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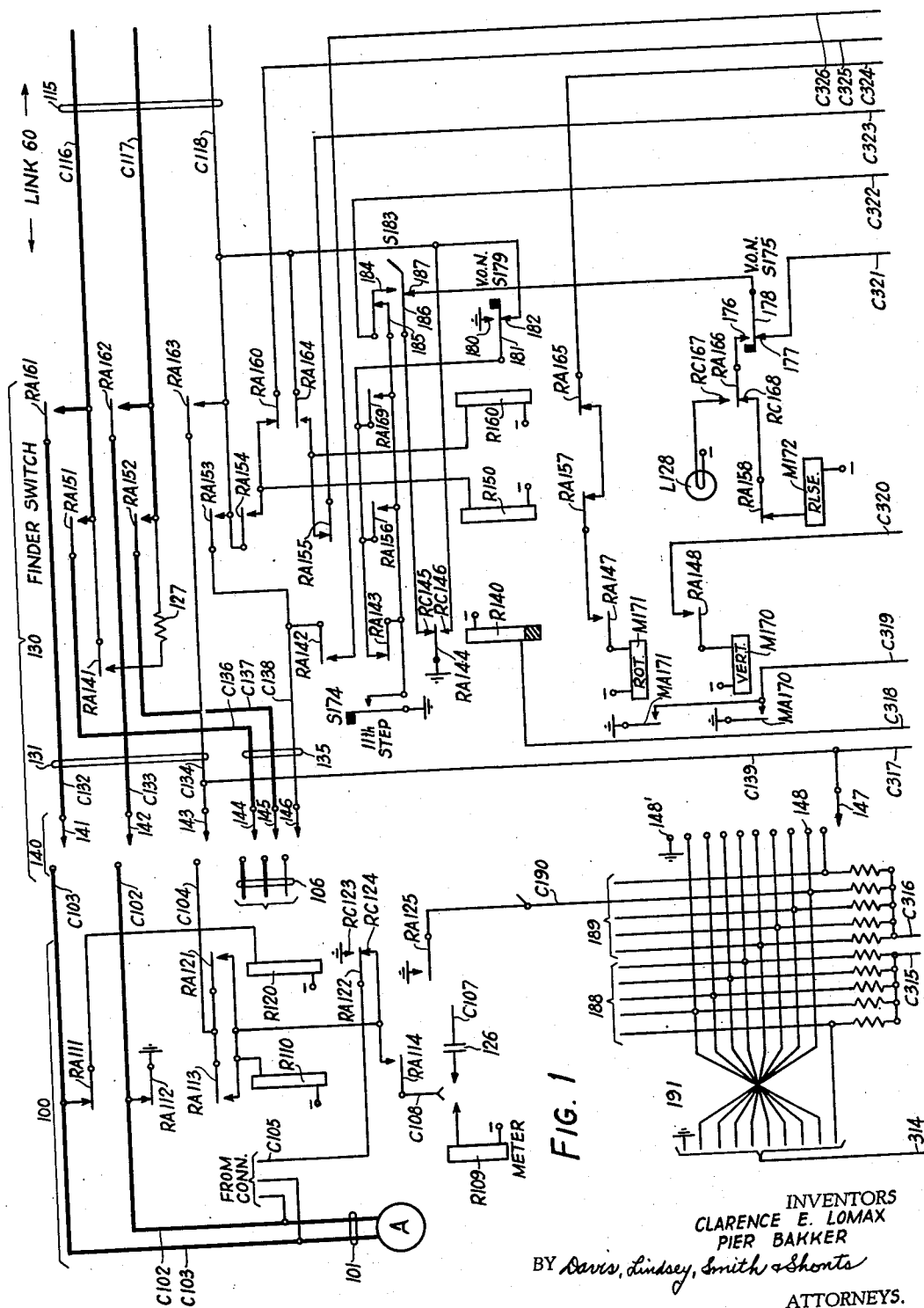
C. E. LOMAX ET AL

TELEPHONE SYSTEM

Filed April 21, 1939

2,214,908

3 Sheets-Sheet 1



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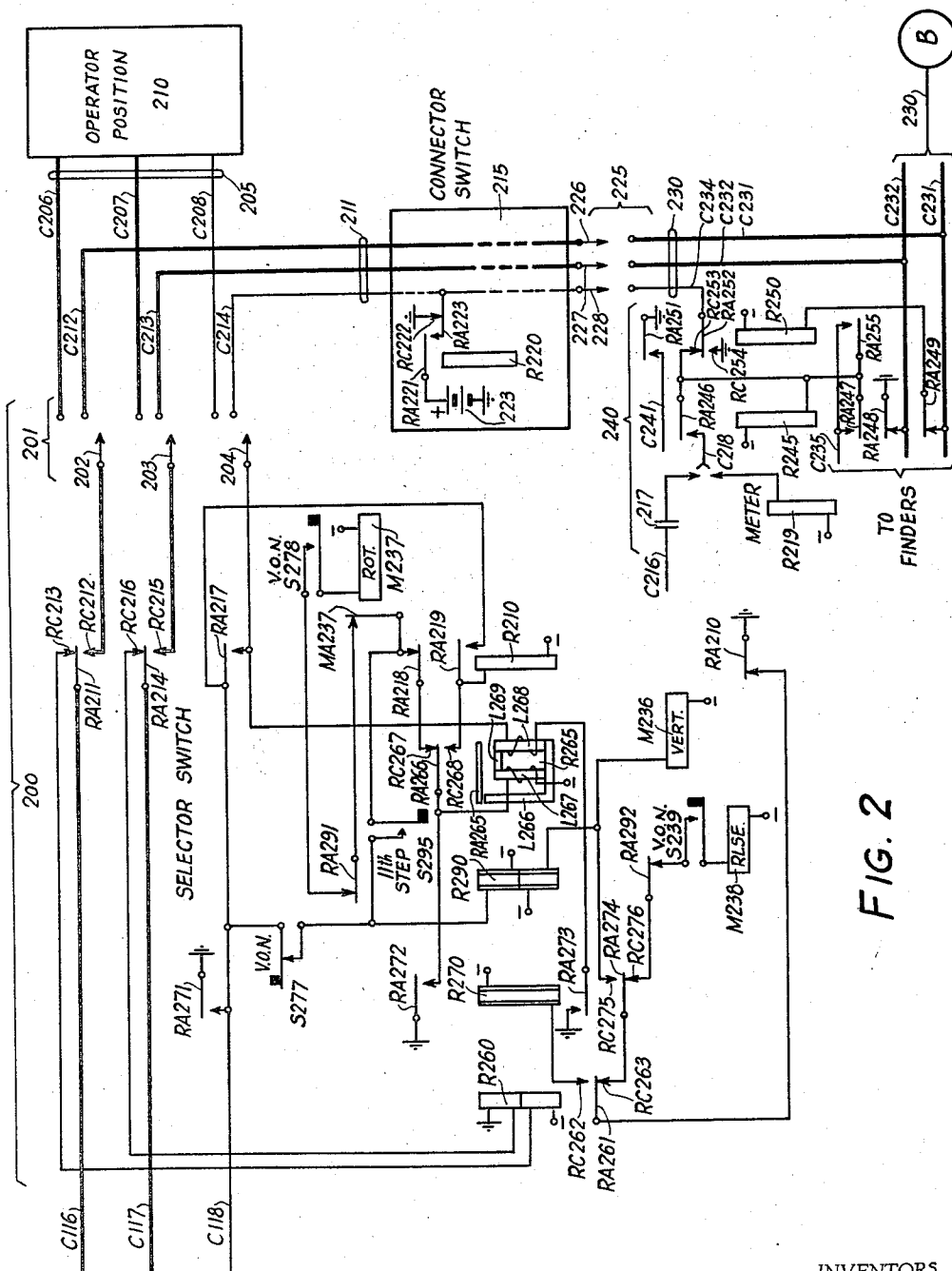
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3 Sheets-Sheet 2



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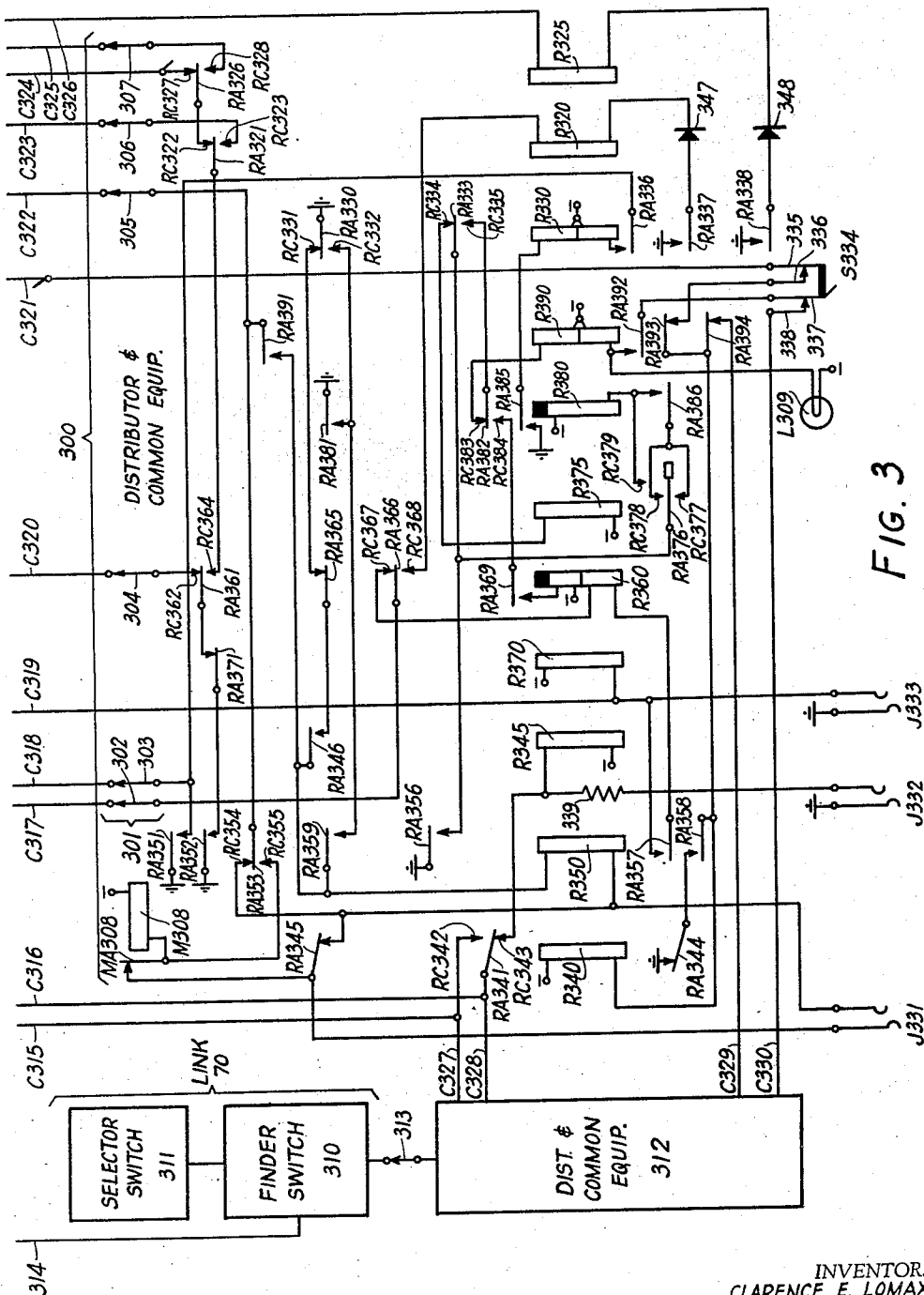
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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

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The present invention relates to telephone systems and, more particularly, to automatic telephone systems in which finder switches are employed to extend connections between calling lines and selector switches.

It is an object of the present invention to provide, in an automatic telephone system, improved distributor apparatus for selecting idle finder switches for the use of calling lines and for controlling the operations of the selected finder switches.

Another object of the invention is to provide, in an automatic telephone system of the character noted, improved apparatus for testing the operations of the distributor apparatus and the finder switches, which testing apparatus is so connected and arranged that it does not interfere with the handling of traffic in the system.

A further object of the system is to provide, in an automatic telephone system of the character noted, an automatic switch embodying improved testing apparatus for controlling the operation thereof, which testing apparatus is connected and arranged to prevent false operation of the switch when it engages a busy line having a metering potential connected to the control conductor thereof.

The features of the present invention are illustrated as being incorporated in a telephone system provided with an exchange terminating first and second groups of lines and comprising first and second groups of finder-selector links, each link including a finder switch and a selector switch, first and second groups of connector switches, and first and second distributors respectively associated with the first and second groups of links. These switches are so connected and arranged that each finder switch has access to each line of the system; each selector switch has access to each connector switch; and the connector switches in the first and second groups of connector switches respectively have access to the lines in the first and second groups of lines.

In accordance with one feature of the invention, each of the finder switches includes first and second wiper sets movable in vertical and rotary directions and respectively having access to the first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and the rotary movements of the wiper sets, a trunk line normally disconnected from the wiper sets, first and second switching relays operative respectively to connect the first and second wiper sets to the trunk

line, and means responsive to the operation of one of the switching relays for preventing the operation of the other of the switching relays. The distributor associated with each group of finder switches comprises a rotary switch operative to select an idle one of the finder switches in the group, means for governing the rotary and the vertical magnets of the selected finder switch, a first test relay operative in response to the seizure of a calling line by the first wiper set in the selected finder switch, a second test relay operative in response to the seizure of a calling line by the second wiper set in the selected finder switch, means responsive to the operation of the first test relay for causing the operation of the first switching relay in the selected finder switch, means responsive to the operation of the second test relay for causing the operation of the second switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of the rotary switch.

More particularly, the first and second test relays in the distributor are individually provided with operating circuits, each operating circuit including a uni-directional current conducting device in the form of a copper oxide rectifier. The arrangement of the copper oxide rectifier in the operating circuits of the first and second test relays prevents these relays from being energized when these operating circuits are completed in such a manner that current tends to flow therein in a direction opposite to that of the normal flow of current therein. This arrangement prevents false operation of the first and second test relays when the first and second wiper sets in the selected finder switch respectively engage busy lines having a metering potential connected to the control conductors thereof.

In accordance with another feature of the invention, each of the distributors includes a transfer relay provided with an operating circuit; and means is included in each idle finder switch in the associated group of finder switches for completing the operating circuit of the transfer relay, whereby the operating circuit of the transfer relay is interrupted when all of the finder switches in the associated group are busy. First and second start conductors are provided which are operatively associated with the first and second groups of lines, whereby start potentials are connected to the start conductors in response to the creation of calling conditions on

lines in the respective groups of lines. The first start conductor is associated with the first distributor, when the transfer relay in the first distributor occupies its operated position, and is associated with the second distributor, when the transfer relay in the first distributor occupies its restored position. The transfer relay in the second distributor controls the association of the second start conductor with the first and second distributors in a similar manner. Operation of each of the distributors is initiated when a start potential is connected to a start conductor associated therewith; and each of the distributors is effective when operation thereof is initiated to cause a selected one of the finder switches in the associated group to find a line having a calling condition thereon. Also, each of the distributors includes timing means operative to interrupt the operating circuit of the transfer relay therein in the event the finder switch selected thereby fails to operate. In order to test the operations of the distributors and the finder switches associated therewith, manually operable means comprising a busy switch and a number of test jacks is individually associated with each of the distributors.

In accordance with another feature of the invention, the selector switch of each of the links comprises a test relay having a field structure provided with a first magnetic path including a shunt leg and a second magnetic path including a movable armature, first and second windings being associated with the field structure. A first circuit is provided for energizing the first winding; and a second circuit including a test wiper of the finder switch is provided for energizing the second winding. The first winding is effective, when energized with current flowing in the first circuit, to produce a magnetic flux in the field structure traversing the first magnetic path; the second winding is effective, when energized with current flowing in a first direction in the second circuit, to produce a magnetic flux in the field structure traversing the first magnetic path; and when energized with current flowing in a second direction in the second circuit to produce a magnetic flux in the field structure opposing the magnetic flux traversing the shunt leg, thereby to divert magnetic flux from the first magnetic path into the second magnetic path. The test relay is so constructed and arranged that it is operated when magnetic flux traverses the second magnetic path. The selector switch comprises automatic means operative to drive the test wiper thereof step by step over a group of test contacts in the contact bank thereof; which test contacts are adapted to have connected thereto an idle potential, a busy potential, or a metering potential, depending upon the condition of the associated line. The second circuit is so connected and arranged that no current flows therein, when the test wiper engages a test contact having a busy potential connected thereto; that current flows therein in the first direction, when the test wiper engages a test contact having a metering potential connected thereto; and that current flows therein in the second direction, when the test wiper engages a test contact having an idle potential connected thereto. Further, each selector switch comprises means controlled by the operation of the test relay therein for arresting the operation of the automatic means.

Further features of the invention pertain to the particular arrangement of the circuit elements of the system and to the particular con-

nection and arrangement of the elements of the distributors and the links incorporated therein, whereby the above-outlined and additional features are attained.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings in which Figures 1 to 3, inclusive, illustrate a telephone system embodying the present invention.

Referring now more particularly to Figs. 1 to 3, inclusive, of the drawings, the telephone system there illustrated comprises an exchange including an operator position 210 and terminating a plurality of subscriber lines, including the subscriber lines 101 and 230. Also, the exchange comprises a number of links, including the links 60 and 70, and a number of connector switches including the connector switch 215 for setting up connections between the various lines. More specifically, the exchange has an ultimate capacity of 200 lines, these lines being arranged in first and second groups of 100 lines each. Each of the links comprises a 200 point finder switch having access to each line in the system and a 100 point selector switch having access to each of the connector switches; while the connector switches are of the 100 point type and are arranged in first and second groups, respectively, having access to the first and second groups of lines of the system.

Furthermore, the links are arranged in first and second groups, each group of links being provided with a distributor individual thereto for assigning idle ones of the links in the group to the use of calling ones of the lines. The number of links included in each group is determined by the amount of traffic which the exchange is required to handle and usually satisfactory service may be rendered when each of the two groups of links includes ten links. Also, the number of connector switches required is determined by the amount of traffic which the exchange is required to handle and usually satisfactory service may be rendered when each of the two groups of connector switches includes ten connector switches.

More particularly, the first group of links includes the link 60, which comprises the finder switch 130 and the selector switch 200, and is provided with the distributor 300; while the second group of links includes the link 70, which comprises the finder switch 310 and the selector switch 312. The first and second groups of lines are respectively associated with the distributors 300 and 312; whereby calling lines in the first group of lines are normally assigned for use idle ones of the links in the first group of links, and calling lines in the second group of lines are normally assigned for use idle ones of the links in the second group of links, thereby rendering it possible to extend simultaneously a call initiated on a line in each of the two groups of lines. Furthermore, the distributors 300 and 312 are so connected and arranged that a call initiated on a line in the first group of lines is assigned for use an idle link in the second group of links in the event all of the links in the first group of links are busy; and a call initiated on a line in the second group of lines is assigned for use an idle link in the first group of links in the event all

of the links in the second group of links are busy.

A subscriber substation is associated with each of the subscriber lines, the subscriber substations A and B being respectively associated with the subscriber lines 101 and 230. Each of the subscriber substations is provided with a telephone instrument, a dial mechanism and a ringer. Also, a line circuit is individually associated with each of the subscriber lines, the line circuits 100 and 240 respectively illustrated in Figs. 1 and 2 being respectively associated with the subscriber lines 101 and 230. Preferably, these line circuits are identical, each including a line relay and a cutoff relay, these relays in the line circuit 100 being respectively indicated at R120 and R110, and these relays in the line circuit 240 being respectively indicated at R250 and R245. Furthermore, a meter relay is associated with each of the line circuits, these relays associated with the line circuits 100 and 240 being respectively indicated at R109 and at R219.

Preferably, each of the links is connected and arranged in a manner similar to that of the link 60 which comprises the finder switch 130 and the selector switch 200. The finder switch 130, as best shown in Fig. 1, comprises a switching mechanism 140 of the Strowger type including a bank of fixed contact sets arranged in ten vertical levels, each level including upper and lower rows of contact sets, each row of contact sets including ten radially disposed contact sets, each contact set terminating a line extending thereto; and a row of fixed contacts arranged in vertical alignment. Also, the Strowger mechanism 140 comprises upper and lower wiper sets respectively including the wipers 141, 142, 143 and 144, 145, 146 carried by a carriage movable in both vertical and rotary directions, the upper and lower wiper sets being respectively associated with the upper and lower rows of contact sets in the bank of fixed contact sets; and a control wiper 147 carried by the carriage, the control wiper 147 being associated with the row of fixed contacts. Also, this Strowger mechanism includes a vertical magnet M170 for moving the carriage in the vertical direction, a rotary magnet M171 for moving the carriage in a rotary direction, and a release magnet M172 for releasing the carriage and for causing it to be returned to its normal position. Associated with this Strowger mechanism are two sets of switch springs S175 and S179 which are actuated by the movement of the carriage in the vertical direction away from its normal position, and a set of switch springs S174 which is actuated by the movement of the carriage into its eleventh rotary position. Also, it is noted that the upper and lower wiper sets respectively terminate the trunk lines 131 and 135 included in the finder switch 130, which trunk lines are operatively associated with the trunk line 115 extending between the finder switch 130 and the selector switch 200. Also, the finder switch 130 comprises a start relay R140, two switching relays R150 and R160, a supervisory lamp L128 and a manually operable busy switch S183.

The selector switch 200, as best shown in Fig. 2, comprises a switching mechanism 201 of the Strowger type including a bank of fixed contact sets arranged in ten vertical levels, each level including ten circumferentially disposed contact sets, each contact set terminating a line extending thereto. Also, the Strowger mechanism 201 comprises a wiper set including the wipers 202,

203 and 204 carried by a carriage movable in both vertical and rotary directions, the wiper set being associated with the bank of fixed contact sets. Also, this Strowger mechanism includes a vertical magnet M236 for moving the carriage in the vertical direction, a rotary magnet M237 for moving the carriage in the rotary direction, and a release magnet M238 for releasing the carriage and for causing it to be returned to its normal position. Associated with this Strowger mechanism are three sets of switch springs S277, S278 and S239 which are actuated by the movement of the carriage in the vertical direction away from its normal position, and a set of switch springs S295 which are actuated by the movement of the carriage into its eleventh rotary position. Also, the selector switch 200 comprises a line relay R260, a hold relay R270, a transfer relay R290, a test relay R265 and a switching relay R210.

Preferably, each of the distributors is connected and arranged in a manner similar to that of the distributor 300 individually associated with the first group of links which comprises, as best shown in Fig. 3, a rotary switch 301 including six banks of fixed contacts and six wipers individually associated therewith, the corresponding contacts in each bank terminating the control conductors extending to the respective links in the first group of links, and the wipers terminating the control conductors extending to the distributor. Also, the rotary switch 301 includes a rotary magnet M308 for driving the wipers associated with the contact banks in a rotary direction. The distributor 300 also comprises a start relay R345, a busy transfer relay R340, a step relay R370, a transfer relay R360, a timing relay R375, first and second test relays R320 and R325, respectively, and a number of control relays R350, R380, R390 and R330. Also associated with the distributor 300 are a supervisory lamp L309, a number of jacks J331, J332 and J333 and a busy switch S334 which are utilized for test purposes in a manner more fully described subsequently.

The distributor 300 is of the preselective type in that an idle link in the first group of links is selected to be assigned to the use of a calling line in the first group of lines prior to the initiation of a call on the line therein and another idle link in the first group of links is automatically selected to be assigned to the use of the next calling line in the first group of lines as soon as the selected link operates to find a calling line in the first group of lines. Also, the distributor 300 is so connected and arranged that, when all of the links in the first group of links are busy, the start circuit of the distributor 300 is transferred to the distributor 312 associated with the second group of lines, whereby the distributor 312 assigns idle ones of the links in the second group of links to the use of calling lines in the first group of lines.

Preferably, each of the connector switches is connected and arranged in a manner similar to that of the connector switch 215, which connector switch is of conventional connection and arrangement and includes a Strowger mechanism 225 and a battery reversing relay R220. It is noted that a trunk line 211 including a control conductor C214 extends to the connector switch 215 and that a battery 223 is included in the connector switch 215 and operatively associated by way of a switching arrangement with the control conductor C214 of the trunk line 211, whereby booster battery potential may be applied to the control

conductor C214 of the trunk line 211 for metering purposes in a manner more fully described hereinafter.

- 5 Preferably, the operator position 210 is of conventional connection and arrangement and includes apparatus thereat for answering an incoming call extending thereto.

A better understanding of the connection and arrangement of the apparatus incorporated in the telephone system will be facilitated from a consideration of the operation thereof incident to the extension of a call from the subscriber substation A to the subscriber substation B. The call is first initiated at the substation A by removing the receiver of the telephone instrument thereat from its hook, thereby to complete a bridge path at the substation A between the line conductors C102 and C103 of the subscriber line 101 extending to the substation A. When this bridge path is completed between the line conductors of the subscriber line 101, a circuit is completed for energizing the line relay R120 in the line circuit 100 individually associated with the subscriber line 101, which circuit extends from ground, at RA112, by way of RA112, C102, the bridge path between the line conductors C102 and C103 of the subscriber line 101, C103, RA111, and the winding of R120 to battery. When energized over the above-traced circuit the line relay R120 operates to complete, at RA122 and RC123, an obvious path for applying ground potential to the control conductor C105 of the subscriber line 101, thereby to mark the subscriber line 101 as busy to the connector switches having access thereto. Also, the line relay R120 completes, at RA125, an obvious path for applying ground potential to the control conductor C190, thereby to cause ground potential to be applied by way of the circuit network 191 to the start conductor C316 extending into the distributor 300, assuming that the subscriber line 101 is included in the first group of subscriber lines. Also, this application of ground potential to the control conductor C190 marks, by way of the circuit network 191 and the contacts in the rows of contacts in the Strowger mechanisms included in the finder switches, the levels wherein the subscriber line 101 is terminated, the contact in the row of contacts in the Strowger mechanism 140 included in the finder switch 130 being indicated at 148. Also, upon operating, the line relay R120 completes, at RA121, a path for applying battery potential to the control conductor C104 of the subscriber line 101, thereby to mark the rotary positions of the contact sets in the contact banks of the Strowger mechanisms included in the finder switches terminating the subscriber line 101. This path for applying battery potential to the control conductor C104 of the subscriber line 101 extends from battery at the winding of the cut-off relay R110, by way of the winding of R110 and RA121, to C104.

This application of ground potential to the start conductor C316 extending into the distributor 300 completes a circuit for energizing the start relay R345, this circuit extending from ground, at RA125, by way of the control conductor C191, a resistor included in the circuit network 191, the start conductor C316, RA341, RC343 and the winding of R345 to battery. When energized over the above-traced circuit, the start relay R345 operates to initiate operation of the distributor 300, thereby to cause the preselected idle one of the links in the first group of links to be assigned to the use of the calling

subscriber line. More particularly, upon operating, the start relay R345 completes, at RA348, a circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308 of the rotary switch 301, this circuit extending from ground, at RA330, by way of RA330, RC331, RA365, RA346, the winding of R350, RA345, MA308, and the winding of M308 to battery. When the above-traced series circuit is completed, the rotary magnet M308 does not operate due to the high series resistance of the winding of the relay R350. However, the control relay R350 does operate. Upon operating, the control relay R350 completes, at RA358, an alternative holding circuit for energizing the busy transfer relay R340, this circuit extending from ground, at RA344, by way of RA344, RA358 and the winding of R340 to battery. It is noted that the busy transfer relay R340 is normally energized by way of a number of multiple circuits completed in idle ones of the finder switches of the first group of links, one of these multiple circuits being completed at this time in the finder switch 130 of the link 60 and extending from ground, at RA144, by way of RA144, RC145, the switch springs 186 and 187 of the busy switch S183, the switch springs 178 and 177 of the set of switch springs S175, the all-trunks-busy conductor C321, the switch springs 335 and 336 of the busy switch S334, RA393, and the winding of R340 to battery. Also, it will be understood that a similar multiple circuit will be completed in each of the finder switches of idle ones of links in the first group of links.

Also, upon operating, the relay R350 completes, at RA356, a point in a circuit traced hereinafter for energizing the timing relay R375, prepares, at RA357, a point in a circuit traced hereinafter for energizing the lower winding of the transfer relay R360, prepares, at RA359, a point in an alternative circuit traced hereinafter for energizing the winding thereof in series with the winding of the rotary magnet M308 of the rotary switch 301, prepares, at RA353 and RC355, a point in a circuit traced hereinafter for energizing the winding of the rotary magnet M308 directly from the guard conductor C322, and prepares, at RA352, a point in a circuit traced hereinafter for energizing the vertical magnet M170 of the finder switch 130 of the link 60, assuming that the link 60 has been preselected by the distributor 300. Also, the control relay R350 completes, at RA351, a circuit traced hereinafter for energizing the start relay R140 of the finder switch 130 of the preselected link 60. As previously noted, the link 60 in the first group of links has been previously selected by the distributor 300 for the use of a calling line in the first group of lines. Accordingly, the wipers 302 to 307, inclusive, of the rotary switch 301 engage the contacts in the associated contact banks terminating the control conductors extending to the finder switch 130.

The circuit for energizing the start relay R140 in the finder switch 130 extends from ground, at RA351, by way of RA351, the wiper 303 and associated contact of the rotary switch 301, the finder start conductor C318, and the winding of R140 to battery. When energized over the above-traced circuit, the start relay R140 operates to complete, at RA141, an obvious path between the line conductors C116 and C117 of the trunk line 115 extending between the finder switch 130 and the selector switch 200 of the link 60, and to complete, at RA144 and RC146, an obvious path for

applying ground potential to the control conductor C118 of the trunk line 115. When the path is completed between the line conductors C116 and C117 of the trunk line 115, a circuit is completed for energizing in series the upper and lower windings of the line relay R260 in the selector switch 200, this circuit extending from ground by way of the upper winding of R260, RC216, RA214, C117, the resistor 127, RA141, C116, RA211, RC213, and the lower winding of R260 to battery. When energized over the above-traced circuit, the line relay R260 operates to interrupt, at RA261 and RC263, a point in a circuit, traced hereinafter, for energizing the winding of the release magnet M238, and to complete, at RA261 and RC262, a circuit for energizing the hold relay R270, the last-mentioned circuit extending from ground at RA210 by way of RA210, RA261, RC262 and the winding of R270 to battery.

When energized over the above-traced circuit, the hold relay R270 operates to complete, at RA271, a multiple path for applying ground potential to the control conductor C118 of the trunk line 115, to complete, at RA272, a circuit for energizing the winding on the core leg L267 of the field structure of the test relay R265, to prepare, at RA273, a circuit, traced hereinafter, for energizing the winding on the core leg L268 of the field structure of the test relay R265, to interrupt, at RA274 and RC276, a further point in the previously mentioned circuit for energizing the winding of the release magnet M238, and to prepare, at RA274 and RC275, a point in a circuit, traced hereinafter, for energizing in multiple the lower winding of the transfer relay R290 and the winding of the vertical magnet M236. The application of ground potential to the control conductor C118 of the trunk line 115 completes a circuit for energizing the upper winding of the transfer relay R290, this circuit extending from the grounded control conductor C118 by way of the set of switch springs S277 and the upper winding of R290 to battery. When energized over the above-traced circuit, the transfer relay R290 operates to interrupt, at RA291, a point in a circuit, traced hereinafter, for energizing the winding of the rotary magnet M237 and to interrupt, at RA292, a point in the previously mentioned circuit for energizing the winding of the release magnet M238. At this time, the selector switch 200 is conditioned to be responsive to a digit dialled thereinto, thereby to cause the wiper set of the Strowger mechanism 201 thereof to be driven away from its normal position in the vertical direction in a manner more fully described hereinafter.

Also, the start relay R140 prepares, at RA142, a circuit, traced hereinafter, for energizing the second test relay R325 in the distributor 300, interrupts, at RA143, a point in a path traced hereinafter for applying ground potential to the guard conductor C322, interrupts, at RA144 and RC145, a point in the previously traced path for applying ground potential in the finder switch 130 to the all-trunks-busy conductor C321, prepares, at RA147, a circuit traced hereinafter for energizing the winding of the rotary magnet M171, and completes, at RA148, a circuit for energizing the vertical magnet M170. The circuit for energizing the vertical magnet M170 extends from ground, at RA352, by way of RA352, RA371, RA361, RC362, the wiper 304 and associated contact of the rotary switch 301, the vertical conductor C320, RA148, and the winding of M170 to battery. When energized over the above-traced

circuit, the vertical magnet M170 operates. Upon operating, the vertical magnet M170 drives the carriage of the Strowger mechanism 140 of the finder switch 130 one step in the vertical direction and completes, at MA170, a circuit for energizing the step relay R370 in the distributor 300. The circuit for energizing the step relay R370 extends from ground, at MA170, by way of MA170, the interrupter conductor C319 and the winding of R370 to battery.

When energized over the above-traced circuit, the step relay R370 operates to interrupt, at RA371, a point in the previously traced circuit for energizing the winding of the vertical magnet M170, thereby to cause the vertical magnet M170 to restore. Upon restoring, the vertical magnet M170 interrupts, at MA170, the previously traced circuit for energizing the step relay R370, thereby to cause the latter relay to restore. Upon restoring, the step relay R370 completes, at RA371, a point in the previously traced circuit for energizing the winding of the vertical magnet M170, whereupon the vertical magnet M170 operates to drive the carriage of the Strowger mechanism 140 of the finder switch 130 an additional step in the vertical direction and to recomplete, at MA170, the previously traced circuit for energizing the step relay R370 in the distributor 300.

The step relay R370 in the distributor 300 and the vertical magnet M170 in the finder switch 130 continue to interact in the above-described manner, thereby to cause the carriage of the Strowger mechanism 140 of the finder switch 130 to be driven step by step in the vertical direction until the carriage wiper 147 engages a contact in the row of contacts associated therewith having marking ground potential thereon. In the present instance, the carriage of the Strowger mechanism 140 of the finder switch 130 is driven two steps in the vertical direction, whereupon the control wiper 147 engages the contact 148 in the row of contacts having marking ground potential thereon. A circuit is then completed for energizing the lower winding of the transfer relay R360 in series with the winding of the step relay R370, this circuit extending from the grounded contact 148 in the row of contacts by way of the control wiper 147, the first test conductor C317, the wiper 302 and associated contact of the rotary switch 301, RA366, RC367, the lower winding of R360, RA357, and the winding of R370 to battery. It is noted that the above-traced circuit for energizing the lower winding of the transfer relay R360 in series with the winding of the step relay R370 is completed immediately the carriage of the Strowger mechanism 140 of the finder switch 130 is driven the second step in the vertical direction. Accordingly, the step relay R370 does not restore incident to the restoration of the vertical magnet M170 at this time.

Shortly after the transfer relay R360 is energized over the above-traced circuit it operates, this relay being of the slow-to-operate type. Upon operating, the transfer relay R360 completes, at RA369, a holding circuit traced hereinafter for energizing the upper winding thereof, interrupts, at RA366 and RC367, a point in the previously traced circuit for energizing the lower winding thereof in series with the step relay R370, and prepares, at RA366 and RC368, a circuit traced hereinafter for energizing the first test relay R320. Also, upon operating, the transfer relay R360 interrupts, at RA365, a point in the previously traced original circuit for energizing the control relay R350 in series with the winding of the

rotary magnet M308, an alternative circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308 being completed at this time; interrupts, at RA361 and RC362, a further point in the previously traced circuit for energizing the vertical magnet M170; and prepares, at RA361 and RC364, a point in a circuit traced hereinafter for energizing the rotary magnet M171.

As previously noted, upon operating, the control relay R350 completes, at RA356, a point for energizing the timing relay R375, this circuit extending from ground, at RA356, by way of RA356, RA333, RC334, and the winding of R375 to battery. When energized over the above-traced circuit, the timing relay R375 operates to complete, at RA376 and RC378, RC379, a circuit for energizing the control relay R380, this circuit extending from ground, at RA356, by way of RA356, RA376, RC378, RC379, and the winding of R380 to battery. Shortly after the control relay R380 is energized by way of the above-traced circuit, this relay operates, this relay being of the slow-to-operate type. Upon operating, the control relay R380 completes, at RA386, a holding circuit for energizing the winding thereof, this circuit extending from ground, at RA356, by way of RA356, RA376, RC378, RA386, and the winding of R380 to battery. Also, upon operating, the control relay R380 interrupts, at RA382 and RC383, a point in a circuit traced hereinafter for energizing the upper winding of the control relay R390, and prepares, at RA382 and RC384, a point in a holding circuit traced hereinafter for energizing the upper winding of the transfer relay R360. Also, the control relay R380 completes, at RA381, the previously mentioned alternative circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308, this circuit extending from ground, at RA381, by way of RA381, RA359, the winding of R350, RA345, MA308, and the winding of M308 to battery. Finally, upon operating, the control relay R380 completes, at RA385, an obvious circuit for energizing the upper winding of the control relay R330, thereby to cause the latter relay to operate. Upon operating, the control relay R330 completes, at RA336, a holding circuit for energizing the lower winding thereof, this circuit extending from ground at RA351 by way of RA351, RA336, and the lower winding of R330 to battery. Also, the control relay R330 interrupts, at RA330 and RC331, a point in the previously traced original circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308, and completes, at RA330 and RC332, a multiple alternative circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308. Furthermore, the control relay R330 interrupts, at RA333 and RC334, a point in the previously traced circuit for energizing the timing relay R375; prepares, at RA333 and RC335, a point in the previously mentioned holding circuit for energizing the upper winding of the transfer relay R360; prepares, at RA337, a point in a circuit traced hereinafter for energizing the first test relay R320; and prepares, at RA338, a point in a circuit traced hereinafter for energizing the second test relay R325.

When the previously traced circuit for energizing the timing relay R375 is interrupted, the latter relay restores, thereby to cause the weighted armature RA376 thereof to vibrate between the associated contacts RC377 and RC378, in order to complete intermittently the previously traced

holding circuit for energizing the control relay R380. It is noted that the weighted armature RA376 vibrates between the contacts noted for a predetermined time interval, thereby to retain the control relay R380 in its operated position during this time interval.

The previously mentioned holding circuit for energizing the upper winding of the transfer relay R360 extends from ground, at RA356, by way of RA356, RA333, RC335, RA382, RC384, RA369, and the upper winding of R360 to battery; while the previously mentioned circuit for energizing the rotary magnet M171 extends from ground, at RA352, by way of RA352, RA371, RA361, RC364, RA321, RC322, RA326, RC327, the rotary conductor C324, RA165, RA157, RA147, and the winding of M171 to battery. When energized over the above-traced circuit, the rotary magnet M171 operates to drive the carriage of the Strowger mechanism 140 of the finder switch 130 one step in the rotary direction and to complete, at MA171, an alternative circuit for energizing the step relay R370 in the distributor 300. The circuit for energizing the step relay R370 extends from ground, at MA171, by way of MA171, the interrupter conductor C319, and the winding of R370 to battery. When energized over the above-traced circuit, the step relay R370 operates to interrupt, at RA371, a point in the previously traced circuit for energizing the rotary magnet M171, thereby to cause the rotary magnet to restore. Upon restoring, the rotary magnet M171 interrupts, at MA171, the previously traced alternative circuit for energizing the step relay R370, thereby to cause the step relay to restore and recomplete, at RA371, the previously traced circuit for energizing the winding of the rotary magnet M171.

The step relay R370 in the distributor 300 and the rotary magnet M171 in the finder switch 130 continue to interact in the manner described above until the carriage of the Strowger mechanism 140 of the finder switch 130 is rotated in the rotary direction to the position of the contact set terminating the calling subscriber line 101, at which time the wiper 143 of the upper wiper set engages the contact of the contact set terminating the control conductor C104 of the subscriber line 101, assuming that the line 101 is accessible to the upper wiper set of the Strowger mechanism 140 of the finder switch 130, whereupon a circuit is completed for energizing the winding of the cutoff relay R110 in the line circuit 100 in series with the first test relay R320 in the distributor 300. The last-mentioned circuit extends from ground at RA337 by way of RA337, the unidirectional current conducting device or copper oxide rectifier 347, the winding of R320, RC368, RA366, the wiper 302 and associated contact of the rotary switch 301, the first test conductor C317, the wiper 143 of the upper wiper set, the associated contact terminating the control conductor C104 of the subscriber line 101, C104, RA121 and the winding of the cutoff relay R110 to battery.

When the cutoff relay R110 in the line circuit 100 is energized by way of the above-traced circuit, it does not operate due to the high series resistance of the first test relay R320 in the distributor 300. However, the first test relay R320 does operate. Upon operating, the first test relay R320 interrupts, at RA321 and RC322, a point in the previously traced circuit for energizing the winding of the rotary magnet M171 and completes, at RA321 and RC323, a circuit for ener-

gizing the switching relay R160 in the finder switch 130. The circuit for energizing the switching relay R160 extends from ground, at RA352, by way of RA352, RA371, RA361, RC364, RA321, RC323, the wiper 306 and associated contact of the rotary switch 301, the conductor C323, RA155, and the winding of R160 to battery. When energized over the above-traced circuit, the switching relay R160 operates to interrupt, at RA165, a further point in the previously traced circuit for energizing the winding of the rotary magnet M171 and to complete, at RA164, a holding circuit for energizing the winding thereof, this circuit extending from the grounded conductor C118 by way of RA164, and the winding of R160 to battery. Also, upon operating, the switching relay R160 connects the trunk line 131 terminated by the upper wiper set to the trunk line 115 extending between the finder switch 130 and the selector switch 200. Specifically, the conductors C132, C133 and C134 of the trunk line 131 are respectively connected, at RA161, RA162 and RA163, to the conductors C116, C117 and C118, respectively, of the trunk line 115. When the grounded control conductor C118 of the trunk line 115 is connected to the control conductor C134 of the trunk line 131, an alternative circuit is completed for energizing the cutoff relay R110 in the line circuit 100, this circuit extending from the grounded control conductor C118 of the trunk line 115 by way of RA163, the control conductor C134 of the trunk line 131, the wiper 143 of the upper wiper set, the associated contact terminating the control conductor C104 of the subscriber line 101, C104, RA121, and the winding of R110 to battery. When energized over the above-traced circuit, the cutoff relay R110 operates to complete, at RA113, a holding circuit for energizing the winding thereof, this circuit extending from the grounded control conductor C104 of the subscriber line 101 by way of C104, RA113, and the winding of R110 to battery. Also, upon operating, the cutoff relay R110 interrupts, at RA111 and RA112, points in the previously traced circuit for energizing the line relay R120, thereby to free the subscriber line 101 of impedance elements and to cause the line relay R120 to restore. Also, upon operating, the cutoff relay R110 completes, at RA114, a circuit for energizing the winding of the meter relay R109 associated with the line circuit 100, assuming that the upper terminal of the winding of the meter relay R109 is connected to the conductor C108. This circuit extends from the grounded control conductor C104 of the subscriber line 101 by way of RA113, RA114, C108, and the winding of R109 to battery. Although the winding of the meter relay R109 is energized, this relay does not operate at this time as this relay is of the marginal type.

When the line conductors C132 and C133 of the trunk line 131 are connected to the line conductors C116 and C117, respectively, of the trunk line 115, an alternative circuit is completed for energizing in series the upper and lower windings of the line relay R260 in the selector switch 200. This circuit extends from ground by way of the upper winding of R260, RC216 and RA214 to the line conductor C117, and from battery by way of the lower winding of R260, RC213 and RA211 to the line conductor C216, the line conductors C216 and C217 of the trunk line 215 being connected together by way of the bridge

path connected between the line conductors C102 and C103 of the subscriber line 101 at the subscriber substation A.

It is noted that, when the carriage of the Strowger mechanism of the finder switch 130 is operated away from its normal position the first step in the vertical direction, the sets of switch springs S175 and S179 are actuated. More specifically, the switch springs 181 and 182 of the set of switch springs S179 are actuated into disengagement; while the switch springs 181 and 180 of the set of switch springs S179 are actuated into engagement. When the switch springs 181 and 180 of the set of switch springs S179 are actuated into engagement, a point is prepared in a path traced hereinafter for applying ground potential to the guard conductor C322. Also, the switch springs 178 and 177 of the set of switch springs S175 are actuated into disengagement and the switch springs 178 and 176 of the set of switch springs S175 are actuated into engagement. When the switch springs 178 and 177 of the set of switch springs S175 are actuated into disengagement, a further point in the previously traced path for applying ground potential to the all-trunks-busy conductor C321 is interrupted; and when the switch springs 178 and 176 of the set of switch springs S175 are actuated into engagement, a point is prepared in a circuit traced hereinafter for illuminating the supervisory lamp L128.

Also, upon operating, the switching relay R160 in the finder switch 130 interrupts, at RA166 and RC168, a point in a circuit traced hereinafter for energizing the release magnet M172, and prepares, at RA166 and RC167, an additional point in the previously mentioned circuit for illuminating the supervisory lamp L128. Furthermore, the switching relay R160 interrupts, at RA160, a point in a circuit traced hereinafter for energizing the switching relay R150, thereby to prevent operation of the switching relay R150 at this time; and completes, at RA169, the previously mentioned path for applying ground potential to the guard conductor C322, this path extending from ground, at the switch spring 180 of the set of switch springs S179, by way of the switch springs 180 and 181 of the set of switch springs S179, RA169, and the switch springs 185 and 184 of the busy switch S183 to the guard conductor C322. This application of ground potential to the guard conductor C322 completes a circuit for energizing the winding of the rotary magnet M308 of the rotary switch 301, this circuit extending from the grounded guard conductor C322 by way of the wiper 305 and associated contact of the rotary switch 301, RA353, RC355, and the winding of M308 to battery. When energized over the above-traced circuit, the rotary magnet M308 operates, thereby to condition the wipers of the rotary switch 301 to be driven one step in the rotary direction. Also, upon operating, the rotary magnet M308 interrupts, at MA308, a point in the previously traced alternative circuit for energizing the winding thereof in series with the winding of the control relay R350, thereby to cause the control relay R350 to restore.

Upon restoring, the control relay R350 interrupts, at RA353 and RC355, a point in the previously traced circuit for energizing the winding of the rotary magnet M308, thereby to cause the rotary magnet M308 to restore. Upon restoring, the rotary magnet M308 drives the wipers 302 to 307, inclusive, of the rotary switch 301 one

step in the rotary direction and into engagement with the contacts in the associated contact banks terminating the control conductors extending to the finder switch of the next link. The subsequent operation of the distributor 300 depends upon the idle or busy condition of the finder switch of the next link, in a manner more fully described subsequently.

Assuming that there are no other calls in the first group of lines at this time, when the line relay R120 of the line circuit 100 associated with the subscriber line 101 restores it interrupts, at RA125, the previously traced path for applying ground potential to the control conductor C190, interrupts, at RA122 and RC123, the previously traced path for applying ground potential to the control conductor C105 of the subscriber line 101, and completes, at RA122 and RC124, an alternative path for applying ground potential to the control conductor C105, thereby to mark the subscriber line 101 as busy to the connector switches having access thereto. The last-mentioned path extends from the grounded control conductor C104 of the subscriber line 101 by way of RA113, RC124 and RA122, to the control conductor C105.

When ground potential is removed from the control conductor C190, the previously traced circuit for energizing the start relay R345 in the distributor 300 is interrupted, thereby to cause the start relay R345 to restore. Upon restoring, the start relay R345 interrupts, at RA346, the previously traced original circuit for energizing the control relay R350 in series with the winding of the rotary magnet M308. Also, when the control relay R350 restores, as previously noted, it interrupts, at RA359, a further point in the circuit for energizing the winding thereof in series with the winding of the rotary magnet M308. Also, at RA353 and RC354, the wiper 305 of the rotary switch 301 is connected by way of the self-interrupting contact MA308 and the winding of the rotary magnet M308 to battery, this connection extending from the wiper 305 by way of RA353, RC354, RA345, MA308, and the winding of M308 to battery.

In the event the finder switch of the next link in the first group is busy at this time, ground potential appears upon the guard conductor C322 of the finder switch 130, as previously noted, thereby to complete a circuit extending by way of the previously traced connection for energizing the winding of the rotary magnet M308. When thus energized, the rotary magnet M308 operates to condition the wipers of the rotary switch 301 to be driven an additional step in the rotary direction and to interrupt, at MA308, the previously traced circuit for energizing the winding thereof. When the previously traced circuit for energizing the winding of the rotary magnet M308 is interrupted, the rotary magnet restores, thereby to drive the wipers of the rotary switch 301 an additional step in the rotary direction. The rotary magnet M308 continues to operate in the above-described manner in order to cause the wipers of the wiper set 301 to be driven step by step in the rotary direction until the finder switch in an idle link of the first group is found. When the finder switch of an idle link of the first group is found, further operation of the rotary magnet M308 is interrupted, due to the fact that no ground potential appears upon the guard conductor thereof, corresponding to the guard conductor C322 of the finder switch 130.

Accordingly, the distributor 300 operates automatically to preselect an idle link in the first group of links immediately after the previously selected link in the first group of links is taken for use by a calling line and operates to find the calling line.

It is noted that the distributor 300 operates in the above-described manner in order to preselect an idle link in the first group of links only in the event that an idle link is available in the first group of links, due to the fact that the busy transfer relay R340 is retained in its operated position at this time only in the event that ground potential is present upon the all-trunks-busy conductor C321, which condition obtains only in the event that there is an idle link available in the first group of links. In the event that all of the links in the first group of links are busy at this time, no ground potential appears upon the all-trunks-busy conductor C321, whereby the circuit for energizing the busy transfer relay R340 is interrupted in order to cause the busy transfer relay R340 to restore. Upon restoring, the busy transfer relay R340 interrupts, at RA344, a further point in the alternative holding circuit for energizing the winding thereof, interrupts, at RA345, a point in the previously traced circuit for energizing the winding of the rotary magnet M308, thereby to prevent operation of the rotary magnet M308, and interrupts, at RA341 and RC343, the connection between the start conductor C316 and the winding of the start relay R345. Also, upon restoring, the busy transfer relay R340 connects, at RA341 and RC342, the conductors C328 and C327 extending to the distributor 312. Accordingly, at this time, the start conductor C316 extending to the distributor 300 is connected, together with the start conductor C315, to the conductor C327 extending to the distributor 312. Hence, at this time, the distributor 312 is operative to assign idle links in the second group of links to the use of calling lines in both the first and second groups of lines.

Continuing now with the release of the distributor 300 incident to the restoration of the start relay R345 and the control relay R350, when the control relay R350 restores it interrupts, at RA351, the previously traced circuit for energizing the start relay R140 in the finder switch 130. Shortly thereafter the start relay R140, being of the slow-to-release type, restores to interrupt, at RA141, the first-mentioned path between the line conductors C116 and C117 of the trunk line 115 and to complete, at RA143, an alternative path for applying ground potential to the guard conductor C322, this path extending from ground, at the switch spring 180 of the set of switch springs S179 by way of the switch springs 180 and 181 of the set of switch springs S179, RA143, and the switch springs 185 and 184 of the busy switch S183 to the guard conductor C322. This application of ground potential to the guard conductor C322 insures that the distributor 300 will not operate to select the busy link 60 at this time. Also, upon restoring, the start relay R140 interrupts, at RA147, a further point in the previously traced circuit for energizing the rotary magnet M171, interrupts, at RA148, a further point in the previously traced circuit for energizing the vertical magnet M170, interrupts, at RA142, a point in the previously mentioned circuit for energizing the second test relay R325 in the distributor 300, and completes, at RA144 and RC145, the previously mentioned circuit for illuminating the supervisory lamp 75

L128, this circuit extending from ground, at RA144, by way of RA144, RC145, the switch springs 186 and 187 of the busy switch S183, the switch springs 178 and 176 of the set of switch springs S175, RA166, RC167 and L128 to battery. The illumination of the supervisory lamp L128 indicates to the exchange attendant that the link 60 is busy upon a call routed therethrough from a line included in the first group of lines.

Also, upon restoring, the control relay R350 in the distributor 300 interrupts, at RA352, the previously traced original circuit for energizing the switching relay R160 in the finder switch 130, interrupts, at RA357, a further point in the previously traced circuit for energizing the lower winding of the transfer relay R360 in the distributor 300, and interrupts, at RA356, a point in the previously traced circuit for energizing the upper winding of the transfer relay R360 and a point in the previously traced holding circuit for energizing the winding of the control relay R380, thereby to cause the transfer relay R360 and the control relay R380 to restore. Upon restoring, the transfer relay R360 interrupts, at RA369, a further point in the holding circuit for energizing the upper winding thereof, interrupts, at RA366 and RC368, a point in the previously traced circuit for energizing the first test relay R320, and prepares, at RA366 and RC367, a point in the previously traced circuit for energizing the lower winding thereof. Also, upon restoring, the transfer relay R360 prepares, at RA365, a point in the previously traced original circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308, interrupts, at RA361 and RC364, a further point in the previously traced circuit for energizing the switching relay R160 in the finder switch 130, and prepares, at RA361 and RC362, a point in a circuit for energizing the vertical magnet in the finder switch of a selected link when the distributor 300 operates to select an idle link in the first group of links to the use of a calling line.

Upon restoring, the control relay R380 interrupts, at RA386, a further point in the holding circuit for energizing the winding thereof, interrupts, at RA385, a point in the holding circuit for energizing the upper winding of the control relay R330, thereby to cause the latter relay to restore, and interrupts, at RA382 and RC384, a further point in the holding circuit for energizing the upper winding of the transfer relay R360. Also, the control relay R380 prepares, at RA382 and RC383, a point in a circuit traced hereinafter for energizing the upper winding of the control relay R390, and interrupts, at RA381, a point in the previously traced alternative circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308.

Upon restoring, the control relay R330 interrupts, at RA336, a further point in the previously traced holding circuit for energizing the lower winding thereof, interrupts, at RA337, a further point in the previously traced circuit for energizing the first test relay R320, and interrupts, at RA338, a point in the previously mentioned circuit for energizing the second test relay R325. Also, the control relay R330 interrupts, at RA333 and RC335, a further point in the holding circuit for energizing the upper winding of the transfer relay R360, prepares, at RA333 and RC334, a point in the previously traced circuit for energizing the timing relay R375, interrupts, at RA330 and RC332, a further point in the pre-

viously traced alternative circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308, and prepares, at RA330 and RC331, a point in the previously traced original circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308.

Upon restoring, the first test relay R320 interrupts, at RA321 and RC323, a further point in the previously traced original circuit for energizing the switching relay R160 in the finder switch 130, and prepares, at RA321 and RC322, a point in a circuit for energizing the rotary magnet in the finder switch of a preselected link. At this time, the distributor 300 is completely released for further use and the subscriber substation A is operatively connected by way of the previously traced circuit to the selector switch 200.

As previously noted, as soon as the finder switch 130 operates to seize the calling subscriber line 101, ground potential is applied therein to the guard conductor C332, thereby to complete the previously traced path for short-circuiting the winding of the control relay R350 in order to cause the control relay R350 to restore and initiate the release of the distributor 300. It is noted that it is not possible to reoperate the relay R350 until the distributor 300 is completely released in spite of the fact that there may be present a calling line in the first group of lines which causes the start relay R375 to remain in its operated condition, due to the fact that, upon restoring, the control relay R350 interrupts, at RA359, the previously traced alternative circuit for energizing the winding thereof in series with the winding of the rotary magnet M308, and the original circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308 is not recompleted until subsequent to the restoration of the transfer relay R360 and the control relay R330, as previously explained. Accordingly, the distributor 300 is completely released each time a finder switch of a link selected thereby operates to find a calling line in spite of the fact that the start relay R345 therein remains operated, due to the presence of other calling lines in the first group of lines.

In the event another calling line is present in the first group of lines at this time, the start relay R345 in the distributor 300 remains in its operated position, and, when the transfer relay R360 and the control relay R330 restore, the previously traced original circuit for energizing the control relay R350 is recompleted, assuming that the rotary magnet M308 has already operated to cause the rotary switch 301 to find an idle link in the first group of links. The control relay R350 then operates, thereby to cause the finder switch of the previously selected link to operate and seize the calling subscriber line in the first group of lines, as explained above.

As previously noted, the distributor 300 is operative to cause the finder switch of a selected link in the first group of links, such as the finder switch 130 of the link 60, to operate and seize a calling line in the second group of lines, which condition may arise when all of the links in the second group of links are busy. In this event, the distributor 312 operates, thereby to cause the conductors C327 and C328 therein to be connected together, in a manner similar to that previously explained, incident to the restoration of the busy transfer relay R340 in the distributor

300 when all of the links in the first group of links are busy. At this time, ground potential applied to the start conductor C315 is extended by way of the conductor C327 and the distributor 312 to the conductor C328, in order to cause the start relay R345 in the distributor 300 to be energized and to operate in the previously described manner. The subsequent operations of the distributor 300 and the finder switch 130 of the link 60, incident to the operation of the start relay R345 in the distributor 300, are the same as previously explained, assuming that the calling line in the second group of lines is also accessible to the upper wiper set of the Strowger mechanism 140 of the finder switch 130.

Furthermore, the finder switch 130 of the link 60 is operative in a manner substantially identical to that previously explained to find a calling line in either the first group of lines or the second group of lines and accessible to the lower wiper set of the switching mechanism 140 thereof. However, in this case, when the carriage of the Strowger mechanism 140 of the finder switch 130 is rotated in the rotary direction to the position of the contact set terminating the calling subscriber line, battery potential is encountered by the wiper 146 in the lower wiper set appearing upon the contact terminating the control conductor of the calling subscriber line. This application of battery potential to the wiper 146 completes the previously mentioned circuit for energizing the second test relay R325 in the distributor 300, this circuit extending from ground at RA338 by way of RA338, the unidirectional current conducting device or copper oxide rectifier 348, the winding of the second test relay R325, the second test conductor C326, RA142, and the control conductor C138 of the trunk line 135 to battery potential appearing upon the wiper 146. When energized over the above-traced circuit, the second test relay R325 operates to interrupt, at RA326 and RC327, a point in the previously traced circuit for energizing the rotary magnet M171 in the finder switch 130, thereby to arrest further operation of the finder switch. Also, upon operating, the second test relay R325 completes, at RA326 and RC328, the previously mentioned circuit for energizing the switching relay R150 in the finder switch 130, this circuit extending from ground, at RA352, by way of RA352, RA371, RA361, RC364, RA321, RC322, RA326, RC328, the wiper 307 and associated contact of the rotary switch 301, the conductor C325, RA160, and the winding of R150 to battery. When energized over the above-traced circuit, the relay R150 operates to interrupt, at RA157, a further point in the previously traced circuit for energizing the rotary magnet M171, and to complete, at RA156, a path for applying ground potential to the guard conductor C322. The path for applying ground potential to the guard conductor C322 extends from ground, at the switch spring 180 of the set of switch springs S179, by way of the switch springs 180 and 181 of the set of switch springs S179, RA156, and the switch springs 185 and 184 of the busy switch S183 to the guard conductor C322. This application of ground potential to the guard conductor C322 causes the distributor 300 to be released and the rotary switch 301 therein to operate and select an idle link in the first group of links, as previously explained.

Also, upon operating, the switching relay R150 interrupts, at RA155, a point in the previously traced circuit for energizing the switching relay

R160, and completes, at RA154, a holding circuit for energizing the winding thereof, this circuit extending from the grounded control conductor C118 of the trunk line 115 by way of RA154 and the winding of R150 to battery. Finally, the switching relay R150 connects the trunk line 135 extending to the lower wiper set of the Strowger mechanism 140 to the trunk line 115. More specifically, the conductors C136, C137 and C138 of the trunk line 135 are respectively connected, at RA151, RA152 and RA153, to the conductors C116, C117 and C118, respectively, of the trunk line 115. When the trunk line 135 is connected to the trunk line 115, the line circuit individually associated with the calling subscriber line and the selector switch 200 operate in the previously described manner.

It is noted that there is a possibility that the upper and lower wiper sets of the Strowger mechanism 140 of the finder switch 130 may simultaneously encounter contact sets in the contact bank terminating calling subscriber lines. In this event, the presence of battery potential appearing upon the contacts in the two contact sets respectively engaged by the wipers 143 and 146 in the upper and lower wiper sets, respectively, of the Strowger mechanism 140 complete the previously traced circuits for respectively energizing the windings of the first and second test relays R320 and R325, respectively, thereby to cause both of these test relays to operate. Upon operating, the first test relay R320 completes, at RA321 and RC323, the previously traced circuit for energizing the switching relay R160, thereby to cause the switching relay R160 to operate, and interrupts, at RA121 and RC122, the previously traced circuit for energizing the switching relay R150, thereby to prevent operation of the switching relay R150. Accordingly, under this condition, the switching relay R160 is operated and the switching relay R150 is not operated. Hence, the finder switch 130 operates to find the calling line accessible to the upper wiper set of the Strowger mechanism 140 thereof in preference to the calling line accessible to the lower wiper set of the Strowger mechanism 140 thereof.

It is noted that, incident to operation of the finder switch 130, the wipers 143 and 146 in the upper and lower wiper sets, respectively, of the Strowger mechanism 140 may engage contacts in the associated contacts of contact sets in the associated contact bank terminating the control conductors of subscriber lines having either ground or booster battery potential appearing thereupon; ground potential appearing upon the control conductors of the subscribers' lines when the subscriber lines are busy, and booster battery potential appearing upon the subscriber lines when the subscriber lines are being metered. When the wiper 143 of the upper wiper set of the Strowger mechanism 140 engages a contact having ground potential appearing thereupon, a path is completed for short-circuiting the winding of the first test relay R320 in the distributor 300, this circuit extending from the grounded control conductor of the subscriber line, by way of the wiper 143 and associated contact, C139, the first test conductor C317, the wiper 302 and associated contact of the rotary switch 301, RA368, RC368, the winding of R320, the copper oxide rectifier 347, and RA337 to ground. When the wiper 143 of the upper wiper set of the Strowger mechanism 140 engages a contact having booster battery potential appearing thereupon, a circuit

is completed substantially identical to the above-traced path, tending to energize the winding of the first test relay R320. However, the copper oxide rectifier 347 is so connected and arranged that current is prevented from traversing this circuit in a direction extending from the wiper 143 to ground at RA337. Accordingly, the first test relay R320 is not effectively energized. Thus, the first test relay R320 does not operate when the wiper 143 of the upper wiper set of the Strowger mechanism 140 engages a contact terminating the control conductor of a subscriber line having either ground or booster battery potential appearing thereon.

In a similar manner, a path is completed for short-circuiting the winding of the second test relay R325 when the wiper 146 in the lower wiper set of the Strowger mechanism 140 engages a contact terminating a control conductor of a subscriber line having ground potential appearing thereon; and a circuit is completed tending to energize the winding of the second test relay R325 when the wiper 146 engages a contact terminating a control conductor of a subscriber line having booster battery potential appearing thereon. However, the copper oxide rectifier 348 prevents the winding of the second test relay R325 from being effectively energized in the last-mentioned case. Hence, the arrangements of the copper oxide rectifiers 347 and 348 in the circuits for respectively energizing the windings of the first and second test relays R320 and R325, respectively, prevent false operation of the finder switch 130 and the consequent seizure thereby of a busy subscriber line having booster battery potential appearing upon the control conductor thereof.

In the foregoing description of the operation of the finder switch 130 of the link 60 to seize the calling subscriber line 101, it was assumed that the finder switch 130 operated properly to seize this calling subscriber line. However, it may occur that the finder switch 130 fails to operate properly to seize the calling subscriber line 101 when the operation thereof is initiated by the distributor 300, due to the fact that the finder switch 130 has become temporarily inoperative. In this event, the finder switch 130 fails to seize the calling subscriber line 101. Accordingly, ground potential is not applied in the finder switch 130 to the guard conductor C322 in order to cause the distributor 300 to be released, as previously explained. Hence, after a predetermined time interval, the vibratory armature RA316 of the timing relay R375 in the distributor 300 assumes an intermediate position between the associated contacts RC377 and RC378, thereby to interrupt the previously traced holding circuit for energizing the control relay R380 in order to cause the control relay R380 to restore. Upon restoring, the control relay R380 interrupts, at RA382 and RC384, the previously traced holding circuit for energizing the upper winding of the transfer relay R360, and completes, at RA382 and RC383, a point in the previously mentioned circuit for energizing the upper winding of the control relay R390. The circuit for energizing the upper winding of the control relay R390 extends from ground, at RA356, by way of RA356, RA333, RC335, RA382, RC383, and the upper winding of R390 to battery. When energized over the above-traced circuit, the control relay R390 operates to complete, at RA392, a holding circuit for energizing the lower winding thereof, this circuit extending from the grounded con-

ductor C330 by way of the switch springs 338 and 337 of the busy switch S334, RA392, and the lower winding of R390 to battery. It is noted that ground potential appears upon the conductor C330 in the distributor 312 so long as ground potential appears upon the all-trunks-busy conductor associated with the finder switches of the links in the second group of links, just as ground potential appears upon the conductor C329 in the distributor 300 so long as ground potential appears upon the all-trunks-busy conductor C321 associated with the finder switches of the links in the first group of links. Also, upon operating, the relay R390 completes, at RA391, a path for short-circuiting the winding of the control relay R350, this path extending from the upper terminal of the winding of R350, by way of RA391, RA353, RC355, MA308, RA345, and the winding of R350 to the upper terminal thereof. When the winding of the control relay R350 is short-circuited, it restores to interrupt, at RA353 and RC355, a point in the previously traced path for short-circuiting the winding thereof, and to complete, at RA353 and RA354, an alternative path for short-circuiting the winding thereof. The alternative path for short-circuiting the winding of the control relay R350 extends from the upper terminal of the winding of R350 by way of RA391, RA353, RC354, and the winding of R350 to the upper terminal thereof. Also, upon restoring, the control relay R350 interrupts, at RA358, a point in the previously traced alternative circuit for energizing the winding of the busy transfer relay R340.

Also, upon operating, the control relay R390 interrupts, at RA393, the previously traced original circuit for energizing the winding of the busy transfer relay R340, and interrupts, at RA394, the normal connection between the conductor C329 extending into the distributor 312 and the winding of the busy transfer relay R340, thereby to cause the busy transfer relay R340 to restore and to insure that it remains in its restored position. Upon restoring, the busy transfer relay R340 completes, at RA341 and RC342, the previously mentioned connection between the conductors C327 and C328 extending to the distributor 312, thereby to cause the distributor 312 to assign links in the second group of links to the use of calling lines in both the first and second groups of lines, as previously explained.

Also, upon operating, the control relay R390 completes, at RA392, a circuit for illuminating the supervisory lamp L309, this circuit extending from the grounded conductor C330 by way of the switch springs 338 and 337 of the busy switch S334, RA392, and the lamp L309 to battery. Illumination of the supervisory lamp L309 indicates to the exchange attendant that the distributor 300 is locked out of service. The release of the remainder of the operated relays in the distributor 300, incident to the restoration of the control relay R350 and the busy transfer relay R340, is the same as that previously described. At this time, the distributor 300 is locked out of service, as previously noted.

It is noted that the distributor 300 remains locked out of service until the busy switch S334 is operated away from its normal position and returned thereto, which switch will not be thus operated until the defective finder switch of one of the links in the first group of links is found and again placed in working order. When the busy switch S334 is operated away from its normal position, the switch springs S337 and S338

are actuated into disengagement, thereby to interrupt the previously traced holding circuit for energizing the lower winding of the control relay R390 in order to cause the control relay R390 to restore. Upon restoring, the control relay R390 reconnects, at RA394, the conductor C329 extending into the distributor 312 to the winding of the busy transfer relay R340, and prepares, at RA393, a point in the previously traced original circuit for energizing the winding of the busy transfer relay R340 by way of the all-trunks-busy conductor C321. When the busy switch S334 is returned to its normal position, there is completed at the switch springs 335 and 336 thereof the previously traced original circuit for energizing the winding of the busy transfer relay R340 by way of the all-trunks-busy conductor C321, in the event one of the links in the first group of links is idle at this time, as previously explained.

It is noted that the finder switch 130 of the link 60 embodies an arrangement for causing the distributor 300 to select another idle link in the first group of links for the use of the calling subscriber line 101 in the event that the finder switch 130 of the selected link 60 in the first group of links fails to find the calling line 101 incident to the operation thereof. More particularly, the set of switch springs S174 in the finder switch 130 is actuated into engagement when the carriage of the Strowger mechanism 140 of the finder switch 130 is driven eleven steps in the rotary direction away from its normal position, due to the failure of the finder switch 130 to find the calling line 101. When the set of switch springs S174 is actuated into engagement, a path is completed for applying ground potential to the guard conductor C322, this path extending from ground, at the set of switch springs S174, by way of the set of switch springs S174, the switch springs 185 and 184 of the busy switch S183 to the guard conductor C322. This application of ground potential to the guard conductor C322 completes the previously traced circuit for energizing the winding of the rotary magnet M308 and for short-circuiting the winding of the control relay R350, thereby to cause the distributor 300 to release and to cause the rotary switch 301 therein to operate and select another idle link in the first group of links for the use of the calling subscriber line 101, in the previously described manner.

It is noted that the finder switch 130 of the link 60 may be rendered busy by operating the busy switch S183. When the busy switch S183 is operated, the switch springs 186, 187 and 184, 185 thereof are actuated into disengagement, and the switch springs 186, 184 thereof are actuated into engagement. When the switch springs 186 and 187 of the busy switch S183 are actuated into disengagement, the previously traced path for applying ground potential in the finder switch 130 to the all-trunks-busy conductor C321 is interrupted; when the switch springs 184 and 185 of the busy switch S183 are actuated into disengagement, a point in the previously traced path for applying ground potential to the guard conductor C322, incident to the operation of the switching relays R150 and R160, is interrupted; and, when the switch springs 186 and 184 of the busy switch S183 are actuated into engagement, a path is completed in the finder switch 130 for applying ground potential to the guard conductor C322. The last-mentioned path for applying ground potential to the guard conductor C322

extends from ground, at RA144, by way of RA144, RC145, and the switch springs 186 and 184 of the busy switch S183, to the guard conductor C322. This application of ground potential to the guard conductor C322 marks the link 60 as busy, thereby to prevent the distributor 300 from selecting the link 60 in the first group of links, or causes the rotary switch 301 in the distributor 300 to operate and select another idle link in the first group of links in the event that the distributor 300 has previously operated to select the link 60 prior to the operation of the busy switch S183 therein. In the event the distributor 300 has operated to select the link 60 in the first group of links prior to operation of the busy switch S183 therein, as explained above, the application of ground potential to the guard conductor C322, incident to the operation of the busy switch S183, causes the rotary switch 301 in the distributor 300 to operate and select another idle link in the first group of links. Specifically, this application of ground potential to the guard conductor C322 completes the previously traced circuit for energizing the winding of the rotary magnet M308 of the rotary switch 301 in the distributor 300. The operation of the rotary magnet M308 to cause the rotary switch 301 to select an idle link in the first group of links is the same as that previously explained.

As previously noted, an arrangement is provided for testing the operation of the distributor 300 and the finder switches of the links associated therewith. This arrangement comprises the busy switch S334 and the test jacks J331, J332 and J333. In order to test the operation of the distributor 300 to select idle links in the first group of links and to test the operation of the selected links in the first group of links, the busy switch S334 is operated away from its normal position and plugs are inserted into the jacks J331 and J332. When the busy switch S334 is operated away from its normal position, a point in the previously traced holding circuit for energizing the lower winding of the control relay R390 is interrupted at the switch springs 337 and 338 thereof, and the previously traced original circuit for energizing the winding of the busy transfer relay R340 is interrupted at the switch springs 335 and 336 thereof. The busy transfer relay R340 then restores to interrupt, at RA344, a further point in the previously traced alternative holding circuit for energizing the winding thereof, to interrupt, at RA345, a point in the previously traced circuit for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308, to interrupt, at RA341 and RC343, a point in the previously traced circuit for energizing the start relay R345, and to complete, at RA341 and RC342, a connection between the conductors C328 and C327 extending into the distributor 312. As previously noted, when the conductors C327 and C328 are connected together, the distributor 312 is operative to assign idle links in the second group of links to the use of calling lines in both the first and second groups of lines. Accordingly, the test of the distributor 300 at this time does not interrupt traffic on the subscriber lines in the first group of lines. When the plug is inserted into the jack J331, an alternative circuit, traced hereinafter, is prepared for energizing the winding of the control relay R350 in series with the winding of the rotary magnet M308; and, when the plug is inserted into the jack J332, an alternative circuit is completed for energizing the winding of

the start relay R345. The last-mentioned circuit extends from ground by way of the jack J332 and associated plug, the resistor 339, and the winding of R345 to battery. When energized over the above-traced circuit, the start relay R345 operates to complete, at RA346, the previously mentioned alternative circuit for energizing in series the winding of the control relay R350 and the winding of the rotary magnet M308, this circuit extending from ground, at RA330, by way of RA330, RC331, RA365, RA346, the winding of R350, the jack J331 and associated plug, MA308, and the winding of M308 to battery. When energized over the above-traced circuit, the control relay R350 operates. However, the rotary magnet M308 does not operate due to the high series resistance of the winding of the control relay R350.

Upon operating, the control relay R350 prepares, at RA357, a point in the previously traced circuit for energizing the lower winding of the transfer relay R360, and completes, at RA356, the previously traced circuit for energizing the winding of the timing relay R375, thereby to initiate the timing operation of the relay R375 and the control relays R380, R390 and R330 in the previously described manner. Also, upon operating, the control relay R350 prepares, at RA359, a point in an alternative circuit for energizing the winding thereof in series with the winding of the rotary magnet M308; prepares, at RA353 and RC355, a point in the previously traced circuit for energizing the winding of the rotary magnet M308 directly from the guard conductor C322; prepares, at RA352, a point in the previously traced circuit for energizing the vertical magnet of the finder switch of the selected link, and completes, at RA351, the previously traced circuit for energizing the start relay of the finder switch of the selected link. Assuming that the rotary switch 301 has previously operated to select the link 60, when the control relay R350 operates it completes, at RA351, the previously traced circuit for energizing the start relay R140 in the finder switch 130 of the link 60. Upon operating, the start relay R140 completes, at RA148, the previously traced circuit for energizing the vertical magnet M170, thereby to initiate operation of the finder switch 130, in the previously described manner. The vertical magnet M170 and the step relay R370 in the distributor 300 interact in the previously described manner, thereby to cause the carriage of the Strowger mechanism 140 of the finder switch 130 to be driven step by step in the vertical direction. In the event that there is a calling line in either the first or second group of lines at this time, the finder switch 130 operates, in the previously described manner, in order to seize the calling subscriber line. However, in the event there is no calling line at this time in either the first or second group of lines, the carriage of the Strowger mechanism 140 of the finder switch 130 is first driven in the vertical direction ten steps away from its normal position, whereupon the control wiper 147 associated with the row of contacts engages the grounded contact 148', thereby to complete the previously traced circuit for energizing the lower winding of the transfer relay R360 in order to cause the transfer relay R360 to operate. Upon operating, the transfer relay R360 completes, at RA361 and RC364, the previously traced circuit for energizing the rotary magnet M171. The rotary magnet M171 then operates to drive the carriage of the Strowger mechanism 140 in the finder switch 130 step by step in the rotary direction

eleven steps away from its normal position, whereupon the set of switch springs S174 is actuated into engagement. When the set of switch springs S174 is actuated into engagement, the previously traced path for applying ground potential to the guard conductor C322 is completed, thereby to cause the distributor 300 to release and to cause the rotary switch 301 to operate and select another idle link in the first group of links in the previously described manner. When another idle link in the first group of links is selected in the previously described manner, the distributor 300 again operates to cause the finder switch of this link either to seize a calling line in the first or second group of lines or to be operated, in the above-described manner. The distributor 300 and the idle links in the first group of links are re-operated in the above-described manner so long as the busy switch S334 remains operated away from its normal position and the plugs are retained in the jacks J331 and J332. In order to restore the operation of the distributor 300 to normal, the busy switch S334 is returned to its normal position and the plugs are removed from the jacks J331 and J332.

In order to test the timing operation of the distributor 300, plugs are inserted into the jacks J332 and J333, while the busy switch S334 remains in its normal position. When the plug is inserted in the jack J332, the previously traced alternative circuit for energizing the start relay R345 is completed; and, when the plug is inserted into the jack J333, an alternative circuit is completed for energizing the winding of the step relay R370. The last-mentioned circuit extends from ground by way of the jack J333 and associated plug, and the winding of R370 to battery. When energized over the above-traced circuit, the step relay R370 operates to interrupt, at RA371, a point in the previously traced circuit for energizing the vertical magnet of the finder switch of the selected link, thereby to prevent operation of the finder switch of the selected link. The operation of the start relay R345 causes operation of the control relay R350, as previously explained. Upon operating, the control relay R350 completes, at RA356, the previously traced circuit for energizing the timing relay R375, which latter relay operates to complete, at RA376 and RC378, RC379, the previously traced circuit for energizing the winding of the control relay R380, thereby to cause the latter relay to operate shortly thereafter. Upon operating, the control relay R380 completes, at RA385, the previously traced circuit for energizing the upper winding of the control relay R330, thereby to cause the latter relay to operate. Upon operating, the control relay R330 completes, at RA336, the previously traced holding circuit for energizing the lower winding thereof, and interrupts at RA333 and RC334, the previously traced circuit for energizing the timing relay R375, thereby to cause the latter relay to restore. Upon restoring, the timing relay R375 sets the weighted armature RA376 into operation, thereby to retain the control relay R380 in its operated position for a predetermined interval, after which the relay R380 restores. Upon restoring, the control relay R380 completes, at RA382 and RC383, the previously traced circuit for energizing the upper winding of the control relay R390, thereby to cause the latter relay to operate. Upon operating, the control relay R390 completes, at RA392, the previously traced holding circuit for energizing the lower winding thereof and for illuminating the supervisory lamp L309. The operation of the con-

trol relay R390 locks the distributor 300 out of service and the illumination of the supervisory lamp L309 indicates to the exchange attendant this condition of the distributor 300, as previously explained.

In order to restore normal operation of the distributor 300, the plugs are removed from the jacks J332 and J333, and the busy switch S334 is operated away from its normal position and then returned to its normal position, as previously explained.

Continuing now with the operation of the selector switch 200 to extend a call from the subscriber substation A to the subscriber substation B, when the finder switch 130 operates to seize the calling subscriber line 101, the selector switch 200 is rendered operative in response to impulses transmitted thereto from the subscriber substation A. At this time, the line relay R260, the hold relay R270 and the transfer relay R290 in the selector switch 200 occupy their operated positions, as previously explained.

It is noted that the test relay R265 in the selector switch 200 is of the shunt field type and comprises a field structure including an L-shaped leg L266, two core legs L267 and L268, a shunt leg L269 and a movable armature RA265, two windings being respectively carried on the core legs L267 and L268. The test relay R265 is so connected and arranged that, when the winding on the core leg L267 is energized, a magnetic flux is produced in the field structure which traverses a first magnetic path extending from the core leg L267 by way of the base of the leg L266, the core leg L268, and the shunt leg L269 to the core leg L267, thereby to polarize the field structure of the test relay R265. When the winding on the core leg L268 is energized with current of one polarity, an additional magnetic flux is produced in the field structure of the test relay R265 which traverses the first magnetic path, this magnetic flux being accumulative with the magnetic flux produced by the winding on the core leg L267. Accordingly, the armature RA265 of the test relay R265 is not operated with respect to the field structure thereof. On the other hand, when the winding on the core leg L268 is energized with current of the opposite polarity, a magnetic flux is produced in the shunt leg L269 which is in opposition to the magnetic flux traversing the shunt leg L269 by way of the first magnetic path. Accordingly, the magnetic flux produced by the winding on the core leg L267 of the field structure is diverted from the shunt leg L269 into a second magnetic path extending from the leg L266 by way of the core legs L267 and L268, and the armature RA265 to the leg L266. Accordingly, the armature RA265 is attracted to the field structure of the test relay R265, thereby to operate the test relay.

The subscriber at the substation A then dials the first digit of the directory number of the called subscriber substation B at the dial mechanism at the substation A, thereby to transmit a first series of impulses by way of the subscriber loop circuit to the line relay R260 in the selector switch 200. The relay R260 follows the dialed impulses in the usual manner, restoring each time the loop circuit is interrupted and operating each time the loop circuit is completed. Each time the line relay R260 restores, it interrupts, at RA261 and RC262, the previously traced circuit for energizing the hold relay R270, and completes, at RA261 and RC263, the pre-

viously mentioned circuit for energizing in multiple the lower winding of the transfer relay R290 and the winding of the vertical magnet M236. The last-mentioned circuit extends from ground, at RA210, by way of RA210, RA261, RC263 and RA274 to RC275, one branch of this circuit extending from RC275 by way of the lower winding of R290 to battery, and the other branch of this circuit extending from RC275 by way of the winding of M236 to battery. The hold relay R270 and the transfer relay R290 are of the slow-to-release type. Thus, these relays remain operated during impulsing. Each time the vertical magnet M236 is energized, the carriage of the Strowger mechanism 201 of the selector switch 200 is driven one step in the vertical direction.

When the carriage of the Strowger mechanism 201 is moved away from its normal position one step in the vertical direction, the sets of switch springs S277, S278, and S239 are actuated. More particularly, the set of switch springs S277 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R290; the set of switch springs S278 is actuated into engagement, thereby to prepare a circuit, traced hereinafter, for energizing the winding of the rotary magnet M237; and the set of switch springs S239 is actuated into engagement, thereby to prepare a circuit traced hereinafter for energizing the winding of the release magnet M238. At the conclusion of the first digit dialed, the relay R260 reoperates, thereby to interrupt, at RA261 and RC263, the previously traced circuit for energizing in multiple the lower winding of the transfer relay R290, and the winding of the vertical magnet M236. When this circuit is interrupted, further operation of the vertical magnet M236 is positively arrested, thereby to arrest the carriage of the Strowger mechanism 201 of the selector switch 200 in a vertical position corresponding to the first digit dialed and to the level in the contact bank of this Strowger mechanism in which are disposed the contact sets terminating the trunks extending to the group of connector switches including the connector switch 215, assuming that this group of connector switches has access to the subscriber line 230 extending to the subscriber substation B.

Shortly after the previously traced circuit for energizing the lower winding of the transfer relay R290 is interrupted, the latter relay restores. Upon restoring, the transfer relay R290 prepares, at RA292, a further point in the previously mentioned circuit for energizing the release magnet M238, and completes, at RA291, the previously mentioned circuit for energizing the winding of the rotary magnet M237. The last-mentioned circuit extends from ground, at RA272, by way of RA272, RA266, RC267, RA218, MA237, RA291, the set of switch springs S278, and the winding of M237 to battery. When energized over the above-traced circuit, the rotary magnet M237 operates, thereby to drive the carriage of the Strowger mechanism 201 of the selector switch 200 one step in the rotary direction, and to interrupt, at MA237, a point in the previously traced circuit for energizing the winding thereof, thereby to cause the rotary magnet M237 to restore. Upon restoring, the rotary magnet M237 re completes, at MA237, the previously traced circuit for energizing the winding thereof.

The rotary magnet M237 continues to operate in buzzer fashion, thereby to drive the carriage of

the Strowger mechanism 201 step by step in the rotary direction until the wiper set thereof engages a contact set in the contact bank terminating a trunk line extending to an idle connector switch in the group of connector switches including the connector switch 215. Assuming that the connector switch 215 is the first idle connector switch in this group of connector switches, further operation of the rotary magnet M237 is arrested when the wiper 204 of the wiper set of the Strowger mechanism 201 engages the contact in the contact set terminating the control conductor C214 of the trunk line 211 extending to the connector switch 215, the connector switch 215 being marked as idle by the presence of battery potential upon the control conductor C214 of the trunk line 211. This application of battery potential to the control conductor C214 of the trunk line 211 completes the previously mentioned circuit for energizing the winding on the core leg L268 of the field structure of the test relay R265, this circuit extending from ground, at RA273, by way of RA273, the winding on the core leg L268, the wiper 204 and associated contact, and the control conductor C214 of the trunk line 211 to battery in the connector switch 215. When energized over the above-traced circuit, the winding on the core leg L268 of the field structure of the test relay R265 causes the test relay R265 to operate, as previously explained. Upon operating, the test relay R265 interrupts, at RA266 and RC267, a point in the previously traced circuit for energizing the rotary magnet M237, and completes, at RA266 and RC268, a circuit for energizing the switching relay R210, this circuit extending from ground, at RA272, by way of RA272, RA266, RC268, and the winding of R210 to battery. When energized over the above-traced circuit, the switching relay R210 operates to complete, at RA219, a holding circuit for energizing the winding thereof, this circuit extending from the grounded control conductor C118 of the trunk line 115 by way of RA219 and the winding of R210 to battery. Also, upon operating, the switching relay R210 interrupts, at RA218, a further point in the previously traced circuit for energizing the winding of the rotary magnet M237, and connects the trunk line 115 to the wiper set of the Strowger mechanism 201, thereby to complete a loop circuit between the subscriber substation A and the connector switch 215. At this time, the line conductor C116 of the trunk line 115 is connected by way of RA211, RC212, and the wiper 201 and associated contact to the line conductor C212 of the trunk line 211; the line conductor C117 of the trunk line 115 is connected by way of RA214, RC215, and the wiper 203 and associated contact to the line conductor C213 of the trunk line 211; and the control conductor C118 of the trunk line 115 is connected by way of RA217 and the wiper 204 and associated contact to the control conductor C214 of the trunk line 211. Thus, ground potential appearing upon the control conductor C118 of the trunk line 115 is extended by way of the control conductor C214 of the trunk line 211 to the connector switch 215, thereby to cause the connector switch to operate and complete a loop circuit between the line conductor C212 and C213 of the trunk line 211 and extending to the subscriber substation A. Also, the connector switch 215 operates to cause ground potential therein to be applied to the control conductor C214 of the trunk line 211, thereby to retain the finder switch

130 and the selector switch 200 of the link 60 in their operated positions.

Also, upon operating, the switching relay R210 interrupts, at RA210, a point in the previously traced circuit for energizing the hold relay R270, and interrupts, at RA211 and RC213, and at RA214 and RC216, points in the previously traced circuit for energizing in series the upper and lower windings of the line relay R260. The line relay R260 immediately restores and, shortly thereafter, the hold relay R270 restores. Upon restoring, the hold relay R270 interrupts, at RA272, the previously traced circuit for energizing the winding on the core leg L267 of the field structure of the test relay R265, and interrupts, at RA273, the previously traced circuit for energizing the winding on the core leg L268 of the field structure of the test relay R265, thereby to cause the test relay R265 to restore. At this time, the switching relay R210 in the selector switch 200 remains in its operated position due to the completed holding circuit for energizing the winding thereof including the control conductor C214 of the trunk line 211. Also, at this time, the connector switch 215 is conditioned to be responsive to impulses transmitted thereto by way of the loop circuit extending thereto from the calling subscriber substation A.

It is noted that, when the connector switch 215 is busy, ground potential appears upon the control conductor C214 of the trunk line 211 extending thereto, this ground potential being derived at RC222 of the battery reversing relay R220 therein and extending from RC222 by way of RC222, RA223 and other elements, not shown, to the control conductor C214. Also, during the course of operation of the connector switch 215, booster battery potential appears upon the control conductor C214 of the trunk line 211 extending thereto, this booster battery potential being derived at the battery 223 in the connector switch 215 and extending therefrom by way of RA221, RA223 and other elements, not shown, to the control conductor C214.

It is noted that the selector switch 200 is so connected and arranged that it will not operate to seize the trunk line 211 when either ground potential or booster battery potential appears upon the control conductor C214. When the wiper 204 of the wiper set of the Strowger mechanism 201 engages the contact in the contact set terminating the control conductor C214 of the trunk line 211, a path is completed for short-circuiting the winding on the core leg L268 of the field structure of the test relay R265 when ground potential appears upon the control conductor C214 of the trunk line 211, this circuit extending from ground, at RA273, by way of RA273, the winding on the core leg L268, and the wiper 204 and associated contact to the grounded control conductor C214 of the trunk line 211. When the wiper 204 of the wiper set of the Strowger mechanism 201 engages the contact in the contact set terminating the control conductor C214 of the trunk line 211, a path is completed for energizing the winding on the core leg L268 of the field structure of the test relay R265 when booster battery potential appears upon the control conductor C214 of the trunk line 211, this circuit extending from the grounded booster battery source of potential in the connector switch 215, by way of the control conductor C214 of the trunk line 211, the wiper 204 and associated contact, the winding on the core leg L268 to ground at RA273. Although the winding on

the core leg L268 of the field structure of the test relay R265 is energized in the present instance, the magnetic flux produced in the shunt leg L269 of the field structure of the test relay R265 is accumulative with the magnetic flux produced therein by the winding on the core leg L267 thereof. Accordingly, the test relay R265 is not operated at this time, as previously noted.

Continuing now with the operation of the connector switch 215 to seize the called subscriber line 230 extending to the subscriber substation B, the subscriber at the calling subscriber substation A then dials two additional digits into the connector switch 215, thereby to cause the connector switch 215 to operate, in the usual manner, and seize the called subscriber line 230. In the event the called subscriber line 230 is busy, ground potential appears upon the control conductor C234 thereof, thereby to cause the connector switch 215 to operate and return busy tone current over the loop circuit extending to the calling subscriber substation A, in the usual manner. On the other hand, in the event the called subscriber line 230 is idle, battery potential appears upon the control conductor C234 thereof, this battery potential being derived at the upper terminal of the winding of the cutoff relay R245 of the line circuit 240, individually associated with the subscriber line 230, and extending therefrom by way of the winding of R245, RC253 and RA252 to the control conductor C234.

The connector switch 215 then operates to cause direct ground potential to be applied to the wiper 228 of the wiper set of the Strowger mechanism 225, thereby to complete a circuit for energizing the cutoff relay R245. The circuit for energizing the cutoff relay R245 extends from ground potential appearing in the connector switch 215 by way of the wiper 228 and associated contact of the Strowger mechanism 225, the control conductor C234 of the subscriber line 230, RA252, RC253 and the winding of R245 to battery. When energized over the above-traced circuit, the cutoff relay R245 operates to interrupt, at RA248 and at RA249, the circuit for energizing the line relay R250, and to complete, at RA247, a path for applying ground potential to the control conductor C235 of the subscriber line 230, this path extending from ground potential appearing upon the control conductor C234 of the subscriber line 230, by way of RA252, RC253 and RA247 to the control conductor C235. This application of ground potential to the control conductor C235 marks the called subscriber line 230 as busy to the finder switches of the links having access thereto. Also, upon operating, the cutoff relay R245 completes, at RA246, a circuit for energizing the winding of the meter relay R219, assuming that the upper terminal of the meter relay R219 is connected to the conductor C218, this circuit extending from the grounded control conductor C234 of the subscriber line 230, by way of RA252, RC253, RA246, the conductor C218, and the winding of R219 to battery. Although the winding of the meter relay R219 is energized over the above-traced circuit, this relay does not operate at this time due to the fact that it is of the marginal type.

After seizing the called subscriber line 230, the connector switch 215 operates to cause ringing current to be projected over the line conductors C231 and C232 of the subscriber line 230 in the usual manner, thereby to cause the ringer at the called substation B to operate. When the

subscriber at the substation B answers the call by removing the telephone receiver of the telephone instrument thereat from its hook, a loop circuit is completed by way of the line conductors of the subscriber line 230 to the connector switch 215, thereby to cause the battery reversing relay R220 in the connector switch 215 to operate in the usual manner. Also, the connector switch 215 operates to complete a connection between the calling subscriber loop circuit extending thereto from the subscriber substation A and the called subscriber loop circuit extending thereto from the substation B. Upon operating, the battery reversing relay R220 in the connector switch 215 completes, at RA221 and RA223, the previously traced path for connecting booster battery potential to the control conductor C214 of the trunk line 211, and interrupts at RA223 and RC222, the previously traced path for connecting ground potential to the control conductor C214 of the trunk line 211. This application of booster battery potential to the control conductor C214 of the trunk line 211 completes a circuit for effectively energizing the winding of the meter relay R109 associated with the line circuit 100 individually associated with the calling subscriber line 101, this circuit extending from booster battery potential appearing upon the control conductor C214 of the trunk line 211, by way of the wiper 204 and associated contact of the Strowger mechanism 201 of the selector switch 200, RA217, C118, RA163, C134, the wiper 143 and associated contact of the Strowger mechanism 140 of the finder switch 130, the control conductor C104 of the subscriber line 101, RA113, RA114, C108, and the winding of R109 to battery. When energized over the above-traced circuit, the meter relay R109 operates, thereby to cause a call register associated therewith to be actuated in the usual manner. It is noted that booster battery potential appearing upon the control conductor C118 of the trunk line 115 extending between the finder switch 130 and the selector switch 200 of the link 60, and upon the control conductor C104 of the subscriber line 100, retains these switches and the line circuit 100 in their operated positions. Shortly after the connector switch 215 operates to cause booster battery potential to be applied to the control conductor C214 of the trunk line 211, it again operates to cause booster battery potential to be removed from the control conductor C214 and ground potential to be reapplied thereto, thereby to retain the link 60 and the line circuit 100 in their operated positions.

The release of the established connection between the subscriber substations A and B is under the control of the subscribers thereat and, when both of the subscribers replace the receivers of the telephone instruments upon their associated switchhooks at the substations A and B, the connector switch 215 first releases. When the connector switch 215 is released, the Strowger mechanism 225 thereof is returned to its normal position and ground potential is removed in the connector switch 215 from the control conductor C214 of the trunk line 211. When the Strowger mechanism 225 of the connector switch 215 is returned to its normal position, the previously traced circuit for energizing the cutoff relay R245 in the line circuit 240 is interrupted, thereby to cause the cutoff relay R245 to restore. Upon restoring, the cutoff relay R245 interrupts, at RA246, a point in the previously traced circuit for energizing the meter relay R219, inter-

rupts, at RA247, a point in the previously traced path for applying ground potential to the control conductor C235 of the subscriber line 230, and prepares, at RA248 and at RA249, points in the previously mentioned circuit for energizing the line relay R250. At this time, the line circuit 240 individually associated with the subscriber line 230 is completely released.

When ground potential is removed from the control conductor C214 of the trunk line 211, the previously traced path for connecting ground potential to the control conductor C118 of the trunk line 115 extending between the finder switch 130 and the selector switch 200 of the link 60 is interrupted. When ground potential is removed from the control conductor C118 of the trunk line 115, the previously traced holding circuit for energizing the winding of the switching relay R210 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the switching relay R210 interrupts, at RA219, a further point in the holding circuit for energizing the winding thereof, prepares, at RA218, a point in the previously traced circuit for energizing the winding of the rotary magnet M237, and interrupts, at RA211 and RC212, at RA214 and RC215 and at RA217 the connection between the trunk line 115 and the wiper set of the Strowger mechanism 201, and prepares, at RA211 and RC213, and at RA214 and RC216, points in the previously traced circuit for energizing in series the upper and lower windings of the line relay R260. Also, upon restoring, the switching relay R210 completes, at RA210, the previously mentioned circuit for energizing the release magnet M238, this circuit extending from ground, at RA210, by way of RA210, RA261, RC263, RA274, RC276, RA292, the set of switch springs S239, and the winding of M238 to battery. When energized over the above-traced circuit, the release magnet M238 operates, thereby to release the carriage of the Strowger mechanism 201 in order to cause it to be returned to its normal position. When the carriage of the Strowger mechanism 201 is returned to its normal position, the sets of switch springs S239, S277 and S278 are actuated. More particularly, the set of switch springs S239 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the winding of the release magnet M238; the set of switch springs S277 is actuated into engagement, thereby to prepare a point in the previously traced circuit for energizing the upper winding of the transfer relay R290; and the set of switch springs S278 is actuated into disengagement, thereby to interrupt a further point in the previously traced circuit for energizing the winding of the rotary magnet M237. At this time, the selector switch 200 is completely released.

When ground potential is removed from the control conductor C118, the previously traced circuit for energizing the switching relay R160 in the finder switch 130 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the switching relay R160 prepares, at RA165, a point in the previously traced circuit for energizing the winding of the rotary magnet M171, interrupts, at RA169, a point in the previously traced path for applying ground potential to the guard conductor C322, interrupts, at RA164, a further point in the holding circuit for energizing the winding thereof, prepares, at RA160, a point in the previously traced circuit for energizing the winding of the switching relay R150,

and interrupts, at RA161, at RA162 and at RA163, the connection between the trunk line 115 and the trunk line 131. Also, upon restoring, the switching relay R160 interrupts, at RA166 and RC167, the previously traced circuit for illuminating the supervisory lamp L128, and completes, at RA166 and RC168, the previously mentioned circuit for energizing the winding of the release magnet M172. The last-mentioned circuit extends from ground, at RA144, by way of RA144, RC145, the switch springs 186 and 187 of the busy switch S183, the switch springs 178 and 176 of the set of switch springs S175, RA166, RC168, RA158, and the winding of M172 to battery. When energized over the above-traced circuit, the release magnet M172 operates, thereby to release the carriage of the Strowger mechanism 140 and to cause it to be returned to its normal position. When the carriage of the Strowger mechanism is returned to its normal position, the sets of switch springs S175 and S179 are actuated. More particularly, the switch springs 180 and 181 of the set of switch springs S179 are actuated into disengagement, thereby to interrupt a further point in the previously traced path for applying ground potential to the guard conductor C322; the switch springs 181 and 182 are actuated into engagement, thereby to connect the guard conductor C322 to the control conductor C118 of the trunk line 115; the switch springs 176 and 178 of the set of switch springs S175 are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the winding of the release magnet M172; and the switch springs 177 and 178 of the set of switch springs S175 are actuated into engagement, thereby to complete the previously traced path for applying ground potential in the finder switch 130 to the all-trunks-busy conductor C321. The previously mentioned connection between the guard conductor C322 and the control conductor C118 of the trunk line 115 extends from the guard conductor C322, by way of the switch springs 184 and 185 of the busy switch S183, RA143, and the switch springs 181 and 182 of the set of switch springs S179 to the control conductor C118 of the trunk line 115. The connection of the guard conductor C322 to the control conductor C118 of the trunk line 115 insures that the link 60 will not be selected by the distributor 300 for the use of a calling one of the lines unless both the finder switch 130 and the connector switch 200 thereof are completely released. At this time, the finder switch 130 is completely released. Accordingly, the link 60 is completely released and is available to be selected by the distributor 300 for the use of a calling one of the lines.

When ground potential is removed from the control conductor C118 of the trunk line 115, the previously traced circuit for energizing the cutoff relay R110 in the line circuit 100 individually associated with the subscriber line 101 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the cutoff relay R110 interrupts, at RA113, a further point in the holding circuit for energizing the winding thereof, prepares, at RA111 and at RA112, points in the previously traced circuit for energizing the line relay R120, and interrupts, at RA114, the previously traced circuit for energizing the meter relay R109 associated with the line circuit 100. At this time, the line circuit 100 is completely released and the subscriber line 101 is marked as

idle to the connector switches having access thereto.

From the foregoing description of the operation of the apparatus incorporated in the telephone system to extend a connection from the calling subscriber substation A to the called subscriber substation B, it will be readily understood that a connection may be extended from the calling subscriber substation A to the operator position 210 in a similar manner, in which case only one digit is dialed at the calling subscriber substation A into the associated link after the finder switch of the associated link has seized the calling subscriber line 101. Assuming that the finder switch 130 of the link 60 has seized the calling subscriber line 101 in the previously described manner, the connection is extended to the operator position 210 by the subscriber at the subscriber substation A upon dialing a predetermined digit into the selector switch 200, thereby to cause the Strowger mechanism 201 in the selector switch 200 to operate and seize an idle trunk line in the group of trunk lines including the trunk line 205 extending to the operator position 210. The operation of the selector switch 200, incident to the seizure of the idle trunk line in the group of trunk lines extending to the operator position, is the same as that previously described. Assuming that the Strowger mechanism 201 of the selector switch 200 operates to seize the trunk line 205, a connection is then completed between the calling subscriber substation A and the operator position 210.

At least some of the subscriber substations are included in a particular class, each of which subscriber substation has a subscriber line extending thereto provided with a modified form of line circuit individually associated therewith. Assuming that the subscriber substation A is included in the class mentioned, the class tone lead C107 will be connected to the conductor C108 in the line circuit 100 individually associated with the subscriber line 101. In this case, when a call is completed between the subscriber substation A and the operator position 210, a signal is operated at the operator position 210 indicating that the call extending thereto originated at a subscriber substation in the class mentioned. The circuit for operating the signal at the operator position 210 extends from the ungrounded terminal of a source of potential appearing upon the class tone lead C107 by way of the condenser 126, the conductor C108, RA114, RA113, C104, the wiper 143 and associated contact of the Strowger mechanism 140 of the finder switch 130, C134, RA163, the control conductor C118 of the trunk line 115, RA217, the wiper 204 and associated contact of the Strowger mechanism 201 of the selector switch 200, the control conductor C208 of the trunk line 205 extending to the operator position 210, and the signal at the operator position 210 to ground. The release of this established connection between the calling subscriber substation A and the operator position 210 is the same as that previously described and is under the joint control of the subscriber at the substation A and the operator at the operator position 210.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, first and second groups of lines; a number of finder switches; each of said finder switches including first and second wiper sets movable in vertical and rotary directions and respectively having access to said first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and rotary movements of said wiper sets, a trunk line normally disconnected from said wiper sets, first and second switching relays operative respectively to connect said first and second wiper sets to said trunk line, and means responsive to the operation of one of said switching relays for preventing the operation of the other of said switching relays; and a distributor associated with said finder switches; said distributor including means operative to select an idle one of said finder switches, means for governing the vertical and the rotary magnets of a selected one of said finder switches, a first test relay operative in response to the seizure of a calling line by the first wiper set in the selected finder switch, a second test relay operative in response to the seizure of a calling line by the second wiper set in the selected finder switch, means responsive to the operation of said first test relay for causing the operation of the first switching relay in the selected finder switch, means responsive to the operation of said second test relay for causing the operation of the second switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of said selecting means.

2. In a telephone system, first and second groups of lines; a number of finder switches; each of said finder switches including first and second wiper sets movable in vertical and rotary directions and respectively having access to said first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and rotary movements of said wiper sets, a trunk line normally disconnected from said wiper sets, first and second switching relays operative respectively to connect said first and second wiper sets to said trunk line, an operating circuit individual to each of said switching relays, and means responsive to the operation of one of said switching relays for interrupting the operating circuit of the other of said switching relays; and a distributor associated with said finder switches; said distributor including means operative to select an idle one of said finder switches, means for governing the vertical and the rotary magnets of a selected one of said finder switches, a first test relay operative in response to the seizure of a calling line by the first wiper set in the selected finder switch, a second test relay operative in response to the seizure of a calling line by the second wiper set in the selected finder switch, means responsive to the operation of said first test relay for completing the operating circuit of the first switching relay in the selected finder switch, means responsive to the operation of said second test relay for completing the operating circuit of the second switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of said selecting means.

3. In a telephone system, first and second groups of lines; a number of finder switches; each

of said finder switches including first and second wiper sets movable in vertical and rotary directions and respectively having access to said first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and rotary movements of said wiper sets, a trunk line normally disconnected from said wiper sets, first and second switching relays operative respectively to connect said first and second wiper sets to said trunk line, an operating circuit individual to each of said switching relays; and a distributor associated with said finder switches; said distributor including means operative to select an idle one of said finder switches; means for governing the vertical and the rotary magnets of a selected one of said finder switches, a first test relay operative in response to the seizure of a calling line by the first wiper set in the selected finder switch, a second test relay operative in response to the seizure of a calling line by the second wiper set in the selected finder switch, means responsive to the operation of said first test relay for completing the operating circuit of the first switching relay and for interrupting the operating circuit of the second switching relay in the selected finder switch, means responsive to the operation of said second test relay for completing the operating circuit of the second switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of said selecting means.

4. In a telephone system, first and second groups of lines; a number of finder switches; each of said finder switches including first and second wiper sets movable in vertical and rotary directions and respectively having access to said first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and rotary movements of said wiper sets, a trunk line normally disconnected from said wiper sets, first and second switching relays operative respectively to connect said first and second wiper sets to said trunk line, and means responsive to the operation of one of said switching relays for preventing the operation of the other of said switching relays; and a distributor associated with said finder switches; said distributor including means operative to select an idle one of said finder switches, means for governing the vertical and the rotary magnets of a selected one of said finder switches, first and second test relays, an operating circuit individual to each of said test relays, means responsive to the seizure of a calling line by the first wiper set in the selected finder switch for completing the operating circuit of said first test relay, means responsive to the seizure of a calling line by the second wiper set in the selected finder switch for completing the operating circuit of said second test relay, means responsive to the operation of said first test relay for causing the operation of the first switching relay in the selected finder switch, means responsive to the operation of said second test relay for causing the operation of the said switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of said selecting means.

5. In a telephone system, first and second groups of lines; each of said lines including a control conductor adapted to have connected thereto, different potentials depending upon the

condition of the line and including a calling potential and a metering potential; a number of finder switches; each of said finder switches including first and second wiper sets movable in vertical and rotary directions and respectively having access to said first and second groups of lines, vertical and rotary magnets operative respectively to control the vertical and rotary movements of said wiper sets, a trunk line normally disconnected from said wiper sets, first and second switching relays operative respectively to connect said first and second wiper sets to said trunk line, and means responsive to the operation of one of said switching relays for preventing the operation of the other of said switching relays; and a distributor associated with said finder switches; said distributor including means operative to select an idle one of said finder switches, means for governing the vertical and the rotary magnets of a selected one of said finder switches, first and second test relays, a circuit individual to each of said test relays and including a winding thereof, means responsive to the encounter of a line by the first wiper set in the selected finder switch for completing the circuit individual to said first test relay in the event that a calling potential or a metering potential is connected to the control conductor thereof, means for blocking the flow of current in the circuit individual to said first test relay in the event that a metering potential is connected to the control conductor of the last-mentioned line, thereby to prevent the winding of said first test relay from being effectively energized, means responsive to the encounter of a line by the second wiper set in the selected finder switch for completing the circuit individual to said second test relay in the event that a calling potential or a metering potential is connected to the control conductor thereof, means for blocking the flow of current in the circuit individual to said second test relay in the event that a metering potential is connected to the control conductor of the last-mentioned line, thereby to prevent the winding of said second test relay from being effectively energized, each of said test relays being operated when the winding thereof is effectively energized, means responsive to the operation of said first test relay for causing the operation of the first switching relay in the selected finder switch, means responsive to the operation of said second test relay for causing the operation of the second switching relay in the selected finder switch, and means responsive to the operation of either one of the switching relays in the selected finder switch for causing the operation of said selecting means.

6. In a telephone system, an automatic switch comprising a contact bank including a group of test contacts, each of said test contacts being adapted to have connected thereto an idle potential, a busy potential or a metering potential, a test wiper having access to said test contacts, a test relay having a field structure provided with a first magnetic path including a shunt leg and a second magnetic path including a movable armature, first and second windings associated with said field structure, a first circuit for energizing said first winding, a second circuit including said test wiper for energizing said second winding, said first winding being effective when energized with current flowing in said first circuit to produce a magnetic flux in said field structure traversing said first magnetic path, said second winding being effective when energized with

current flowing in a first direction in said second circuit to produce a magnetic flux in said field structure traversing said first magnetic path and being effective when energized with current flowing in a second direction in said second circuit to produce a magnetic flux in said field structure opposing the magnetic flux traversing said shunt leg, thereby to divert magnetic flux from said first magnetic path into said second magnetic path, said test relay being so constructed and arranged that it is operated when magnetic flux traverses said second magnetic path, means for seizing said switch, means responsive to the seizure of said switch for completing said first circuit, automatic means operative to drive said test wiper step by step over said test contacts, said second circuit being so connected and arranged that no current flows therein when said test wiper engages a test contact having a busy potential connected thereto, that current flows therein in said first direction when said test wiper engages a test contact having a metering potential connected thereto and that current flows therein in said second direction when said test wiper engages a test contact having an idle potential connected thereto, and means controlled by the operation of said test relay for arresting the operation of said automatic means.

7. In a telephone system, an automatic switch comprising a contact bank including a group of test contacts, each of said test contacts being adapted to have connected thereto an idle potential, a busy potential or a metering potential, a test wiper having access to said test contacts, a test relay having a field structure provided with a first magnetic path including a shunt leg and a second magnetic path including a movable armature, first and second windings associated with said field structure, a first circuit for energizing said first winding, a second circuit including said test wiper for energizing said second winding, said first winding being effective when energized with current flowing in said first circuit to produce a magnetic flux in said field structure traversing said first magnetic path, said second winding being effective when energized with current flowing in a first direction in said second circuit to produce a magnetic flux in said field structure traversing said first magnetic path and being effective when energized with current flowing in a second direction in said second circuit to produce a magnetic flux in said field structure opposing the magnetic flux traversing said shunt leg, thereby to divert magnetic flux from said first magnetic path into said second magnetic path, said test relay being so constructed and arranged that it is operated when magnetic flux traverses said second magnetic path, means for seizing said switch, means responsive to the seizure of said switch for completing said first circuit, means including a motor magnet operative to drive said test wiper step by step over said test contacts, an operating circuit for said motor magnet, means for completing said operating circuit, said second circuit being so connected and arranged that no current flows therein when said test wiper engages a test contact having a busy potential connected thereto, that current flows therein in said first direction when said test wiper engages a test contact having a metering potential connected thereto and that current flows therein in said second direction when said test wiper engages a test contact having an idle potential connected thereto, and means controlled by

the operation of said test relay for interrupting said operating circuit.

8. In a telephone system, first and second groups of lines, first and second groups of finder switches, each of said finder switches having access to said lines, first and second distributors respectively associated with said first and second groups of finder switches, each of said distributors including a transfer relay provided with an operating circuit, means included in each idle finder switch in said first group of finder switches for completing the operating circuit of the transfer relay in said first distributor, whereby the operating circuit of the last-mentioned transfer relay is interrupted when all of the finder switches in said first group are busy, means included in each idle finder switch in said second group of finder switches for completing the operating circuit of the transfer relay in said second distributor, whereby the operating circuit of the last-mentioned transfer relay is interrupted when all of the finder switches in said second group are busy, first and second start conductors, said first start conductor being associated with said first distributor when the transfer relay in said first distributor occupies its operated position and being associated with said second distributor when the transfer relay in said first distributor occupies its restored position, said second start conductor being associated with said second distributor when the transfer relay in said second distributor occupies its operated position and being associated with said first distributor when the transfer relay in said second distributor occupies its restored position, means responsive to the creation of a calling condition on a line in said first group of lines for connecting a start potential to said first start conductor, means responsive to the creation of a calling condition on a line in said second group of lines for connecting a start potential to said second start conductor, means included in each of said distributors and responsive to the connection of a start potential to a start conductor associated therewith for initiating operation of the distributor, each of said distributors being operative to select an idle finder switch in the group of finder switches associated therewith and being effective when operation thereof is initiated to cause the selected finder switch to find a line having a calling condition thereon, and manually operable means individually associated with said distributors for initiating operation thereof independently of said start conductors, thereby to test the operation of said distributors and said finder switches associated therewith.

9. In a telephone system, first and second groups of lines, first and second groups of finder switches, each of said finder switches having access to said lines, first and second distributors respectively associated with said first and second groups of finder switches, each of said distributors including a transfer relay provided with an operating circuit, means included in each idle finder switch in said first group of finder switches for completing the operating circuit of the transfer relay in said first distributor, whereby the operating circuit of the last-mentioned transfer relay is interrupted when all of the finder switches in said first group are busy, means included in each idle finder switch in said second group of finder switches for completing the operating circuit of the transfer relay in said second distributor whereby the operating circuit of the last-

mentioned transfer relay is interrupted when all of the finder switches in said second group are busy, first and second start conductors, said first start conductor being associated with said first distributor when the transfer relay in said first distributor occupies its operated position and being associated with said second distributor when the transfer relay in said first distributor occupies its restored position, said second start conductor being associated with said second distributor when the transfer relay in said second distributor occupies its operated position and being associated with said first distributor when the transfer relay in said second distributor occupies its restored position, means responsive to the creation of a calling condition on a line in said first group of lines for connecting a start potential to said first start conductor, means responsive to the creation of a calling condition on a line in said second group of lines for connecting a start potential to said second start conductor, means included in each of said distributors and responsive to the connection of a start potential to a start conductor associated therewith for initiating operation of the distributor, each of said distributors being operative to select an idle finder switch in the group of finder switches associated therewith and being effective when operation thereof is initiated to cause the selected finder switch to find a line having a calling condition thereon, and manually operable means individually associated with said distributors for interrupting the operating circuits of the transfer relays therein independently of the idle or busy conditions of said finder switches associated therewith.

10. In a telephone system, first and second groups of lines, first and second groups of finder switches, each of said finder switches having access to said lines, first and second distributors respectively associated with said first and second groups of finder switches, each of said distributors including a transfer relay provided with an operating circuit, means included in each idle finder switch in said first group of finder switches for completing the operating circuit of the transfer relay in said first distributor, whereby the operating circuit of the last-mentioned transfer

relay is interrupted when all of the finder switches in said first group are busy, means included in each idle finder switch in said second group of finder switches for completing the operating circuit of the transfer relay in said second distributor, whereby the operating circuit of the last-mentioned transfer relay is interrupted when all of the finder switches in said second group are busy, first and second start conductors, said first start conductor being associated with said first distributor when the transfer relay in said first distributor occupies its operated position and being associated with said second distributor when the transfer relay in said first distributor occupies its restored position, said second start conductor being associated with said second distributor when the transfer relay in said second distributor occupies its operated position and being associated with said first distributor when the transfer relay in said second distributor occupies its restored position, means responsive to the creation of a calling condition on a line in said first group of lines for connecting a start potential to said first start conductor, means responsive to the creation of a calling condition on a line in said second group of lines for connecting a start potential to said second start conductor, means included in each of said distributors and responsive to the connection of a start potential to a start conductor associated therewith for initiating operation of the distributor, each of said distributors being operative to select an idle finder switch in the group of finder switches associated therewith and being effective when operation thereof is initiated to cause the selected finder switch to find a line having a calling condition thereon, each of said distributors including timing means operative to interrupt the operating circuit of the transfer relay therein in the event the finder switch selected thereby fails to operate, and manually operable means individually associated with said distributors for preventing operation of the finder switches selected thereby, thereby to test the operation of the timing means in said distributors.

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CERTIFICATE OF CORRECTION.

Patent No. 2,214,908.

September 17, 1940.

CLARENCE E. LOMAX, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 19, first column, line 67, claim 4, for the word "said" read --second--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of October, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.