March 16, 1926. 1,577,033

M. B. KERR

AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 1

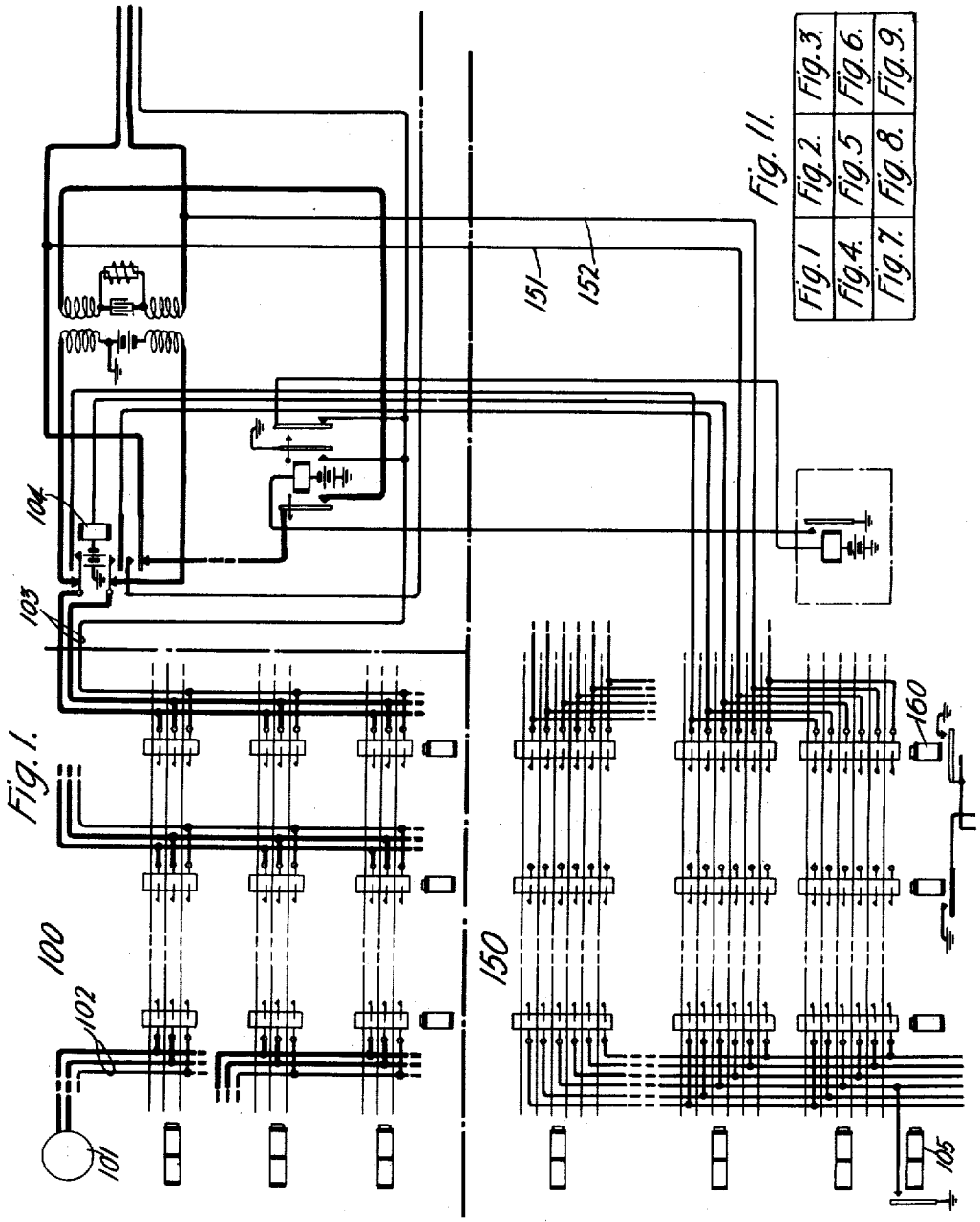

Fig. 1.

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by E. W. Adams Atty.

March 16, 1926. 1,577,033

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 2

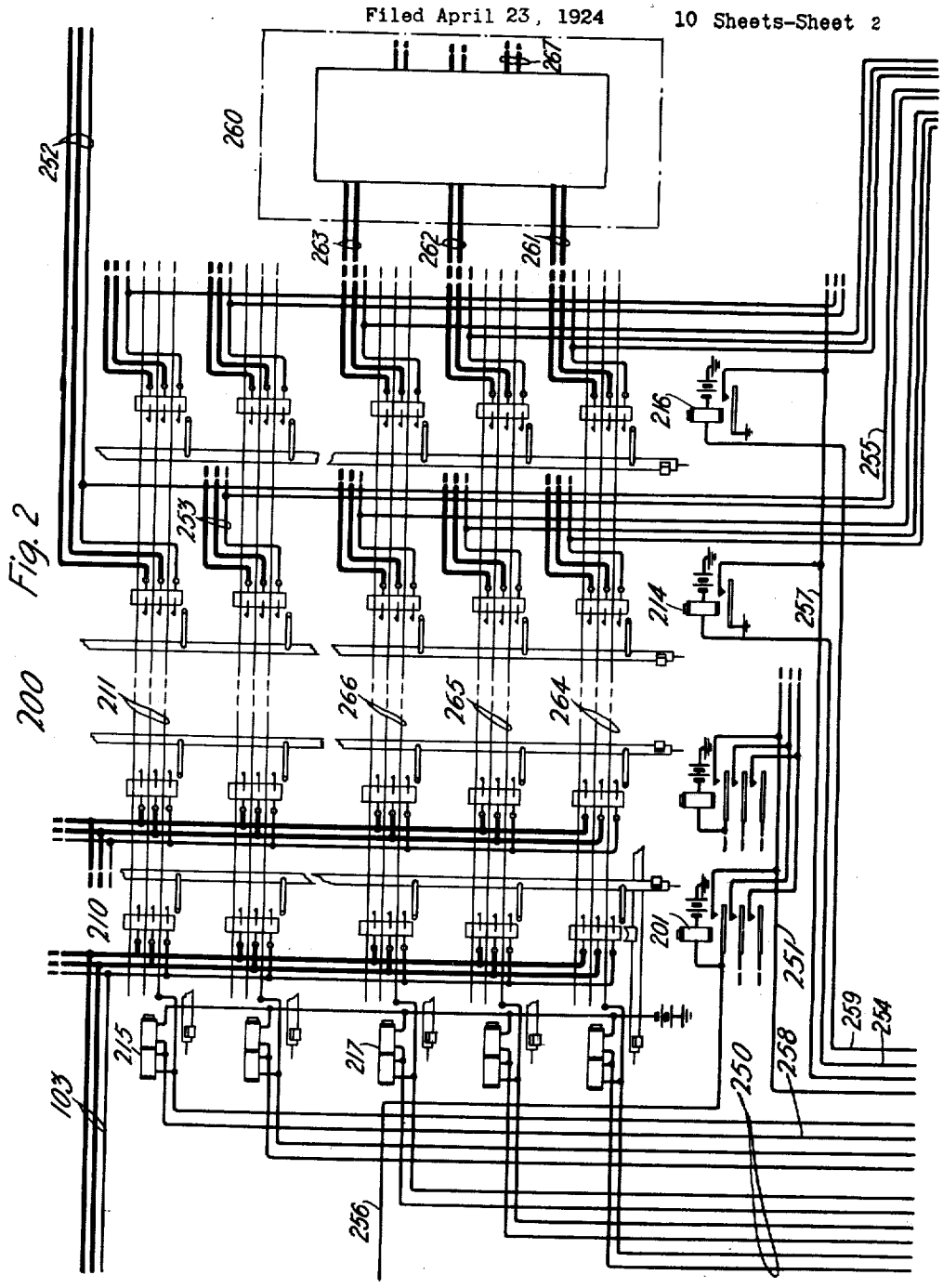

Fig. 2

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 3

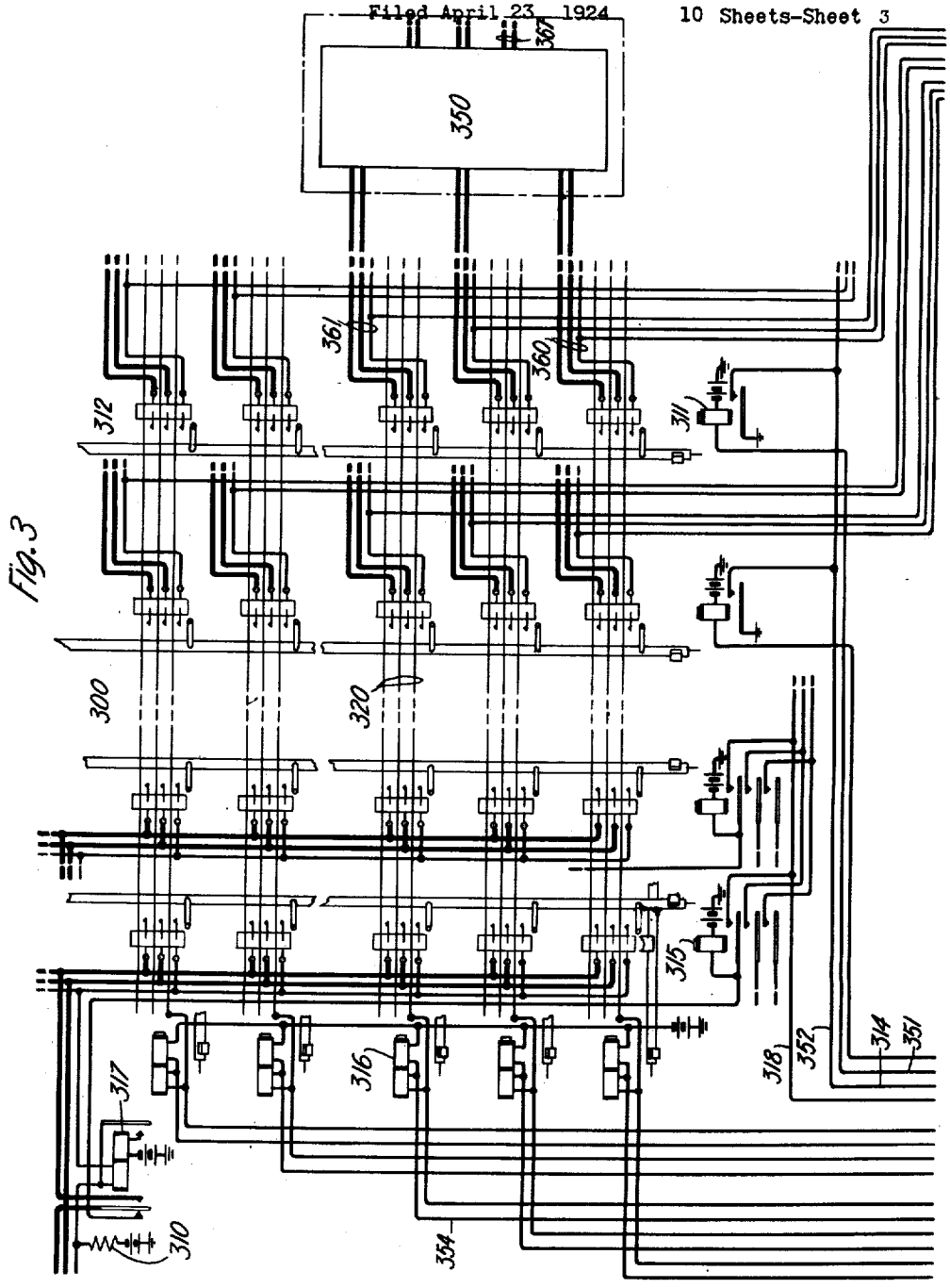

Fig. 3

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 4

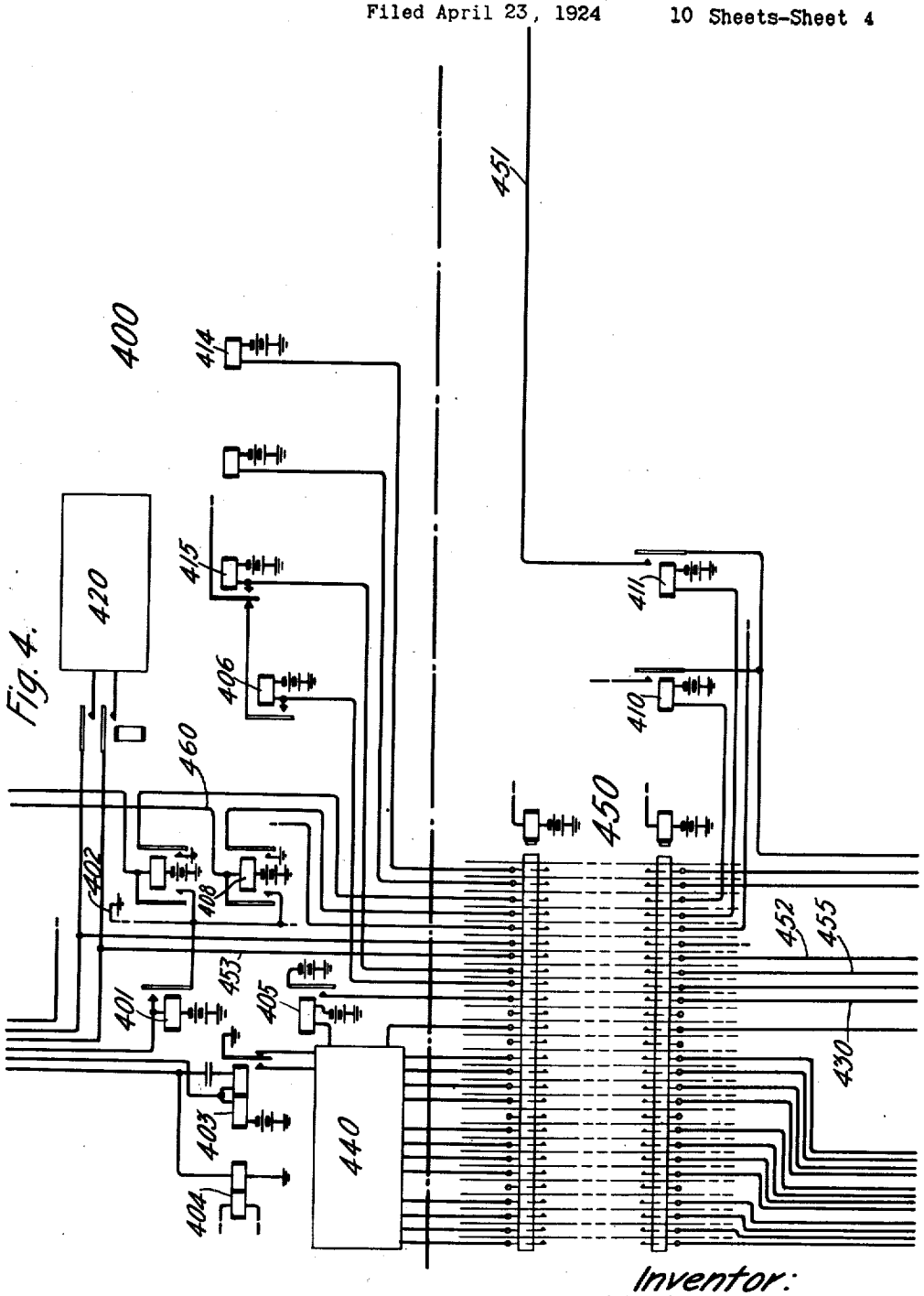

Fig. 4.

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 5

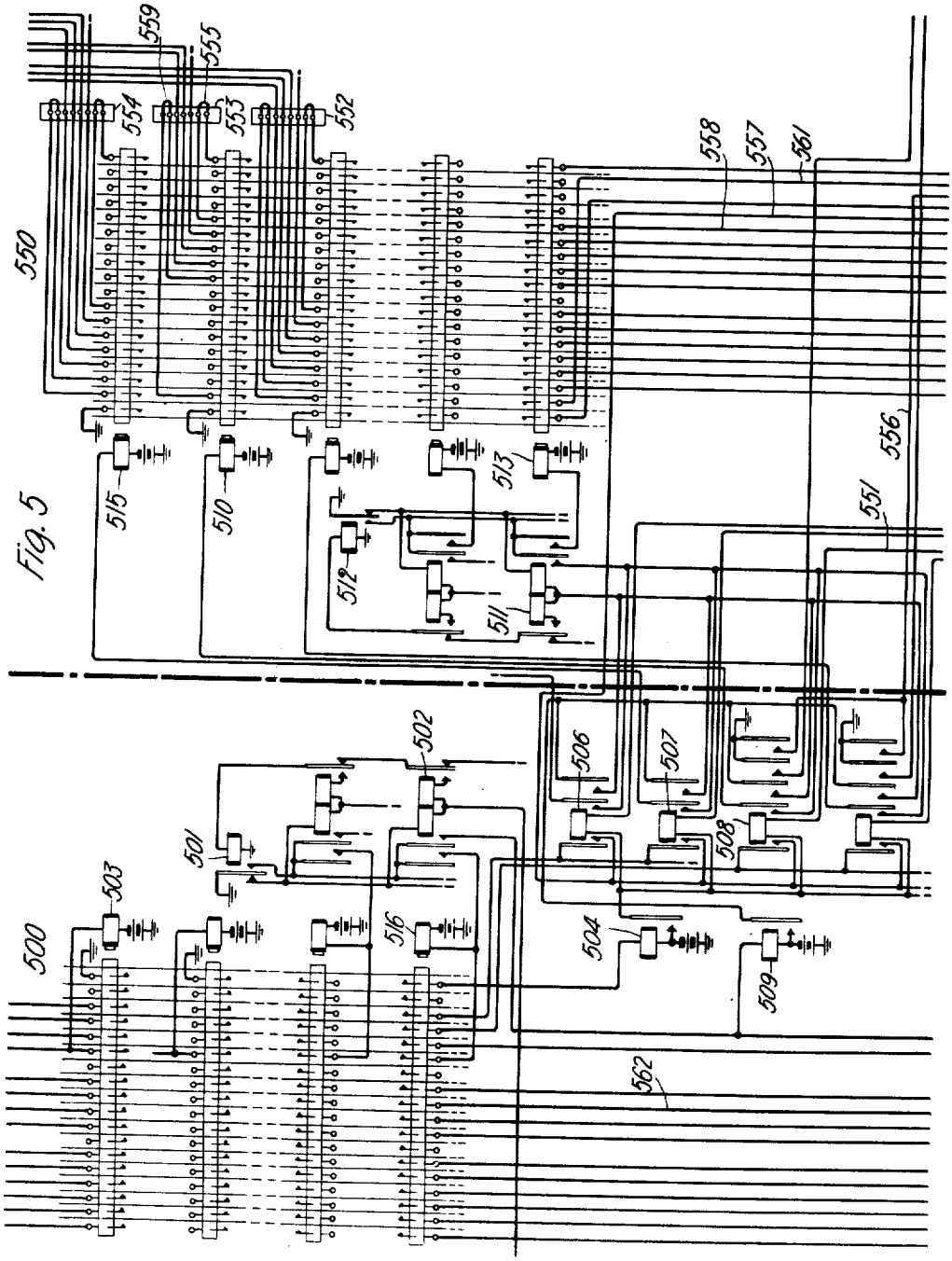

Fig. 5

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 6

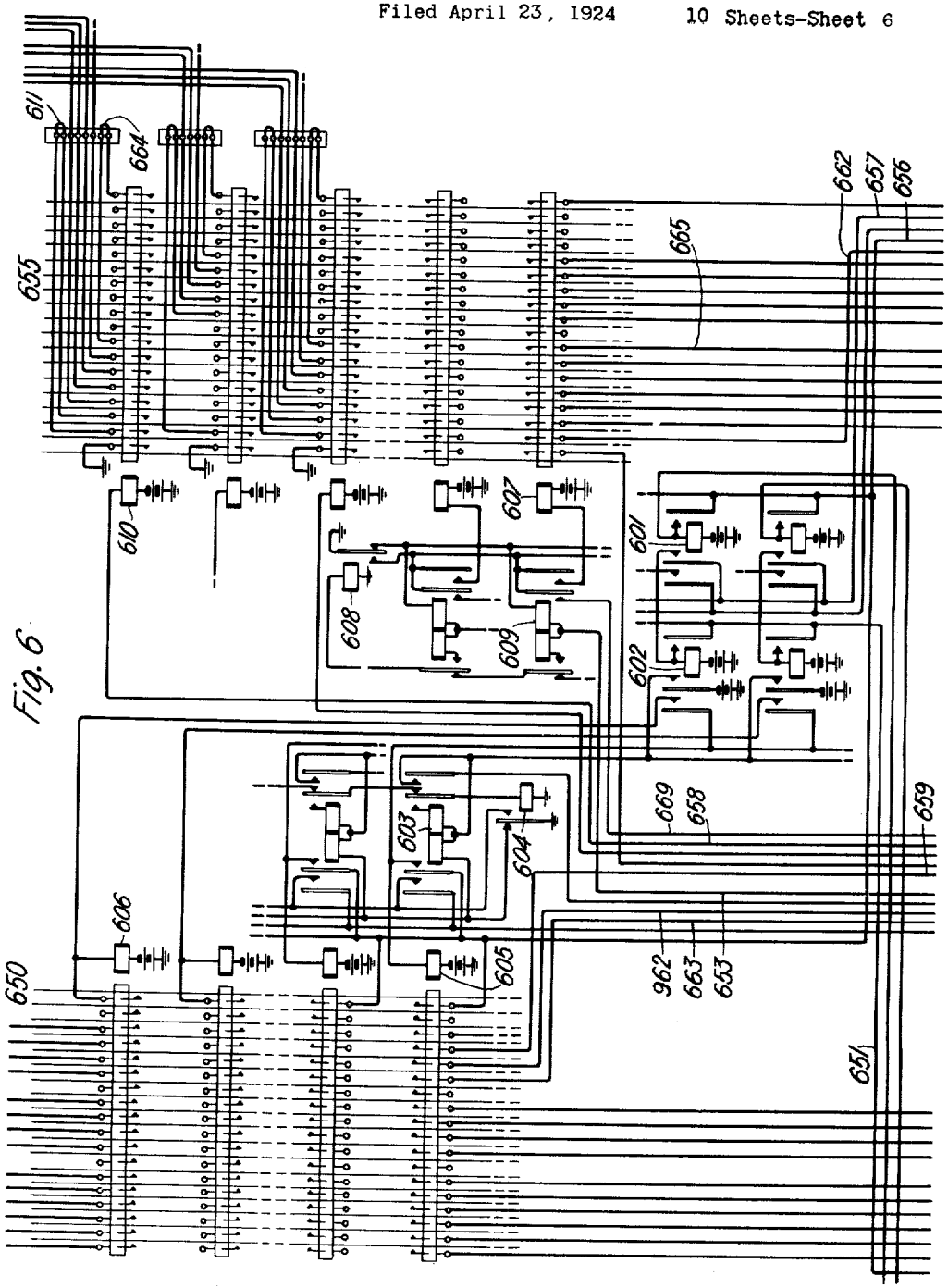

Fig. 6

Inventor:
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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 7

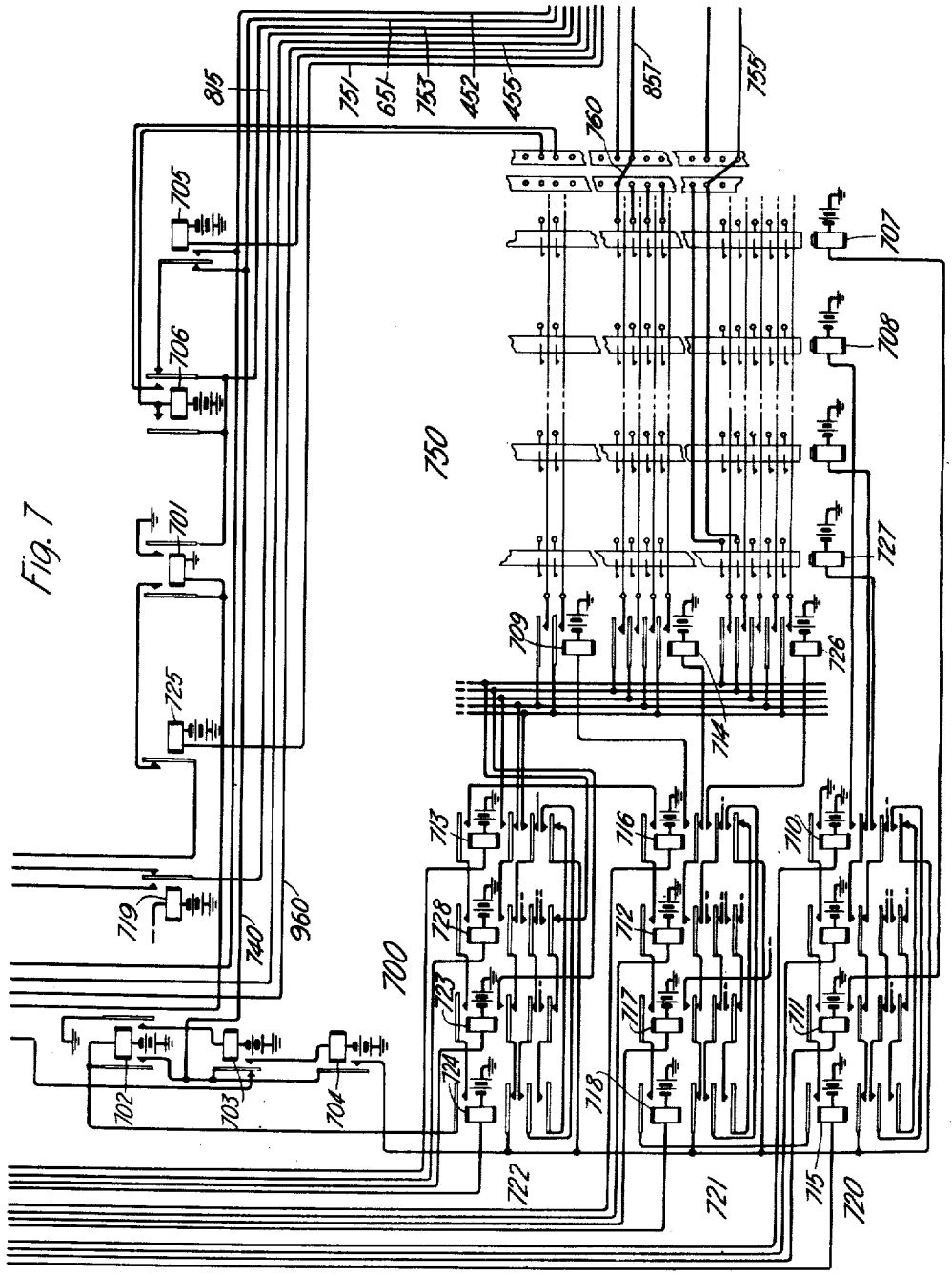

Fig. 7

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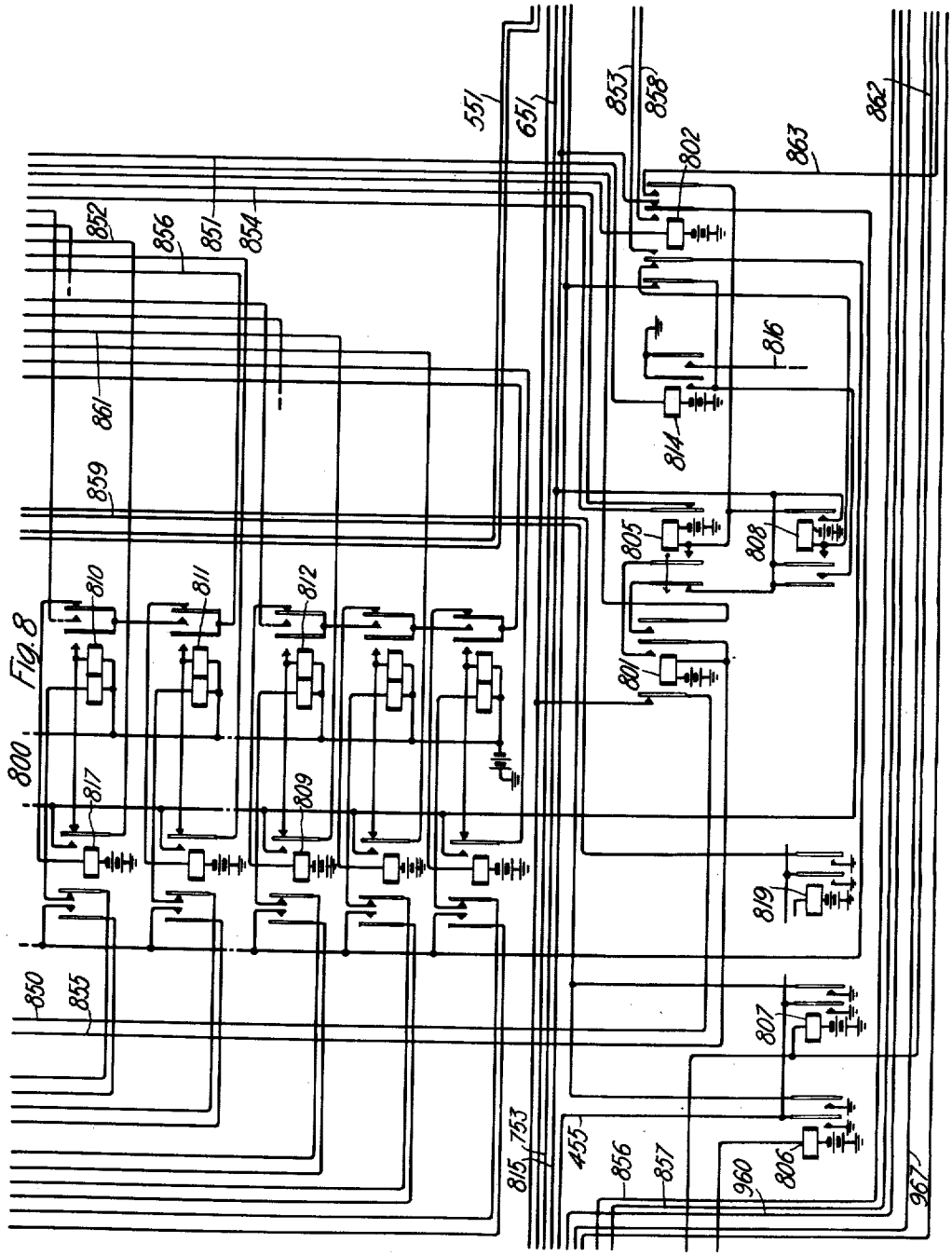
AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 8



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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 9

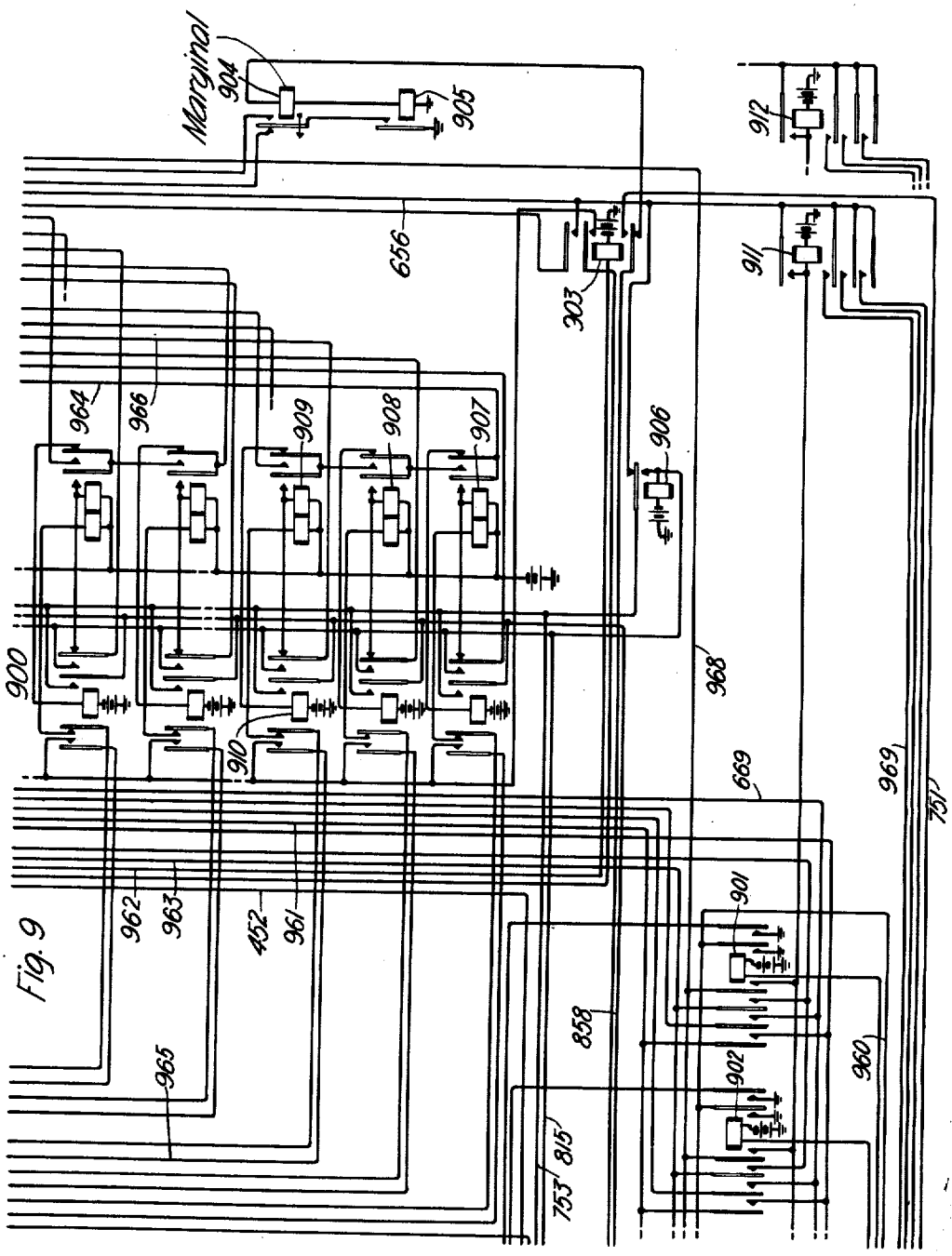

Fig. 9

Inventor:
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March 16, 1926. 1,577,033

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AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed April 23, 1924 10 Sheets-Sheet 10

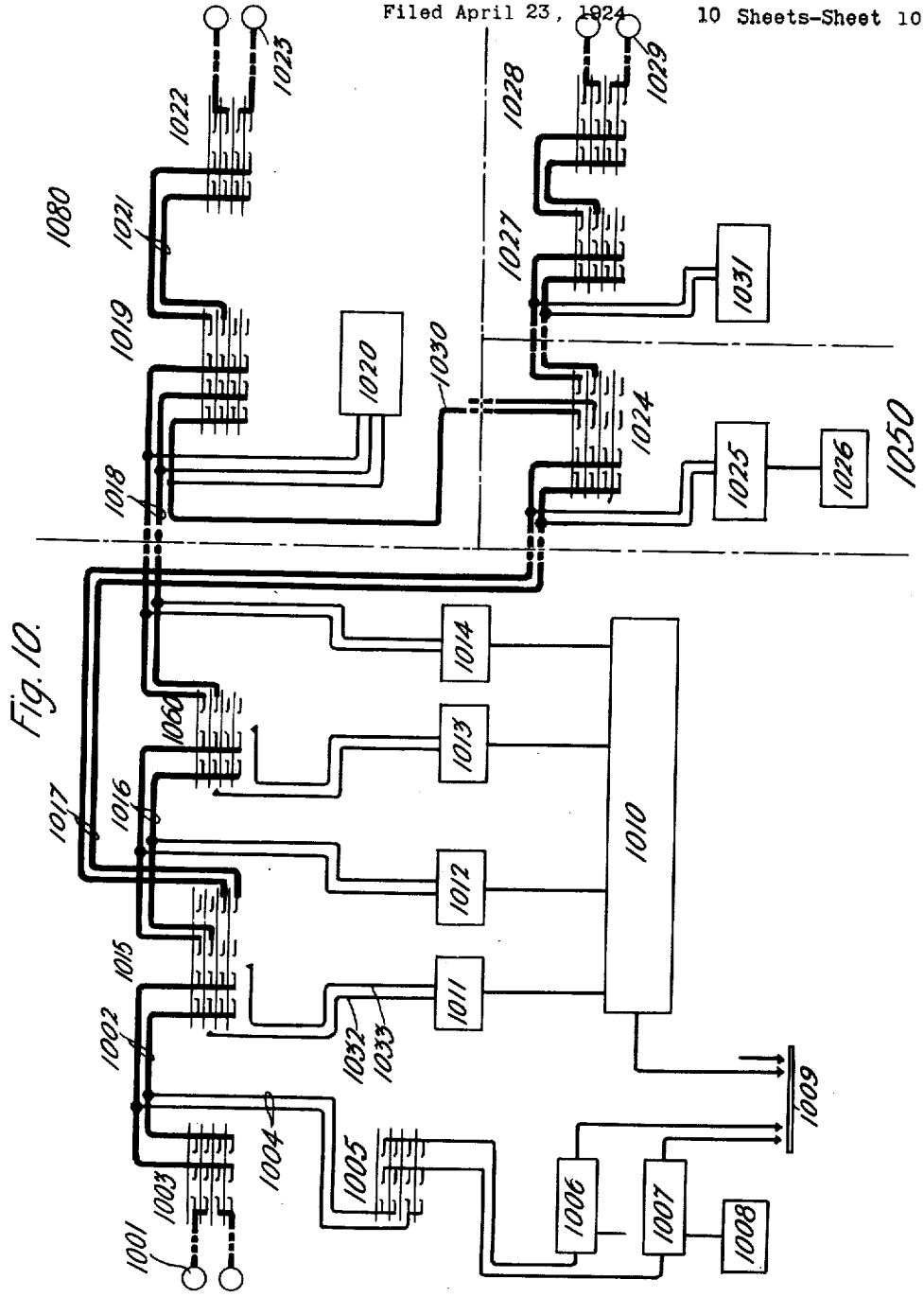

Fig. 10.

Inventor:
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Patented Mar. 16, 1926. 1,577,033

UNITED STATES PATENT OFFICE.

MARK B. KERR, OF ROSEBANK, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE-EXCHANGE SYSTEM.

Application filed April 23, 1924. Serial No. 708,358.

To all whom it may concern:

Be it known that I, MARK B. KERR, a citizen of the United States of America, residing at Rosebank, Staten Island, in the county of Richmond and State of New York, have invented certain new and useful Improvements in Automatic Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to automatic telephone exchange systems and more particularly to systems in which subscribers' lines terminate in different exchanges and wherein trunks are provided for completing connections between the lines in the several exchanges.

In a multi-office telephone system there are provided groups of trunks for interconnecting subscribers' lines in any two main offices. However, in such systems where a comparatively large number of offices are situated within the same area and the traffic between offices is heavy, considerations of economy necessitate the routing of a certain amount of this traffic through a central or tandem office which serves as a common intermediate distributing point for traffic between the several main offices.

It is an object of this invention to render more efficient the comparatively small number of direct office trunks by automatically rerouting the abnormal or overflow traffic to a tandem point where it is directively routed to the desired point.

A feature of the invention relates to a common controlling mechanism which functions in accordance with the recorded designations of wanted lines, the controlling mechanism being so arranged that its normal function corresponds to such a recorded designation with means for automatically revising the controlling function of such a mechanism when certain traffic conditions occur.

Another feature of the invention relates to a common controlling mechanism which receives, in a translated form, called line designations, and subsequently controls the operation of selective switches in accordance with the translated record together with means for allowing the first translated record to be nullified and a new translation to be effective when in its controlling operations the common mechanism encounters abnormal traffic conditions.

A further feature of the invention relates to a system in which groups of direct trunks are provided between calling and called offices and other groups of trunks are provided for giving access to a called office by means of an intermediate or tandem office, the arrangement of the circuits being such that when all the first group of trunks are busy, an idle one of the second group of trunks is selected, which trunk is located in a different switch from that in which the first group of trunks is located.

Another feature of the invention relates to telephone systems wherein markers are used, the said markers being adapted to control the operation of selective switches to extend a calling line directly to a called office or by means of an intermediate or tandem office, the arrangement of the markers being such that when all direct paths to a called office are busy, the marker functions automatically to reroute the call through a tandem office.

A still further feature of the invention relates to the means for indicating to a controlling sender whether the calling line is to be extended to a distant office directly or by means of an intermediate office, these class-of-service indications being normally dependent upon the called line designation together with means for automatically changing the original class-of-service indication in the sender when traffic conditions necessitate the extension of the calling line through a tandem office.

Another feature of the invention pertains to a telephone system wherein switches of the coordinate type are employed and wherein a marker or controlling mechanism is adapted to test the condition of the link circuits in a plurality of switches and the condition of the trunks outgoing from these switches prior to the operation of either thereof.

Other features and advantages of the in-

vention will be better understood after reference to the following description and the appended claims.

The accompanying drawings when arranged in the order shown in Fig. 11 illustrate in sufficient detail a preferred form of carrying out the invention.

Fig. 1 illustrates, to the left and above the broken line, one of a number of coordinate line switches in which the subscribers' lines appear. Terminating in certain contacts of this switch are also shown a number of outgoing district trunks. To the right and above the broken line is shown certain controlling equipment associated with one of the district trunks. Below the broken line is shown a sender selector switch also of the coordinate type.

Fig. 2 illustrates a coordinate district selector switch. This figure also shows within the dotted rectangle, a diagrammatic representation of a tandem office with incoming and outgoing trunks.

Fig. 3 shows one of a number of coordinate office selector switches in which trunks, outgoing from the district selector switches, terminate. In this figure is also shown schematically a distant called office.

Fig. 4 shows in diagrammatic form, a subscriber's register and controlling sender, and a device for connecting said sender to a common controlling mechanism or marker. This figure also illustrates schematically the mechanism for transmitting characteristic impulses over the outgoing trunks to control automatic switches at distant offices.

Fig. 5 to the left of the broken line illustrates one of a number of district frame connectors for connecting the test and operating conductors of the district switches to the testing mechanism in the marker. To the right of the broken line is shown a district trunk connector for allowing the marker to test the condition of the trunks outgoing from the district selector switches.

Fig. 6 shows an office frame connector and an office trunk connector, which in connection with office selector switches, function similarly to the connectors shown in Fig. 5.

Figs. 7, 8 and 9, when taken together, disclose one of a number of markers or common controlling mechanisms which are associable with any calling line.

Fig. 10 is a schematic layout of a system embodying the features of the invention and to which reference will be made in the following general description.

General description.

The line switch 100, sender selector switch 150, district selector switch 200 and office selector switch 300 are all of the coordinate type, such as disclosed in the U. S. patent to C. L. Goodrum and J. N. Reynolds, No. 1,515,735, issued Nov. 18, 1924, and also in the patent to S. B. Williams Jr., No. 1,517,331, issued December 2, 1924. These switches consist, in the main, of a plurality of operating bars and a plurality of horizontal conducting links, the selective operation being determined by the conjoint operation of a particular vertical bar and an operating member associated with a particular horizontal link.

Referring to Fig. 10, it will be seen that the subscribers' lines such as 1001 have an appearance in the vertical rows of contacts of a line switch such as 1003. The selective operation of a line switch in response to the initiation of a call on a subscriber's line automatically connects the said line to an idle one of the district trunks 1002 which terminate in contacts of district selector switches, as 1015. At the same time that the calling line is extended to the district selector switch, the operation of a sender selector switch as 1005 is initiated. The switch 1005 in its selective operation associates an idle one of the register senders 1006 with the calling line. The sender receives and records the designation of the wanted line as dialed by the calling subscriber. When the code or office portion has been thus recorded, connecting device 1009 is operated to connect the register sender with an idle marker or controlling mechanism 1010. The latter operation takes place in such a manner as to preclude more than one sender being connected to the same marker. Immediately that the connector device 1009 is operated, the office portion of the recorded designation is transferred from the sender 1006 to the marker.

Each of the district frame connectors, as 1011, is related to a particular vertical row of contacts in the sender selector switch 1005. Therefore, the operation of a vertical magnet in the switch 1005 at the same time serves to identify the particular district frame in which the extended calling line appears, and also causes the operation of the corresponding district frame connector. With frame connector 1011 operated, the group of testing and operating conductors 1032 and 1033 are extended to the testing equipment located in the marker 1010 for the purpose of determining and selecting an idle horizontal link.

The office designation as recorded in the marker is translated therein in such a manner as to cause the operation of an office trunk group relay which identifies the desired office trunk group. The operation of this office trunk group relay in turn controls the operation of a corresponding district trunk group relay. Thus the office code portion of a called line designation serves to locate the selected group of trunks in the district and office switches. With the proper district trunk group relay operated,

a circuit is closed to operate the proper one of the district trunk connectors 1012. The frame and trunk connectors 1011 and 1012 now cooperate to actuate a particular vertical magnet in the district selector switch 1015 which magnet is associated with the desired group of trunks outgoing from switch 1015.

At this point, it should be observed that the trunks leading from the district selector switch are arranged in a number of groups, such as group 1016 and group 1017. The group of trunks 1016, it will be further observed, lead to an office selector switch 1060 whereas the group of trunks 1017 lead to the tandem office 1050 which is shown schematically.

It is clear, therefore, that the translation in the marker of the office code determines the particular group of trunks, whether tandem or direct, over which the calling line will be extended. Assume for a moment that the call is of such a nature as to necessitate the use of trunk group 1016. The operation of the district trunk group relay as a result of translation in the marker determines the operation of the proper one of the vertical magnets associated with this desired group of trunks leading from the district selector switch. At this time also the sleeve conductors of this group of trunks are connected by means of the trunk connector 1012 to the testing equipment in the marker 1010. Also the operation of the office trunk group relay causes the operation of the proper office frame and trunk connectors as 1013 and 1014. The frame connector 1013 functions to connect the office testing equipment in the marker to the horizontal links in the switch 1060 and the trunk connector 1014 functions to connect the test conductors of the selected group of office trunks to the testing equipment.

The testing mechanism is of such a nature that a simultaneous test is made both of the links and the outgoing trunks, in both the district and office switches, and neither the switch 1015 nor switch 1060 is operated until idle paths through and from said switches have been found. Should, however, there be no available cross-points in the district switch, a signal is transmitted to the sender 1006 and a characteristic busy tone transmitted back to the calling subscriber. Should, however, an available cross-point be located in the district switch, as well as an idle trunk outgoing from the office switch, circuits are closed to operate the proper horizontal connecting magnets in both of these switches, thus extending the calling line through contacts of the line switch 1003, district switch 1015, office switch 1060 to a trunk in group 1018 which leads to the desired office.

Returning to the point where the test conductors of the trunks outgoing from the office switch were connected by means of trunk connector 1014 to the marker testing equipment, should all the trunks in the selected group 1018 be busy, notification will be sent to the marker which will cause the release of the operated translator mechanism, testing mechanism and the district trunk group relay. At the same time a transfer relay will be operated in the marker which will automatically function to operate another district trunk group relay which is associated with a group of trunks as 1017 leading to a tandem office. The operation of this second trunk group relay will cause the operation of the corresponding vertical magnet of the district selector switch. When an idle one of the trunks leading to the tandem office is located, the calling line is extended through contacts of the district switch to a tandem trunk in group 1017, and thence to a tandem office shown schematicaly at 1050. The impulsing mechanism 1008 is now connected through contacts of switch 1005 to the trunk 1002 for the purpose of controlling selection through the switches in the tandem office 1050. For the manner in which these impulses are transmitted to perform the above operation, reference may be had to the patent to S. B. Williams and E. S. Gibson, No. 1,543,967, issued June 30, 1925. The numerical portion of the designation as recorded in sender 1006 is now transferred in the manner described in the above mentioned application to the register and controlling sender 1026 located in the tandem office, which functions to selectively operate the incoming switch 1024 to select an idle trunk, such as 1030 leading to the desired office 1080. From the above description, it will be seen that a test is made of the trunks outgoing from the district and office selector switches, the operation of these two switches being contingent upon the finding of an idle trunk giving access to the called office. In the event that such a trunk is not found the recording mechanism in the marker is released and a new record automatically set up so as to give the calling line access to a tandem trunk which leads directly from contacts of the district selector switch.

Detailed description.

For the purpose of better illustrating the use of the invention, let it be assumed that the subscriber at station 101 desires to communicate with another subscriber whose line terminates in a different office, such as shown diagrammatically at 350 to which a number of direct trunks 360, 361, etc., lead. The removal of the receiver by the calling subscriber causes the line switch 100 to operate to extend the line 102 to an idle trunk such as 103. When the calling line has been so extended the sender selector

switch 150 is also caused to operate to associate an idle sender 400 with the calling line. When a sender has been thus associated, relays 104 and 401 operate to ground at the armature of sender selector control relay 105. Relay 105 subsequently releases but relays 104 and 401 remain locked to the sender control ground 402. Relay 104 in operating transfers the tip and ring conductors of the calling line from the outgoing trunk to the windings of impulse relay 403 and retardation coil 404. The circuit is now in readiness to receive impulses transmitted by the calling subscriber's dial. Relay 403 follows the impulses and causes them to be recorded on the registers 440. When the code or office portion of the called line designation has been transmitted and recorded on the registers, the connecting device 450 is operated to connect the sender with an idle outgoing marker, such as shown in Figs. 7, 8 and 9, whereupon the record of the office code is transferred from the sender registers 440 to the marker registers 700.

For a detailed description of the manner in which the above operations take place, reference may be had to the application of W. W. Carpenter, Serial No. 703,362, filed April 1, 1924.

When the sender connector 450 operates, the marker start relay 405 is actuated and connects battery through its armature and contact, contacts of connector 450, conductor 430, to battery through the winding of marker ground control relay 701. When the connector 450 operated, circuits were also closed as described in the above mentioned application, Serial No. 703,362, filed April 1, 1924, to operate all the recording relays 700. Certain of these recording relays operate over circuits traceable through front contacts to the operated register relays in the register set 440, while the remainder of the relays 700 operate in circuits traceable through normal contacts of the unoperated sender register relays. When all the relays 700 have been operated, a circuit is completed from ground at the upper armature and contact of relay 710, upper armature and contact of the remaining recording relays in series to battery through the winding of relay 702. Relay 702 operates and completes an obvious circuit for relay 703. When relay 703 operates it closes a circuit for relay 704 traceable from battery, through the winding of the said relay, left armature and front contact of relay 703, left armature and back contact of relay 705, right armature and back contact of relay 706 to ground at the right armature of relay 701. The operation of relay 703 also causes the release of those recording relays 700 which were operated through normal contacts of sender register relays so that only those recording relays remain operated which correspond to the operated sender register relays. The manner in which the former relays release is described in detail in the application, Serial No. 703,362, filed April 1, 1924, hereinbefore referred to. It will be apparent from an inspection of the drawing that the registers 720, 721 and 722 correspond respectively to the first, second and third digits of the office code. Assume for the purpose of this description that the record on the sender registers 440 has caused the marker recording relays 711, 712 and 723 to remain operated. The translator 750 is now operated in such a manner as to cause the actuation of a particular one of the office trunk group relays as 901, 902, etc. The particular combination of operated and unoperated relays in registers 720 will determine the operation of the proper one of the multi-contact relays 707, 708, etc. In a similar way, the register 721 determines which one of the relays 709, 714, etc., will be operated. Each of the ten relays 709, 714, etc., carries ten contact sets, but for the purpose of economy in the drawing a fewer number of these relays and a fewer number of their contact sets are shown. Finally, the register 722 determines which one of the operated contact sets will be effective in operating the proper office trunk group relay.

When the first digit of the office designation has been transferred to register 720, a circuit is closed from the grounded conductor 740, armature and front contact of relay 704, lower inner armature and contact of relay 715, lower inner armature and front contact of relay 711 to battery through the winding of relay 707. The transfer of the record to register 721 causes the operation of relay 714 in a circuit which may be traced from battery through the winding of the said relay, lower inner armature and back contact of relay 716, lower inner armature and front contact of relay 712, lower inner armatures and back contacts of relays 717 and 718 to ground as above traced. The record on register 722 extends the same ground through the lower inner armature and contact of relay 724, lower inner armature and front contact of relay 723, upper outer armature and contact of relay 714, contact of relay 707, and thence by means of connecting block 760 and conductor 857 to battery through the winding of office trunk group relay 901. Relay 901 operates and closes a circuit from ground through its right inner armature and contact, conductor 960, contacts of sender connector 450, to battery through the winding of the class relay 406. Relay 406 operates and serves as an indication to the sender that this particular call is to be extended directly to a distant office.

Each of the relays 410 and 411 relates to a particular district frame such as 200. Since the extended calling line appears in district switch 200, it will be necessary to operate relay 411 associated therewith. Furthermore, each of the vertical rows of contacts in the sender selector switch 150 is also related to a particular group of trunks terminating in the several district selector switches. Since vertical magnet 160 was operated as a result of the seizure of trunk 103, a circuit is closed from ground at the lower inner armature and contact of magnet 160, conductor 460, winding of relay 408 to battery. Relay 408 closes a circuit through the contacts of connector 450, to battery through the winding of relay 411 which operates. Since the district selector frame is now identified a circuit is completed to operate frame connector 500 so as to connect the group of conductors 250 to the district test equipment 800 located in the marker. Accordingly, a circuit is completed from ground at the left armature and back contact of relay 501, left winding of relay 502, conductor 451, armature and contact of relay 411, left armature and contact of relay 725, left armature and contact of relay 701, conductor 430, contacts of connector 450, to battery at the armature and contact of relay 405. Relay 502 locks through its right hand winding in series with the winding of relay 501 which operates, thus preventing more than one district frame being simultaneously associated with this marker. Relay 501 also extends ground through its left armature and front contact, left inner armature and front contact of relay 502 to battery through the winding of relay 509. Relays 502 and 501 close an obvious circuit for the multi-contact relay 516 which is individual to the particular marker shown.

A circuit to operate district trunk vertical magnet 201, is now closed from battery through the winding of said magnet, conductor 256, lower armature and front contact of relay 104, conductor 151, contacts of sender selector 150, conductor 453, contacts of connector 450, conductor 452, left armature and contact of relay 801, conductor 850, to ground through the left inner armature and contact of relay 502. Magnet 201 prepares the vertical row of contacts 210 and extends the above traced ground through its lower armature and front contact, conductor 251, to battery through the winding of multi-contact relay 516. An obvious circuit is now completed for operating relay 504 which is individual to the group of trunks which includes trunk 103 and which terminate in district switch 200. The operation of relay 504 completes a circuit for the particular one of the district trunk group relays 506, 507, etc., whose circuit has been partially completed by the operation of the office trunk relay 901. The circuit for this purpose may be traced from battery at the armature and contact of relay 504, winding of relay 508, conductor 551 to ground at the right outer armature and contact of relay 901. Relay 508 completes a circuit from ground through its right outer armature and contact, conductor 556 to battery through the winding of relay 802 which operates for purposes hereinafter described. With relay 508 operated, a circuit is also completed for actuating the district trunk connector 550 in such a way as to connect the test conductors of the selected group of district trunks to the marker testing mechanism. Accordingly, relay 511 operates in a circuit traceable from ground at the armature and back contact of relay 512, right winding of relay 511, next to innermost right contact and armature of relay 508 to battery at the armature and contact of relay 509. Relay 511 locks through its left winding in series with relay 512 which operates. An obvious operating circuit is now closed for the multi-contact relay 513 which is individual to the marker shown. Another circuit is completed for multi-contact relay 510 which is individual to the group of selected district trunks. The circuit for this purpose may be traced from battery through the winding of relay 510, innermost armature and contact of relay 508, right inner armature and contact of relay 511 to ground at the armature and contact of relay 512. A circuit is now completed for the vertical magnet 214 associated with this group of trunks. This circuit may be traced from battery through the winding of magnet 214, conductor 254, left armature and contact of relay 508, conductor 557, right armature and contact of relay 805, conductor 854, to ground through the contacts of relays 513 and 510. Relay 801 also operates in a circuit traceable from battery through its winding, conductor 855, contacts of frame connector 500, conductor 257 to ground at the lower armature and contact of magnet 214. The operation of relay 801 opens the original operating circuit of vertical magnet 201, but this magnet remains locked to grounded conductor 251.

With frame connector 500 and trunk connector 550 operated, the test conductor of the horizontal links in switch 200 as well as the test conductors of the group of trunks which includes trunks 252 and 253 are now extended to the district testing mechanism 800.

It will be observed that each of the test relays 810, 811, 812, etc., has its left winding connected through contacts of frame connector 500 to the several horizontal links in the switch 200. Similarly, the right hand windings of these test relays are connected by means of trunk connector 550 to the test

conductors of the selected group of district trunks. Should either a trunk or a link be busy, the test relay connected thereto will be operated, thus providing a test of all available cross points in switch 200. It will be further observed that provision is made by means of the connecting blocks 552, 553, etc., for rendering effective certain portions of the testing relays in accordance with the maximum number of the trunks in the group to be tested. For example, assume that trunk 253 is the first trunk in this group then by means of the block 553 the test conductor is connected to the right winding of relay 811. Assume trunk 252 to be the last trunk in this group then its test conductor is connected to the winding of relay 810. In a similar manner, other trunks in this group will be connected to corresponding relays. Should all available cross points in switch 200 be busy, then a circuit is closed from battery through the winding of relay 814, conductor 851, contacts of relays 513 and 510, loop 555, returning through contacts of relays 510 and 513, conductor 558, right outer armature and front contact of relay 810, right outer armature and front contact of relay 811, conductor 856, contacts of relays 513 and 510, loop 559 returning through contacts of relays 510 and 513, conductor 561, right outer armature and contact of relay 801, left outer armature and contact of relay 805, to the grounded conductor 753. Relay 814 operates and connects ground through its right outer armature and contact to conductor 816 which may serve as an indication to the sender that all paths through this district switch are busy, and in the manner described in the patent to S. B. Williams, Jr., No. 1,517,331, issued December 2, 1924, a tone is sent back to the calling subscriber as a busy indication.

Assuming, however, that trunk 252 and link 211 are both idle, a circuit is completed to operate relay 817 associated with this idle cross point. This circuit may be traced from battery through the winding of relay 817, right outer armature and back contact of relay 810, right outer armature and front contact of relay 811, conductor 856, contacts of relays 513 and 510, loop 559, returning through contacts of relays 510 and 513, conductor 561, to ground as above traced. With relay 817 operated a circuit is prepared from battery, through the right winding of magnet 215, conductor 258, contacts of connector 500, conductor 562, left outer armature and contact of relay 817 to the right inner armature of relay 802. However, relay 802 being operated, prevents the operation of magnet 215 until a test has been made of the links and trunks in the office switch 300.

When trunk connector 550 operated, a circuit was completed from battery through the characteristic resistance 310, sleeve conductor of trunk 252, conductor 255, contacts of relays 510 and 513, conductor 852, right armature and front contact of relay 817, left armature and front contact of relay 802, conductor 853, lower armature and back contact of relay 903, winding of marginal relay 904, to ground through the winding of relay 905. Assuming that resistance 310 is of such a value as to permit the operation of relays 904 and 905, it will be seen then that the combination of marginal relay 904 and resistance 310 provides a means for identifying the office frame to which the calling line is to be extended. It will be remembered that the selected group of trunks which includes trunk 252 was identified by the operation of district group relay 508. In a similar way the location of this group of trunks is identified by the operation of relay 601. Relay 601 operated at substantially the same time that relay 508 operated over an obvious circuit. Relay 601 now closes a circuit to operate relay 602 which is individual to the switch 300. The circuit for this purpose may be traced from battery through the winding of relay 602, left inner armature and contact of relay 601, conductor 657, left armature and front contact of relay 904 to ground at the armature and contact of relay 905. Relay 602 locks through its winding and locking contact, conductor 651, left armature and back contact of relay 705, right armature and back contact of relay 706, to ground at the armature and contact of relay 701. Relay 602 connects battery through its left inner armature and contact, left winding of relay 603, to ground at the armature and contact of relay 604. Relay 603 locks in series with relay 604 which operates. Relay 603 closes a circuit for the multi-contact relay 605 traceable from battery through the winding of the latter relay, left inner armature and contact of relay 603, conductor 656, armature and back contact of relay 906 to the grounded conductor 753. Relay 603 in conjunction with office frame relay 602 also completes a circuit for multi-contact relay 606. This circuit may be traced from battery through the winding of relay 606, left outer armature and contact of relay 602, left inner armature and contact of relay 603 to ground over conductor 656, as above traced. A circuit is now completed from ground at the armature and back contact of relay 608, right winding of relay 609, conductor 653, left armature and contact of relay 901, conductor 963, right outer armature and contact of relay 603 to battery at the left inner armature of relay 602. Relay 609 operates in this last traced circuit and locks through its left winding in series with the winding of relay 608, which operates. An obvious circuit is now completed for the

multi-contact relay 607, at the same time a circuit is completed for operating the multi-contact relay 610 which is associated with the group of trunks which includes trunks 360, 361, etc. The circuit for operating relay 610 is traced from battery through its winding, conductor 658, left armature and contact of relay 901, conductor 669, right inner armature and contact of relay 609 to ground at the armature and front contact of relay 608.

A circuit is now completed for vertical magnet 311 traceable from battery through the winding of said magnet, conductor 351, contacts of connector 650, conductor 659, left outer armature and contact of relay 901, conductor 961, to ground through the contacts of relays 607 and 610. Magnet 311 prepares the vertical row of contacts 312 and extends ground through the lower armature and contact, conductor 314 contacts of connector 650, conductor 962, to battery through the winding of relay 903. Relay 903 operates and opens the circuits of relays 904 and 905.

With connectors 650 and 655 operated, the test conductors of the links and trunks outgoing from switch 300 are connected to the office test mechanism 900. Assuming that trunk 360 is the first of its group and trunk 361 the last, then from an inspection of the drawing it will be seen that the test conductor of trunk 360 is connected to the right hand winding of relay 907 and the test conductor of trunk 361 is connected to the right hand winding of relay 909. In a similar manner, test conductors of other trunks in the group are connected to the right hand windings of corresponding test relays. Assuming for the present that trunk 361 and the link 320 are both idle then relay 909 associated therewith is normal, and a circuit is completed from battery through the winding of relay 910, right outer armature and back contacts of relay 909, right outer armatures and front contacts of preceding test relays, conductor 964, contacts of relays 607 and 610, loop 611, returning through contacts of relays 610 and 607, conductor 662, upper outer armature and contact of relay 903, armature and back contact of relay 906 to the grounded conductor 753.

An idle trunk having been found outgoing from switch 300, a circuit is now closed for operating horizontal magnet 215 in the district switch 200. This circuit may be traced from battery, through the right hand winding of magnet 215, conductor 258, contacts of relays 503 and 516, conductor 562, left outer armature and front contact of relay 817, right inner armature and front contact of relay 802, conductor 858, right inner armature and contact of relay 910 to the grounded conductor 753. Magnet 215 operates and completes the connection of trunk 103 with trunk 252 by means of link 211. A circuit is now completed for operating vertical magnet 315 traceable from battery through the winding of said magnet, left armature and back contact of relay 317, tip conductor of trunk 252, contacts of switch 200, tip conductor of trunk 103, conductor 151, contacts of switch 150, conductor 453, contacts of connector 450, conductor 452, left outer armature and contact of relay 603 to ground at the armature and contact of relay 604. This same ground is extended through the lower inner armature and contact of magnet 315, conductor 318, contacts of connector 650, conductor 663, upper inner armature and contact of relay 903, left outer armature and contact of relay 910, conductor 965, contacts of connector 650, conductor 354 to battery, through the right hand winding of magnet 316. A circuit is now closed from battery, through both windings of magnet 316 in series, contact of switch 300, sleeve conductor of the trunk, left winding of relay 317 to the sleeve of trunk 252 which is grounded in the manner described in the above mentioned application of W. W. Carpenter, Serial No. 703,362, filed April 1, 1924. Relay 317 does not operate at this time, however, since its operating winding is shunted by the ground above traced for operating magnet 316. The operation of magnet 316 completes the connection through the switch 300.

When horizontal magnet 215 operated, a circuit was completed from battery, through the winding of relay 906, right outer armature and front contact of relay 910, conductor 966, contacts of connector 655 to the grounded sleeve conductor of trunk 361. Relay 906 operates and initiates the release of the several frame connectors and the discharge of the marker. When relay 906 operates, it extends the grounded conductor 753 through its armature and front contact, conductor 815, armature and back contact of relay 719, contacts of connector 450 to battery, through the winding of sender release relay 414. In the manner described in the above mentioned application of W. W. Carpenter, Serial No. 703,362, filed April 1, 1924, relay 414 causes the release of sender connector 450 and the release of the operated translator relays 700. The release of the translator relays in turn causes the release of office trunk group relay 901 and district trunk relay 508. It will be remembered that when trunk vertical magnet 311 operated, it closed a circuit for actuating relay 903. Relay 903 in turn opened the energizing circuit of slow release relay 904 which began to release. The release period of relay 904 is of sufficient length to permit the testing and operation of the district and office horizontal magnets. When district trunk group relay 508 released, it in

turn released relay 802. The release of relay 802 now completes a circuit from battery through the winding of relay 808, left inner armature and back contact of relay 802, right armature and front contact of relay 817, conductor 852, contacts of connector 550 to the grounded sleeve conductor of trunk 252. When trunk group relay 508 released, it also caused the discharge of trunk connector 550; and when relay 602 releases as a result of the release of relay 904 the office frame and trunk connectors 650 and 655 are also released.

As soon as horizontal magnet 215 operated, the function of the marker in controlling selection through the office and district frames was finished and a circuit completed from battery through the winding of relay 725, lower inner armature and front contact of relay 903, conductor 853, left inner armature and front contact of relay 802, right armature and front contact of relay 817, conductor 852 and thence to the grounded sleeve conductor of trunk 252. Relay 725 operates and opens the locking circuit for ground control relay 701 which releases, in turn causing release of the district frame connector 500. The release of the several frame and trunk connectors in turn causes the release of the operated vertical magnets, connection through the office and district switches being maintained by the continued energization of horizontal magnets 316 and 215 respectively. When office frame connector 650 releases, the shunt is removed from the winding of relay 317 which operates in series with both windings of magnet 316. The operation of relay 317 completes the circuit of the tip conductor of trunk 252. The marker is now discharged and made accessible to other calling lines.

The local district trunk 103 is now connected to the outgoing trunk 361 which leads to the desired office, and when the complete numerical designation has been recorded on the registers 440, the sender having previously been notified of the character of this particular call, the impulsing mechanism 420 functions to send characteristic impulses over the tip and ring conductors of the outgoing trunk to control the operation of the selective switches at the distant office. For the manner in which the sender adjusts itself upon the receipt of the class designation and for the manner in which the said impulses are transmitted, reference may be had to the patent to S. B. Williams and E. S. Gibson, Patent No. 1,543,967, issued June 30, 1925. When the sender has completed the above functions, switch 150 is released, causing in turn the release of the sender. The release of the sender also causes the release of relay 104 and the calling line 102 is now extended through contacts of switches 100, 200, 300, and switches at the distant office to the desired called line.

Normal tandem operation.

Should the line of the subscriber with whom the subscriber at station 101 desires to converse be located in a distant office to which no direct trunks lead from the calling subscriber's office, then it becomes necessary to extend the calling line by means of a trunk, such as 261, 262, etc., leading to a tandem office such as 260, and thence by means of a trunk 267 to the desired called office.

The operation in such a case is similar to that already described as far as the point where an office trunk group relay is to be operated. From an inspection of Fig. 2, it will be seen that a certain group of trunks including trunks 261, 262, etc., lead to the tandem office 260. Consequently, it will be necessary, in order to gain access to one of these trunks to operate vertical magnet 216.

Assuming that as a result of the calling subscriber's manipulation of his dial, the transfer of the record from the sender registers 440 to the marker register 700 results in the operation of relays 710, 716, and 723. Accordingly, in the manner already described, multi-contact relay 727 operates as well as relay 726. With this combination of translator relays operated, marker ground is extended through the contact of relay 704, lower inner armature and contact of relay 724, lower inner armature and front contact of relay 723, armature and contact of relay 726, contact of relay 727, cross connecting block 760, conductor 755 to battery, through the winding of tandem trunk group relay 806. The operation of relay 806 connects ground through its inner armature and contact, conductor 455, contacts of connector 450 to battery through the winding of tandem class relay 415. The operation of relay 415 serves as a class of call indication to the sender. In addition, relay 806 extends ground through its outer armature to conductor 859, winding of group relay 507, to battery at the armature and contact of relay 504. Relay 507 identifies the group of trunks outgoing from district switch 200 to the tandem office 260. Relay 507 also causes the actuation of connector 550 by operating relays 513 and 515. The operation of the district frame and trunk connectors and the testing of the several trunks 261, 262, etc., is accomplished in the manner already described. In this case, however, there being no office selection required, neither the office frame nor the office trunk connector is operated. When an idle one of these tandem trunks is located, the corresponding horizontal magnet is actuated and the local district trunk 103 is

extended through contacts of switch 200 to the tandem office. Assuming that the extension of the calling line has been completed through link 266, a circuit is thereupon completed from battery, through the winding of relay 808, left inner armature and back contact of relay 802, right armature and front contact of relay 809, conductor 861, contacts of relays 513 and 515 to the grounded sleeve conductor of trunk 263. Relay 808 locks to the groundsd conductor 753. The operation of relay 808 also closes a circuit from the grounded conductor 753, right armature and contact of relay 808 to battery, through the winding of relay 805. Relay 805 at its left outer armature and back contact breaks the holding circuit for the operated test relays 800 which now release. Relay 805 at its right armature and back contact also opens the energizing circuit of vertical magnet 216 which releases. When relay 808 operated, it also extended the grounded conductor 753 through its left outer armature and front contact, left outer armature and back contact of relay 802, conductor 815, armature and back contact of relay 719, contacts of connector 450 to battery, through the winding of sender release relay 414. In the manner before mentioned, relay 414 causes the release of sender connector 450 and the operated relays in the marker. The release of the marker relays causes the discharge of connectors 500 and 550 which in turn causes the release of vertical magnet 201 as already described.

The sender having previously received a class of service indication now functions to retransmit sets of impulses to control the operation of the incoming selector switch at the tandem office. The operation of this latter switch causes the selection of an idle trunk, such as 267 which gives access to the called office 350. Inasmuch as the manner of controlling the switches at the tandem office to select such a trunk is not a feature of this invention, a detailed description thereof is not deemed necessary.

Automatic rerouting through tandem office.

It will be remembered in connection with the first detailed description that a test was made both of the trunks outgoing from the switch 200 as well the trunks outgoing from switch 300 prior to the operation of either of the switches. Returning, then, to the point where the sleeve conductors of the links and trunks in switch 300 were connected to the test relays 900, let it be assumed that all cross points giving access to the group of trunks including trunks 360, 361, etc., are busy. Accordingly, the test relays 907, 908, etc., are operated and a circuit is closed from battery through the winding of tandem transfer relay 911, left inner armature and front contact of relay 901, conductor 968, contacts of relays 607 and 610, loop 664, returning through contacts of relays 610 and 607, conductor 665, right outer armatures and front contacts of all the operated test relays, conductor 964, contacts of relays 607 and 610, loop 611, returning through contacts of relays 610 and 607, conductor 662, upper outer armature and contact of relay 903, upper armature and back contact of relay 906 to the grounded conductor 753. Relay 911 operates and immediately closes a locking circuit through its winding and locking contact to the above traced ground. At this time, a circuit is also completed from battery, through the winding of relay 807, conductor 862, lower intermediate front contact and armature of relay 911 to ground as above traced. Relay 807 operates and connects ground through its inner armature and contact, conductor 455 to operate tandem class relay 415 which serves as an indication to the sender that the existing call requires extension through a tandem office as previously described. It will be observed that relay 807 functions similarly to the normal tandem trunk group relay 806 causing the operation of relay 507. Consequently, the operation of relay 807 identifies the particular group of trunks outgoing from the switch 200 and leading to tandem office 260.

Should the called line be located in a distant office other than office 350, then, when a busy condition is encountered on all trunks leading to this office, a corresponding transfer relay 912 will be operated, in turn causing the operation of a relay such as 819 which performs a function similar to relay 807. In this case, the operation of relay 819 will result in the identification and selection of a different group of tandem trunks which lead to a second tandem office.

The operation of transfer relay 911 also completed a circuit from battery, through the winding of relay 805, right outer armature and contact of relay 802, conductor 863, lower outer armature and contact of relay 911, armature and back contact of relay 906 to the grounded conductor 753. Relay 805 at its right armature and contact opens the circuit of vertical magnet 214 which releases, in turn releasing relay 801. At the left outer armature and back contact of relay 805, the holding circuit for the operated test relays 811, 812, etc., is broken and these relays now release. Relay 805 as described under normal tandem operation causes release relay 414 to operate with the consequent release of the connector 450, and the release of translator 750.

When transfer relay 911 operated, it extended round through its lower inner armature and front contact, conductor 969 to battery through the winding of relay 705. Re-

lay 705 in operating removes ground from conductor 740 which causes the release of the office trunk group relay 901. Relay 901 in turn causes the release of district trunk group relay 508. Relay 508 opens the locking circuit of relays 511 and 512 which release and in turn cause the release of trunk connector 550. The release of the office trunk group relay 901 also caused the release of the office class relay 406 in the sender. Relay 911 also brings about the release of office frame and trunk connectors 650 and 655, together with the operated test relays 907, 908, etc., and trunk vertical magnet 311. Thus, the operation of transfer relay 911 as a result of all paths being busy at the office switch resulted in the release of the district trunk connector, office trunk connector, office frame connector, and the disconnection of the marker testing mechanism from the district and office switches. However, the marker is not released as yet since connector 450 is still operated, consequently vertical magnet 201 and frame connector 500 remain in their operated condition.

When the district trunk vertical magnet 214 released, it caused the release of relay 801 which in turn opened the locking circuit of slow relay 805 which began to release. A circuit is now completed to operate the particular district trunk connector associated with the newly selected group of tandem trunks which correspond to group relay 507. Accordingly, the trunk connector start relay 511 is operated from ground at the armature and back contact of relay 512, right hand winding of relay 511, right outer armature and contact of relay 507 to battery at the armature and contact of relay 509. Relay 511 locks in series with relay 512 which operates. Thereupon, a circuit is completed for the actuation of multi-contact relay 513, and a circuit is also completed for multi-contact relay 515, traceable from battery through the winding of relay 515, right inner armature and contact of relay 507 to ground at the armature and contact of relay 512. With the relays 513 and 515 operated, the test conductors of the selected group of tandem trunks are connected to the testing mechanism 800. When relay 805 retracts its armatures as a result of the release of vertical magnet 214, a circuit is closed from battery through the winding of vertical magnet 216, conductor 259, contacts of connector 500, left armature and front contact of relay 507, conductor 557, right armature and contact of relay 805, conductor 854, to ground, through the contacts of relays 513 and 515. With the test conductors of the trunks 261, 262, etc., and the test conductors of links 264 and 265, etc., connected to the testing equipment 800, a test is made in the manner already described and the horizontal magnet corresponding to the first idle cross point is energized and the trunk 103 extended to the selected idle trunk.

Assuming link 266 and trunk 263 to be idle, then horizontal magnet 217 is operated and a circuit is completed from the grounded sleeve conductor of trunk 263, contacts of relays 515, 513 and 517, right armature and front contact of relay 809, left inner armature and back contact of relay 802 to battery through the winding of relay 808. Relay 808 immediately closes a locking circuit through its winding and locking contact to the grounded conductor 753. In a manner already described, relay 808 closes an operating circuit for relay 805. The operation of relays 805 and 808 causes the operation of sender release relay 414 which, as already described, brings about the release of the sender connector 450 and the subsequent release of the marker. The sender is not released at this time, however, and since it had received a tandem class indication, it is now in readiness to transmit series of impulses by means of the impulse mechanism 420 over trunks 103 and 263 to the tandem office 260 where the selective switches are operated in such a manner as to select an idle trunk as 265 leading to the called office 350. For the manner in which the sender adjusts itself upon the reception of the class indication to transmit these impulses, and the manner in which the record may further be sent to the final office to cause the selection of the wanted line therein, reference may be had to the above mentioned patent to S. B. Williams and E. S. Gibson, No. 1,543,967, issued June 30, 1925.

While in the foregoing description, it has been chosen to illustrate the invention as applied to an all trunks busy condition at the office switch 300, it is to be understood that the invention is not to be limited in this regard. The invention might equally well be applied to meet similar conditions existent at the district switch 200 or any other switch which is controlled in its selective operation by a marker controlling mechanism.

For details of operation referred to herein and not particularly illustrated reference is made to the above mentioned patents to S. B. Wiliams, No. 1,517,331, December 2, 1924 and S. B. Williams and E. S. Gibson, No. 1,543,967, June 30, 1925, and W. W. Carpenter, Serial No. 703,362, filed April 1, 1924.

What is claimed is:

1. In a telephone exchange system, calling lines, called lines, selective switches for extending a calling line to one of said called lines, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for recording the designation of

a called line, means operable in accordance with said recorded designation for causing said selective switches to operate to extend the calling line, means for nullifying a portion of said recorded designation and for causing one of said switches to extend said calling line towards said called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said recorded designation.

2. In a telephone exchange system, a calling line, a called line, a first office in which said calling line terminates, a second office in which said called line terminates, a plurality of trunks directly connecting said first and second offices, a plurality of selective switches for extending said calling line to said called line, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for recording the designation of a called line, means operable in accordance with said recorded designation for causing said selective switches to operate to extend the calling line, means dependent upon the condition of said plurality of trunks for nullifying a portion of said recorded designation and for causing one of said switches to extend said calling line towards said called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said recorded designation.

3. In a telephone exchange system, a calling line, a called line, a first office in which said calling line terminates, a second office in which said called line terminates, a plurality of trunks directly connecting said first and second offices, a plurality of selective switches for extending said calling line to said called line, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for recording a portion of the designation of a called line, means in said mechanism for testing the condition of said plurality of trunks, means dependent upon the condition of said testing means for rendering said recorded designation ineffective and for causing one of said switches to extend said calling line towards said called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said recorded designation.

4. In a telephone exchange system, a calling line, a called line, a first office in which said calling line appears, a second office in which said called line appears, a plurality of selective switches for extending said calling to said called line, a first set of trunks for interconnecting certain of the selective switches of the first office, a second set of trunks for interconnecting the selective switches of the first and second offices, a mechanism in said first office accessible in common to a plurality of calling lines for controlling the operation of the selective switches in said first office, means in said mechanism for recording the designation of said called line and for testing the condition of said plurality of sets of trunks, means operable in accordance with said recorded designation for directively operating a plurality of selective switches in said first office, means dependent upon the condition of said second set of trunks for revising said recorded designation to thereby cause one of said switches to extend said calling line towards said called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said recorded designation.

5. In a telephone exchange system, calling lines, called lines, selective switches for extending a calling line to one of said called lines, a register sender for recording the complete designation of wanted lines, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for receiving a portion of a recorded designation, means in said mechanism for translating said portion of said recorded designation, means operable in accordance with said translated record for causing a plurality of said switches to operate to extend the calling line, means effective prior to the operation of said switches for nullifying said translated record and for automatically setting up a new translation to cause one of said switches to extend the calling line towards the called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said complete designation.

6. In a telephone exchange system, a calling line, a called line, a first office in which said calling line terminates, a second office in which said called line terminates, a plurality of trunks for directly connecting said first and second offices, a plurality of selective switches for extending said calling line, a register sender for recording the complete designation of said called line, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for translating a portion of said recorded designation, means in said mechanism for testing the busy or idle condition of said plurality of trunks, means under control of the trans-

lated record for causing a plurality of selective switches to operate to extend the calling line, means under control of said testing means for nullifying said translated record and for automatically setting up a new translation to thereby cause one of said switches to partially extend the calling line independently of the designation of said called line, and means for completing the extension of said calling line in accordance with said complete designation.

7. In a telephone exchange system, a calling line, a called line, a first office in which said calling line appears, a second office in which said called line appears, a plurality of selective switches for extending said calling line to said called line, a first set of trunks for interconnecting certain of the selective switches of the first office, a second set of trunks for interconnecting the selective switches of the first and second offices, a register sender for recording the complete designation of said called line, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means in said mechanism for receiving and translating a portion of said recorded designation and for testing the condition of said second set of trunks, means under control of the translated record for directively operating a plurality of selective switches in said first office, means dependent upon the condition of said second set of trunks for rendering ineffective said translated record and for causing one of said switches to extend the calling line towards the called line independently of the designation of said called line, and means for completing the extension of said calling line to said called line in accordance with said complete designation.

8. In a telephone exchange system, a calling line, a called office, a first selective switch, a second selective switch, a first group of trunks extending from said first selective switch, a second group of trunks extending between said second switch and said called office, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means under control of said mechanism for selecting a particular trunk in said first group of trunks and for testing the trunks of said second group of trunks, and means effective when all the trunks in said second group are busy for releasing said particular selected trunk and automatically selecting a different trunk in said first group of trunks.

9. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks extending from said first switch, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all trunks in a particular one of said second groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a second trunk in a different one of said first plurality of groups of trunks.

10. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks bearing certain numerical designations and extending from said first switch, each group bearing a different numerical designation, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all the trunks in a particular one of said second mentioned groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a trunk bearing a different numerical designation in another of said first plurality of groups of trunks.

11. In a telephone exchange system, a calling office, a called office, an intermediate office, a plurality of direct talking paths between said calling and said called office, a plurality of indirect talking paths leading from said calling office through said intermediate office to said called office, means at said calling office for making a record of the designation of said called office, means controlled by said record for directively seizing an idle one of said direct talking paths, and means effective when all the direct talking paths are busy for automatically changing said record to cause the seizure of one of said indirect talking paths.

12. In a telephone exchange system, a calling office, a called office, an intermediate office, a plurality of direct talking paths between said calling and said called offices, a plurality of indirect talking paths leading from said calling office through said intermediate office to said called office, recording means at said calling office, means under control of a calling subscriber for making a record on said means of the designation of said called office to directively seize an idle one of said direct talking paths, and means effective when all the direct talking paths are busy for automatically changing said record to cause the seizure of one of said indirect talking paths.

13. In a telephone exchange system, a calling office, a called office, an intermediate office, a plurality of direct talking paths between said calling and said called office, a plurality of indirect talking paths leading from said calling office through said inter-

mediate office to said called office, registering and controlling senders at said calling office, a plurality of selective switches at each of said offices, a switch controlling device at said calling office accessible in common to said senders, means for transferring a record of the designation of said called office from a selected sender to said controlling device to cause the seizure of one of said direct paths, and means effective when all said direct paths are busy for automatically changing the transferred record to cause said device to control the seizure of one of said indirect talking paths.

14. In a telephone exchange system, a calling office, selector switches at said calling office, a called office, an intermediate office, a plurality of trunks leading from a first selector switch to said intermediate office, a plurality of trunks leading from a second selector switch to said called office, a controlling device accessible in common to all of said switches, means in said device for simultaneously testing trunks leading from said first and said second switches without completely operating said switches, means effective when idle trunks exist in both of said switches for causing said device to operate said switches to complete a connection over said idle trunks to said called office, and means effective when all the trunks leading from said second switch are busy for causing said device to operate said first switch to extend the connection from said calling office through said intermediate office to said called office.

15. In a telephone exchange system, a calling office, a called office, an intermediate office, a first selective switch located in the calling office, a plurality of direct talking paths leading from said first selective switch to said called office, a plurality of indirect talking paths leading from said first selective switch through said intermediate office to said called office, means for directively seizing an idle one of said direct talking paths, and means effective when all said direct talking paths are busy at said first selective switch for automatically seizing one of said indirect talking paths at said first selective switch.

16. In a telephone exchange system, a calling office, a called office, trunks extending between said calling and said called offices, a register sender for recording the designations of wanted lines in said called office, a mechanism accessible in common to a number of lines in said calling office for controlling the selection of one of said trunks and for receiving and translating a portion of said recorded designation, means effective upon the translation of said portion of the recorded designation for transmitting to said sender an indication of the class of service, and means rendered effective when all of said trunks are busy for automatically changing the class of service indication in the sender.

17. In a telephone exchange system, a calling office, a called office, an intermediate office, trunks for completing a connection between said calling and said called offices, trunks for completing a connection between said calling and said intermediate office, a register sender for recording the designations of wanted lines in said called office, means for indicating to the sender different classes of service required, means under control of a subscriber in the calling office for directively selecting one of said first mentioned trunks and for indicating to the sender a corresponding class of service, and means effective when all of said first mentioned trunks are busy for automatically selecting an idle one of said second trunks and for automatically indicating to the sender a new class of service required.

18. In a telephone exchange system, a calling office, a called office, an intermediate office, trunks for completing a connection between said calling and said called offices, trunks for completing a connection between said calling and said intermediate offices, a register sender for recording the designations of wanted lines in said called office, a common controlling mechanism in said calling office for controlling the selection of one of said first mentioned trunks, means effective upon the selection of said one of said trunks and under control of said mechanism for transmitting a class of service indication to said sender, and means rendered effective when all of said first mentioned trunks are busy for automatically selecting an idle one of said second trunks and for changing the class of service indication in the sender.

19. In a telephone exhange system, calling lines, a called office, first and second selective switches, each comprising a plurality of link circuits, a plurality of trunks extending between said first and second switches, another plurality of trunks extending between said second switch and said called office, means accessible in common to a plurality of calling lines for testing the condition of links in said first and second switches and for testing the condition of said first and second plurality of trunks prior to the operation of either said first or said second switch.

20. In a telephone exchange system, calling lines, a called office, first and second selective switches, each comprising a plurality of link circuits, a plurality of trunks extending between said first and second switches, another plurality of trunks extending between said second switch and said called offices, means accessible in common

to a plurality of calling lines for testing the condition of links in said first and second switches and for testing the condition of said first and second plurality of trunks prior to the operation of either said first or said second selective switches, and means effective upon the selection of an idle link in each of said switches and an idle trunk outgoing from each of said switches for operating said first and second switches.

In witness whereof, I hereunto subscribe my name this 21 day of April, A. D. 1924.

MARK B. KERR.

to a plurality of calling lines for testing the condition of links in said first and second switches and for testing the condition of said first and second plurality of trunks prior to the operation of either said first or said second selective switches, and means effective upon the selection of an idle link in each of said switches and an idle trunk outgoing from each of said switches for operating said first and second switches.

In witness whereof, I hereunto subscribe my name this 21 day of April, A. D. 1924.

MARK B. KERR.

DISCLAIMER.

1,577,033.—*Mark B. Kerr*, Rosebank, N. Y. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM. Patent dated March 16, 1926. Disclaimer filed October 4, 1928, by the assignee, *Western Electric Company, Incorporated.*

Hereby enters this disclaimer to the said claims of said Letters Patent which are in the following words to wit:

"8. In a telephone exchange system, a calling line, a called office, a first selective switch, a second selective switch, a first group of trunks extending from said first selective switch, a second group of trunks extending between said second switch and said called office, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means under control of said mechanism for selecting a particular trunk in said first group of trunks and for testing the trunks of said second group of trunks, and means effective when all the trunks in said second group are busy for releasing said particular selected trunk and automatically selecting a different trunk in said first group of trunks.

"9. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks extending from said first switch, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all trunks in a particular one of said second groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a second trunk in a different one of said first plurality of groups of trunks.

"10. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks bearing certain numerical designations and extending from said first switch, each group bearing a different numerical designation, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all the trunks in a particular one of said second mentioned groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a trunk bearing a different numerical designation in another of said first plurality of groups of trunks."

[*Official Gazette October 23, 1928.*]

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"8. In a telephone exchange system, a calling line, a called office, a first selective switch, a second selective switch, a first group of trunks extending from said first selective switch, a second group of trunks extending between said second switch and said called office, a mechanism accessible in common to a plurality of selective switches for controlling the operation thereof, means under control of said mechanism for selecting a particular trunk in said first group of trunks and for testing the trunks of said second group of trunks, and means effective when all the trunks in said second group are busy for releasing said particular selected trunk and automatically selecting a different trunk in said first group of trunks.

"9. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks extending from said first switch, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all trunks in a particular one of said second groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a second trunk in a different one of said first plurality of groups of trunks.

"10. In a telephone exchange system, a calling office, called offices, a first selective switch, a second selective switch, a plurality of groups of trunks bearing certain numerical designations and extending from said first switch, each group bearing a different numerical designation, another plurality of groups of trunks extending between said calling office and said called offices, means for selecting a trunk in a particular one of said first mentioned groups, means for testing all the trunks in a particular one of said second mentioned groups, and means effective when all the trunks of the latter group are busy for releasing the first selected trunk and for selecting a trunk bearing a different numerical designation in another of said first plurality of groups of trunks."

[*Official Gazette October 23, 1928.*]