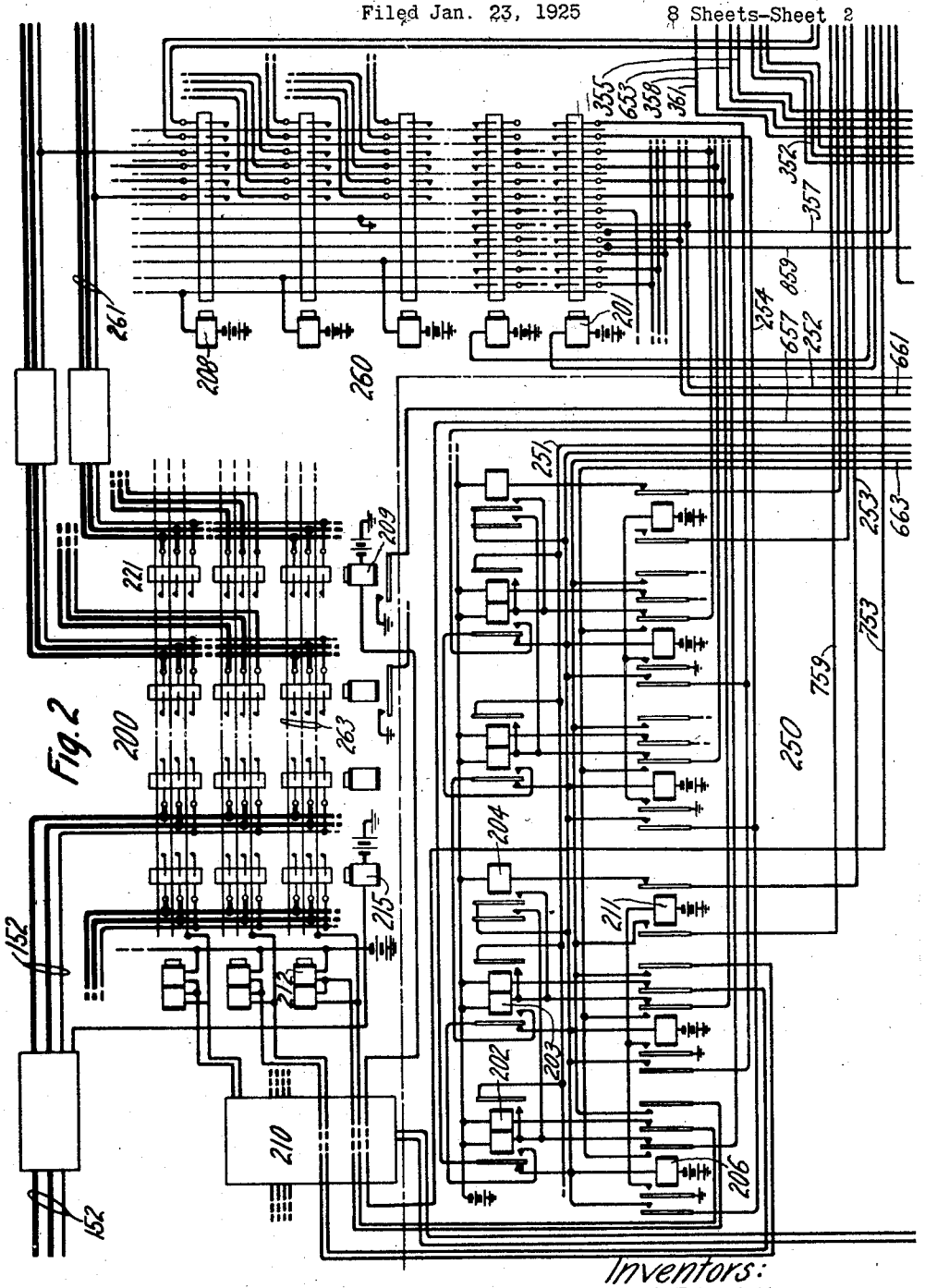


Fig. 2

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TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 3

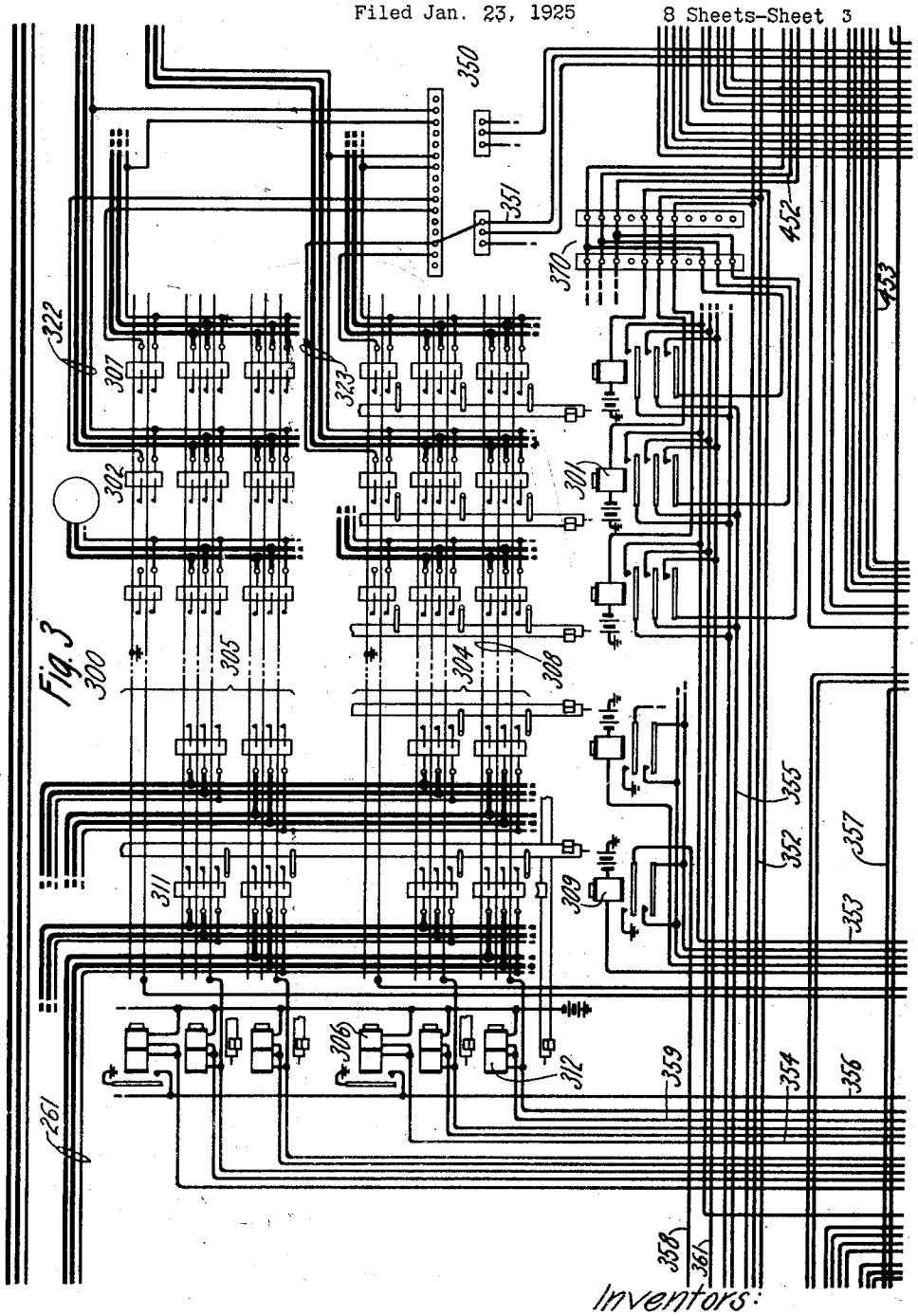


Fig. 3

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TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 4

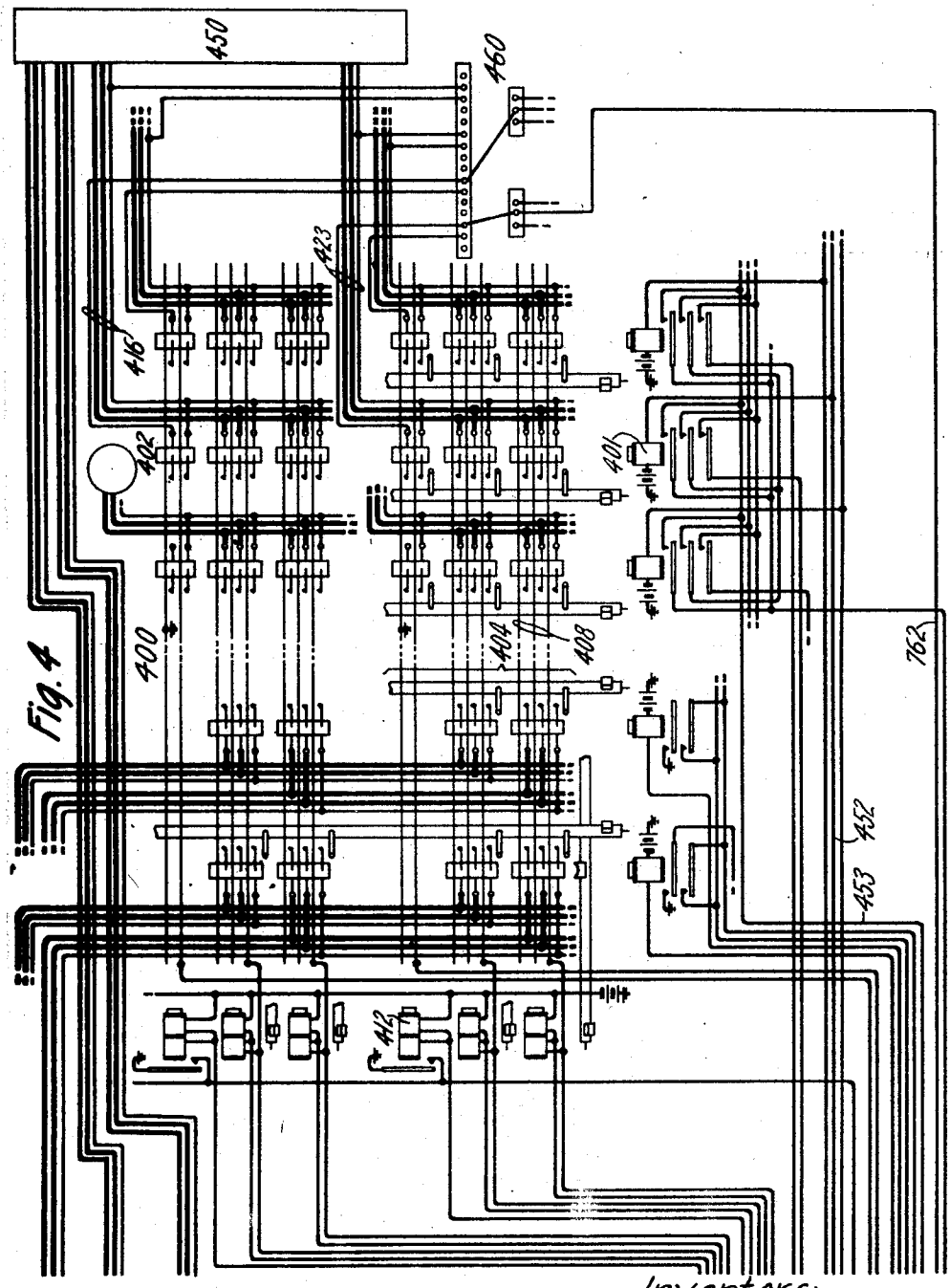


Fig. 4

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S. B. WILLIAMS ET AL

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 5

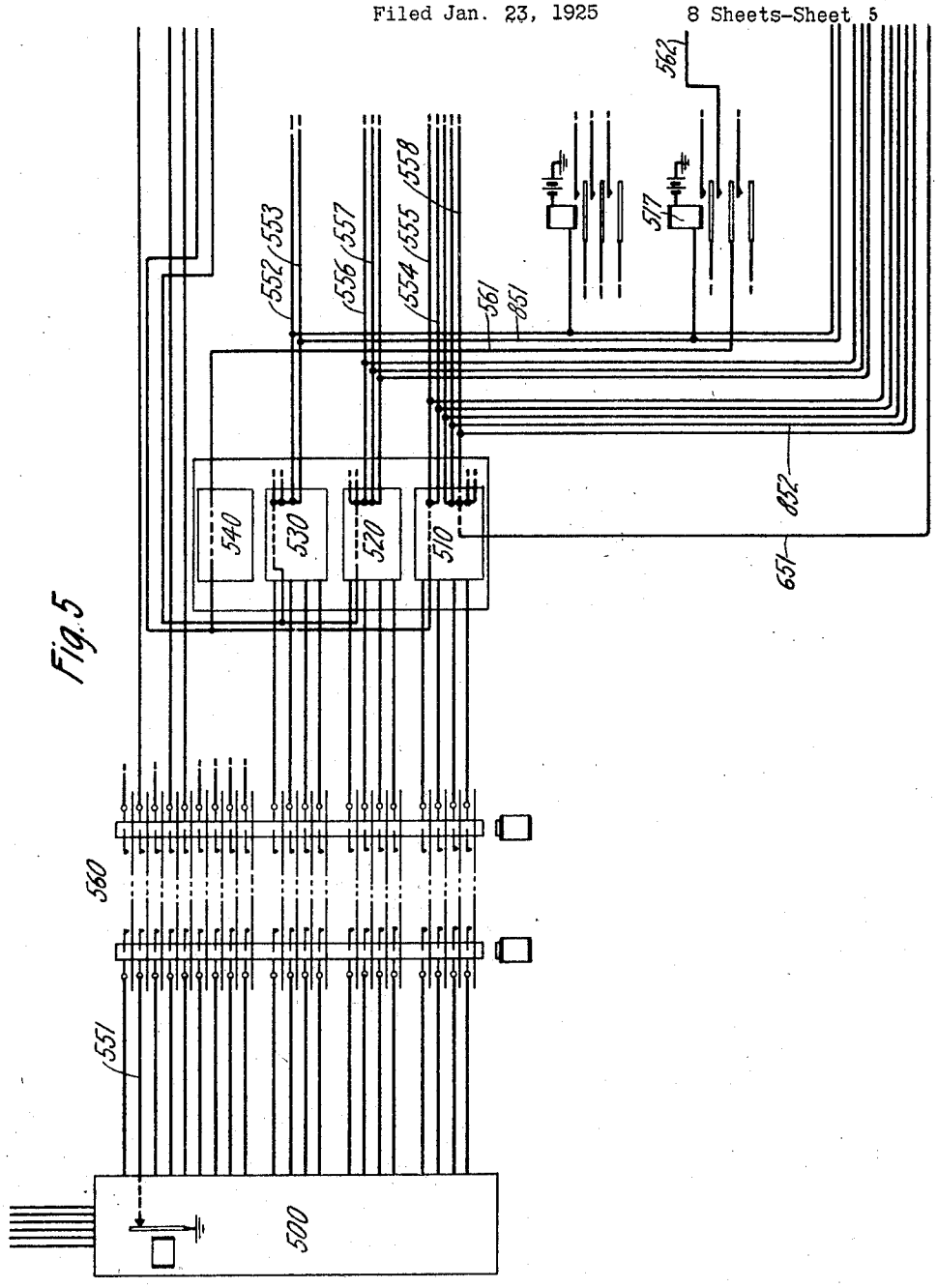


Fig. 5

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S. B. WILLIAMS ET AL

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 6

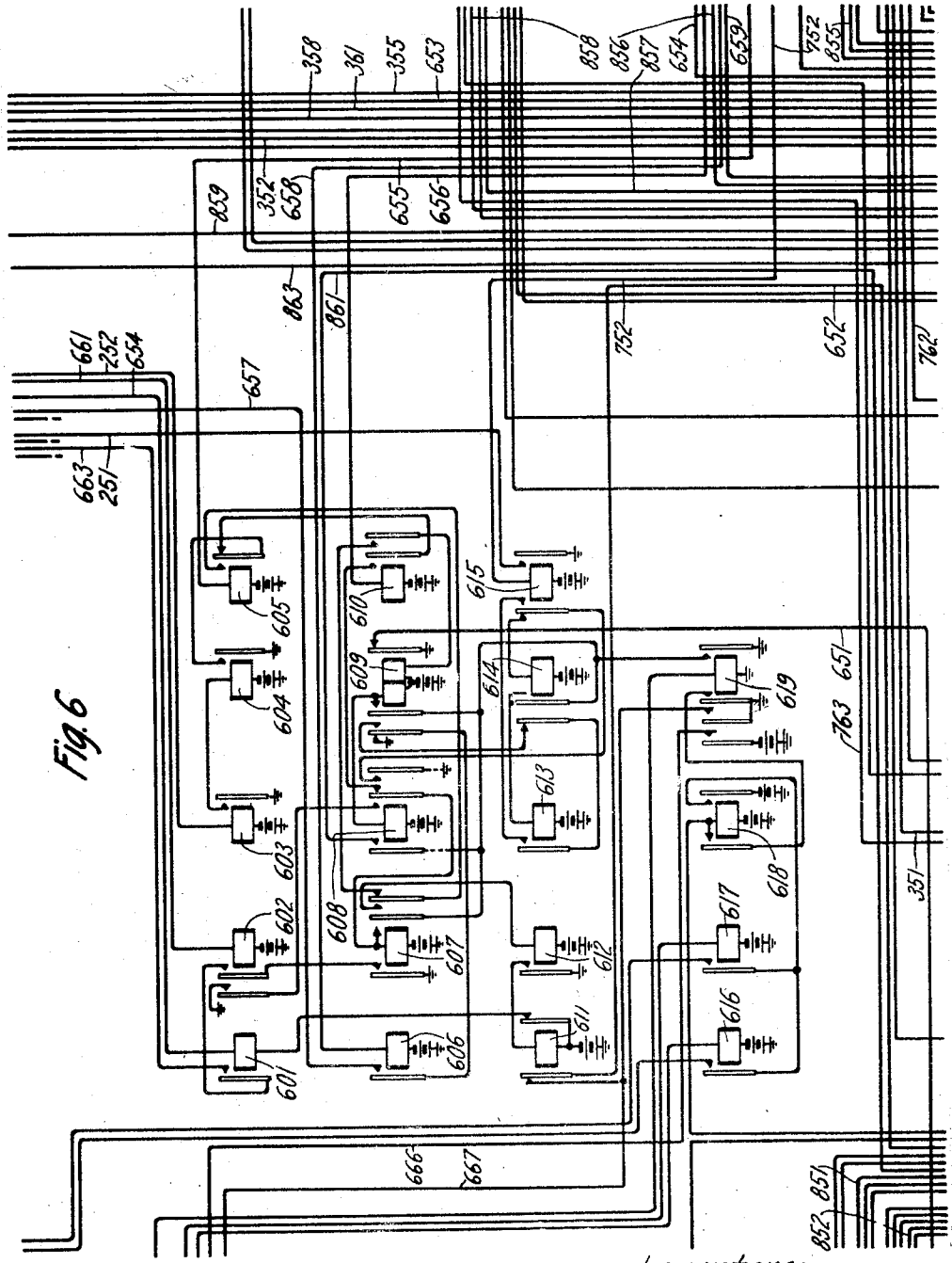


Fig. 6

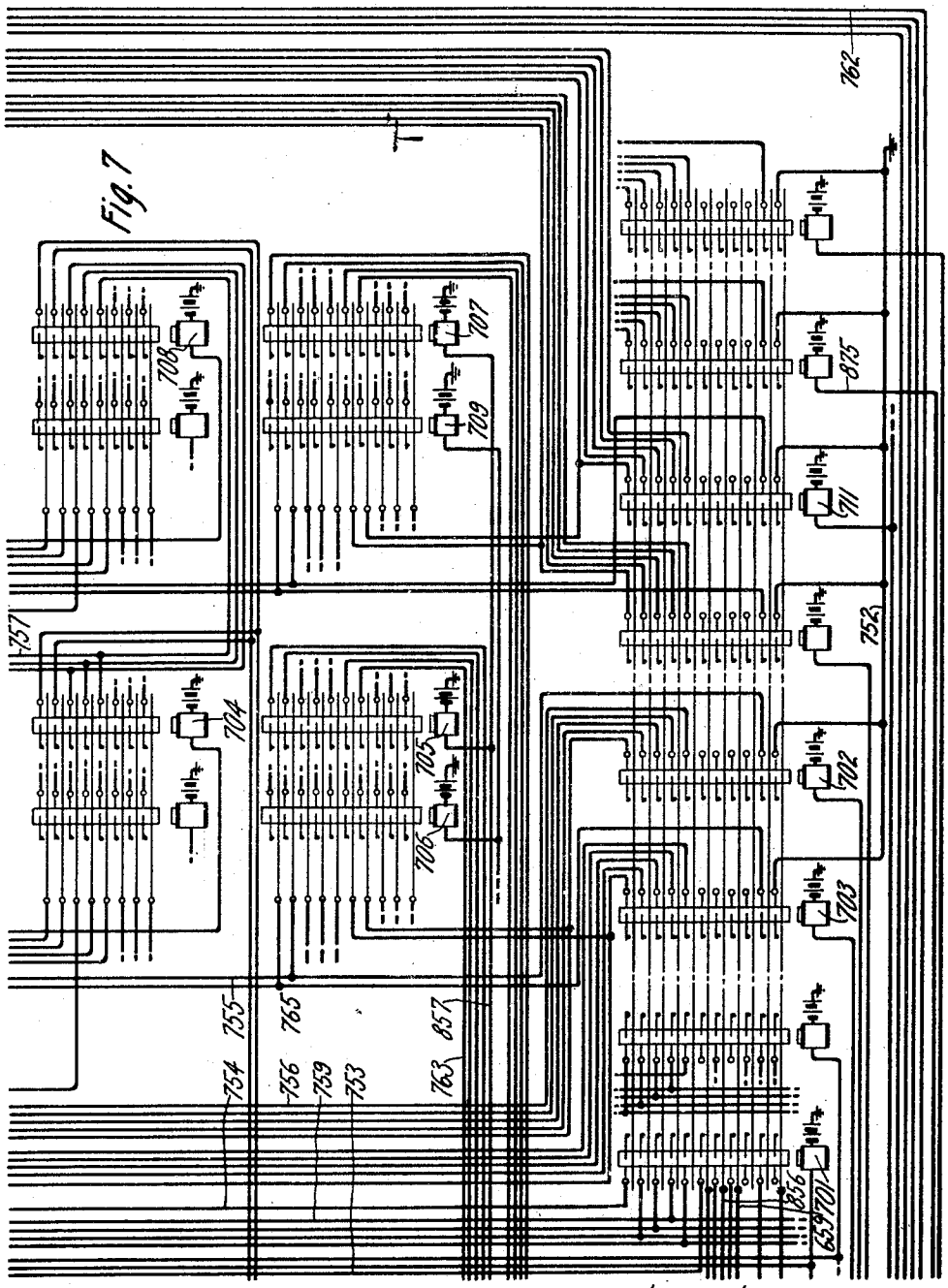
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S. B. WILLIAMS ET AL.

TELEPHCNE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 7



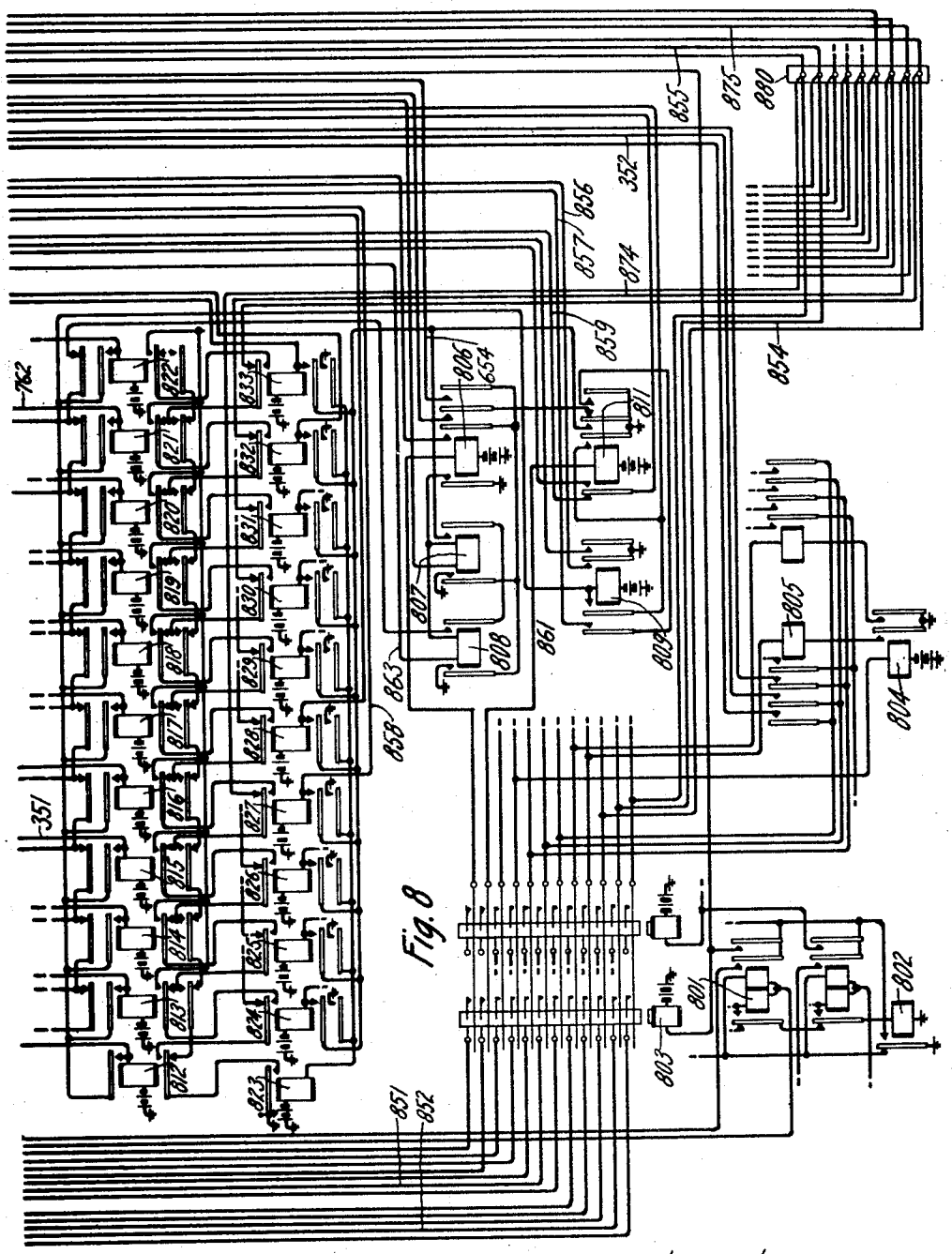
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S. B. WILLIAMS ET AL

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 23, 1925 8 Sheets-Sheet 8



Inventors:
Samuel B. Williams
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Patented Jan. 5, 1926. 1,568,306

UNITED STATES PATENT OFFICE.

SAMUEL B. WILLIAMS, OF BROOKLYN, NEW YORK, AND EARL S. GIBSON, OF RIDGEWOOD, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed January 23, 1925. Serial No. 4,147.

To all whom it may concern:

Be it known that we, SAMUEL B. WILLIAMS and EARL S. GIBSON, citizens of the United States of America, residing at Brooklyn, in the county of Kings and State of New York, and Ridgewood, in the county of Bergen and State of New Jersey, respectively, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems and more especially to such systems wherein automatic switches and automatic switch controlling devices are employed in the establishment and completion of conversational connections.

An object of the invention is to improve the serviceability of telephone systems by providing an improved trunk testing mechanism whereby a simultaneous test may be made of a group of trunks which lead from a plurality of equivalent selector switches.

A feature of the invention relates to means for associating simultaneously all the test conductors of a marked group of trunks, leading to a private branch exchange, with a common testing equipment.

Another feature resides in the novel means for partially operating a plurality of selector switches wherein the trunks of a selected group originate and for completely operating only that switch wherein the first idle trunk of the group originates.

Other inherent features and advantages will become apparent after a consideration of the following description and from a consideration of the appended claims.

The several figures of the drawing when arranged in the manner indicated in Fig. 9 disclose a sufficient portion of a telephone system embodying the present invention, and in sufficient detail to enable a complete understanding to be attained thereof.

Referring to the drawings, Fig. 1 represents in schematic form a line switch and a subscriber's line terminating therein. This figure also shows a district selector switch and a sender selector switch. In addition there is shown diagrammatically one of a number of trunks extending between the line switch and the district switch.

Fig. 2 in the upper central portion illustrates a section of an incoming selector switch in which trunks leading from the district switch of Fig. 1 terminate. This figure also represents in diagrammatic form an incoming frame connector, and in comparative detail an incoming trunk connector. The portion of this figure included below, and to the left of the broken line shows a series of test relays located in the marker.

Fig. 3 shows one of a number of final selector switches in which appear trunks leading from the incoming switch of Fig. 2. This figure also shows a called subscriber's line and a number of groups of trunks which lead from the final switch to a private branch exchange.

Fig. 4 shows another final selector switch similar to the switch of Fig. 3.

Fig. 5 in the left hand portion schematically illustrates a registering and controlling sender. The central portion of this figure shows a sender connector, while the right hand portion illustrates schematically certain registers of the marker.

Fig. 6 shows certain controlling relays located in the marker.

Fig. 7 illustrates a number of connecting devices for associating the final selector switch with the marker and final translator.

Fig. 8 shows part of a final translator. The upper portion of this figure shows series of testing and blocking relays for testing and controlling the selection of an idle P. B. X. trunk. The remainder of this figure illustrates certain controlling relays of the final translator.

Fig. 9 shows the manner in which the several sheets of the drawing are to be arranged to produce a unitary circuit disclosure.

The invention is illustrated as applied to a telephone system of the general character disclosed in the copending application of Warren W. Carpenter, Serial No. 703,362, filed April 1, 1924. Reference may be had to said application for the details of construction and operation of the various markers and connecting devices referred to hereinafter.

The line switch 100, district switch 150, sender selector switch 160, incoming switch 200, final switches 300 and 400 may all be of the coordinate type such as described and claimed in U. S. patent to J. N. Reynolds, No. 1,507,140, granted September 2, 1924,

and further described in the U. S. patent to S. B. Williams, No. 1,517,331. Reference may be had to both of the above mentioned patents for a description of the construction and the mode of operation of the various selector switches.

Inasmuch as the present invention is concerned principally with the manner of testing for and seizing an idle trunk leading to a private branch exchange, the operation of the various selector switches and the connecting devices, as well as the manner in which these switches are controlled by the senders and markers will be described hereinafter in a comparatively general manner.

Detailed description.

Let it be assumed that the subscriber at station 101 has initiated a call with the purpose of communicating with a subscriber whose line is located in the private branch exchange represented diagrammatically by the rectangle 450. In response to the removal of the calling subscriber's receiver from its switchhook, line 102 is extended by means of line switch 100 to the district trunk 151. At the time trunk 151 is seized, sender selector switch 160 is actuated, resulting in the association of an idle registering and controlling sender 500 with trunk 151. In response to the dialing of the office code by the calling subscriber the district switch 150 is selectively operated to seize a trunk such as trunk 152 which leads to the proper group of incoming switches. Subsequently to the seizure of trunk 152, the sender connector 560 is actuated, resulting in the association of an idle incoming marker, or switch controlling mechanism, with the incoming sender 500. This marker comprises a set of register relays for receiving the numerical designations of wanted lines, a plurality of controlling relays and sets of testing relays. Subsequently to the operation of connector 560 the numerical record is transferred from the registers of sender 500 to corresponding registers in the marker. Four of the marker registers are represented diagrammatically, namely, the units register 510, tens register 520, hundreds register 530 and thousands register 540. At the time connector 560 is operated conductor 551 is grounded in the sender, resulting in the operation of relay 619. Relay 619 is a ground control relay and supplies ground for operating and locking various relays in the marker. With the complete record transferred to registers 510, 520, etc., a circuit is closed from ground through the left contacts of relay 619, conductor 667, through the hundreds register to battery, through the winding of relay 517. The next step in the sequence of operations is the association of an idle final translator with the incoming marker of Figs. 5 and 6. The selection of this translator being determined by the combined setting of the thousands and hundreds registers 540 and 530 respectively, as described in the application of W. W. Carpenter Serial No. 703,362. Assuming the translator represented in Fig. 8 to be idle at this time, a circuit is completed from battery, through the left outer contacts of relay 619, conductor 666, through thousands register 540, conductor 561, contacts of relay 517, conductor 562, right winding of relay 801, to ground at the back contacts of relay 802. Relay 801 locks through its left winding in series with the winding of relay 802. Relay 802 operates by means of this locking circuit and prevents a second marker from seizing this translator. At this time also the record of the incoming frame involved, which has been previously registered in the sender 500 causes relay 617 to be energized. For a detailed description of the manner in which the aforemention operations are effected, reference may be had to the application of W. W. Carpenter, Serial No. 703,362, referred to hereinbefore.

With relays 801 and 802 energized ground is extended through front contacts of these relays, thence to battery through the winding of multi-contact relay 803; also by means of parallel circuits through the windings of multi-contact relays 701 and 201. Relays 701 and 803 associate the marker with the final translator. The ground which was effective in operating relay 803 is also extended through the inner front contacts of relay 801, thence to battery through the winding of relay 618 which operates and locks to ground at the contacts of relay 619. In the manner described in detail in the Carpenter application, Serial No. 703,362, referred to above, relays 617 and 618 cooperate to cause the actuation of the incoming frame connector 210 resulting in the operation of vertical magnet 215. At this time also the multi-contact relay 208 is operated. The frame connector 210 associates the horizontal operating and testing conductors of switch 200 with the right hand windings of the test relays 202, 203, 204, etc. The left hand windings of these test relays are associated by means of relays 201 and 208 with the sleeve conductors of the proper group of trunks to which relay 208 is individual and including trunk 261. If either a link or a trunk is busy the test conductor thereof is grounded causing the corresponding test relay to operate and lock through its left winding.

In the manner described in detail in the application of W. W. Carpenter, Serial No. 703,362, referred to above, the setting of the hundreds register 530 causes ground to be connected through the left middle contacts of relay 619, through contacts of hundreds

register relays to one of the conductors 552, 553, etc. Assuming conductor 553 to be thus grounded then a circuit is completed, comprising contacts of relay 803, to cause the operation of relay 804. At this time also the record of the units digit on register 510 causes battery to be applied to either conductor 554 or conductor 555 depending on whether the units digit is even or odd. Assuming the units digit to be even, then battery is connected through the left outer contacts of relay 619, conductor 668, through contacts of the units register relays 510, to conductor 554, causing the operation of relay 805.

The setting of the tens register 520 causes ground to be connected over conductor 667, through contacts of tens relays 520 to one of the conductors 556, 557, etc., to be grounded. Assuming conductor 557 to be thus grounded, a circuit is completed for operating the vertical magnet 301, which is associated with the vertical row of contacts 302 wherein is located the first trunk leading to the private branch exchange, namely, trunk 323. The circuit for energizing magnet 301 may be traced from battery, through the winding of said magnet, through the cross connection blocks 370, conductor 352, front contacts of relay 805, contacts of relay 803, conductor 851, contacts of tens relays 520, to the grounded conductor 667. The setting of the units register causes ground to be extended through the right contacts of relay 609, conductor 651, through relays of the units register 510, conductor 852, contacts of relay 803, conductor 854, conductor 855, to battery through the winding of horizontal group relay 702. Relay 702 is individual to the section 304 of switch 300 wherein appears the first trunk in the desired P. B. X. group. Similarly relay 703 may be individual to a succeeding section as section 305. The operation of relay 702 extends ground through the lowermost contacts thereof, over conductor 752, to battery through the winding of relay 615. Relay 615 at its right contacts provides a locking circuit for the testing relays 250.

It will be noted that relay 806 was operated when the marker ground control relay 619 was energized. The circuit for operating relay 806 may be traced from battery, through the winding thereof, contacts of relay 803, conductor 652, left contacts of relay 611, to ground at the contacts of relay 619. With vertical magnet 301 operated a circuit is now completed from ground, through the left contacts of relay 806, winding of relay 807, conductor 653, lower innermost contacts of magent 301, conductor 353 to battery through the winding of relay 704. Both relays 704 and 807 operate in this circuit. Relay 807 extends ground through its left contacts, thence through the outermost front contacts of relay 806, conductor 654, contacts of relay 701, conductor 753, through the frame connector 210, to battery through the winding of vertical magnet 209. The operation of magnet 209 in this circuit prepares the vertical row of contacts 221 in which appear the selected group of trunks including trunk 261. Magnet 209 extends ground through its lower contacts, over conductor 654, through the winding of relay 601, to battery at the contacts of relay 611. The test horizontal magnet 306 which is individual to section 304 in switch 300 is now energized over a circuit which may be traced from battery, through the right winding of magnet 306, conductor 354, contacts of relays 702 and 701, conductor 754, lower middle contacts of magnet 301, conductor 355, right middle contacts of relay 806, to ground at the right back contact of relay 811.

It will be assumed that the first trunk 323 of the P. B. X. group is idle when magnet 306 operates. Magnet 306 in operating closes a test circuit which includes the sleeve conductor of the P. B. X. trunk 323. This circuit may be traced from battery, through the winding of relay 605, conductor 655, contacts of relay 701 and 702, conductor 755, lower conductor of the test link, thence through contacts in row 302 to the test conductor of trunk 323. Trunk 323 being idle there exists no ground potential on the sleeve conductor thereof and relay 605 remains normal. Magnet 306 in operating also extends ground through its left contacts over conductor 356, contacts of relay 704, conductor 357, contacts of relay 201, conductor 252, to battery through the winding of relay 603. Relay 603 operates and closes an obvious energizing circuit for relay 604. Magnet 306 also extends the grounded, upper conductor of the test link through contacts in vertical row 302, through the connecting blocks 350, over conductor 351 to battery through the winding of the blocking relay 815. Relay 815 operates to mark the beginning of the P. B. X. group for purposes to be explained hereinafter.

The structure of the switches 300 and 400 is such that the horizontal link circuits are divided into five groups, corresponding to the digits 0 to 4 and 5 to 9, inclusive. Thus in switches 300 and 400 there are ten different horizontal groups. Consequently by means of the connecting block 350, the test links of these groups may be associated with the blocking relays 812, 813, 814, etc. in any desired manner. It has been assumed that section 304 of switch 300 is the fourth section, thus the fourth blocking relay 815 was operated as above described. The operation of relay 815 is an indication to the translator that the first line of the P. B. X. group

is located in the fourth section of switch 300. The purpose of operating relay 815 will be described in detail hereinafter.

Relay 815 also completes a circuit from battery, through the winding of relay 809, thence through the upper front contact of relay 815, to ground as above traced. Relay 809 extends ground through its inner right front contact, over conductor 856, contacts of relay 701, conductor 656, to battery through the winding of relay 610. The operation of relay 610 in this circuit, serves as an indication to the marker that the connection is to be extended to a private branch exchange. Relay 610 completes a circuit from battery through the winding of relay 607, inner back contacts of relay 608, inner front contacts of relay 610, back contacts of relay 605 to ground at contacts of relay 604. Relay 607 immediately locks to ground at the armature of relay 619.

When relay 702 operates as above described, it associates the test conductors of the links in section 304 of switch 300 with the test relays 250. A three point test is now made to determine an idle link in switch 200, an idle link in section 304 of switch 300, and an idle trunk interconnecting both these links. It will be assumed that link 263, trunk 261, and link 308 are simultaneously idle. A test circuit is now prepared from battery through the right winding of relay 202, right middle contacts of relay 206, through the frame connector 210 to the test conductor of link 263. Link 263 being idle no ground potential exists thereon and the right winding of relay 202 remains deenergized. Another test circuit is prepared from battery through the left winding of relay 202, right inner back contacts of relay 206, through contacts of relays 201 and 208 to the sleeve conductor of trunk 261. Trunk 261 being idle, the left winding of relay 202 is not energized, consequently relay 202 remains normal. A third test circuit is completed from battery through the winding of relay 204, back contacts of relay 211, conductor 253, contacts of relays 701 and 702, conductor 756, to the test conductor of link 308. Link 308 being idle the test relay 204 remains normal. With relays 202 and 204 normal a circuit is completed from battery, through the winding of relay 206, left back contacts of relay 202, conductor 657, front contacts of relay 606, to ground at the left back contacts of relay 609. It will be noted that relay 606 was operated when relay 807 operated. This circuit may be traced from battery, through the winding of relay 606, conductor 658, contacts of relay 701, conductor 659, right inner front contacts of relay 806, to ground at the contacts of relay 807. The operation of relay 206 as described above identifies the selection of links 263 and 308 as well as the selection of trunk 261. A circuit is now completed from battery through the winding of vertical magnet 309, contacts of relay 704, conductor 757, contacts of relays 208 and 201, conductor 254, left outer front contacts of relay 206, left back contacts of relay 202, to ground over conductor 657 as above described. Magnet 309 prepares the contacts of vertical row 311 and extends ground through its lower inner contacts, over conductor 358, through the left back contacts of relay 811, conductor 859, contacts of relay 201, conductor 661, to battery through the winding of relay 602. Relay 206 in operating closes an obvious energizing circuit for relay 211 which operates and disconnects the test relay 204 from the link 308 to prevent a false operation of relay 204 when the test conductor of link 308 is subsequently grounded. Horizontal magnets 212 and 312 are now actuated. The circuit for operating magnet 212 may be traced from battery through the right winding thereof, through the frame connector 210, right outer front contact of relay 206, conductor 663, contacts of relays 601 and 602 to ground at the left contacts of relay 607. The circuit for operating horizontal magnet 312 may be traced from battery through the right winding of said magnet, over conductor 359, contacts of relays 702 and 701, conductor 759, left contacts of relay 211, to ground over conductor 663. The operation of magnets 212 and 312 completes the connection between trunk 152 and trunk 261, and also between trunk 261 and the first P. B. X. trunk 323. In the manner described in detail in the application of W. W. Carpenter, referred to hereinbefore, the sleeve conductor of trunk 261 is grounded when magnet 212 operates thus closing the previously described circuit for test relay 605. Relay 605 operates and completes a circuit from battery through the winding of release relay 612, right outer front contact of relay 607, front contacts of relay 605 to ground at the contacts of relay 604. Relay 612 completes an obvious operating circuit for relay 611. In the manner described in detail in the application of W. W. Carpenter, Serial No. 703,362 already referred to, the operation of relay 611 brings about the release of the marker. Subsequently to the release of the marker, the translator, the connectors 210 and 260, sender connector 560, sender 500 and sender selector 160 are released. The release of the marker results in the release of vertical magnets 215, 209, 309 and 301. The connection through switch 200 is maintained by magnet 212 which is now locked in a circuit comprising both windings of this magnet, contacts of switch 200, and the grounded sleeve conductor of trunk 261. In a similar manner connection is maintained

through switch 300, by magnet 312 which is held in a circuit comprising both its windings and the grounded sleeve conductor of trunk 261. The above mentioned application of W. W. Carpenter also describes in detail the manner in which ringing current is applied to the called line in the private branch exchange, and also the manner in which the connection is disrupted at the termination of conversation.

Sequence of operations when the first trunk of the P. B. X. group is busy.

It will now be assumed that the first trunk 323 is busy when the test horizontal magnet 306 operates as hereinbefore described. In this case the sleeve conductor of trunk 323 is grounded and when magnet 306 is energized, the circuits already traced for relays 605 and 827 are closed resulting in the operation of both of these relays. Relay 605 in operating opens the operating circuit of relay 607, so that when relay 610 operates as described above, a circuit is completed from battery through the right winding of relay 609, right outer contacts of relay 610, right outer back contacts of relay 607, front contacts of relay 605 to ground at the contacts of relay 604. Relay 609 operates and immediately locks by means of a circuit completed through its left winding and locking contact to ground at the contacts of relay 619. It will be noted that relays 815 and 809 operate in the manner hereinbefore described. Relay 609 extends ground through its inner front contacts to operate relay 608. A circuit is thereupon completed from battery, through the winding of relay 811, contacts of relay 803, conductor 861, left contacts of relay 608 to ground at the contacts of relay 619. Relay 811 at its right inner contacts provides a locking circuit for relays 809 and 815. In addition relay 811 by its operation indicates to the translator that the first P. B. X. trunk is busy. With relays 809 and 811 operated ground is extended through the outermost front contacts of relay 811, left outer contacts of relay 809, conductor 857 to battery through the windings of relay 705 and 707 in parallel. Relay 705 is individual to a section of the desired P. B. X. trunk group, which section appears in vertical row 302, while relay 707 is individual to the corresponding row 402 of switch 400 wherein appear the remaining trunks of the desired P. B. X. group. In similar manner relays 706 and 709 may be individual to the P. B. X. trunks of another group appearing in a different pair of vertical rows, such as rows 307 and 407. The P. B. X. line test relay 827 is now connected to the sleeve conductor of the first P. B. X. trunk 323. This circuit may be traced from battery, through the winding of relay 827, conductor 858, contacts of relay 705, conductor 755, lower conductor of the test link associated with section 304, thence to the grounded sleeve conductor of trunk 323 thus causing relay 827 to operate and lock to ground at the contacts of relay 811. It has already been mentioned that relay 815 indicates to the translator that the first trunk in the desired P. B. X. group appears in the fourth section of switch 300. It will be asumed that this trunk group comprises seven trunks, two of which have an appearance in sections 304 and 305 of switch 300 while the remaining five have an appearance in the five sections of switch 400. As yet there has been given to the translator no indication as to the size of the trunk group, or in what section of switch 300 or switch 400 the last trunk appears. When relay 609 operates as above described it opens the original operating circuit for vertical magnet 309 which releases. Relay 609 also opens the previously described circuit for group relay 702 which now releases and disassociates the test relays 250 from the links in section 304. The operation of relay 811 as above described also opens the energizing circuit of test horizontal magnet 306 which releases. The energizing circuits of relays 605 and 615 are also opened when relay 702 releases, both of said relays retracting their armatures. Relay 615 upon releasing opens the locking circuit of those test relays 250 which had become energized as a result of the testing of the links in switches 200 and 300. A circuit may now be traced for operating vertical magnet 401 which controls the vertical row of contacts 402 in which appear the remaining five trunks of the group including trunks 323, 322, 416, etc. This circuit is completed from battery through the winding of magnet 401, conductors 452, through connecting blocks 370, lowermost contacts of magnet 301, conductor 361, to ground at the right inner contacts of relay 811. It will be noted that when relay 809 operated a circuit was completed from ground through the left outer contacts of said relay, conductor 857, thence in parallel through the windings of relays 705 and 707.

It will be remembered that relays 807 and 704 operated when vertical magnet 301 was actuated. Similarly, the actuation of magnet 401 as described, causes relays 808 and 708 to operate. This circuit may be traced from ground at the left contacts of relay 806, thence through the winding of relay 808, conductor 863, lower innermost contacts of magnet 401, conductor 453, to battery through the winding of relay 708. Circuits are now completed for operating the last two test horizontal magnets of switch 300 and the five test horizontal magnets associated with switch 400. The circuit for operating magnet 306 alone will be

traced since similar circuits exist for operating the remaining test magnets. The circuit for magnet 306 may be traced from battery through the right winding thereof, conductor 354, contacts of relay 705, conductor 763, upper outer armatures and back contacts of relays 816, 817, 818, etc. in series, right contacts of relays 808 and 807, to ground at the contacts of relay 811. It is to be noted that as a result of the operation of blocking relay 815, the test horizontal magnets associated with the first three sections of switch 300 remain normal.

It will be assumed that the first five trunks of the P. B. X. group, namely, the two trunks appearing in switch 300, are busy and the trunks appearing before the first three sections of switch 400, and that the sixth P. B. X. trunk, namely, the trunk 423 is idle. In order to preserve relative simplicity in the drawing, only the last two sections in each of the switches 300 and 400 are shown. With the required test horizontal magnets operated, the P. B. X. trunk testing relays 827, 828, etc. are connected to the lower or test conductors of the corresponding sections in switches 300 and 400. Accordingly, a circuit is completed from battery through the winding of relay 827, thence by means of conductor 858 through contacts of relay 705, conductor 755, contacts in vertical row 302 to the grounded conductor of the busy trunk 323. Similar circuits exist for operating relays 828, 829, 830 and 831, which lock to ground at the contacts of relay 811. Since trunk 423 is idle, however, the corresponding test relay 832 remains normal. It will be noted that when test magnet 412 operates a circuit is completed from battery through the winding of relay 821, conductor 762, through the connecting block 460, contacts in vertical row 402 to the grounded upper conductor of the test link associated with magnet 412. Relay 821 immediately locks through its winding and locking contacts, thence through the locking contacts of relay 809 to ground at the contacts of relay 811. Relay 821 upon operating opens the energizing circuits of all the test horizontal magnets which thereupon release. The operation of any of the relays 827, 828 as above described closes an obvious operating circuit for the relay 823. Relay 823 is designed to be slow in operating to permit the testing relays 824, 825, etc. to take their proper setting. When relay 823 has completely attracted its armatures, a circuit is completed from ground through the contacts of relay 823, lower outer back contacts of relays 812, 813 and 814, lower outer front contacts of relay 815, upper front contacts of relay 827, lower inner back contacts of relay 816, upper front contacts of relay 828, lower inner back contacts of relay 817, upper front contacts of relay 829, lower inner back contacts of relay 818, upper front contacts of relay 830, lower inner back contacts of relay 819, upper front contacts of relay 831, lower inner back contacts of relay 820, upper back contacts of relay 832, conductor 874 through the connecting block 880, conductor 875, to battery through the winding of group relay 711. Relay 711 is individual to the section 404 wherein the first idle P. B. X. trunk appears. It will be noted that even though the succeeding P. B. X. trunk 416 may also be idle and the corresponding test relay 833 be normal, the start circuit is opened at the upper contacts of relay 832 and group relay 711 alone is energized. Relay 711 extends ground through its lowermost contacts over conductor 752 to battery through the winding of relay 615 which operates. Relay 711 also connects the test conductors of the links in section 404 with the marker test relays 250. A three-point test is now made comprising links in switch 200, trunks in the group interconnecting switches 200 and 400 as well as the links in section 404. The manner of making this test and the manner in which the idle P. B. X. trunk 423 is seized by the operation of switches 200 and 400 has been described hereinbefore in detail. The manner in which the connection is disrupted after the termination of conversation is similar to that described in detail in the application of W. W. Carpenter Serial No. 703,362, filed April 1, 1924. It will be noted that subsequent to the seizure of the idle trunk 423 when the translator and marker release, the operating ground for maintaining vertical magnets 301 and 401 energized is removed and both these magnets release simultaneously.

In the foregoing description it has been chosen to illustrate the invention as applied to a P. B. X. trunk group which terminates in two final switches, but it will be apparent to any one skilled in the art that trunk groups appearing in more than two final switches may be employed.

What is claimed is:

1. In combination, a group of trunks, selective switches in which said trunks appear, testing means normally associable with a particular one of said trunks, and means for partially operating said switches to associate all of said trunks with said testing means.

2. In combination, a group of trunks, selective switches in which said trunks appear, testing means normally associable with a particular one of said trunks, means for partially operating said switches to associate all of said trunks with said testing means to mark for selection an idle trunk, means effective when said trunk has been marked for completely operating that

switch alone in which said idle trunk appears.

3. In combination, a group of trunks, selective switches comprising groups of link circuits before which said trunks appear, testing means normally associable with a particular one of said trunks, and means effective if said particular trunk is busy for partially operating said switches to associate said testing means with all of said trunks.

4. In combination, selective switches comprising groups of link circuits, a group of trunks, each of said trunks appearing before a corresponding group of said link circuits, means for testing said link circuits, other testing means normally associable with a particular trunk in said group, means effective when said particular trunk is inacessible for partially operating said switches to associate said other testing means with all the trunks in said group to mark for selection an idle one thereof, and means responsive to the marking of said idle trunk for associating said first mentioned testing means with the group of link circuits before which said idle trunk appears.

5. In combination, selective switches comprising groups of link circuits, a group of trunks each trunk appearing before a corresponding group of links, testing means for testing the condition of the links in said switches, other testing means normally associable with a particular trunk in said group, means for operating one of said switches to seize said particular trunk, means effective when said particular trunk is inaccessible for partially operating another of said switches to associate said other testing means with the remainder of said trunks to mark for selection an idle one thereof, and means responsive to the marking of said idle trunk for associating said first mentioned testing means with the group of link circuits before which the marked idle trunk appears.

6. In combination, selective switches, a group of trunks appearing in said switches, testing means associable in common with said switches, means for partially operating one of said switches to test the condition of a particular one of said trunks, means effective in one condition of said particular trunk for completely operating said one of said switches to seize said trunk, and means effective in another condition of said trunk for associating said testing means with the remainder of said trunks to mark for selection an idle one thereof.

7. In combination, selective switches comprising groups of link circuits, a group of trunks, each trunk appearing before a corresponding group of link circuits, means for marking for selection a particular one of said trunks, testing means for said link circuits other testing means normally associable with said particular trunk, means effective dependent upon the busy condition of said particular trunk for operating said switch to associate said other testing means with the remaining trunks of said group to mark for selection an idle one thereof, and means effective when said trunk has been so marked for associating said first mentioned testing means with the group of link circuits before which the marked trunk appears.

8. In combination, selective switches comprising groups of link circuits, a group of trunks, each trunk appearing before a corresponding group of link circuits, means for testing the condition of said link circuits, other means for testing the condition of said trunks, means for partially operating one of said switches to test the condition of a particular one of said trunks, means effective in one condition of said trunk for completely operating said one of said switches to seize said trunk, means effective in another condition of said trunk for partially operating another of said switches to associate said other testing means with the remaining trunks of said group and to mark for selection an idle one thereof, means effective when said idle trunk has been marked for associating said first mentioned testing means with the group of link circuits before which said idle trunk appears, and means for completely operating the switch in which said idle trunk appears.

9. In combination, a first selective switch, a second selective switch each of said switches comprising groups of link circuits, a plurality of trunks interconnecting said first and said second switches, a group of trunks outgoing from said second switch, a common mechanism for controlling the operation of said first and said second switches, testing means in said mechanism, means for associating said testing means with links in said first and second switches and with said interconnecting trunks, other testing means for the trunks outgoing from said second switch, means for operating said second switch to test the condition of a particular trunk in said group of outgoing trunks, means effective when said particular trunk is busy for disassociating said first mentioned means from the links in said second switch alone and for associating said other testing means with the remaining trunks in said outgoing group of trunks to mark for selection an idle one thereof, and means effective when said trunk has been marked for causing said controlling mechanism to operate said first and said second switches to complete a connection to said idle trunk.

10. In combination, a private branch ex-

change, selective switches, a group of trunks leading from said switches to said private branch exchange, one of said trunks bearing a numerical designation the remainder of said trunks bearing no numerical designation, means for operating one of said switches to seize said designated trunk, testing means normally associable with the numerically designated trunk, means effective when said designated trunk is inaccessible for associating said testing means with all the non-designated trunks to mark for selection an idle one thereof, and means for operating the particular switch in which said idle trunk appears.

11. In combination, a private branch exchange, selective switches comprising groups of link circuits, a group of trunks, each trunk appearing before a corresponding group of link circuits, testing means for said link circuits, means for associating said testing means with a particular group of link circuits, other testing means for said group of trunks, means effective dependent upon the condition of the trunk appearing before said particular group of link circuits for disassociating said first mentioned testing means from said group of link circuits and for associating said other testing means with all the trunks of said group to mark for selection an idle one thereof, means effective when said idle trunk has been marked for associating said first mentioned testing means with the group of links before which said idle trunk appears, and means for operating the switch in which said idle trunk appears to complete a connection between said idle trunk and an idle link in the corresponding group of links.

12. In combination, a selective switch comprising link circuits arranged in groups, a group of trunks, each trunk appearing before a corresponding group of link circuits, a test link for each of said groups of link circuits, means for operating one of said test links to cause a test to be made of a particular one of said trunks, means effective when said particular trunk is busy for operating all the said test links to cause a test to be made of all the trunks in said group for the purpose of marking for selection an idle one thereof, and means effective when said trunk has been so marked for releasing all of said test links and for completely operating the switch in which said idle trunk appears to complete a connection to said idle trunk.

13. In combination, selective switches comprising groups of link circuits, a group of trunks each trunk appearing before a corresponding group of link circuits, test links for each of said group of link circuits, means for partially operating one of said switches to test the condition of a particular one of said trunks, means effective when said trunk is busy for operating all of said test links to cause a test to be made of all the trunks in said group and for partially operating another of said selective switches, and means effective when an idle trunk is found for releasing all of said test links and for completely operating the switch before which the idle trunk appears,

In witness whereof, we hereunto subscribe our names this 22 day of January A. D., 1925.

SAMUEL B. WILLIAMS.
EARL S. GIBSON.