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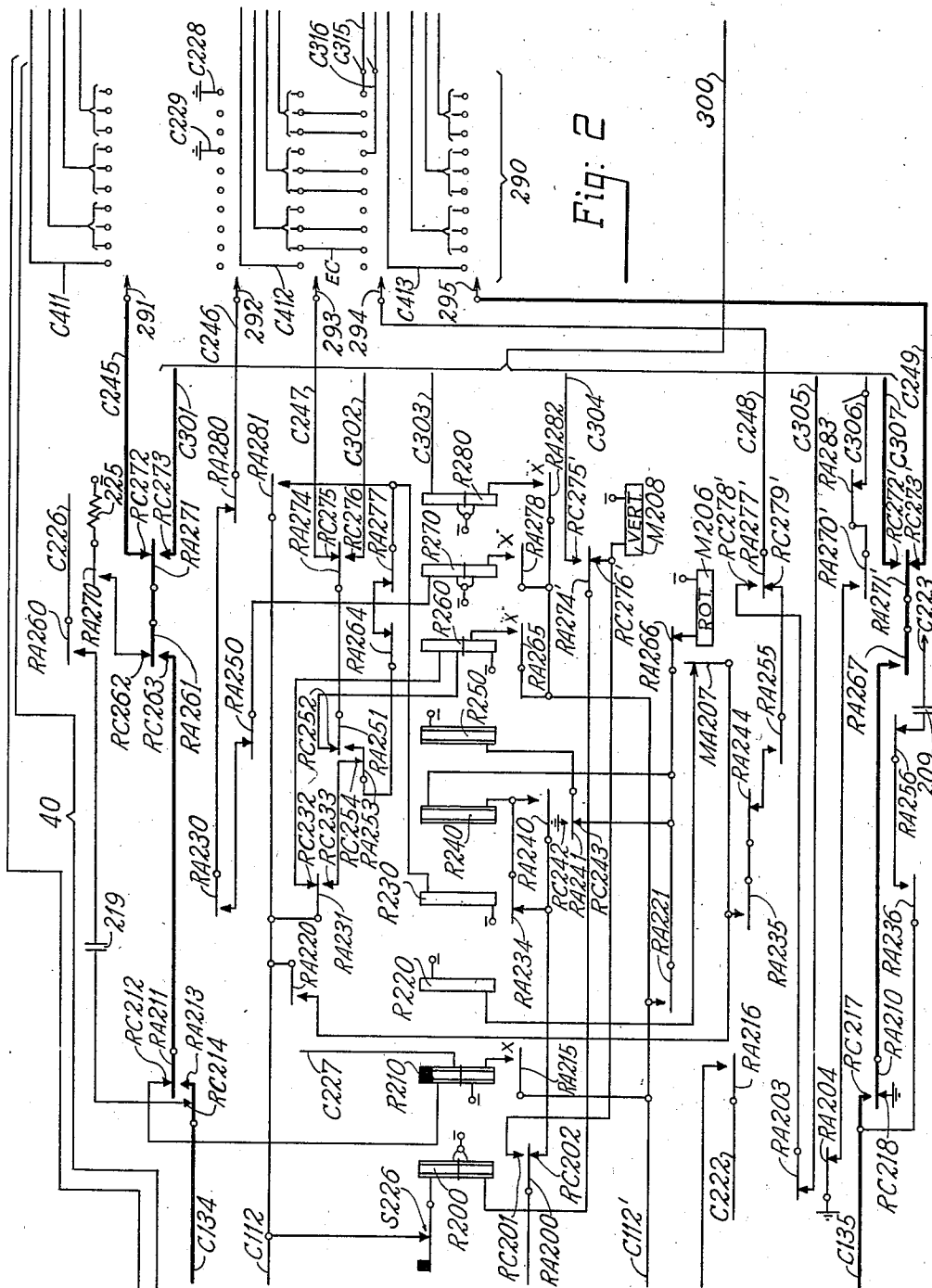
H. P. MAHONEY ET AL

2,267,987

SIGNALING SYSTEM

Filed Dec. 19, 1938

5 Sheets-Sheet 2



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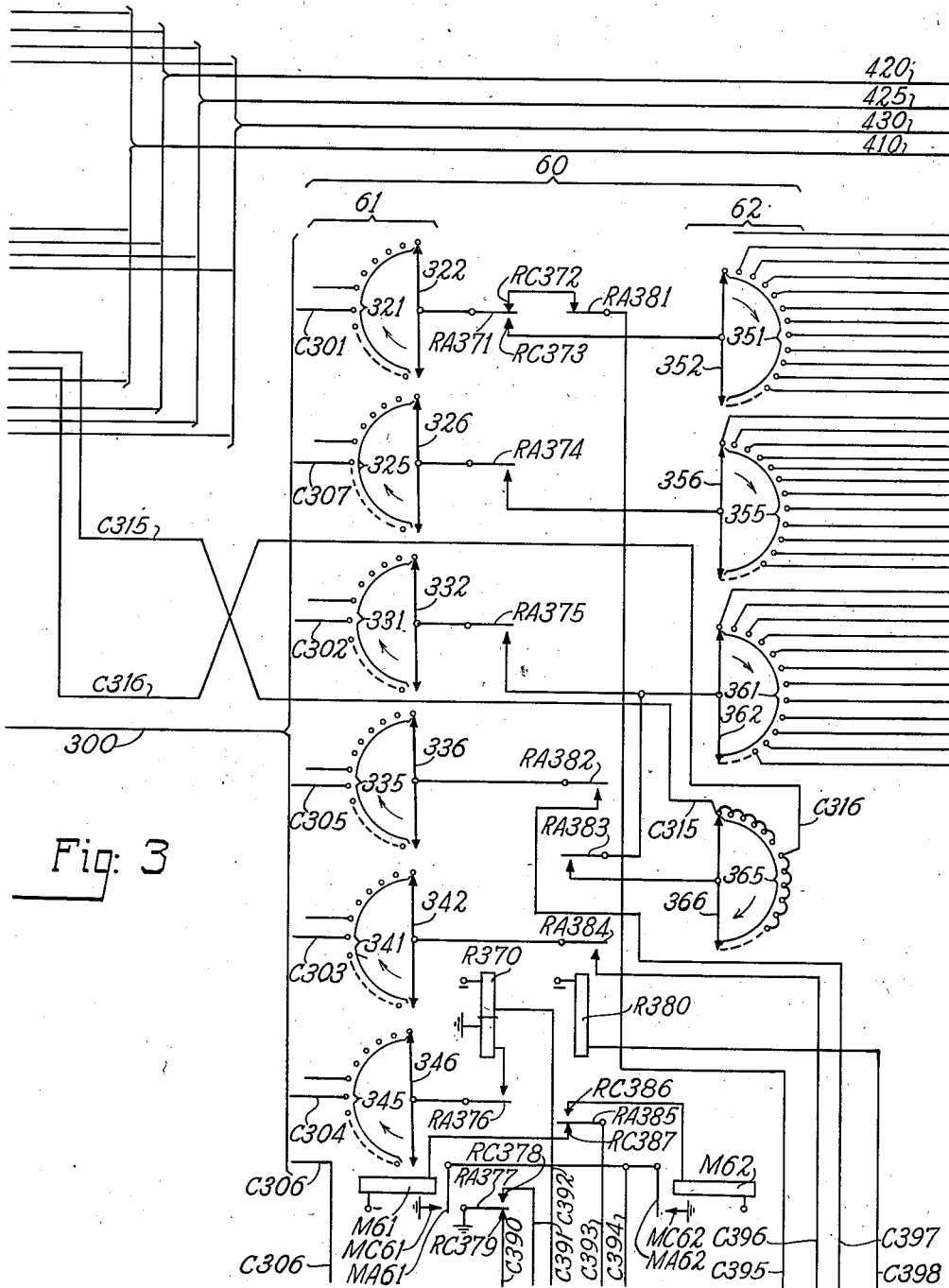
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5 Sheets-Sheet 3



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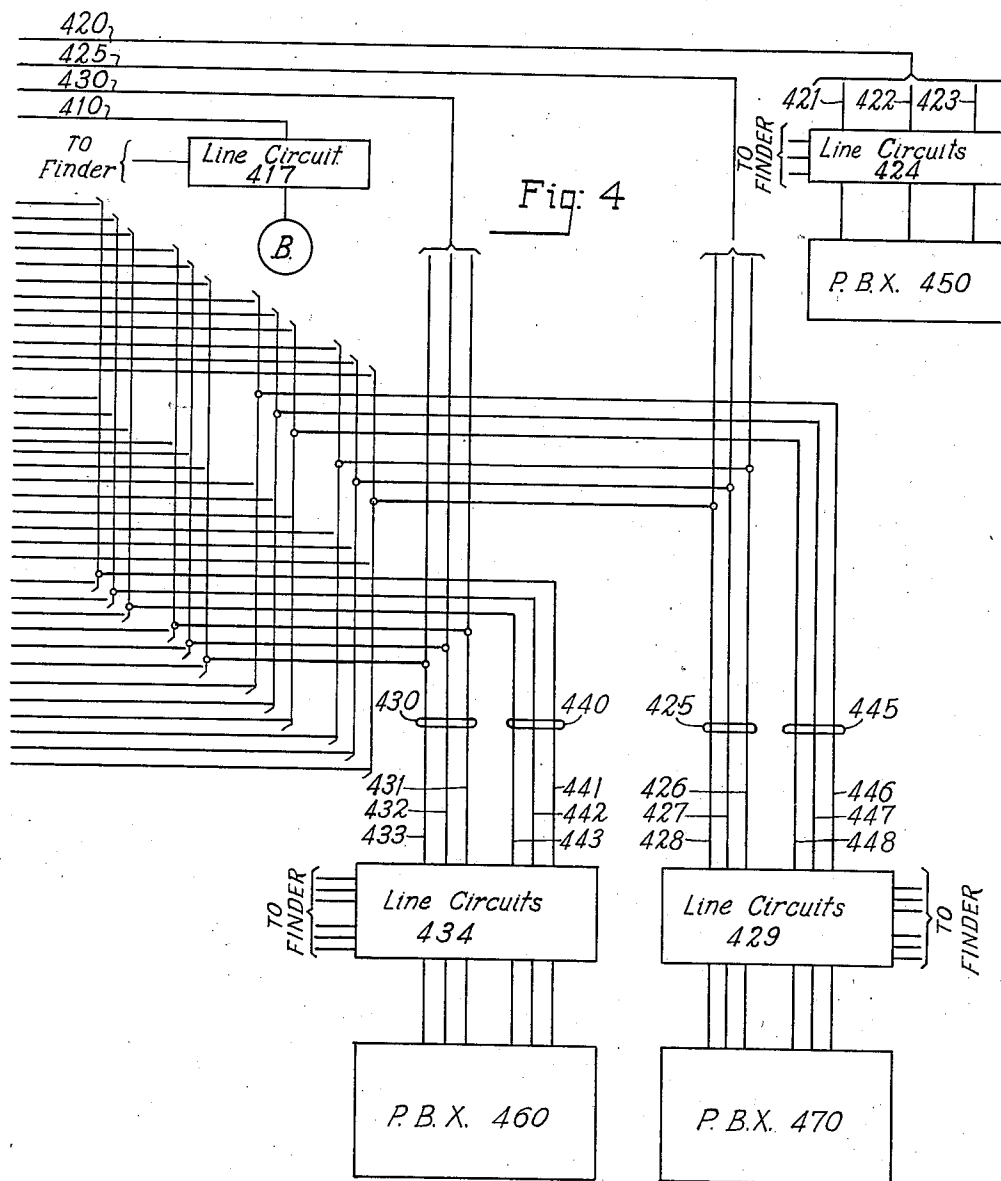
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SIGNALING SYSTEM

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5 Sheets-Sheet 4



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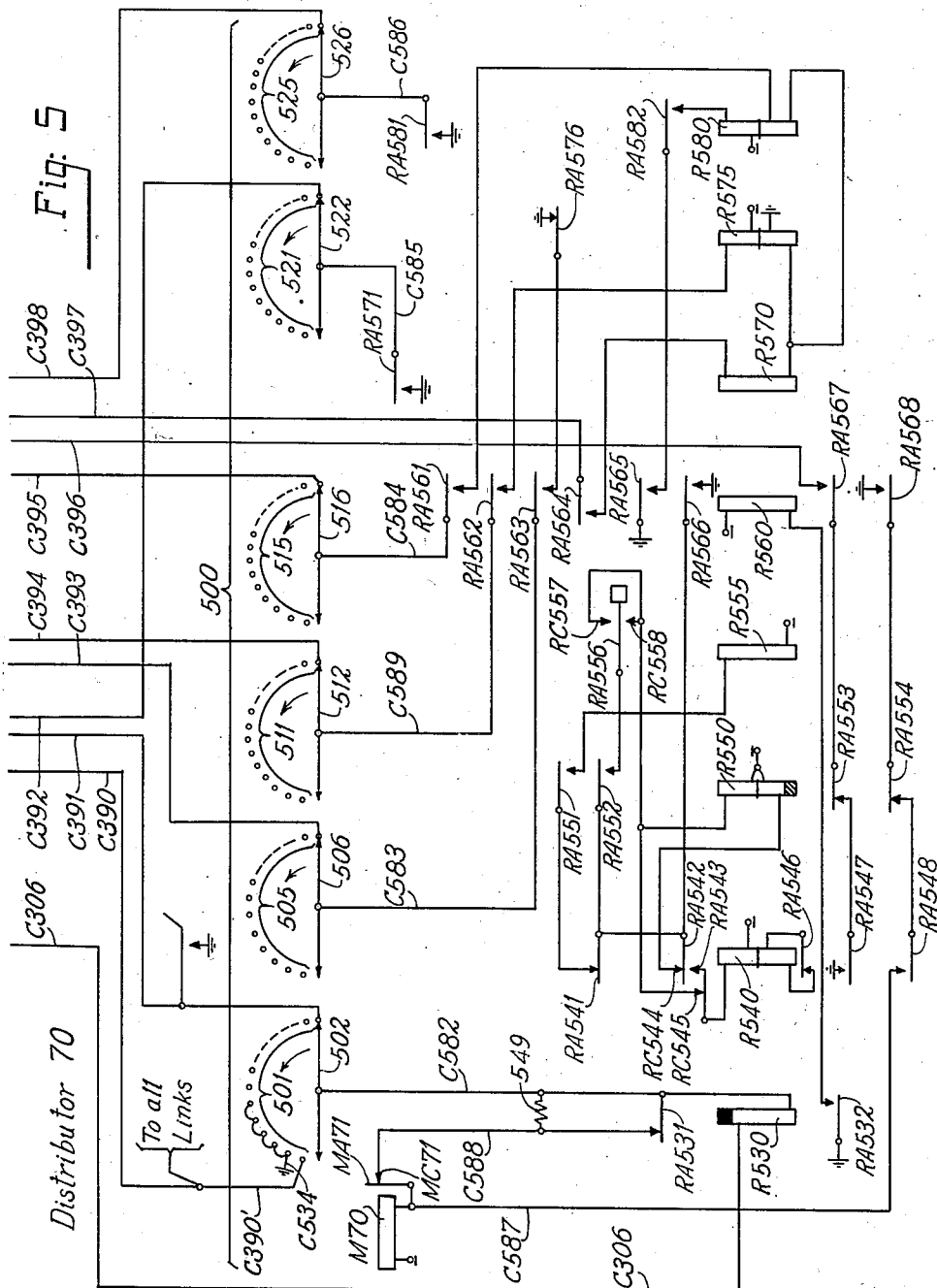
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SIGNALING SYSTEM

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,267,987

SIGNALING SYSTEM

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Application December 19, 1938, Serial No. 246,616

53 Claims. (Cl. 179—18)

The present invention relates to signaling systems and more particularly to automatic telephone systems provided with main and branch exchanges.

In a telephone system of the previously mentioned type, apparatus is provided for the purpose of setting up a connection between one line and any other line in the system, which conventionally comprises finder and connector switches having access to each line in the system and a number of intermediate traffic concentrating switches interposed between the finder and connector switches. In a small telephone system, intermediate concentrating switches are unnecessary and the finder and connector switches are directly arranged in links, the finder switch of each link being operative to find a calling line in the system and the connector switch of each link being operative to select a desired called line in the system. Each of the connector switches is usually of the numerical trunk hunting type and is so connected and arranged that it is operative in response to a predetermined series of digits dialed therein to select a corresponding line extending to a subscriber substation and operative in response to a different predetermined series of digits dialed therein to select the first trunk line in a corresponding group of trunk lines extending to a branch exchange. The connector switch then operates automatically to select the second trunk line in the group of trunk lines in the event the first trunk line in the group of trunk lines is busy. More particularly, the connector switch operates automatically as a trunk hunting switch to search for an idle trunk line in the group of trunk lines. In the event an idle trunk line is found, the idle trunk line is selected and further operation of the connector switch is arrested.

Frequently, due to increased traffic demands in an existing telephone system, it is necessary to extend additional trunk lines between the main and one or more of the branch exchanges. Although the links of the telephone system are usually able to accommodate additional trunk lines, it frequently occurs that additional trunk lines cannot be accommodated without assigning additional directory numbers thereto, due to the fact that the group of lines including the group of trunk lines in the connector switches of the links are all in use and that the available lines are included in another group of lines in the connector switches of the links. In view of the fact that many of the branch exchanges

comprise private branch exchanges or P. B. X, the provision of a second group of trunk lines, extending between the main exchange and the P. B. X and having a directory number different from that of the first group of trunk lines extending between the main exchange and the P. B. X, would be highly objectionable due to the commercial good-will which the P. B. X subscriber has acquired in connection with his directory number. It has been proposed to obviate this objection by providing a number of auxiliary hunting switches individually associated with the connector switches of the links and having access to the second group of trunk lines extending between the main exchange and the P. B. X, each of the hunting switches being operative to search for an idle trunk line in the second group of trunk lines extending between the main exchange and the P. B. X in the event the associated connector switch of the link fails to find an idle trunk line in the first group of trunk lines extending between the main exchange and the P. B. X.

While the above-described arrangement is satisfactory in operation, it has not been generally accepted commercially due, primarily, to the large number of auxiliary hunting switches required therein. More particularly, it is noted that, in the above-mentioned arrangement, an auxiliary hunting switch must be individually associated with the connector switch of each link and be individual to a particular one of the P. B. X having both first and second groups of trunk lines extending thereto. Thus, for example, even in a small telephone system having only two P. B. X having both first and second groups of trunk lines extending thereto and comprising only ten links, twenty auxiliary hunting switches are required in the above-mentioned arrangement.

Accordingly, it is an object of the present invention to provide, in a telephone system of the type described, an improved arrangement for accommodating a second group of trunk lines extending to a branch exchange and having the same directory number as a first group of trunk lines extending thereto, which arrangement comprises a minimum amount of apparatus connected and arranged in an extremely simple manner.

Another object of the invention is to provide, in a telephone system of the type described, an improved arrangement for accommodating a number of second groups of trunk lines extending to a number of different and corresponding

branch exchanges and having the same directory numbers as a number of first groups of trunk lines extending to the number of different and corresponding branch exchanges.

It is another object of the invention to provide a signaling system comprising a group of lines and improved switching apparatus for searching for a line having a predetermined condition thereon in the group of lines.

A further object of the invention is to provide an improved signaling system comprising a number of groups of lines and improved switching apparatus for searching in a predetermined order the groups of lines for a line therein having a predetermined condition thereon.

It is a further object of the invention to provide a signaling system comprising a number of lines and improved switching apparatus for setting up connections between the various lines of the system.

The features of the present invention are illustrated as being incorporated in an automatic signaling or telephone system including a main exchange, a number of private branch exchanges or P. B. X, main groups of trunk lines extending between the main exchange and the P. B. X, auxiliary groups of trunk lines extending between the main exchange and some of the P. B. X, and a number of subscriber lines terminating at the main exchange. Also, the system comprises switching apparatus including a number of main links, each comprising a finder switch and a connector switch, a number of overflow links, each comprising a finder switch and a hunting switch, a main distributor for assigning the main links for use, and an overflow distributor for assigning the overflow links for use.

In accordance with one feature of the invention, the telephone system is so connected and arranged that the main distributor is operative in response to the creation of a calling condition on any one of the lines in the system to assign an idle one of the main links for use; whereupon, the finder switch of the assigned main link, having access to each line in the system, operates automatically to find the calling line. The connector switch of the assigned main link is then rendered operative selectively to select any subscriber line and to search for an idle trunk line in any one of the main groups of trunk lines extending to the P. B. X in the system. Also means is provided in each of the connector switches for causing ringing current to be projected over an idle subscriber line or trunk line selected thereby and busy tone current to be returned over the calling line in the event the line selected thereby is a busy subscriber line or in the event no idle trunk line is available in the main group of trunk lines searched thereby, provided there is no auxiliary group of trunk lines associated with the main group of trunk lines searched thereby. Also, an arrangement is provided which is operative in the event there is an auxiliary group of trunk lines associated with the previously mentioned main group of trunk lines searched by the connector switch of the assigned main link for causing the connector switch, after having failed to find an idle trunk line in the previously mentioned main group of trunk lines, to cause an overflow trunk individually associated with the connector switch to be marked and to cause the overflow distributor to assign an idle one of the overflow links for use. Furthermore, control apparatus is provided for causing the finder switch of the assigned over-

flow link, having access to the group of overflow trunks individually associated with the connector switches of the main links, to operate automatically to search for the marked overflow trunk in the group of overflow trunks and to select the marked overflow trunk.

In accordance with another feature of the invention, the hunting switch of the assigned overflow link is so connected and arranged that it has access to each of the main and auxiliary groups of trunk lines extending to P. B. X having both main and auxiliary groups of trunk lines extending thereto, and is operative automatically to search for an idle trunk line in only the previously mentioned main group of trunk lines and the previously mentioned auxiliary group of trunk lines associated therewith, at this time. More particularly, the hunting switch of the assigned overflow link is operative to search for an idle trunk line in the previously mentioned auxiliary group of trunk lines and then to search for an idle trunk line in the previously mentioned main group of trunk lines. Also, apparatus is incorporated in the overflow distributor which is effective to cause the hunting switch of the assigned overflow link to be operative for a predetermined time interval or through a predetermined number of cycles of operation thereof, in order repeatedly to search for an idle trunk line in the previously mentioned main and auxiliary groups of trunk lines, and then to arrest operation thereof. The previously mentioned means included in the connector switch of the assigned main link is operative to cause ringing current to be projected over a trunk line selected by the hunting switch in either the previously mentioned main or auxiliary groups of trunk lines, and operative to cause busy tone current to be returned over the calling line in the event the hunting switch of the assigned overflow link fails to find an idle trunk line in either the previously mentioned main or auxiliary groups of trunk lines during the above-mentioned predetermined operation thereof. Also, an arrangement is included in the connector switch of the assigned main link for connecting the calling line to the trunk line selected by the hunting switch of the assigned overflow link after a call is answered at the P. B. X to which the selected trunk line in the previously mentioned main or auxiliary groups of trunk lines extend, the call being routed between the calling line and the selected P. B. X trunk line by way of the assigned main link, the overflow trunk individually associated with the connector switch of the assigned main link and the assigned overflow link.

Further features of the invention pertain to the particular arrangement of the circuit elements of the system and to the particular connection and arrangement of the elements of the switching apparatus 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 5, inclusive, taken together, illustrate diagrammatically the details of a telephone sys-

tem including an automatic central exchange and a number of private branch exchanges and having incorporated therein the present invention.

Description of the apparatus incorporated in the telephone system

Referring now more particularly to Figs 1 to 5, inclusive, of the drawings, the telephone system there illustrated comprises an automatic central exchange, a number of private branch exchanges or P. B. X, including the P. B. X indicated at 450, 460 and 470, and a number of P. B. X trunk lines extending between the central exchange and each of the P. B. X and terminating at the central change. The P. B. X trunk lines extending from the central exchange to the various P. B. X are arranged in groups, at least some of the P. B. X having main and auxiliary groups of P. B. X trunk lines extending thereto. For example, each of the P. B. X 450, 460 and 470 have a main group of P. B. X trunk lines extending thereto, while the P. B. X 460 and 470 also have an auxiliary group of P. B. X trunk lines extending thereto. More particularly, the main groups of P. B. X trunk lines 420, 425 and 430, comprising the P. B. X trunk lines 421, 422, 423 and 426, 427, 428 and 431, 432, 433, respectively, extend to the P. B. X 450, 470 and 460, respectively; and the auxiliary groups of P. B. X trunk lines 440 and 445, comprising the P. B. X trunk lines 441, 442, 443 and 446, 447, 448, respectively, extend to the P. B. X 460 and 470, respectively. Also, a number of subscriber lines, including the subscriber lines 100 and 410, are terminated at the central exchange. Furthermore, the central exchange comprises a number of main links, including the illustrated link 20, and a number of overflow links, including the illustrated link 60, which are employed in setting up the connections between the various lines in a manner more fully described subsequently. More specifically, the central exchange has an ultimate capacity of one hundred lines. The number of main links included in the system is determined by the total amount of traffic which the central exchange is required to handle and usually satisfactory service may be rendered when the central exchange is provided with ten main links. The number of overflow links included in the system is determined by the amount of P. B. X traffic which the central exchange is required to handle and usually the number of overflow links provided in the central exchange corresponds to the number of P. B. X having auxiliary groups of trunk lines extending thereto. In the central exchange, a distributor 50 is provided for the purpose of assigning the main links for use in a predetermined order; and a distributor 70 is provided for the purpose of assigning the overflow links for use in a predetermined order.

Each of the main links may be identical to the link 20 which comprises a finder portion or switch 30 and a connector portion or switch 40, the finder switch 30 having direct access to each subscriber line, to each main P. B. X trunk line and to each auxiliary P. B. X trunk line in the system, and the connector switch 40 having direct access to each subscriber line and to each main P. B. X trunk line in the system. Also, the connector switch 40 has direct access to the overflow trunk 300 individually associated therewith. Each of the overflow links may be identical to the link 60 which comprises a finder por-

tion or switch 61 and a hunting portion or switch 62; the finder switch 61 having direct access to each overflow trunk in the system, and the hunting switch 62 having direct access to each auxiliary P. B. X trunk line and to each main P. B. X trunk line extending to a P. B. X having a group of auxiliary P. B. X lines extending thereto in the system. Accordingly, the connector switch of each main link has access to each auxiliary P. B. X trunk line only by way of one of the overflow links.

A subscriber substation is associated with each of the subscriber lines, the subscriber substations indicated at A and B being associated with the subscriber lines 100 and 410, respectively. Each of the subscriber substations is provided with a telephone instrument, a dial mechanism and a ringer. Also, each of the P. B. X is provided with the usual apparatus for extending the calls to the subscriber substations therein and usually comprises an operator's position provided with a telephone instrument, a dial mechanism and a signal device thereat. Also, a line circuit is individually associated with each of the subscriber lines and each of the P. B. X trunk lines, the line circuits individually associated with the subscriber lines 100 and 410 being indicated respectively at 101 and 417, the line circuits individually associated with the P. B. X trunk lines 421, 422, 423 and 426, 427, 428, 446, 447, 448 and 431, 432, 433, 441, 442, 443 being indicated at 424, 429 and 434, respectively. Preferably, the line circuits are of identical connection and arrangement and may be of any of the well known types.

Preferably, each of the main links is connected and arranged in a manner similar to that of the link 20 which comprises, as best shown in Figs. 1 and 2, the finder switch 30 and the connector switch 40, each of these switches including a mechanism of the Strowger type. The Strowger mechanism included in the finder switch 30 is connected and arranged in a conventional manner and has not been illustrated in the interest of brevity. The Strowger mechanism included in the connector switch 40, as best shown in Fig. 2, comprises a bank of fixed contacts arranged in ten vertical levels, including the illustrated level 290, each level including ten radially disposed contact sets, each contact set terminating a line extending thereto; and a wiper set, including the wipers 291 to 295, inclusive, associated with the contact bank and carried by a carriage movable in both vertical and radial directions. The illustrated level 290 in the contact bank may be any level therein, although it is preferable that this level be the tenth level. More particularly, it will be observed that the subscriber line 410 terminates at the first contact set in the level 290; the main group of P. B. X trunk lines 420 terminate at the second, third and fourth contact sets in the level 290; the main group of P. B. X trunk lines 425 terminate at the fifth, sixth and seventh contact sets in the level 290; and the main group of P. B. X trunk lines 430 terminate at the eighth, ninth and tenth contact sets in the level 290. Accordingly, it will be understood that the directory number of the subscriber line 410 extending to the subscriber substation B is 01; and the directory numbers of the main groups of P. B. X trunk lines 420, 425 and 430 extending to the P. B. X 450, 470 and 460, respectively, are 02, 05 and 08, respectively. Also, this Strowger mechanism includes a vertical magnet M208 for moving the

carriage in the vertical direction, a rotary magnet M206 for moving the carriage in the radial direction, and a release magnet M150 for releasing the carriage and for causing the carriage to be returned to its normal position. Also associated with this Strowger mechanism are two sets of switch springs S151 and S226, the switch springs S151 being actuated into engagement and the switch springs S226 being actuated into disengagement when the carriage is moved in a vertical direction away from its normal position.

The connector switch 40 also comprises a group of relays and their control and controlled circuits, this group of relays including a line relay R130, a hold relay R140, a battery reversing relay R120, a transfer relay R200, a ring cut-off relay R210, a busy relay R230, a switch-through relay R260, a switch-over relay R270, a trunks busy relay R280, and a number of control relays R220, R240 and R250.

Preferably, each of the overflow links is connected and arranged in a manner similar to that of the link 60 which comprises, as best shown in Fig. 3, the finder switch 61 and the hunting switch 62, each of these switches being of the rotary type and including a number of contact banks and associated wipers. More particularly, the finder switch 61 comprises the contact banks 321, 325, 331, 335, 341 and 345 provided with the associated wipers 322, 326, 332, 336, 342 and 346, respectively, each of these wipers being of the double-ended type. Also, the finder switch 61 includes a rotary magnet M61 for rotating simultaneously the wipers noted. More particularly, the hunting switch 62 comprises the contact banks 351, 355, 361 and 365 provided with the associated wipers 352, 356, 362 and 366, respectively, each of these wipers being of the double-ended type. Also, the hunting switch 62 includes a rotary magnet M62 for rotating simultaneously the wipers noted. Also, it is noted that the conductors of the overflow trunks extending from the connector switches of the main links in the system are terminated at the respective and corresponding contacts in the contact banks noted of the finder switch 61. For example, the conductors of the overflow trunk 300 extending from the connector switch 40 of the illustrated main link 20 are terminated at the respective and corresponding contacts illustrated in the contact banks noted of the finder switch 61. Furthermore, it is noted that the conductors comprising the main and auxiliary groups of P. B. X trunk lines extending to the P. B. X 460 and 470 are terminated at the respective and corresponding contacts in some of the contact banks noted of the hunting switch 62. More particularly, in the arrangement illustrated the first, second and third respective contacts in the contact banks 351, 355 and 361 of the hunting switch 62 terminate the auxiliary P. B. X trunk lines 441, 442 and 443, respectively, extending to the P. B. X 460; the fourth, fifth and sixth respective contacts in the above-mentioned contact banks of the hunting switch 62 terminate the main P. B. X trunk lines 431, 432 and 433, respectively, extending to the P. B. X 460; the seventh, eighth and ninth respective contacts in the above-mentioned contact banks of the hunting switch 62 terminate the auxiliary P. B. X trunk lines 446, 447 and 448, respectively, extending to the P. B. X 470; and the tenth, eleventh and twelfth respective contacts in the above-mentioned contact banks of the hunting switch 62 terminate the main P. B. X trunk

lines 426, 427 and 428, respectively, extending to the P. B. X 470. Accordingly, during the operation of the hunting switch 62 the wipers noted respectively and successively engage the contacts in the associated contact banks noted terminating the individual P. B. X trunk lines in the auxiliary group of trunk lines 440, then the individual P. B. X trunk lines in the main group of P. B. X trunk lines 430, then the individual P. B. X trunk lines in the auxiliary group of P. B. X trunk lines 445, and, finally, the individual P. B. X trunk lines in the main group of P. B. X trunk lines 425.

Furthermore, the link 60 comprises a switch-through relay R370 and a transfer relay R380 and the control and controlled circuits therefor.

The distributor 50, which is operative to assign idle ones of the main links for use, is of entirely conventional connection and arrangement and has not been shown in detail in the interest of brevity. However, it is preferable that the distributor 50 is of the preselective type, such that an idle main link is selected to be assigned to the use of a calling line prior to the initiation of a call on a line in the system, and another idle main link is automatically selected to be assigned to the use of the next calling line as soon as the selected main link operates to find a calling line in the system.

The distributor 70, which is operative to assign idle ones of the overflow links in a predetermined order, comprises a rotary switch 500 provided with a number of contact banks each having an associated wiper. More particularly, the rotary switch 500 includes the contact banks 501, 505, 511, 515, 521 and 525 provided with the wipers 502, 506, 512, 516, 522 and 526, respectively, each of these wipers being of the double-ended type. Furthermore, the rotary switch 500 includes a rotary magnet M70 for rotating simultaneously the wipers noted. Also, the distributor 70 comprises a group of relays and their control and controlled circuits, this group of relays including a start relay R530, a trunks busy relay R540, a timing relay R555, a stepping relay R575, a switch-through control relay R570, a transfer control relay R580 and two control relays R550 and R560. It is noted that the control conductors extending to the overflow links are terminated at the respective and corresponding contacts in the contact banks noted.

The distributor 70 is of the preselective type in that an idle overflow link is selected to be assigned to the use of a calling one of the overflow trunks prior to the creation of the calling condition on the overflow trunk, and another overflow link is automatically selected to be assigned to the use of the next calling overflow trunk as soon as the selected overflow link is operated to find a calling overflow trunk.

Ordinary substation to substation calls

An ordinary call which is to be extended from one subscriber substation to another is initiated at the calling substation by removing the receiver of the telephone instrument thereat from its hook. For example, in extending 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 circuit by way of the subscriber line 100 for causing the line circuit 101 individually associated therewith to be operated in a well known manner. This operation of the line cir-

circuit 101 is effective to apply ground potential to the start conductor C107 extending into the distributor 50, thereby to initiate operation of the distributor. The distributor 50 then operates to assign the previously selected idle main link to the use of the calling subscriber line 100. Assuming that the illustrated main link 20 is assigned to the use of the calling line 100, the distributor 50 initiates operation of the Strowger mechanism included in the finder switch 30. Also, the line circuit 101 individually associated with the subscriber line 100 marks both the level and radial position of the contact set in the contact bank of the Strowger mechanism included in the finder switch 30 wherein the calling subscriber line 100 terminates. The Strowger mechanism included in the finder switch 30 then operates to move the carriage in the vertical direction to the level wherein the calling subscriber line 100 terminates, whereupon further movement of the carriage in the vertical direction is arrested. The Strowger mechanism included in the finder switch 30 then operates to move the carriage in the radial direction to the radial position wherein the calling subscriber line 100 terminates, whereupon further movement of the carriage is arrested. At this time the calling subscriber line 100 is seized by the finder switch 30. The finder switch 30 then operates to connect the calling subscriber line 100 to the trunk line 110, thereby to cause the line and hold relays R130 and R140, respectively, in the connector switch 40 of the selected link 20 to be operated in a manner more fully described subsequently. Upon operating, the hold relay R140 causes ground potential to be applied to the control conductor C112 of the trunk line 110. This application of ground potential to the control conductor C112 of the trunk line 110 causes the line circuit 101 individually associated with the calling subscriber line 100 to be further operated, thereby to mark the calling subscriber line 100 as busy to the connector switches of the links having access thereto by the application of ground potential to the control conductor C106 thereof. Further, the line circuit 101 operates to remove the application of ground potential to the start conductor C107 extending into the distributor 50, thereby to cause the distributor 50 to operate and select another idle main link to be assigned to the use of the next calling line.

As previously noted, when the finder switch 30 seizes the calling line 100 the line relay R130 in the connector switch 40 is operated, this relay being energized by way of a loop circuit extending between the subscriber substation A and the line relay R130. This loop circuit extends from ground at the lower winding of R130, by way of the lower winding of R130, RC126 and RA125 to the line conductor C113 of the trunk line 110; and from battery at the upper winding of R130, by way of the upper winding of R130, RC122 and RA123 to the line conductor C111 of the trunk line 110, the line conductors C113 and C111 of the trunk line 110 being connected by way of the operated finder switch 30 and the operated line circuit 101 to the line conductors C105 and C103 of the calling subscriber line 100, and the line conductors C105 and C103 of the subscriber line 100 being included in a bridge circuit at the substation A. Upon operating, the line relay R130 completes, at RA131 and RC132, an obvious circuit for energizing the hold relay R140. When thus energized, the hold relay R140 operates to

complete, at RA141, an obvious path for applying ground potential to the control conductor C112 of the trunk line 110 extending to the finder switch 30, as previously noted. Also, upon operating, the hold relay R140 prepares, at RA142 and RC143, a point in a circuit, traced hereinafter, for energizing in multiple the vertical magnet M208 and the lower winding of the transfer relay R200; interrupts, at RA142 and RC144, a point in a circuit, traced hereinafter, for energizing the release magnet M150; and completes, at RA145, an obvious path for applying ground potential to the control conductor C112, for a purpose more fully explained subsequently. Also, the application of ground potential to the control conductor C112 completes a circuit for energizing the upper winding of the transfer relay R200, this circuit extending from the grounded control conductor C112 by way of the switch springs S226 and the upper winding of R200 to battery. When energized over the above-traced circuit, the relay R200 operates to prepare, at RA200 and RC201, a further point in the previously mentioned circuit for energizing in multiple the vertical magnet M208 and the lower winding of the transfer relay R200, and interrupts, at RA200 and RC202, a point in a circuit, traced hereinafter, for energizing in series the control relay R240 and the rotary magnet M206. At this time the connector switch 40 is conditioned to be responsive to series of digits dialed at the substation A in order to cause the Strowger mechanism included therein to operate and seize the desired called line.

The subscriber at the substation A then dials the first digit of the directory number of the called subscriber line at the dial mechanism thereat, thereby to transmit a first series of impulses by way of the subscriber loop circuit to the line relay R130. The relay R130 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 relay R130 restores, it interrupts, at RA131 and RC132, the circuit for energizing the hold relay R140, and completes, at RA131 and RC133, the previously mentioned circuit for energizing in multiple the vertical magnet M208 and the lower winding of the transfer relay R200. The last-mentioned circuit extends from ground at RA131, by way of RC133, RA142, RC143 and RA200 to RC201, one branch of this circuit extending from RC201 by way of the winding of M208 to battery, and the other branch of this circuit extending from RC201 by way of RC276, RA274 and the lower winding of R200 to battery. The relays R140 and R200 being of the slow-to-release type remain operated during impulsing. Each time the vertical magnet M208 is energized over the above-traced circuit, the carriage of the Strowger mechanism included in the connector switch 40 is moved one step in the vertical direction. When the carriage of this Strowger mechanism is moved away from its normal position one step in the vertical direction the switch springs S151 and S226 are actuated into engagement and disengagement, respectively. When the switch springs S151 are actuated into engagement, a further point in the previously mentioned circuit for energizing the release magnet M150 is prepared, and when the switch springs S226 are actuated into disengagement, the circuit for energizing the upper winding of the relay R200 is interrupted. At the conclusion of the first digit dialed, the relay

R130 reoperates, thereby to interrupt, at RA131 and RC133, the previously traced circuit for energizing in multiple the lower winding of the relay R200 and the winding of the vertical magnet M208. When this circuit it interrupted further operation of the vertical magnet M208 is arrested, thereby to arrest the carriage of the Strowger mechanism included in the connector switch 40 in a vertical position corresponding to the first digit dialed and to the level in the contact bank of this Strowger mechanism in which the subscriber line extending to the called subscriber substation B is terminated. In the present instance the called subscriber line 410 is terminated in the tenth level 290 in the contact bank of the Strowger mechanism included in the connector switch 40. Accordingly, the first digit dialed is the digit 0. Also, when this circuit is interrupted, the circuit for energizing the lower winding of the transfer relay R200 is interrupted, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the relay R200 interrupts, at RA200 and RC201, a further point in the previously traced circuit for energizing in multiple the vertical magnet M208 and the lower winding of the relay R200, and prepares, at RA200 and RC202, a further point in the previously mentioned circuit for energizing in series the control relay R240 and the rotary magnet M206.

The subscriber at the substation A then dials the second digit of the directory number of the called subscriber line at the dial mechanism thereat, thereby to transmit a second series of impulses by way of the subscriber loop circuit to the line relay R130. The line relay R130 follows the dialed impulses as previously explained. Each time the relay R130 operates it completes, at RA131 and RC132, the previously traced circuit for energizing the hold relay R140. Each time the line relay R130 restores it completes, at RA131 and RC133, the previously mentioned circuit for energizing in series the control relay R240 and the rotary magnet M206. The last-mentioned circuit extends from ground at RA131, by way of RC133, RA142, RC143, RA200, RC202, RA234, the winding of R240, RA266 and the winding of M206 to battery. The relays R140 and R240, being of the slow-to-release type, remain operated during impulsing. When energized over the above-traced circuit, the relay R240 operates to complete, at RA240, a multiple path around the contacts controlled by the armature RA234 of the busy relay R230 in the previously mentioned circuit for energizing in series the relay R240 and the rotary magnet M206. Also, the relay R240 completes, at RA241 and RC242, an obvious circuit for energizing the control relay R250. When thus energized, the relay R250 operates to interrupt, at RA250, a point in a circuit, traced hereinafter, for energizing the upper winding of the switch-over relay R270; to interrupt, at RA251 and RC252, a point in a circuit, traced hereinafter, for energizing the upper winding of the switch-through relay R260; and to prepare, at RA251 and RA253, a point in a circuit, traced hereinafter, for energizing the busy relay R230. Each time the rotary magnet M206 is energized the carriage of the Strowger mechanism included in the connector switch 40 is moved one step in the radial direction. At the conclusion of the second digit dialed, the carriage of the Strowger mechanism included in the connector switch 40 occupies a radial position corresponding to the second digit dialed and

causes the wipers carried thereby to engage the contacts in the contact bank of this Strowger mechanism terminating the called subscriber line. In the present instance the called subscriber line 410 is terminated at the first contact set in the level 290 in the contact bank of the Strowger mechanism included in the connector switch 40. Accordingly, the second digit dialed comprises the digit 1 and the wipers 291, 293 and 295, respectively, engage the contacts in the level 290 terminating the conductors C411, C412 and C413 of the called subscriber line 410. Also, at the conclusion of the second digit dialed, the line relay R130 reoperates to interrupt, at RA131 and RC133, a point in the previously traced circuit for energizing in series the control relay R240 and the rotary magnet M206, thereby to arrest further operation of the rotary magnet M206 and consequently further movement in a radial direction of the carriage of the Strowger mechanism included in the connector switch 40 and to cause the control relay R240 to restore shortly thereafter.

At this time the called subscriber line 410 has been seized by the connector switch 40 and the subsequent operation connector switch depends upon the idle or busy condition of this line. It is noted that ground potential appears upon the control conductor C412 of the called subscriber line 410 in the event this line is busy, whereas battery potential appears upon this control conductor in the event this line is idle. Assuming that the called subscriber line 410 is busy, the presence of ground potential upon the control conductor C412 thereof completes a circuit for energizing the busy relay R230, this circuit extending from the grounded control conductor C412 by way of the wiper 293 and associated contact in the level 290, C247, RC275, RA274, RA251, RA253, RA264, RA277 and the winding of R230 to battery. When energized over the above-traced circuit, the relay R230 operates to interrupt, at RA231 and RC232, a further point in the previously mentioned circuit for energizing the winding of the switch-through relay R260; to prepare, at RA231 and RC233, a holding circuit, traced hereinafter, for energizing the winding thereof; to interrupt, at RA234, a point in the original circuit for energizing the control relay R240 in series with the rotary magnet M206; and to prepare, at RA236, a circuit, traced hereinafter, for returning busy tone current over the loop circuit extending to the calling substation A. Shortly after the busy relay R230 operates, the control relay R240, being of the slow-to-release type, restores to interrupt, at RA240, a further point in the circuit for energizing in series the relay R240 and the rotary magnet M206, and to interrupt, at RA241 and RC 242, the circuit for energizing the control relay R250, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the control relay R250 completes, at RA253 and RC254, the previously mentioned holding circuit for energizing the busy relay R230, this circuit extending from the grounded control conductor C112 by way of RA231, RC233, RC254, RA253, RA264, RA277, and the winding of R230 to battery. Also, the relay R250 interrupts, at RA251 and RA253, a point in the original circuit for energizing the busy relay R230 and completes, at RA256, the previously mentioned circuit for returning busy tone current over the loop circuit extending to the calling substation A. This loop

circuit extends from the ungrounded terminal of a grounded busy tone transformer winding, by way of the busy tone conductor C223, the condenser 299, RA256, RA236, C135 and the condenser 137 to the line conductor C113 of the trunk line 110; and from battery, at the upper winding of R130, by way of the upper winding of R130, RC122 and RA123 to the line conductor C111 of the trunk line 110, the line conductors C113 and C111 of the trunk line 110 being connected to the line conductors C105 and C103 of the subscriber line 100 by way of the operated finder switch 30 and the line circuit 101, as previously noted. When busy tone current is returned over the loop circuit to the calling substation A, the receiver of the telephone instrument thereat is actuated to produce busy tone. The production of busy tone in the receiver of the telephone instrument at the substation A indicates to the subscriber thereat that the desired connection cannot immediately be had due to the busy condition of the called subscriber line 410. The subscriber at the calling substation A then releases the operated main link 20, including the finder switch 30 and the connector switch 40, and the line circuit 101 by replacing the receiver of the telephone instrument at the substation A upon its hook. The exact manner in which these operated pieces of apparatus are released is described in detail hereinafter.

Assuming that the called subscriber line 410 is idle when it is seized by the connector switch 40, battery potential appearing upon the control conductor C412 thereof completes a path for short-circuiting the winding of the busy relay R230, this path being substantially the same as the previously traced path for energizing the winding of R230, thereby to retain the busy relay R230 in its restored position. Also, when the connector switch 40 seizes the called subscriber line 410, the line circuit 417 individually associated therewith operates to mark the subscriber line 410 as busy to the connector switches of the other links having access thereto. Shortly after the connector switch 40 operates to seize the called subscriber line 410, the control relay R240 restores to interrupt, at RA241 and RC242, the previously mentioned circuit for energizing the control relay R250, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the relay R250 completes, at RA251 and RC252, the previously mentioned circuit for energizing the upper winding of the switch-through relay R260, this circuit extending from battery potential appearing upon the control conductor C412 of the called subscriber line 410 by way of the wiper 293 and associated contact in the level 290, C247, RC275, RA274, RA251, RC252, the upper winding of R260, RC232 and RA231 to the grounded control conductor C112. When energized over the above-traced circuit, the relay R260 partially operates to close the "X" contacts associated with the armature RA265, thereby to complete a holding circuit for energizing the lower winding thereof, this circuit extending from the grounded control conductor C112' by way of RA265 and the lower winding of R260 to battery. When the lower winding of the relay R260 is energized over the above-traced holding circuit, this relay fully operates to complete, at RA260, a circuit for returning ring-back tone current over the loop circuit extending to the calling subscriber substation A, this circuit extending from the ungrounded terminal of a grounded ring-back tone current transformer

winding, by way of the ring-back tone conductor C226, RA260, the condenser 219, RC214, RA213, C134 and the condenser 136 to the line conductor C111 of the trunk line 110, and from ground at the lower winding of R130, by way of the lower winding of R130, RC126 and RA125 to the line conductor C113 of the trunk line 110, the line conductors C111 and C113 of the trunk line 110 being included in the loop circuit extending by way of the subscriber line 100 to the calling subscriber substation A, as previously noted. The ring-back tone current returned over the loop circuit extending to the calling substation A actuates the receiver of the telephone instrument thereat, thereby to cause the receiver to produce ring-back tone. The ring-back tone produced by the receiver of the telephone instrument at the calling substation A indicates to the subscriber thereat that ringing current is being projected over the called subscriber line. Also, upon operating, the relay R260 completes, at RA261, RC263 and at RA267, a circuit for projecting ringing current over the subscriber line 410 extending to the called substation B, this circuit extending from the ungrounded terminal of a grounded ringing current transformer winding by way of the ringing conductor C227, the upper winding of the ring cut-off relay R210, RC212, RA211, RC263, RA261, RA271, RC272, C245 and the wiper 291 and associated contact to the line conductor C411 of the subscriber line 410; and from ground, at RC218, by way of RA210, RA267, RA271', RC273', C249 and the wiper 295 and associated contact to the line conductor C413 of the subscriber line, the line conductors C411 and C413 of the subscriber line being connected together by way of the ringer at the called substation B. The ringing current projected by way of the subscriber line 410 to the called substation B causes the ringer thereat to be actuated, thereby to indicate to the subscriber thereat that the substation B is a called substation.

The call is answered at the called substation B by removing the receiver of the telephone instrument thereat from its hook, thereby to complete a bridge circuit including the telephone instrument thereat between the line conductors C411 and C413 of the subscriber line 410. This bridge circuit across the line conductors of the subscriber line completes a low resistance circuit for energizing the upper winding of the ring cut-off relay R210. The circuit for energizing the upper winding of the relay R210 is substantially identical to the previously traced circuit for projecting ringing current over the subscriber line 410. When thus energized, the relay R210 partially operates to close the "X" contacts associated with the armature RA215 in order to complete a holding circuit for energizing the lower winding thereof, this circuit extending from the grounded control conductor C112', by way of RA215 and the lower winding of R210 to battery. When energized over the above-traced holding circuit, the relay R210 fully operates to interrupt, at RA211, RC212 and at RA210, RC218, points in the previously traced circuit for projecting ringing current over the called subscriber line 410; to interrupt, at RA213 and RC214, a point in the previously traced circuit for returning ring-back tone current over the loop circuit extending to the calling substation A; and to complete, at RA211, RC213 and at RA210, RC217, a loop circuit extending between the battery reversing relay R120 and the called substation B. This loop circuit extends from ground at the lower wind-

ing of R/20 by way of the lower winding of R/20, C/35, RC/217, RA/210, RA/267, RA/271', RC/273', C/249 and the wiper 295 and associated contact in the level 290 to the line conductor C/413 of the subscriber line 410; and from battery at the upper winding of R/20, by way of the upper winding of R/20, C/134, RA/213, RA/211, RC/263, RA/261, RA/271, RC/272, C/245, and the wiper 291 and associated contact in the level 290 to the line conductor C/411 of the subscriber line 410, the line conductors C/413 and C/411 of the subscriber line 410 being connected together by way of a bridge path including the telephone instrument at the called substation B. When energized over the above-traced loop circuit, the battery reversing relay R/20 operates to complete, at RA/121, RA/123 and at RA/124, RA/125, points in an alternative loop circuit extending by way of the subscriber line 100 to the calling substation A; and to interrupt, at RA/123, RC/122 and at RA/125, RC/126, points in the original loop circuit extending by way of the subscriber line 100 to the calling substation A, thereby to reverse the application of battery potential to the line conductors C/111 and C/113 of the trunk line 110 included in the loop circuit extending by way of the subscriber line 100 to the calling substation A. At this time ground at the lower winding of R/130 is connected by way of the lower winding of R/130, RA/121 and RA/123 to the line conductor C/111 of the trunk line 110, and battery at the upper winding of R/130 is connected by way of the upper winding of R/130, RA/124 and RA/125 to the line conductor C/113 of the trunk line 110. This reversal of battery potential as applied to the line conductors C/111 and C/113 of the trunk line 110 may be utilized for supervisory purposes in order to operate a call register or the like associated with the trunk line 110. Furthermore, the relay R/20 interrupts, at RA/127, a further point in the previously mentioned circuit for energizing the release magnet M/150 and completes, at RA/128 and RC/129, a multiple path for applying ground potential to the control conductor C/112'.

At this time talking battery is supplied by way of the line relay R/130 to the loop circuit extending by way of the subscriber line 100 to the calling substation A; and talking battery is supplied by way of the battery reversing relay R/20 to the loop circuit extending by way of the subscriber line 410 to the called substation B. Furthermore, the loop circuit extending to the calling substation A is connected by way of the voice frequency current condensers 136 and 137 to the loop circuit extending to the called substation B, thereby to interconnect the calling and called subscriber substations A and B for two-way communication therebetween. More particularly, the line conductors C/111 and C/113 of the trunk line 110 included in the loop circuit extending to the calling substation A are respectively connected by way of the condensers 136 and 137, respectively, to the line conductors C/134 and C/135, respectively, the last-mentioned line conductors being included in the loop circuit extending to the called substation B.

The release of the established connection between the calling subscriber substation A and the called subscriber substation B is primarily under the control of the subscriber at the calling substation A. When the receiver of the telephone instrument at the called substation B is placed upon its associated hook, the loop circuit extending to the called substation B is interrupted,

thereby to cause the battery reversing relay R/20 to restore. Upon restoring, the battery reversing relay R/20 interrupts, at RA/121, RA/123 and at RA/124, RA/125, points in the second-mentioned loop circuit extending to the calling substation A and completes, at RA/123, RC/122 and at RA/125, RC/126, points in the original loop circuit extending to the calling substation A, thereby to again reverse battery over the line conductors C/111 and C/113 of the trunk line 110 included in the loop circuit extending to the calling substation A for supervisory purposes. Also, upon restoring, the battery reversing relay R/20 prepares, at RA/127, a point in the previously mentioned circuit for energizing the release magnet M/150; interrupts, at RA/128 and RC/129, the multiple path for applying ground potential to the control conductor C/112'; and prepares, at RA/128 and RC/120, a point in a circuit, traced hereinafter, for operating a supervisory signal associated with connector switch 40. When the receiver of the telephone instrument at the calling substation A is replaced upon its hook, the loop circuit extending to the calling substation A is interrupted, thereby to cause the line relay R/130 to restore. Upon restoring, the relay R/130 interrupts, at RA/131 and RC/132, the circuit for energizing the hold relay R/140, thereby to cause the latter relay to restore shortly thereafter; and prepares, at RA/131 and RC/133, the previously mentioned circuit for energizing the release magnet M/150. The last-mentioned circuit is completed at RA/142 and RC/144 when the hold relay R/140 restores and extends from ground at RA/131 by way of RC/133, RA/142, RC/144, RA/127, the switch springs S/151 and the winding of M/150 to battery. When energized over the above-traced circuit, the release magnet M/150 operates to release the carriage of the Strowger mechanism included in the connector switch 40, thereby to cause the carriage to be rotated and then translated back to its normal position. When the carriage of the Strowger mechanism included in the connector switch 40 is returned to its normal position, the wipers 291, 293 and 295 disengage the associated contacts in the level 290 and the switch springs S/151 and S/226 are actuated into disengagement and engagement, respectively. When the switch springs S/151 are actuated into disengagement, the circuit for energizing the release magnet M/150 is interrupted; and when the switch springs S/226 are actuated into engagement, the previously traced circuit for energizing the upper winding of the transfer relay R/200 is prepared.

Also, upon restoring, the hold relay R/140 interrupts, at RA/141 and RA/145, the paths for applying ground potential to the control conductors C/112 and C/112', respectively. When ground potential is removed from the control conductor C/112', the holding circuits for energizing the lower windings of the ring cut-off relay R/210 and the switch-through relay R/260 are interrupted, thereby to cause these relays to restore. Upon restoring, the relay R/210 interrupts, at RA/211, RA/213 and at RA/210, RC/217, further points in the loop circuit extending to the called substation B; prepares, at RA/211, RC/212 and at RA/210, RC/218, points in the original circuit for projecting ringing current over a called subscriber line; prepares at RA/213 and RC/214, a point in the original circuit for returning ring-back tone current over a calling subscriber line; and interrupts, at RA/215, a further point in the holding circuit for energizing the lower winding thereof. Finally, the relay R/210 interrupts, at RA/216, a

point in the previously mentioned circuit for operating the supervisory signal associated with the connector switch 40. The last-mentioned circuit extends from ground at RA128 by way of RC120, RA216, the control conductor C222 and the winding of the supervisory signal associated with the connector switch 40 to battery. When the battery reversing relay R120 restores, the last-mentioned circuit is completed in order to cause operation of the supervisory signal associated with the connector switch 40 in the event the ring cut-off relay R210 does not restore shortly thereafter to interrupt, at RA216, this circuit. When the last-mentioned circuit has been completed a predetermined time interval, the supervisory signal associated with the connector switch 40 is operated, thereby to indicate to a supervisory operator that the connector switch 40 has failed to release properly.

Upon restoring, the switch-through relay R260 interrupts, at RA261, RC263 and at RA267, further points in the circuit for projecting ringing current over a called subscriber line; prepares, at RA264, a point in the previously traced circuit for energizing the busy relay R230; and interrupts, at RA265, a further point in the holding circuit for energizing the lower winding thereof. Also, when ground potential is removed from the control conductor C112, the circuit for energizing the upper winding of the switch-through relay R230 is interrupted, the line circuits 101 and 417 individually associated with the subscriber lines 100 and 410 are released, and the finder switch 30 is released. When the line circuits 101 and 417 individually associated with the subscriber lines 100 and 410 are released, the respective subscriber lines are marked as idle to the connector switches of the links having access thereto. At this time the link 20 is completely released for further use and the calling and called subscriber lines 100 and 410 are marked as idle to the connector switches of the links having access thereto.

Calls from a substation to the P. B. X 450

A call which is to be extended from one subscriber substation to the P. B. X 450 is initiated at the calling substation by removing the receiver of the telephone instrument thereat from its hook. For example, in extending a call from the subscriber substation A to the P. B. X 450, the call is first initiated at the substation A by removing the receiver of the telephone instrument thereat from its hook, thereby to cause the line circuit 101 individually associated with the subscriber line 100 to be operated in the previously described manner. This operation of the line circuit 101 causes the distributor 50 to assign a previously selected idle main link to the use of the calling subscriber line 100. Assuming that the distributor 50 operates to assign the previously selected idle link 20 illustrated to the use of the calling subscriber line 100, the finder switch 30 of the link 20 operates, in the previously described manner, and seizes the calling subscriber line 100. When the subscriber line 100 is seized by the finder switch 30, the line circuit 101 individually associated therewith then operates to cause the distributor to select an idle main link to the use of the next calling line in the previously described manner. Assuming that the illustrated link 20 is assigned to the use of the calling subscriber line 100, when the finder switch 30 seizes the calling subscriber line 100, the previously traced loop circuit between the substation

A and the line relay R130 is completed, thereby to cause the latter relay to operate as previously described. Upon operating, the line relay R130 causes the hold relay R140 to operate, which latter relay causes the transfer relay R200 to operate as previously explained, thereby to cause the line circuit 101 to operate further and mark the subscriber line 100 as busy to the connector switches of the links having access thereto and to condition the connector switch 40 to be responsive to digits dialed at the calling substation A.

The subscriber at the calling substation A then dials the first digit of the directory number of the main group of P. B. X trunk lines 420 extending to the P. B. X 450, which digit in the present instance is 0, thereby to transmit a first series of impulses by way of the subscriber loop circuit to the line relay R130. The line relay R130 follows the dialed impulses in the previously describer manner, thereby to alternately complete the previously mentioned circuit for energizing the hold relay R140 and the previously traced circuit for energizing the transfer relay R200 in multiple with the vertical magnet M208. The relays R140 and R200 being of the slow-to-release type remain operated during impulsing and the vertical magnet M208 is successively energized to cause the carriage of the Strowger mechanism included in the connector switch 40 to be moved in the vertical direction to the level 250 in the associated contact bank. When the carriage of the Strowger mechanism included in the connector switch 40 is moved away from its normal position, the switch springs S151 and S226 are actuated in order to prepare the previously traced circuit for energizing the release magnet M150; and to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R200, respectively, as previously noted. Shortly following the conclusion of the first digit, the transfer relay R200 restores in order to prepare, at RA200 and RC202, the previously traced circuit for energizing in series the control relay R240 and the rotary magnet M206, as previously noted. The subscriber at the substation A then dials the second digit of the directory number of the main group of P. B. X trunk lines 420 extending to the P. B. X 450, which digit in the present instance is 2, thereby to transmit a second series of impulses by way of the subscriber loop circuit to the line relay R130. The line relay R130 follows the dialed impulses, thereby to alternately complete the previously mentioned circuit for energizing the hold relay R140 and the previously traced circuit for energizing in series the control relay R240 and the rotary magnet M206, as previously noted. The relays R140 and R240 remain operated during impulsing and the rotary magnet M206 is successively energized to rotate the carriage of the Strowger mechanism included in the connector switch 40 to the contact set in the level 290 terminating the first P. B. X trunk line 421 in the main group of P. B. X trunk lines 420 extending to the P. B. X 450. Upon operating, the control relay R240 completes, at RA241 and RC242, the previously mentioned circuit for energizing the control relay R250, thereby to cause the latter relay to operate; and interrupts, at RA244, a point in a circuit, traced hereinafter, for energizing the control relay R220. Upon operating, the control relay R250 prepares, at RA255, the previously mentioned circuit for en-

energizing the control relay R220; interrupts, at RA256, the previously mentioned circuit for returning busy tone current over the loop circuit extending to the calling substation A; interrupts, at RA251 and RC252, a point in the previously traced circuit for energizing the upper winding of the switch-through relay R260; interrupts, at RA253 and RC254, a point in the previously traced holding circuit for energizing the busy relay R230; and prepares, at RA251 and RA253, a point in the previously traced original circuit for energizing the busy relay R230.

At this time the wipers 291, 293, 294 and 295 carried by the carriage of the Strowger mechanism included in the connector switch 40 engage the contacts in the associated level 290 terminating the first P. B. X trunk line 421 in the main group of P. B. X trunk lines 420 extending to the P. B. X 450; the wipers 291 and 295 engaging the contacts terminating the line conductors of the P. B. X trunk line 421; the wiper 293 engaging the contact terminating the control conductor of the P. B. X trunk line 421; and the wiper 294 engaging the contact terminating the "EC" conductor connected to the contact terminating the control conductor of the P. B. X trunk line 421.

At this time ground potential or battery potential appears upon the control conductor of the P. B. X trunk line 421 depending upon whether this P. B. X trunk line is busy or idle, respectively. Assuming that the P. B. X trunk line 421 is busy the presence of ground potential upon the control conductor thereof completes the original circuit for energizing the busy relay R230, this circuit extending from the grounded control conductor of the P. B. X trunk line 421 by way of the wiper 293 and associated contact, C247, RC275, RA274, RA251, RA253, RA264, RA277 and the winding of R230 to battery. When energized over the above-traced circuit the busy relay R230 operates to interrupt, at RA231 and RC232, a point in the previously traced circuit for energizing the upper winding of the switch-through relay R230; to prepare, at RA231 and RC233, a point in the previously traced holding circuit for energizing the winding thereof; to prepare, at RA235, a point in the previously mentioned circuit for energizing the control relay R220; and to prepare, at RA236, a point in the previously traced circuit for returning busy tone current over the loop circuit extending to the calling substation A.

Shortly following the conclusion of the second digit dialed and the operation of the busy relay R230, the control relay R240, being of the slow-to-release type, restores to complete, at RA244, the previously mentioned circuit for energizing the control relay R220, this circuit extending from the grounded control conductor of the P. B. X trunk line 421 by way of the "EC" conductor illustrated, the wiper 294 and associated contact, C248, RA277, RC279, RA255, RA244, RA235, MA207 and the winding of R220 to battery. When energized over the above-traced circuit, the control relay R220 completes, at RA220, a holding circuit for energizing the winding thereof extending from the grounded control conductor C112 by way of RA220, MA207 and the winding of R220 to battery. Also, upon restoring, the control relay R240 prepares, at RA241 and RC243, an alternative circuit for energizing the control relay R250, which circuit is completed at RA221 upon the operation of the control relay

R220 and extends from the grounded control conductor C112 by way of RA221, RC243, RA241 and the winding of R250 to battery. Accordingly, the control relay R250 remains operated, thereby to retain interrupted, at RA253 and RC254, the previously traced holding circuit for energizing the busy relay R230. Also, upon operating, the relay R220 completes, at RA221, a circuit for energizing the rotary magnet M206, this circuit extending from the grounded control conductor C112 by way of RA221, RA266 and the winding of M206 to battery. When energized over the above-traced circuit, the rotary magnet M206 operates to move the carriage of the Strowger mechanism included in the connector switch 40 an additional step in the radial direction, thereby to cause the wipers noted to engage the contacts in the associated level 290 terminating the conductors of the second P. B. X trunk line 422 in the main group of P. B. X trunk lines 420 extending to the P. B. X 450. Also, upon operating, the rotary magnet M206 interrupts, at MA207, the holding circuit for energizing the control relay R220, thereby to cause the latter relay to restore. Upon restoring, the control relay R220 interrupts, at RA220, a further point in the holding circuit for energizing the winding thereof and interrupts, at RA221, the previously traced circuits for energizing the rotary magnet M206 and the control relay R250. The rotary magnet M206 immediately restores to prepare again, at MA207, the previously traced original circuit for energizing the control relay R220 and the control relay R250, being of the slow-to-release type, does not immediately restore. Also, when the wiper 293 disengages the associated contact in the level 290 terminating the control conductor of the first P. B. X trunk line 421, the circuit for energizing the busy relay R230 is interrupted, thereby to cause this relay to restore. Furthermore, when the wiper 293 engages the associated contact in the level 290 terminating the control conductor of the second P. B. X trunk line 422, the previously traced circuit for energizing or short-circuiting the winding of the busy relay R230 is completed, depending upon whether ground or battery potentials, respectively, appear upon this control conductor, corresponding to busy or idle conditions, respectively, of the P. B. X trunk line 422. In the event the P. B. X trunk line 422 is busy, ground potential appears upon the control conductor thereof, thereby to complete the previously traced original circuit for energizing the busy relay R230. The busy relay R230 then operates to complete, at RA235, the previously traced original circuit for energizing the control relay R220, which latter relay then operates to complete, at RA220, the holding circuit for energizing the winding thereof. Further, the control relay R220 completes, at RA221, the previously traced circuits for energizing the control relay R250 in multiple with the rotary magnet M206. When thus energized, the rotary magnet M206 again operates to move the carriage of the Strowger mechanism included in the connector switch 40 an additional step in the radial direction, thereby to cause the wipers noted to engage the contacts in the associated level 290 terminating the third P. B. X trunk line 423 in the main group of P. B. X trunk lines 420 extending to the P. B. X 450. It will be apparent that the operations of the relays noted above are effective to cause the connector switch 40 to operate as a trunk hunt-

ing connector switch, which operation continues until an idle P. B. X trunk line or the last P. B. X trunk in the main group of P. B. X trunk lines 420 is seized.

In the event the third and last P. B. X trunk line 423 is busy, ground potential appearing upon the control conductor thereof completes the original circuit for energizing the busy relay R230; and the previously traced original circuit for energizing the control relay R220 is not completed due to the fact that no "EC" conductor is associated with the control conductor of the last P. B. X trunk line in any group of P. B. X trunk lines. Accordingly, the rotary magnet M206 is not further operated and shortly after the busy P. B. X trunk line 423 is seized, the control relay R250 restores. Upon restoring, the control relay R250 completes, at RA253 and RC254, the previously traced holding circuit for energizing the busy relay R230. Furthermore, the control relay R250 completes, at RA256, the previously traced circuit for returning busy tone current over the loop circuit extending to the calling substation A, thereby to indicate to the subscriber thereat that each of the P. B. X trunk lines in the main group of P. B. X trunk lines 420 extending to the P. B. X 450 is busy and that the desired connection to the P. B. X 450 may not immediately be had. The subscriber at the substation A then releases the operated apparatus including the line circuit 100 and the main link 20 by replacing the receiver of the telephone instrument thereat upon its hook in the previously described manner.

Assuming that one of the P. B. X trunk lines in the main group of P. B. X trunk lines 420 extending to the P. B. X 450 is idle when it is seized by the connector switch 40, battery potential appearing upon the control conductor thereof completes the previously traced circuit for short-circuiting the winding of the busy relay R230, thereby to prevent operation of this relay. Shortly after the idle P. B. X trunk line is seized, the control relay R250 restores to complete, at RA251 and RC252, the previously traced circuit for energizing the upper winding of the switch-through relay R260, which latter relay operates to cause ringing current to be projected over the idle seized P. B. X trunk line in the previously described manner. Also, when the idle P. B. X trunk line in the main group of P. B. X trunk lines 420 is seized by the connector switch 40, the line circuit individually associated therewith in the group of line circuits 424 operates to mark the seized P. B. X trunk line as busy to the connector switches of the other main links having access thereto. The call at the P. B. X 450 is answered in the usual manner by the attendant thereat, thereby to cause the ring cut-off relay R210 to be operated, as previously explained. Upon operating, the ring cut-off relay R210 completes the previously traced loop circuit between the battery reversing relay R120 and the seized P. B. X trunk line extending to the P. B. X 450. The subsequent operations of the relays in the connector switch 40 incident to the operations of the ring cutoff relay R210 and the battery reversing relay R120 are the same as those previously described, thereby to complete an established connection between the calling substation A and the P. B. X 450. The release of this established connection is the same as the release of the established connection previously described and is primarily under the control of the calling substation A.

Calls from a substation to the P. B. X 460

A call which is to be extended from one subscriber substation to the P. B. X 460 is initiated at the calling substation by removing the receiver of the telephone instrument thereat from its hook. For example, in extending a call from the subscriber substation A to the P. B. X 460, the call is first initiated at the substation A by removing the receiver of the telephone instrument thereat from its hook, thereby to cause the line circuit 101 individually associated with the subscriber line 100 to be operated in the previously described manner. This operation of the line circuit 101 causes the distributor 50 to assign a previously selected idle main link to the use of the next calling line in the previously described manner.

Assuming that the illustrated link 20 is assigned to the use of the calling subscriber line 100, when the finder switch 30 seizes the calling subscriber line 100, the previously traced loop circuit between the subscriber substation A and the connector switch 40 is completed, thereby to condition the connector switch 40 to be responsive to digits dialed at the calling substation A and to cause the line circuit 101 to operate further and mark the subscriber line 100 as busy to the connector switches of the links having access thereto and cause the distributor to select another idle main link to be assigned to the use of the next calling line in the previously described manner.

The subscriber at the substation A then dials successively the two digits of the directory number of the main group of P. B. X trunk lines 430 extending to the P. B. X 460. In the present instance the directory number of this main group of P. B. X trunk lines is 08. The operation of the connector switch 40 in response to the successive digits 0 and 8 dialed thereinto is substantially the same as the previously described operation thereof when the successive digits 0 and 2 are dialed thereinto. In the present instance the connector switch 40 operates as a trunk hunting connector switch to hunt for an idle P. B. X trunk line in the main group of P. B. X trunk lines 430 in the same manner as it operated to hunt for an idle P. B. X trunk line in the main group of P. B. X trunk lines 420, as previously described. In the event the connector switch 40 finds an idle P. B. X trunk line in the main group of P. B. X trunk lines 430, it operates in the previously described manner in order to cause ringing current to be projected over the idle seized P. B. X trunk line. However, in this instance the connector switch 40 does not operate immediately to cause busy tone current to be returned over the loop circuit extending to the calling substation A when the last P. B. X trunk line 433 in the main group of P. B. X trunk lines 430 is tested busy in the event that each of the P. B. X trunk lines in the main group of P. B. X trunk lines 430 is busy, as it did when the last P. B. X trunk line 423 in the main group of P. B. X trunk lines 420 was tested busy.

In the present instance, when the connector switch 40 seizes the last P. B. X trunk line 433 in the main group of P. B. X trunk lines 430 extending to the P. B. X 460 and this P. B. X trunk line is tested busy, the circuit for energizing the busy relay R230 is completed as previously explained. However, the previously traced original circuit for energizing the control relay R220 is not completed due to the fact that no "EC" conductor is associated with the control conductor of the last P. B. X trunk line 433 in the main

group of P. B. X trunk lines 430, as previously noted. Shortly after the busy relay R230 operates, the control relay R250 restores to complete, at RA253 and RC254, the holding circuit for energizing the busy relay R230; to complete, at RA256, the previously traced circuit for returning busy tone current over the loop circuit extending to the calling substation A; and to complete, at RA250, a circuit for energizing the upper winding of the switch-over relay R270. The last-mentioned circuit extends from the grounded conductor C228 terminated by the contact in the level 290 associated with the wiper 292 by way of the wiper 292, C246, RA280, RA230, RA250 and the upper winding of R270 to battery. When energized over the above-traced circuit, the relay R270 operates to close the "X" contacts associated with the armature RA278, thereby to complete a holding circuit for energizing the lower winding thereof extending from the grounded control conductor C112' by way of RA278 and the lower winding of R270 to battery. When this holding circuit for energizing the lower winding of the relay R270 is completed, the latter relay fully operates to interrupt, at RA277, the previously traced holding circuit for energizing the busy relay R230, thereby to cause the busy relay to restore. Upon restoring, the busy relay R230 interrupts, at RA236, a point in the previously traced circuit for returning busy tone current over the loop circuit extending to the calling substation A. Thus, it will be apparent that the circuit for returning busy tone current over the loop circuit extending to the calling substation A is completed and then interrupted substantially instantaneously. Accordingly, the receiver of the telephone instrument at the calling substation A is not actuated to produce busy tone.

Also, upon operating, the switch-over relay R270 interrupts, at RA271, RC272 and at RA271', RC273', points in the connections between the line conductors C134 and C135, respectively, and the line conductors C245 and C249, respectively, extending to the wipers 291 and 295, respectively; and prepares, at RA271, RC273 and at RA271', RC272', points in paths traced hereinafter for connecting the line conductors C134 and C135, respectively, to the line conductors C301 and C307, respectively, of the overflow trunk 300. Further, the relay R270 completes, at RA270, a path for applying battery potential to the line conductor C301 of the overflow trunk 300, this path extending from battery at the resistor 225, by way of the resistor 225, RA270, RC262, RA261, RA271 and RC273 to the line conductor C301. Furthermore, the relay R270 prepares, at RA274 and RC276, a circuit traced hereinafter for energizing the upper winding of the switch-through relay R260; prepares, at RA274' and RC275', a circuit traced hereinafter for energizing the lower winding of the transfer relay R200; and completes, at RA277' and RC278', a connection between the control conductor C248 extending to the wiper 294 and the control conductor C305 of the overflow trunk 300 for a purpose more fully described subsequently. The last-mentioned connection extends from the control conductor C248 by way of RA277', RC278' and RA203 to the control conductor C305. Finally, the relay R270 completes, at RA270', a path for applying ground potential to the start conductor C306 of the overflow trunk 300 extending to the distributor 70, this path extending from ground, at RA204, by

way of RA270' and RA283 to the start conductor C306.

This application of ground potential to the start conductor C306 of the overflow trunk 300 completes a circuit for energizing the start relay R530 in series with the rotary magnet M70 in the distributor 70, this circuit extending from the grounded start conductor C306 by way of the winding of R530, RA531, C588, MC71, MA71 and the winding of M70 to battery. Shortly after the start relay R530 is energized over the above-traced circuit, this relay, being of the slow-to-operate type, operates to interrupt, at RA531, a point in the original circuit for energizing the winding thereof and to insert the resistor 549 in a holding circuit for energizing the relay R530 in series with the rotary magnet M70, this holding circuit extending from the grounded start conductor C306 by way of the winding of R530, the resistor 549, C588, MC71, MA71 and the winding of M70 to battery. The winding of the rotary magnet M70 is not sufficiently energized over either the original circuit or the holding circuit for energizing the winding thereof in series with the winding of the start relay R530 to cause operation thereof, due to the high series resistance of the winding of the start relay R530.

Also, upon operating, the start relay R530 completes, at RA532, an obvious circuit for energizing the control relay R560, thereby to cause the latter relay to operate. Upon operating, the control relay R560 prepares, at RA561, a circuit traced hereinafter for energizing the lower winding of the transfer control relay R580 in series with the lower winding of the stepping relay R575; prepares, at RA562, a circuit traced hereinafter for energizing the upper winding of the stepping relay R575; prepares, at RA564, a circuit traced hereinafter for energizing the winding of the switch-through control relay R570 in series with the lower winding of the stepping relay R575; prepares, at RA565, a circuit traced hereinafter for energizing the upper winding of the transfer control relay R580; prepares, at RA567, a path traced hereinafter for applying ground potential to the trunks busy conductor C396; and prepares, at RA568, a first circuit traced hereinafter for energizing the rotary magnet M70. Furthermore, the control relay R560 completes, at RA566, a circuit for energizing the lower winding of the control relay R550, this circuit extending from ground at RA566 by way of RA542, RC544 and the lower winding of R550 to battery. When energized over the above-traced circuit, the control relay R550 operates to complete, at RA551, a circuit for energizing the timing relay R555, this circuit extending from ground at RA566 by way of RA541, RA551, and the winding of R555 to battery. Further, the control relay R550 prepares, at RA552, a circuit, traced hereinafter, for energizing the upper winding thereof; interrupts, at RA553, a point in the previously mentioned path for applying ground potential to the trunks busy conductor C396; and interrupts, at RA554, a point in the previously mentioned circuit for energizing the rotary magnet M70. When energized over the above-traced circuit the timing relay R555 operates to set the weighted armature RA556 thereof into operation in order to cause this vibrating armature to engage alternately the associated contacts RC557 and RC558 arranged on opposite sides thereof. The alternate engagements of the weighted armature RA556 with the contacts RC557 and RC558 intermittently com-

plete circuits for energizing the upper winding of the control relay R550 and the upper winding of the trunks busy relay R540. The first-mentioned circuit extends from ground at RA556 by way of RA552, RA556, and RC557 or RC558 and the upper winding of R550 to battery; and the last-mentioned circuit extends from ground at RA556 by way of RA552, RA556 and RC557 or RC558, RC545, RA543 and the upper winding of R540 to battery. Due to the facts that the above-traced circuit for energizing the upper winding of the trunks busy relay R540 is only intermittently completed and that the latter relay is of the slow-to-operate type, the lower winding thereof being short-circuited under the control of the armature RA546, the trunks busy relay R540 does not immediately operate.

Finally, the control relay R550 completes, at RA553, a circuit for energizing the rotary magnet M61, this circuit extending from ground at R576 by way of RA553, C583, the wiper 505 and contact in the associated contact bank 505 terminating the control conductor C393, C393, RA395, RC387 and the winding of M61 to battery. When energized over the above-traced circuit, the rotary magnet M61 operates to condition the wipers 322, 326, 332, 336, 342 and 346 of the rotary finder switch 61 to be operated one step in a counterclockwise direction and completes, at MA61 and MC61, the previously mentioned circuit for energizing the upper winding of the stepping relay R575, this circuit extending from ground at MC61 by way of MA61, the control conductor C394, the wiper 512 and contact in the associated contact bank terminating C394, C589, RA562 and the upper winding of R575 to battery. When energized over the above-traced circuit, the stepping relay R575 operates to interrupt, at RA576, the previously traced circuit for energizing the rotary magnet M61, thereby to cause the rotary magnet M61 to restore. Upon restoring, the rotary magnet M61 causes the wipers noted of the rotary finder switch 61 to be stepped one step in the counterclockwise direction and into engagement with the respective contacts in the associated contact banks terminating the conductors of an overflow trunk extending thereto from the connector switch of one of the main links. Also, upon restoring, the rotary magnet M61 interrupts, at MA61 and MC61, the previously traced circuit for energizing the stepping relay R575, which latter relay restores to complete, at RA576, the previously traced circuit for energizing the rotary magnet M61. The rotary magnet M61 again operates to condition the wipers of the rotary finder switch 61 to be rotated an additional step in the counterclockwise direction and to complete the previously traced circuit for energizing the upper winding of the stepping relay R575. The rotary magnet M61 and the stepping relay R575 continue to interact in the above-described manner until the wipers noted of the rotary finder switch 61 engage the respective contacts in the associated contact banks terminating the conductors of the overflow trunk 300 extending to the connector switch 40 of the main link 20, at which time the previously mentioned circuit for energizing in series the lower windings of the transfer control relay R580 and the stepping relay R575 is completed. The last-mentioned circuit extends from battery potential appearing upon the line conductor C301 of the overflow trunk 300 by way of the contact in the contact bank 321 terminating C301, the associated wiper 322, RA371, RC372,

RA381, the control conductor C395, the contact in the contact bank 515 terminating C395, the associated wiper 516, C584, RA561, the lower winding of R580 and the lower winding of R575 to battery. This circuit constitutes a holding circuit for energizing the lower winding of the stepping relay R575, thereby to prevent the stepping relay R575 from restoring when the rotary magnet M61 is restored to drive the wipers noted of the rotary finder switch 61 into engagement with the respective contacts in the associated contact banks terminating the conductors of the overflow trunk 300.

When energized over the above-traced circuit, the transfer control relay R580 operates to complete, at RA562, the previously mentioned holding circuit for energizing the upper winding thereof, this circuit extending from ground at RA565 by way of RA582 and the upper winding of R580 to battery. Also, upon operating, the relay R580 completes, at RA581, a circuit for energizing the transfer relay R380, this circuit extending from ground at RA581 by way of C586, the wiper 526, the contact in the associated contact bank 525 terminating the control conductor C398, C398 and the winding of R380 to battery. When energized over the above-traced circuit, the transfer relay R380 operates to interrupt, at RA381, a point in the previously traced circuit for energizing the lower winding of the transfer control relay R580 in series with the lower winding of the stepping relay R575; to prepare, at RA382, a further point in the previously mentioned circuit for energizing the winding of the switch-through control relay R570 in series with the lower winding of the stepping relay R575; to complete, at RA383, an obvious connection between the wipers 362 and 366 included in the rotary hunting switch 62; and to complete, at RA384, a connection between the trunks busy conductor C303 in the overflow trunk 300 and the trunks busy conductor C396, this connection extending from the trunks busy conductor C303 by way of the contact in the contact bank 341 terminating C303, the associated wiper 342 and RA384 to the trunks busy conductor C396. Finally, the transfer relay R380 interrupts, at RA385 and RC387, a point in the circuit for energizing the rotary magnet M61; and prepares, at RA385 and RC386, a point in a circuit traced hereinafter for energizing the rotary magnet M62.

When the previously traced circuit for energizing the lower windings of the relays R580 and R575 is interrupted, the relay R575 restores to complete, at RA576, the previously mentioned circuit for energizing the winding of the rotary magnet M62. The last-mentioned circuit extends from ground at RA576 by way of RA563, C583, the wiper 506, the contact in the associated contact bank 505 terminating the control conductor C393, C393, RA385, RC386 and the winding of M62 to battery. When energized over the above-traced circuit, the rotary magnet M62 operates to condition the wipers 352, 356, 362 and 366 of the rotary hunting switch 62 to be rotated one step in a clockwise direction. Also, upon operating, the rotary magnet M62 completes, at MA62 and MC62, an alternative circuit for energizing the upper winding of the stepping relay R575, this alternative circuit extending from ground at MC62 by way of MA62, the control conductor C394, the contact in the contact bank 511 terminating C394, the associated wiper 512, C589, RA562 and the upper winding of R575 to battery.

When energized over the above-traced circuit, the stepping relay R575 operates to interrupt, at RA576, the previously traced circuit for energizing the rotary magnet M62, thereby to cause the rotary magnet M62 to restore. Upon restoring, the rotary magnet M62 drives the wipers noted of the rotary hunting switch 62 one step in the clockwise direction; and interrupts, at MA62 and MC62, the previously traced alternative circuit for energizing the upper winding of the stepping relay R575, thereby to cause the latter relay to restore and complete, at RA576, the previously traced circuit for energizing the rotary magnet M62 in order to cause the rotary magnet M62 to operate and condition the wipers noted of the rotary hunting switch 62 to be rotated an additional step in the clockwise direction and to complete the previously traced alternative circuit for energizing the upper winding of the stepping relay R575, thereby to cause operation thereof. The stepping relay R575 and the rotary magnet M62 interact, in the manner described above, in order to cause the wipers noted of the rotary hunting switch 62 to be moved step by step in a clockwise direction until an idle P. B. X trunk line extending to the P. B. X 460 is found or until the elapse of a predetermined time interval. More particularly, when an idle P. B. X trunk line extending to the P. B. X 460 is found, the previously mentioned circuit for energizing in series the switch-through control relay R570 and the lower winding of the stepping relay R575 is completed in a manner more fully described subsequently. It is pointed out that as the wipers noted of the rotary hunting switch 62 are rotated, the respective contacts in the associated contact banks terminating the auxiliary group of trunk lines 440 are successively engaged and subsequently the respective contacts in the associated contact banks terminating the main group of P. B. X trunk lines 430 are successively engaged. Thus, it will be apparent that the hunting switch 62 first tests successively the idle or busy condition of the P. B. X trunk lines 441, 442 and 443 of the auxiliary group of trunk lines 440 extending to the P. B. X 460 and subsequently tests successively the P. B. X trunk lines 431, 432 and 433 in the main group of P. B. X trunk lines 430 extending to the P. B. X 460. Furthermore, it is pointed out that the wipers noted of the hunting switch 62 are rotated at least once during the operation of the hunting switch 62 before the elapse of the predetermined time interval mentioned. Accordingly, both ends of the wipers noted of the hunting switch 62 are rotated across the associated contact banks in the event no idle P. B. X trunk line extending to the P. B. X 460 is found, whereby both the auxiliary and main groups of P. B. X trunk lines extending to the P. B. X 460 are tested at least twice before the elapse of the predetermined time interval mentioned. Thus, the hunting switch 62 is cyclically operative; and, preferably, the rate of operation thereof is so correlated with respect to the predetermined time interval mentioned that this switch is operative through a predetermined number of cycles of operation during the predetermined time interval mentioned.

During the operation of the hunting switch 62 the wiper 362 successively engages in the associated contact bank 361 the contacts terminating the control conductors of the P. B. X trunk lines in the auxiliary and main groups of P. B. X trunk lines 440 and 430, respectively, extending to the P. B. X 460. When the wiper 362 engages in the

associated contact bank 361 a contact terminating the control conductor of a busy P. B. X trunk line extending to the P. B. X 460, ground potential appearing upon the control conductor completes a path for short-circuiting in series the switch-through control relay R570 and the lower winding of the stepping relay R575. This circuit extends from the grounded control conductor of the P. B. X trunk line by way of the contact in the contact bank 361 terminating this control conductor, the associated wiper 362, RA383, the wiper 366 and the multiplied contacts in the associated contact bank 365, the control conductor C315, the wiper 294 and associated contact in the level 290 terminating C315, C248, RA277', RC278', RA203, the control conductor C305 of the overflow trunk 300, the wiper 336 and associated contact in the contact bank 335 terminating C305, RA382, C397, RA564, the winding of R570 and the lower winding of R575 to ground.

On the other hand, when the wiper 362 engages in the associated contact bank 361 a contact terminating the control conductor of an idle P. B. X trunk line extending to the P. B. X 460, battery potential appearing upon the control conductor completes a circuit for energizing in series the switch-through control relay R570 and the lower winding of the stepping relay R575, this circuit being substantially identical to the previously traced circuit for short-circuiting in series the switch-through control relay R570 and the lower winding of the stepping relay R575. It is noted that the previously mentioned circuit for energizing the winding of the switch-through control relay R570 in series with the lower winding of the stepping relay R575, which circuit when completed causes further operation of the rotary magnet M62 to be arrested and the overflow link 60 to be switched through, includes the control conductor C315 terminated at the multiplied contacts in the contact bank 365 of the rotary hunting switch 62; and that the multiplied contacts mentioned are engaged by the associated wiper 366 only during the portion of the cycle of operation of the rotary hunting switch 62 while the wiper 362 is engaging in the associated contact bank 361 the contacts terminating the control conductors of the P. B. X trunk lines in the auxiliary and main groups of P. B. X trunk lines 440 and 430, respectively, extending to the P. B. X 460. Accordingly, at this time, the hunting switch 62 effectively tests only the P. B. X trunk lines extending to the P. B. X 460; and the previously mentioned energizing circuit can be completed only in the event that an idle P. B. X trunk line extending to the P. B. X 460 is found. This arrangement positively prevents, at this time, the overflow link 60 from being switched through due to the presence in the contact banks of the rotary hunting switch 62 thereof of an idle P. B. X trunk line extending to another P. B. X, such, for example, as the P. B. X 470.

When the above-mentioned circuit for energizing in series the winding of the switch-through control relay R570 and the lower winding of the stepping relay R575 is completed, the stepping relay R575 is retained in its operated position and does not restore incident to the interruption of the circuit for energizing the upper winding thereof, when the rotary magnet M62 is restored in order to cause the wipers noted of the rotary hunting switch 62 to be driven an additional step in the clockwise direction and into engagement with the contacts in the associated contact banks

terminating the conductors of the idle P. B. X trunk line in either the auxiliary or main groups of P. B. X trunk lines 440 or 430, respectively, extending to the P. B. X 460. Accordingly, the previously traced circuit for energizing the rotary magnet M62 is not again completed and further operation of the rotary hunting switch 62 is positively arrested.

Also, when the above-mentioned circuit for energizing in series the switch-through control relay R570 and the lower winding of the stepping magnet R575 is completed, the relay R570 operates to complete, at RA571, the previously mentioned circuit for energizing the upper winding of the switch-through relay R370. This circuit extends from ground at RA571 by way of C585, the wiper 522 and contact in the associated contact bank 521 terminating the control conductor C392, C392 and the upper winding of R370 to battery. When energized over the above-traced circuit, the switch-through relay R370 operates to complete, at RA376, a holding circuit for energizing the lower winding thereof in series with the lower winding of the transfer relay R200 in the connector switch 40 of the main link 20. This circuit extends from ground at the lower winding of R370 by way of the lower winding of R370, RA376, the wiper 346 and contact in the associated contact bank 345 terminating the control conductor C304 of the overflow trunk 300, C304, RC275', RA274', and the lower winding of R200 to battery. Also, upon operating, the switch-through relay R370 completes, at RA375, a circuit for energizing the upper winding of the switch-through relay R260 in the connector switch 40 of the main link 20, this circuit extending from the grounded control conductor C112, by way of RA231, RC232, the upper winding of R260, RC252, RA251, RA274, RC276, the control conductor C302 of the overflow trunk 300, the contact in the contact bank 331 terminating C302 and the associated wiper 332, RA375, the wiper 362 and contact in the associated contact bank 361 terminating the control conductor of the idle P. B. X trunk line seized, battery potential appearing upon this control conductor. Also, when the idle P. B. X trunk line in the main or auxiliary groups of P. B. X trunk lines 430 or 440, respectively, is seized by the hunting switch 62 the line circuit individually associated therewith in the group of line circuits 434 operates to mark the seized main P. B. X trunk line as busy to the connector switches of the main links and the hunting switches of the other overflow links or to mark the seized auxiliary P. B. X trunk line as busy to the hunting switches of the other overflow links. Further, the switch-through relay R370 completes, at RA371, RC373 and at RA374, connections between the line conductors of the seized P. B. X trunk line and the line conductors C301 and C307 of the overflow trunk 300. The connection between one of the line conductors of the seized P. B. X trunk line and the line conductor C301 of the overflow trunk 300 extends from the one line conductor of the P. B. X trunk line by way of the contact in the contact bank 351 terminating the one line conductor and the associated wiper 352, RC373, RA371, the wiper 322 and the contact in the associated contact bank 321 terminating C301 to the line conductor C301; and the connection between the other line conductor of the seized P. B. X trunk line and the other line conductor C307 of the overflow trunk 300 extends from the

other P. B. X trunk line by way of the contact in the contact bank 355 terminating the other line conductor and the associated wiper 356, RA374, the wiper 326 and the contact in the associated contact bank 325 terminating C307 to the line conductor C307.

When the upper winding of the switch-through relay R260 in the connector switch 40 is energized over the above-traced circuit, this relay partially operates to close the "X" contacts associated with the armature RA265, thereby to complete the previously traced holding circuit for energizing the lower winding thereof. When the holding circuit for energizing the lower winding of the relay R260 is completed, this relay fully operates to complete, at RA260, the previously traced circuit for returning ring-back tone current over the loop circuit extending to the calling substation A; to interrupt at RA261 and RC262, a further point in the previously traced circuit for energizing in series the lower windings of the transfer control relay R580 and the stepping relay R575 in the distributor 70. Further, the switch-through relay R260 completes, at RA261, RC263 and at RA267, a circuit for projecting ringing current over the seized P. B. X trunk line extending to the P. B. X 460, this circuit extending from ground at RC218 by way of RA210, RA267, RA271' and RC272' to the line conductor C307 of the overflow trunk 300; and from the ungrounded terminal of the grounded ringing current transformer winding by way of the ringing current conductor C227, the upper winding of the ring cut-off relay R210, RC212, RA211, RC263, RA261, RA271 and RC273 to the line conductor C301 of the overflow trunk 300, the line conductors C307 and C301 of the overflow trunk 300 being connected to the line conductors of the seized P. B. X trunk line by way of the operated overflow link 60 over the previously traced connections. The ringing current projected by way of the above-traced circuit over the P. B. X trunk line extending to the P. B. X 460 causes the signal thereat to be operated, thereby to indicate to the attendant at the P. B. X 460 that an incoming call is extended thereto. The call is answered at the P. B. X 460 in the usual manner to complete a circuit substantially identical to the above-traced circuit for projecting ringing current over the seized P. B. X trunk line for energizing the upper winding of the ring cut-off relay R210. When the upper winding of the ring cut-off relay R210 is energized, this relay partially operates to close the "X" contacts associated with the armature RA215, thereby to complete the previously traced holding circuit for energizing the lower winding thereof. When the holding circuit for energizing the lower winding of the ring cut-off relay R210 is thus completed, this relay fully operates to interrupt, at RA211, RC212 and at RA210, RC218, the previously traced circuit for projecting ringing current over the seized P. B. X trunk line; to interrupt, at RA213 and RC214, the previously traced circuit for returning ring-back tone current over the loop circuit extending to the calling substation A; and to complete, at RA211, RA213 and at RA210, RC217, a loop circuit extending between the battery reversing relay R120 and the P. B. X 460, this loop circuit extending from ground at the lower winding of R120 by way of the lower winding of R120, C135, RC217, RA210, RA267, RA271' and RC272' to the line conductor C307 of the overflow trunk 300; and from battery

at the upper winding of R120 by way of the upper winding of R120, C134, RA213, RA211, RC263, RA261, RA271 and RC273 to the line conductor C301 of the overflow trunk 300, the line conductors C307 and C301 of the overflow trunk 300 being connected by way of the operated overflow link 60 to the line conductors of the seized P. B. X trunk line; and the line conductors of the seized P. B. X trunk line being included in a bridge circuit at the P. B. X 460. When this loop circuit extending between the battery reversing relay R120 and the P. B. X 460 is completed, the latter relay operates in the previously described manner in order to cause battery potential to be reversed over the loop circuit extending to the calling substation A. At this time an established connection is completed between the calling substation A and the P. B. X 460.

Continuing now with the operation of the distributor 70 to assign an idle overflow link to the use of the next calling overflow trunk, when the switch-through relay R370 in the illustrated overflow link 60 operates, it completes, at RA376, the previously traced circuit for energizing the lower winding thereof in series with the lower winding of the transfer relay R200 in the connector switch 40 of the main link 20. When the transfer relay R200 is thus energized, it operates to interrupt, at RA204, the previously traced path for applying ground potential to the start conductor C306 extending into the distributor 70, thereby to interrupt the circuit for energizing the start relay R530 in series with the rotary magnet M70, whereupon the latter relay restores. Also, the transfer relay R200 interrupts, at RA203, the previously traced circuit for energizing the switch-through control relay R570 in series with the lower winding of the stepping relay R575, thereby to cause the latter relays to restore. Upon restoring, the start relay R530 interrupts, at RA532, the previously mentioned circuit for energizing the control relay R560, thereby to cause the latter relay to restore. Upon restoring, the relay R560 interrupts, at RA561, a further point in the previously traced circuit for energizing the lower winding of the transfer control relay R580 in series with the lower winding of the stepping relay R575; interrupts, at RA562, a further point in the previously traced circuit for energizing the upper winding of the stepping relay R575; interrupts, at RA563, a further point in the previously traced circuit for energizing the rotary magnet M62; interrupts, at RA564, a point in the previously traced circuit for energizing the switch-through relay R570 in series with the lower winding of the stepping relay R575; interrupts, at RA565, the previously traced holding circuit for energizing the upper winding of the transfer control relay R580; interrupts, at RA566, the previously traced circuit for energizing the lower winding of the control relay R550; interrupts, at RA567, a further point in the previously mentioned path for applying ground potential to the trunks busy conductor C396; and interrupts, at RA568, a further point in the previously mentioned first circuit for energizing the rotary magnet M70. Also, upon restoring, the start relay R530 prepares, at RA531, the previously mentioned second circuit for energizing the rotary magnet M70.

When the previously traced circuit for energizing the switch-through relay R570 in series with the lower winding of the stepping relay R575 is interrupted, the latter relays restore; and

when the holding circuit for energizing the upper winding of the transfer control relay R580 is interrupted, the latter relay restores.

Upon restoring, the transfer control relay R580 interrupts, at RA581, the previously traced circuit for energizing the transfer relay R380, thereby to cause the latter relay to restore. When the stepping relay R575 restores, it prepares, at RA576, a point in the previously traced circuit for energizing the rotary magnet M61; and when the switch-through control relay R570 restores, it interrupts, at RA571, the previously traced circuit for energizing the upper winding of the switch-through relay R370, the latter relay being retained in its operated position due to the completed holding circuit for energizing the lower winding thereof. When the previously traced circuit for energizing the lower winding of the control relay R550 is interrupted, the latter relay restores to interrupt, at RA551, the previously traced circuit for energizing the timing relay R555, thereby to cause the latter relay to restore.

Also, upon operating, the switch-through relay R370 interrupts, at RA371 and RC372, a further point in the previously traced circuit for energizing the lower winding of the transfer control relay R580 in series with the lower winding of the stepping relay R575; interrupts, at RA377 and RC379, the path for applying ground potential in the overflow link 60 to the control conductor C390, for a purpose more fully described subsequently; and completes, at RC377 and RC378, the second circuit for energizing the rotary magnet M70. This circuit extends from ground at RA377, by way of RC378, the control conductor C391, the contact in the contact bank 501 terminating the control conductor C391 and the associated wiper 502, C582, RA531, C588, MC71, MA71 and the winding of M70 to battery.

When the rotary magnet M70 is energized over the above-traced circuit, it operates to condition the wipers 502, 506, 512, 516, 522 and 526 of the rotary switch 500 in the distributor 70 to be rotated one step in the counterclockwise direction and interrupts, at MA71 and MC71, the previously traced circuit for energizing the winding thereof, thereby to cause the rotary magnet M70 to restore. Upon restoring, the rotary magnet M70 drives the wipers noted of the rotary switch 500 one step in the counterclockwise direction and prepares, at MA71 and MC71, an auxiliary circuit for again energizing the winding thereof. When the wipers noted of the rotary switch 500 are rotated one step in the counterclockwise direction, they engage, in the associated contact banks 501, 505, 511, 515, 521 and 525, respectively, the contacts terminating the control conductors extending to the next overflow link. In the event the next overflow link is busy, ground potential appears upon the control conductor thereof corresponding to the control conductor C391 extending into the illustrated overflow link 60, thereby to complete the previously mentioned auxiliary circuit for energizing the winding of the rotary magnet M70, whereupon the rotary magnet M70 then operates in order to drive the wipers noted of the rotary switch 500 an additional step in the counterclockwise direction. The rotary magnet M70 continues to operate in order to drive the wipers noted of the rotary switch 500 step by step in a counterclockwise direction until an idle overflow link is found, at which time no potential appears upon the

control conductor thereof corresponding to the control conductor C391 extending into the illustrated overflow link 60. Accordingly, the circuit for energizing the winding of the rotary magnet M70 is not recompleted, thereby to arrest further operation of the rotary magnet M70.

In the event that the rotary magnet M70 continues to operate due to the fact that there are no idle overflow links available to be assigned to the use of the next calling overflow trunk, the wiper 502 of the rotary switch 500 is rotated into engagement with the first contact in the associated contact bank 501 which is multiplied to the grounded conductor C534, thereby to complete an auxiliary circuit for energizing the rotary magnet M70, this circuit extending from the grounded conductor C534 by way of the first contact which is multiplied thereto in the contact bank 501 and the associated wiper 502, C582, RA531, C588, MC71, MA71 and the winding of M70 to battery. When the rotary magnet M70 is energized over the above-traced circuit, it continues to operate, thereby to drive the wipers noted of the rotary switch 500 additional steps in the counterclockwise direction, as previously explained, until the wiper 502 engages the last contact in the associated contact bank 501. When the last contact in the contact bank 501 is engaged by the associated wiper 502, an alternative circuit for energizing the rotary magnet M70 is completed by way of the control conductor C390' only in the event that one of the overflow links is idle, this control conductor C390' being multiplied to each of the control conductors corresponding to the control conductor C390 extending into the illustrated overflow link 60. When the last overflow link is rendered busy, ground potential is removed from the control conductor thereof corresponding to the control conductor C390, thereby to remove ground potential from the control conductor C390' in order to prevent further operation of the rotary magnet M70 when the wiper 502 engages the last contact in the associated contact bank 501. In the event that one of the overflow links has become idle since being tested by the rotary switch 500, ground potential appears upon the control conductor C390', thereby to cause further operation of the rotary magnet M70. The rotary magnet then continues to operate until the idle overflow link is selected by the rotary switch 500, at which time further operation of the rotary magnet M70 is arrested due to the fact that no ground potential appears upon the control conductor of the selected idle overflow link corresponding to the control conductor C391 extending into the illustrated overflow link 60. At this time all of the relays in the distributor 70 are restored and the rotary switch 500 included in the distributor 70 has been operated in order to select an idle overflow link to be assigned to the use of the next calling overflow trunk.

The release of the established connection between the calling subscriber substation A and the P. B. X 460 is primarily under the control of the subscriber at the substation A and is effected when the subscriber at the substation A replaces the receiver of the telephone instrument thereat upon its hook, thereby to interrupt the loop circuit extending between the substation A and the line relay R130 in the connector switch 40 of the main link 29 in order to cause the latter relay to restore. Upon restoring, the line relay R130 causes the hold relay R140 to restore, which latter relay, upon restoring, interrupts, at RA141 and RA145, the previously traced paths for apply-

ing ground potential to the control conductors C112 and C112', respectively, in the event the battery reversing relay R120 has been restored to interrupt, at RA128 and RC129, the multiple path for applying ground potential to the control conductor C112'. When ground potential is removed from the control conductor C112', the ring cut-off relay R210 and the switch-through relay R260 restore and the Strowger mechanism included in the connector switch 40 is released, as previously noted. Also, the holding circuit for energizing the lower winding of the switch-over relay R270 is interrupted when ground potential is removed from the control conductor C112', thereby to cause the latter relay to restore and interrupt, at RA274' and RC275', the previously traced circuit for energizing in series the lower winding of the transfer relay R200 in the connector switch 40 and the switch-through relay R370 in the overflow link 60, thereby to cause the latter relays to restore. Upon restoring, the switch-through relay R370 interrupts, at RA371, RC373, at RA374 and at RA375, the previously traced connections between the rotary finder and hunting switches 61 and 62 in the overflow link 60 in order to interrupt further points in the loop circuit between the battery reversing relay R120 in the connector switch 40 and the P. B. X 460. At this time the main link 20 and the overflow link 60 are completely released for further use and the line circuit 110 associated with the subscriber line 100 and the one of the line circuits 434 individually associated with the previously mentioned P. B. X trunk line are operated to mark the subscriber line 100 as idle to the connector switches of the main links having access thereto, and to mark the last-mentioned P. B. X trunk line, in the event it is a main P. B. X trunk line, as idle to the connector switches of the main links and to the hunting switches of the overflow links having access thereto or to mark the last-mentioned P. B. X trunk line, in the event it is an auxiliary P. B. X trunk line, as idle to the hunting switches of the overflow links having access thereto.

As previously noted, when the operation of the distributor 70 is initiated, the start relay R530, the control relays R560 and R550 and the timing relay R555 therein are operated. Upon operating, the timing relay R555 sets its weighted armature RA556 into operation as previously noted, thereby to initiate a timing operation during which timing operation the illustrated overflow link 60 is operated to hunt for an idle P. B. X trunk line extending to the P. B. X 460. More particularly, the operation or vibration of the weighted armature RA556 of the timing relay R555 is effective to complete intermittently the previously traced circuits for energizing in multiple the upper windings of the control relay R550 and the trunks busy relay R540. As previously noted, the trunks busy relay R540 is slow to operate due to the facts that the above-mentioned circuit for energizing the upper winding thereof is only intermittently completed and the lower winding thereof is short-circuited by the armature RA546. However, after a predetermined time interval, the weighted armature RA556 of the timing relay R555 ceases operating and permanently engages the contact RC558. Shortly thereafter, the trunks busy relay R540 operates to interrupt, at RA542 and RC544, the previously traced circuit for energizing the lower winding of the control relay R550; and to complete, at RA542 and RA543, a holding circuit for

energizing the upper winding thereof, this circuit extending from ground at RA566, by way of RA542, RA543 and the upper winding of R540 to battery. Also, upon operating, the relay R540 prepares, at RA547, a point in the previously mentioned circuit for applying ground potential to the trunks busy conductor C396; and prepares, at RA548, a point in the previously mentioned first circuit for energizing the rotary magnet M70. Finally, the relay R540 interrupts, at RA543 and RC545, a point in the original circuit for energizing the upper winding thereof; and interrupts, at RA541, the previously traced circuit for energizing the timing relay R555, thereby to cause the latter relay to restore. Upon restoring, the weighted armature RA556 of the timing relay R555 is again intermittently operated into engagements with the contacts RC557 and RC558, thereby to complete intermittently the previously traced circuit for energizing the upper winding of the control relay R550. After a second predetermined time interval the weighted armature RA556 of the timing relay R555 assumes a position intermediate the contacts RC557 and RC558, thereby to interrupt the previously traced circuit for energizing the upper winding of the control relay R550 in order to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the control relay R550 interrupts, at RA551, a further point in the circuit for energizing the timing relay R555; interrupts, at RA552, a further point in the previously traced circuit for energizing the upper winding thereof; and completes, at RA553, the previously mentioned path for applying ground potential to the trunks busy conductor C396, this path extending from ground at RA547 by way of RA553 and RA567 to C396. This application of ground potential to the trunks busy conductor C396 completes a circuit for energizing the upper winding of the trunks busy relay R280 in the connector switch 40 of the main link 20, this circuit extending from the grounded trunks busy conductor C396 by way of RA384, the wiper 342 and contact in the associated contact bank 341 terminating the control conductor C303 of the overflow trunk 300, C303 and the upper winding of R280 to battery. When energized over the above-traced circuit, the trunks busy relay R280 operates for a purpose more fully described subsequently. Also, upon restoring, the control relay R550 completes, at RA554, the first circuit for energizing the rotary magnet M70, this circuit extending from ground at RA568 by way of RA554, RA548 and the winding of M70 to battery. When energized over the above-traced circuit, the rotary magnet M70 operates to condition the wipers noted of the rotary switch 500 to be rotated one step in the counterclockwise direction.

When the trunks busy relay R280 in the connector switch 40 partially operates, it closes the "X" contacts associated with the armature RA282, thereby to complete a holding circuit for energizing the lower winding thereof, this circuit extending from the grounded control conductor C112' by way of RA282 and the lower winding of R280 to battery. When this holding circuit is completed, the relay R280 fully operates to complete, at RA281, an alternative circuit for energizing the busy relay R230, this circuit extending from the grounded control conductor C112 by way of RA281 and the winding of R230 to battery. When energized over the above-traced circuit, the busy relay R230 operates to interrupt, at RA231 and RC232, a point in the previously traced cir-

cuit for energizing the switch-through relay R260; and completes, at RA236, the previously traced circuit for returning busy tone current over the loop circuit extending to the calling substation A. Also, upon fully operating, the trunks busy relay R280 interrupts, at RA283, a further point in the path for applying ground potential to the start conductor C306 of the overflow trunk 300 extending into the distributor 70, thereby to interrupt a further point in the previously traced circuit for energizing the start relay R530 in the distributor 70. At this time, one point in the previously traced circuit for energizing the start relay R530 and the rotary magnet M70 in the distributor 70 in series is interrupted, at MA71 and MC71, upon operation of the rotary magnet M70, thereby to cause the last-mentioned relay to restore.

Upon restoring, the start relay R530 interrupts, at RA532, the previously mentioned circuit for energizing the control relay R560 in order to cause the latter relay to restore; and prepares, at RA531, the second-mentioned circuit for energizing the rotary magnet M70. Upon restoring, the control relay R560 interrupts, at RA565, the previously traced circuit for energizing the upper winding of the transfer control relay R580 in order to cause the latter relay to restore and interrupt, at RA581, the previously traced circuit for energizing the transfer relay R380 in the overflow link 60 in order to cause the latter relay to restore. Also, upon restoring, the control relay R560 interrupts, at RA566, the previously traced holding circuit for energizing the trunks busy relay R540 in order to cause the latter relay to restore, and interrupts, at RA567, a point in the previously traced path for applying ground potential to the trunks busy conductor C396 in order to interrupt a further point in the original circuit for energizing the upper winding of the trunks busy relay R280 in the connector switch 40. Finally, the control relay R560 interrupts, at RA568, the first circuit for energizing the rotary magnet M70, thereby to cause the rotary magnet M70 to restore. Upon restoring, the rotary magnet M70 drives the wipers noted of the rotary switch 500 one step in the counterclockwise direction and into engagement with the contacts in the associated contact banks terminating the control conductors extending to the next overflow link. Subsequent operation of the rotary magnet M70 depends upon the idle or busy condition of this overflow link, as previously noted, the rotary magnet M70 being effective to cause the rotary switch 500 to select an idle overflow link for the use of the next calling overflow trunk. At this time the distributor 70 and the overflow link 60 are completely released for further use and busy tone current is returned over the loop circuit to the calling substation A, thereby to indicate to the subscriber thereat that the desired connection to the P. B. X 460 may not immediately be had due to the fact that all of the P. B. X trunk lines extending thereto are busy. The release of the operated link 20 is under the control of the subscriber at the substation A and is effected when the subscriber thereat replaces the receiver of the telephone instrument at the substation A upon its hook in the same manner as that previously described.

Calls from a substation to the P. B. X 470

A call which is to be extended from one subscriber substation to the P. B. X 470 is initiated at the calling substation by removing the receiver

of the telephone instrument thereat from its hook. For example, in extending a call from the subscriber substation A to the P. B. X 470, the call is first initiated at the substation A by removing the receiver of the telephone instrument thereat from its hook, thereby to cause the line circuit 101 individually associated with the subscriber line 100 to be operated in the previously described manner. This operation of the line circuit 101 causes the distributor 50 to assign a previously selected idle main link to the use of the next calling line in the previously described manner.

Assuming that the illustrated link 20 is assigned to the use of the calling subscriber line 100, when the finder switch 39 seizes the calling subscriber line 100, the previously traced loop circuit between the subscriber substation A and the connector switch 40 is completed, thereby to condition the connector switch 40 to be responsive to digits dialed at the calling substation A and to cause the line circuit 101 to operate and mark the subscriber line 100 as busy to the connector switches of the links having access thereto in the previously described manner.

The subscriber at the substation A then dials consecutively the two digits of the directory number of the main group of P. B. X trunk lines 425 extending to the P. B. X 470. In the present instance the directory number of this group of main P. B. X trunk lines is 05. The operation of the connector switch 40 in response to the successive digits 0 and 5 dialed thereinto is substantially the same as the previously described operation thereof when the successive digits 0 and 8 were dialed thereinto. More particularly, the connector switch 40 operates as a trunk hunting connector switch and successively tests the P. B. X trunk lines 426, 427 and 428 in the main group of P. B. X trunk lines 425 extending to the P. B. X 470. In the event there is an idle P. B. X trunk line in this main group of P. B. X trunk lines 425, the connector switch 40 seizes the idle P. B. X trunk line and causes ringing current to be projected thereover in the previously described manner. However, in the event that each of the P. B. X trunk lines in the main group of P. B. X trunk lines 425 is busy, the connector switch 40 operates to cause the distributor 70 to be set into operation, thereby to assign a previously selected one of the overflow links 60 to the use of the calling overflow trunk 300. Assuming that the illustrated overflow link 60 is assigned by the distributor 70 to the use of the calling overflow trunk 300, the finder switch 61 thereof operates to find the overflow trunk 300 extending between the finder switch 61 and the connector switch 40 of the main link 20. Subsequently, the hunting switch 62 of the overflow link 60 operates to hunt successively an idle P. B. X trunk line in the auxiliary group of P. B. X trunk lines 445 and then an idle P. B. X trunk line in the main group of P. B. X trunk lines 425. In the event an idle P. B. X trunk line in one of these groups of P. B. X trunk lines extending to the P. B. X 470 is found, an alternative circuit for energizing the winding of the switch-through control relay R570 in series with the lower winding of the stepping relay R575 is completed, thereby to cause further operation of the rotary magnet M62 to be arrested and the overflow link 60 to be switched through, whereby the idle P. B. X trunk line is seized and ringing current is projected thereover in the previously described manner. The alternative circuit mentioned extends from ground, at the lower winding

of the stepping relay R575, by way of the lower winding of R575, the winding of R570, RA564, C397, RA382, the wiper 336, the contact in the associated contact bank 335 terminating the control conductor C305, C305, RA203, RC278', RA277', C248, the wiper 294, the contact in the associated level 290 terminating the control conductor C316, C316, the multiplied contacts in the contact bank 365 terminating C315, the associated wiper 366, RA383, the wiper 362 and the contact in the associated contact bank 361 terminating the control conductor of the idle P. B. X line extending to the P. B. X 470, battery potential appearing upon the last-mentioned control conductor. This alternative circuit includes the control conductor C316 terminated by the multiplied contacts mentioned; and the multiplied contacts mentioned are engaged by the associated wiper 366 only during the portion of the cycle of operation of the rotary hunting switch 62 while the wiper 362 is engaging in the associated contact bank 361 the contacts terminating the control conductors of the P. B. X trunk lines in the auxiliary and main groups of P. B. X trunk lines 445 and 425, respectively, extending to the P. B. X 470. Accordingly, this arrangement positively prevents, at this time, the overflow link 60 from being switched through due to the presence in the contact banks of the rotary switch 62 thereof of an idle P. B. X trunk line extending to another P. B. X, such, for example, as the P. B. X 460.

In the event that each of the P. B. X trunk lines in the auxiliary and main groups of P. B. X trunk lines 445 and 425, respectively, extending to the P. B. X 470 is busy, the hunting switch 62 of the overflow link 60 operates for a predetermined time interval, as previously noted. At the termination of this predetermined time interval, the distributor 70 operates to cause busy tone current to be returned over the loop circuit extending to the calling substation A in order to indicate to the subscriber thereat that the desired connection cannot immediately be had due to the fact that all of the P. B. X trunk lines extending to the P. B. X 470 are busy. The release of the operated link 20 and the overflow link 60 is under the control of the subscriber at the calling substation A and is effected when the subscriber at the substation A replaces the receiver of the telephone instrument thereat upon its hook in the previously described manner.

Conclusions

From the foregoing, it is apparent that there has been provided an arrangement for accommodating additional groups of P. B. X trunk lines extending to a number of different P. B. X, wherein the additional groups of P. B. X trunk lines have the same directory numbers as the original groups of P. B. X trunk lines extending to the different P. B. X, which arrangement utilizes exceedingly simple circuit connections and is thoroughly reliable in operation.

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, a main exchange, two branch exchanges, first main and auxiliary groups of lines extending between said main exchange and one of said branch exchanges, second main

and auxiliary groups of lines extending between said main exchange and the other of said branch exchanges, a number of first automatic switches each having access to said main groups of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to each of said groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search selectively for an idle line in said first and second main groups of lines, means for assigning idle ones of said overflow links for use, control means operative upon the failure of an assigned one of said first switches to find an idle line in one of said main groups of lines for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said first main and auxiliary groups of lines in the event said one assigned first switch failed to find an idle line in said first main group of lines and for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said second main and auxiliary groups of lines in the event said one assigned first switch failed to find an idle line in said second main group of lines.

2. In a telephone system, a main exchange, two branch exchanges, first main and auxiliary groups of lines extending between said main exchange and one of said branch exchanges, second main and auxiliary groups of lines extending between said main exchange and the other of said branch exchanges, a number of first automatic switches each having access to said main groups of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said auxiliary groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search selectively for an idle line in said first and second main groups of lines, means for assigning idle ones of said overflow links for use, control means operative upon the failure of an assigned one of said first switches to find an idle line in one of said main groups of lines for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said first auxiliary group of lines in the event said one assigned first switch failed to find an idle line in said first main group of lines and for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said second auxiliary group of lines in the event said one assigned first switch failed to find an idle line in said second main group of lines.

3. In a telephone system, main and branch ex-

changes, first and second groups of lines extending between said exchanges, a number of first automatic switches each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said first and second groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said first and second groups of lines.

4. In a telephone system, main and branch exchanges, first and second groups of lines extending between said exchanges, a number of first automatic switches each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said second group of lines.

5. In a telephone system, main and branch exchanges, first and second groups of lines extending between said exchanges, a trunk line, a number of first automatic switches each having access to said first group of lines, a number of second automatic switches each having access to said first and second groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said switches to search for any idle line in said first group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for governing said last-mentioned means, means for causing an assigned one of said second switches to search for any idle line in said first group of lines or said second group of lines, and means for selectively connecting said trunk line to said first and second switches, whereby said trunk line is connected to an assigned one of said switches finding an idle line.

6. In a telephone system, main and branch exchanges, first and second groups of lines extending between said exchanges, a trunk line, a number of first automatic switches each having access to said first group of lines, a number of second automatic switches each having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for any idle line in said first group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for governing said last-mentioned means, means for causing an assigned one of said second switches to search for any idle line in said second group of lines, and means for selectively connecting said trunk line to said first and second switches, whereby said trunk line is connected to an assigned one of said switches finding an idle line.

7. In a telephone system, a main exchange, two branch exchanges, first main and auxiliary groups of lines extending between said main exchange and one of said branch exchanges, second main and auxiliary groups of lines extending between said main exchange and the other of said branch exchanges, a first automatic switch having access to said main groups of lines, a second automatic switch having access to each of said groups of lines, means for causing said first switch to search selectively for an idle line in said first and second main groups of lines, means controlled upon the failure of said first switch to find an idle line in said first main group of lines for causing said second switch to search for an idle line in said first main and auxiliary groups of lines, and means controlled upon the failure of said first switch to find an idle line in said second main group of lines for causing said second switch to search for an idle line in said second main and auxiliary groups of lines.

8. In a telephone system, a main exchange, two branch exchanges, first main and auxiliary groups of lines extending between said main exchange and one of said branch exchanges, second main and auxiliary groups of lines extending between said main exchange and the other of said branch exchanges, a first automatic switch having access to said main groups of lines, a second automatic switch having access to said auxiliary groups of lines, means for causing said first switch to search selectively for an idle line in said first and second main groups of lines, means controlled upon the failure of said first switch to find an idle line in said first main group of lines for causing said second switch to search for an idle line in said first auxiliary group of lines, and means controlled upon the failure of said first switch to find an idle line in said second main group of lines for causing said second switch to search for an idle line in said second auxiliary group of lines.

9. In a telephone system, main and branch exchanges, first and second groups of lines extending between said exchanges, a first automatic switch having access to said first group of lines and operative to search for any idle line in said first group of lines, a second automatic switch having access to said first and second groups of lines and operative to search for any idle line in said first group of lines or said second group of lines, means for initiating operation of said first switch, and means controlled

upon the failure of said first switch to find an idle line for initiating operation of said second switch.

10. In a telephone system, main and branch exchanges, first and second groups of lines extending between said exchanges, a numerical switch having access to said first group of lines and operative automatically to search for any idle line in said first group of lines, a hunting switch having access to said first and second groups of lines and operative automatically to search for any idle line in said first group of lines or said second group of lines, impulse responsive means for initiating operation of said numerical switch, and means controlled upon the failure of said numerical switch to find an idle line for initiating operation of said hunting switch.

11. In a signaling system, first main and auxiliary groups of lines, second main and auxiliary groups of lines, a number of first automatic switches each having access to said main groups of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to each of said groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search selectively said first and second main groups of lines for a line therein having a predetermined condition thereon, means for assigning idle ones of said overflow links for use, control means operative upon the failure of an assigned one of said first switches to find a line in one of said main groups of lines having said predetermined condition thereon for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search said group of overflow trunks for a marked trunk therein, and means for causing the hunting switch of an assigned one of said overflow links to search said first main and auxiliary groups of lines for a line therein having said predetermined condition thereon in the event said one assigned first switch failed to find a line in said first main group of lines having said predetermined condition thereon and for causing the hunting switch of an assigned one of said overflow links to search said second main and auxiliary groups of lines for a line therein having said predetermined condition thereon in the event said one assigned first switch failed to find a line in said second main group of lines having said predetermined condition thereon.

12. In a signaling system, first main and auxiliary groups of lines, second main and auxiliary groups of lines, a number of first automatic switches each having access to said main groups of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and a hunting switch having access to said first and second auxiliary groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search selectively said first and second main groups of lines for a line therein having a predetermined condition thereon, means

for assigning idle ones of said overflow links for use, control means operative upon the failure of an assigned one of said first switches to find a line in one of said main groups of lines having said predetermined condition thereon for marking the overflow trunk individually associated therewith and for governing said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search said group of overflow trunks for a marked trunk therein, and means for causing the hunting switch of an assigned one of said overflow links to search said first auxiliary group of lines for a line therein having said predetermined condition thereon in the event said one assigned first switch failed to find a line in said first main group of lines having said predetermined condition thereon and for causing the hunting switch of an assigned one of said overflow links to search said second auxiliary group of lines for a line therein having said predetermined condition thereon in the event said one assigned first switch failed to find a line in said second main group of lines having said predetermined condition thereon.

13. In a signaling system, first and second groups of lines extending to a signaling station, a number of first automatic switches each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said first and second groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for marking the overflow trunk individually associated therewith and for controlling said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said first and second groups of lines.

14. In a signaling system, first and second groups of lines extending to a signaling station, a number of first automatic switches, each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for marking the overflow trunk individually associated therewith and for controlling said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said

overflow links to search for an idle line in said second group of lines.

15. In a signaling system, a group of lines extending to a signaling station, a number of first automatic switches each having access to said group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for marking the overflow trunk individually associated therewith and for controlling said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search for a marked overflow trunk in said group of overflow trunks, and means for causing the hunting switch of an assigned one of said overflow links to search for an idle line in said group of lines.

16. In a signaling system, first and second groups of lines, a number of first automatic switches each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said first and second groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search said first group of lines for a line therein having a predetermined condition thereon, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find a line having said predetermined condition thereon for marking the overflow trunk individually associated therewith and for controlling said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search said group of overflow trunks for a marked trunk therein, and means for causing the hunting switch of an assigned one of said overflow links to search said first and second groups of lines for a line therein having said predetermined condition thereon.

17. In a signaling system, first and second groups of lines, a number of first automatic switches each having access to said first group of lines, a group of overflow trunks individually associated with said first switches, a number of overflow links, each of said overflow links including an automatic finder switch having access to said group of overflow trunks and an automatic hunting switch having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search said first group of lines for a line therein having a predetermined condition thereon, means for assigning idle ones of said overflow links for use, means controlled upon the failure of an assigned one of said first switches to find a line having said predetermined condition thereon for marking the overflow trunk individually associated therewith and for controlling

said last-mentioned means, means for causing the finder switch of an assigned one of said overflow links to search said group of overflow trunks for a marked trunk therein, and means for causing the hunting switch of an assigned one of said overflow links to search said second group of lines for a line therein having said predetermined condition thereon.

18. In a signaling system, a trunk line, a group of lines extending to a signaling station, a number of first automatic switches each having access to said group of lines, a second automatic switch having access to said group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said group of lines, means controlled upon the failure of an assigned one of said first switches to find an idle line for causing said second switch to search for an idle line in said group of lines, and means for selectively connecting said trunk line to said first switches and to said second switch.

19. In a signaling system, a trunk line, a group of lines extending to a signaling station, a first automatic switch having access to said group of lines, a number of second automatic switches each having access to said group of lines, means for causing said first switch to search for an idle line in said group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of said first switch to find an idle line for controlling said last-mentioned means, means for causing an assigned one of said second switches to search for an idle line in said group of lines, and means for selectively connecting said trunk line to said first switch and to said second switches.

20. In a signaling system, a trunk line, a group of lines extending to a signaling station, a number of first automatic switches each having access to said group of lines, a number of second automatic switches each having access to said group of lines, means for assigning idle one of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for controlling said last-mentioned means, means for causing an assigned one of said second switches to search for an idle line in said group of lines, and means for selectively connecting said trunk line to said first and second switches.

21. In a signaling system, a trunk line, first and second groups of lines extending to a signaling station, a number of first automatic switches each having access to said first group of lines, a number of second automatic switches each having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for controlling said last-mentioned means, means for causing an assigned one of said second switches to search for an idle line in said second group of lines, and means for selectively connecting said trunk line to said first and second switches.

22. In a signaling system, a trunk line, first and second groups of lines extending to a signal-

ing station, a number of first automatic switches each having access to said first group of lines, a number of second automatic switches each having access to said first and second groups of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search for an idle line in said first group of lines, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find an idle line for controlling said last-mentioned means, means for causing an assigned one of said second switches to search for an idle line in said first and second groups of lines, and means for selectively connecting said trunk line to said first and second switches.

23. In a signaling system, a trunk line, first and second groups of lines, a number of first automatic switches each having access to said first group of lines, a number of second automatic switches each having access to said second group of lines, means for assigning idle ones of said first switches for use, means for causing an assigned one of said first switches to search said first group of lines for a line therein having a predetermined condition thereon, means for assigning idle ones of said second switches for use, means controlled upon the failure of an assigned one of said first switches to find a line having said predetermined condition thereon for controlling said last-mentioned means, means for causing an assigned one of said second switches to search said second group of lines for a line therein having said predetermined condition thereon, and means for selectively connecting said trunk line to said first and second switches.

24. In a signaling system, a group of lines extending to a signaling station, a numerical switch having access to said group of lines and operative automatically to search said group of lines for an idle line therein, a hunting switch having access to said group of lines and operative automatically to search said group of lines for an idle line therein, impulse responsive means for initiating operation of said numerical switch, and means controlled upon the failure of said numerical switch to find an idle line for initiating operation of said hunting switch.

25. In a signaling system, a group of lines, a first automatic switch having access to said group of lines and operative to search said group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said group of lines and operative to search repeatedly said group of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having said predetermined condition thereon is found by said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is found by said second switch, and additional means controlled upon the failure of said second switch to find a line having said predetermined condition thereon after a predetermined operation of said second switch for arresting operation of said second switch.

26. In a signaling system, first and second main groups of lines, first and second auxiliary

groups of lines, a first automatic switch having access to said main groups of lines, a second automatic switch having access to each of said groups of lines, means for causing said first switch to search selectively in said first and second main groups of lines for a line having a predetermined condition thereon, means controlled upon the failure of said first switch to find a line in said first main group of lines for causing said second switch to search in said first main and auxiliary groups of lines for a line having said predetermined condition thereon, and means controlled upon the failure of said first switch to find a line in said second main group of lines for causing said second switch to search in said second main and auxiliary groups of lines for a line having said predetermined condition thereon.

27. In a signaling system, first main and auxiliary groups of lines extending to a first signaling station, second main and auxiliary groups of lines extending to a second signaling station, a first automatic switch having access to said main groups of lines, a second automatic switch having access to each of said groups of lines, means for causing said first switch to search selectively in said first and second main groups of lines for an idle line, means controlled upon the failure of said first switch to find an idle line in said first main group of lines for causing said second switch to search in said first main and auxiliary groups of lines for an idle line, and means controlled upon the failure of said first switch to find an idle line in said second main group of lines for causing said second switch to search in said second main and auxiliary groups of lines for an idle line.

28. In a signaling system, first main and auxiliary groups of lines extending to a first signaling station, second main and auxiliary groups of lines extending to a second signaling station, a numerical switch having access to said main groups of lines, a hunting switch having access to each of said groups of lines, impulse responsive means for causing said numerical switch to search automatically and selectively in said first and second main groups of lines for an idle line, means controlled upon the failure of said first switch to find an idle line in said first main group of lines for causing said second switch to search automatically in said first main and auxiliary groups of lines for an idle line, and means controlled upon the failure of said first switch to find an idle line in said second main group of lines for causing said second switch to search automatically in said second main and auxiliary groups of lines for an idle line.

29. In a signaling system, first and second main groups of lines, first and second auxiliary groups of lines, a first automatic switch having access to said main groups of lines, a second automatic switch having access to said auxiliary groups of lines, means for causing said first switch to search selectively in said first and second main groups of lines for a line having a predetermined condition thereon, means controlled upon the failure of said first switch to find a line in said first main group of lines for causing said second switch to search in said first auxiliary group of lines for a line having said predetermined condition thereon, and means controlled upon the failure of said first switch to find a line in said second main group of lines for causing said second switch to search in said second auxiliary group of lines for a line having said predetermined condition thereon.

30. In a signaling system, first main and auxiliary groups of lines extending to a first signaling station, second main and auxiliary groups of lines extending to a second signaling station, a first automatic switch having access to said main groups of lines, a second automatic switch having access to said auxiliary groups of lines, means for causing said first switch to search selectively in said first and second main groups of lines for an idle line, means controlled upon the failure of said first switch to find an idle line in said first main group of lines for causing said second switch to search in said first auxiliary group of lines for an idle line, and means controlled upon the failure of said first switch to find an idle line in said second main group of lines for causing said second switch to search in said second auxiliary group of lines for an idle line.

31. In a signaling system, first main and auxiliary groups of lines extending to a first signaling station, second main and auxiliary groups of lines extending to a second signaling station, a numerical switch having access to said main groups of lines, a hunting switch having access to said auxiliary groups of lines, impulse responsive means for causing said numerical switch to search automatically and selectively in said first and second main groups of lines for an idle line, means controlled upon the failure of said numerical switch to find an idle line in said first main group of lines for causing said hunting switch to search automatically in said first auxiliary group of lines for an idle line, and means controlled upon the failure of said numerical switch to find an idle line in said second main group of lines for causing said hunting switch to search automatically in said second auxiliary group of lines for an idle line.

32. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to select in a predetermined order the lines in said first group of lines, a second automatic switch having access to said first and second groups of lines and operative to select in a predetermined order the lines in said first and second groups of lines, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having a predetermined condition thereon is selected by said first switch, means controlled upon the failure of said first switch to select a line having said predetermined condition thereon for arresting operation of said first switch and for initiating operation of said second switch, and means for arresting operation of said second switch when a line having said predetermined condition thereon is selected by said second switch.

33. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to select in a predetermined order the lines in said first group of lines, a cyclically operating second automatic switch having access to said first and second groups of lines and operative through one cycle of operation thereof to select in a predetermined order the lines in one of said groups of lines and then to select in a predetermined order the lines in the other of said groups of lines, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having a predetermined condition thereon is selected by said first switch, means controlled upon the failure of said

first switch to select a line having said predetermined condition thereon for arresting operation of said first switch and for initiating operation of said second switch, and means for arresting operation of said second switch when a line having said predetermined condition thereon is selected by said second switch.

34. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to select in a predetermined order the lines in said first group of lines, a cyclically operating second automatic switch having access to said first and second groups of lines and operative through one cycle of operation thereof to select in a predetermined order the lines in one of said groups of lines and then to select in a predetermined order the lines in the other of said groups of lines, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having a predetermined condition thereon is selected by said first switch, means controlled upon the failure of said first switch to select a line having said predetermined condition thereon for arresting operation of said first switch and for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is selected by said second switch, and additional means for arresting operation of said second switch after a predetermined number of cycles of operation thereof.

35. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to select in a predetermined order the lines in said first group of lines, a cyclically operating second automatic switch having access to said first and second groups of lines and operative through one cycle of operation thereof to select in a predetermined order the lines in one of said groups of lines and then to select in a predetermined order the lines in the other of said groups of lines, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having a predetermined condition thereon is selected by said first switch, means controlled upon the failure of said first switch to select a line having said predetermined condition thereon for arresting operation of said first switch and for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is selected by said second switch, and additional means for arresting operation of said second switch after operation thereof a predetermined time interval.

36. In a signaling system, first and second groups of lines extending to a signaling station, a first automatic switch having access to said first group of lines and operative to search said first group of lines for an idle line therein, a second automatic switch having access to said first and second groups of lines and operative to search said first and second groups of lines for an idle line therein, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find an idle line for initiating operation of said second switch.

37. In a signaling system, first and second groups of lines extending to a signaling station, a first automatic switch having access to said first group of lines and operative to search said

first group of lines for an idle line therein, a second automatic switch having access to said first and second groups of lines and operative to search in a predetermined order said first and second groups of lines for an idle line therein, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find an idle line for initiating operation of said second switch.

38. In a signaling system, first and second groups of lines extending to a signaling station, a first automatic switch having access to said first group of lines and operative to search said first group of lines for an idle line therein, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly said first and second groups of lines for an idle line therein, means for initiating operation of said first switch, means for arresting operation of said first switch when an idle line is found thereby, means controlled upon the failure of said first switch to find an idle line for initiating operation of said second switch, means for arresting operation of said second switch when an idle line is found thereby, and additional means controlled upon the failure of said second switch to find an idle line after a predetermined operation thereof for arresting operation of said second switch.

39. In a signaling system, first and second groups of lines, a numerical switch having access to said first group of lines and operative automatically to search said first group of lines for a line therein having a predetermined condition thereon, a hunting switch having access to said first and second groups of lines and operative automatically to search said first and second groups of lines for a line therein having said predetermined condition thereon, impulse responsive means for initiating operation of said numerical switch, and means controlled upon the failure of said numerical switch to find a line having said predetermined condition thereon for initiating operation of said hunting switch.

40. In a signaling system, first and second groups of lines extending to a signaling station, a numerical switch having access to said first group of lines and operative automatically to search said first group of lines for an idle line therein, a hunting switch having access to said first and second groups of lines and operative automatically to search said first and second groups of lines for an idle line therein, impulse responsive means for initiating operation of said numerical switch, and means controlled upon the failure of said numerical switch to find an idle line for initiating operation of said hunting switch.

41. In a signaling system, a trunk line, first and second groups of lines extending to a first signaling station, a number of other lines extending to other signaling stations, a numerical switch having access to said first group of lines and to said other lines and selectively operative automatically to search said first group of lines for an idle line therein and to select any one of said other lines, a hunting switch having access to said first and second groups of lines and operative automatically to search said first and second groups of lines for an idle line therein, impulse responsive means for selectively operating said numerical switch, and means for selectively connecting said trunk line to an idle one of said other lines selected by said numerical switch and

to an idle one of said lines found by either one of said switches.

42. In a signaling system, first and second groups of lines extending to a first signaling station, a number of other lines extending to other signaling stations, a numerical switch having access to said first group of lines and to said other lines and selectively operative automatically to search said first group of lines for an idle line therein and to select any one of said other lines, a hunting switch having access to said first and second groups of lines and operative automatically to search said first and second groups of lines for an idle line therein, impulse responsive means for initiating operation of said numerical switch, means controlled upon the failure of said numerical switch to find an idle line in said first group of lines for initiating operation of said hunting switch, a source of signal voltage, and means for selectively connecting said source of signal voltage to an idle one of said other lines selected by said numerical switch and to an idle one of said lines found by either one of said switches.

43. In a signaling system, a trunk line, first and second groups of lines extending to a first signaling station, a number of other lines extending to other signaling stations, a numerical switch having access to said first group of lines and to said other lines and selectively operative automatically to search said first group of lines for an idle line therein and to select any one of said other lines, a hunting switch having access to said first and second groups of lines and operative automatically to search said first and second groups of lines for an idle line therein, impulse responsive means for selectively operating said numerical switch, means for arresting operation of said numerical switch when an idle line in said first group of lines is found thereby, means controlled upon the failure of said numerical switch to find an idle line in said first group of lines for initiating operation of said hunting switch, means for arresting operation of said hunting switch when an idle line in said first or second groups of lines is found thereby, additional means operative upon the failure of said hunting switch to find an idle line in said first or second groups of lines to arrest operation of said hunting switch, a source of signal voltage, and means for selectively connecting said source of signal voltage to said trunk line in response to the selection of a busy one of said other lines by said numerical switch and to the operation of said additional means.

44. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch.

45. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to

search in a predetermined order said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch.

46. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch.

47. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly and in a predetermined order said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, and means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch.

48. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having said predetermined condition thereon is found by said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is found by said second switch, and additional means controlled upon the failure of said second switch to find a line having said predetermined condition thereon after a predetermined operation for said second switch for arresting operation of said second switch.

49. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means for arresting operation of said first switch when a line

having said predetermined condition thereon is found by said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is found by said second switch, and additional means controlled upon the failure of said second switch to find a line having said predetermined condition thereon within a predetermined time interval after operation of said second switch is initiated for arresting operation of said second switch.

50. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search repeatedly said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having said predetermined condition thereon is found by said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is found by said second switch, and additional means controlled upon the failure of said second switch to find a line having said predetermined condition thereon after operation of said second switch to search repeatedly said first and second groups of lines a predetermined number of times for arresting operation of said second switch.

51. In a signaling system, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating oper-

ation of said second switch, a source of signal voltage, and automatic means for connecting said source of signal voltage to a line found by either one of said switches.

52. In a signaling system, a trunk line, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second groups of lines and operative to search said first and second group of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, and means for connecting said trunk line to a line found by either one of said switches.

53. In a signaling system, a trunk line, first and second groups of lines, a first automatic switch having access to said first group of lines and operative to search said first group of lines for a line therein having a predetermined condition thereon, a second automatic switch having access to said first and second group of lines and operative to search repeatedly said first and second groups of lines for a line therein having said predetermined condition thereon, means for initiating operation of said first switch, means for arresting operation of said first switch when a line having said predetermined condition thereon is found by said first switch, means controlled upon the failure of said first switch to find a line having said predetermined condition thereon for initiating operation of said second switch, means for arresting operation of said second switch when a line having said predetermined condition thereon is found by said second switch, first and second sources of signal voltage, automatic means for connecting said first source of signal voltage to a line found by either one of said switches, additional means controlled upon the failure of said second switch to find a line having said predetermined condition thereon after a predetermined operation of said second switch for arresting operation of said second switch, and means controlled by said additional means for connecting said second source of signal voltage to said trunk line.

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