

March 15, 1932.

N. H. SAUNDERS

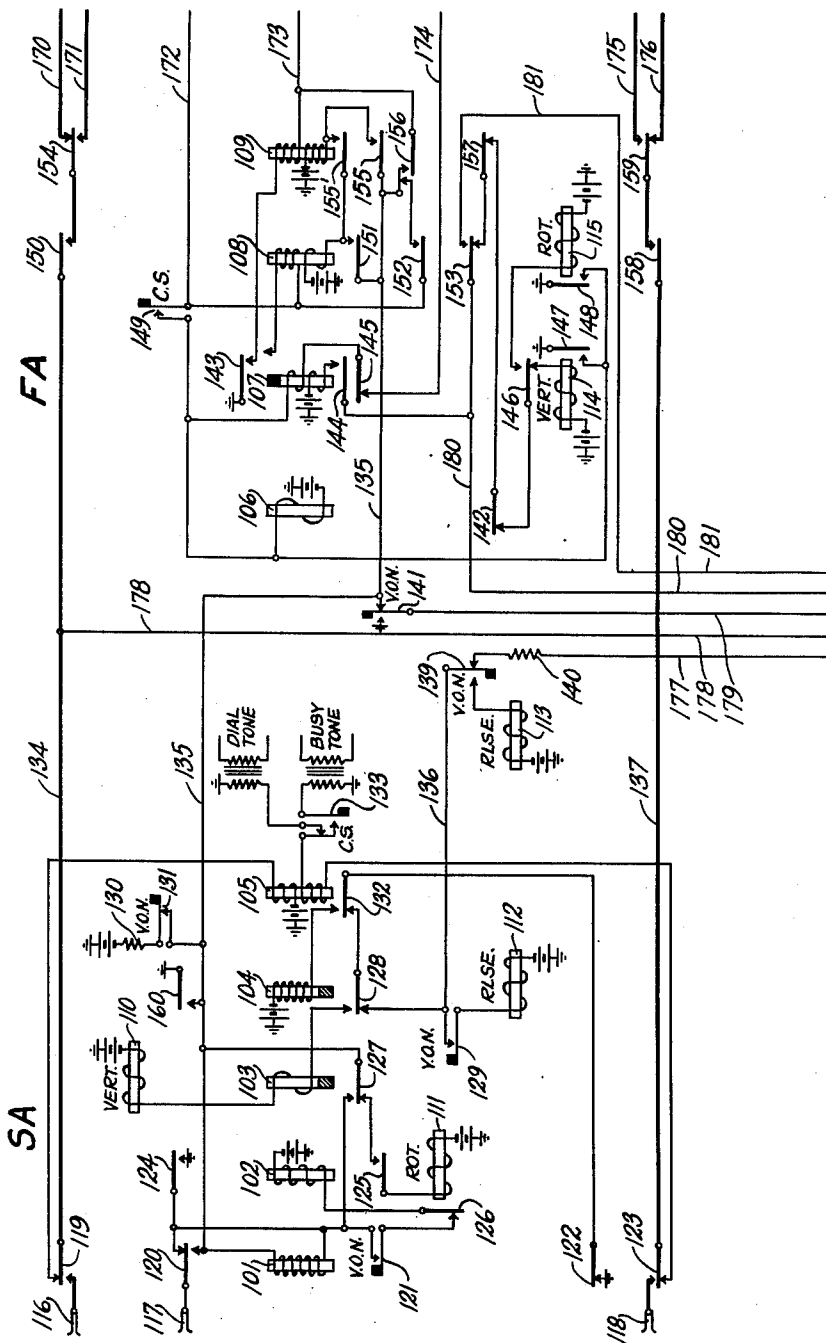
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AUTOMATIC TELEPHONE SYSTEM

Original Filed Jan. 23, 1930

5 Sheets-Sheet 1

Fig. 1



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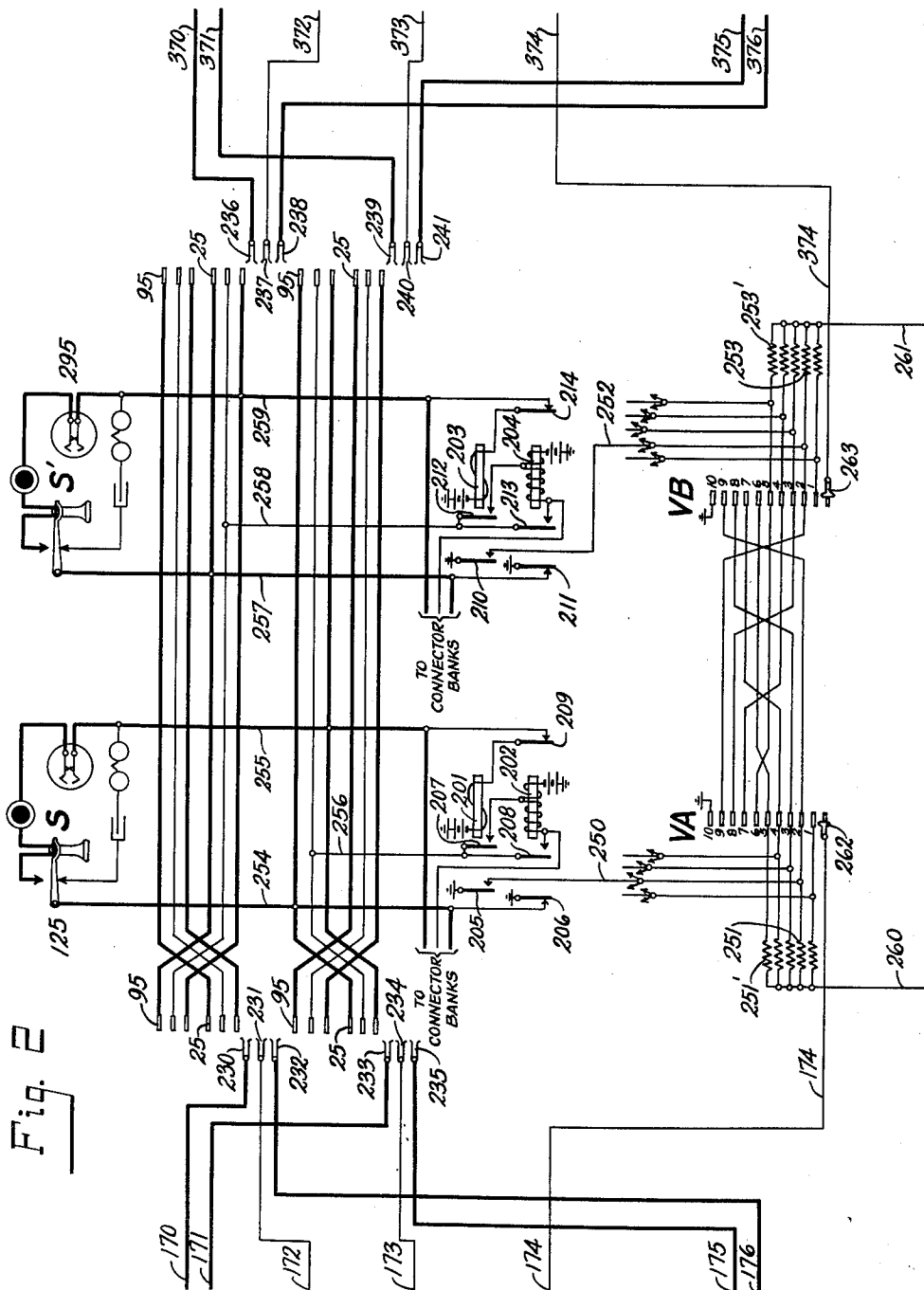
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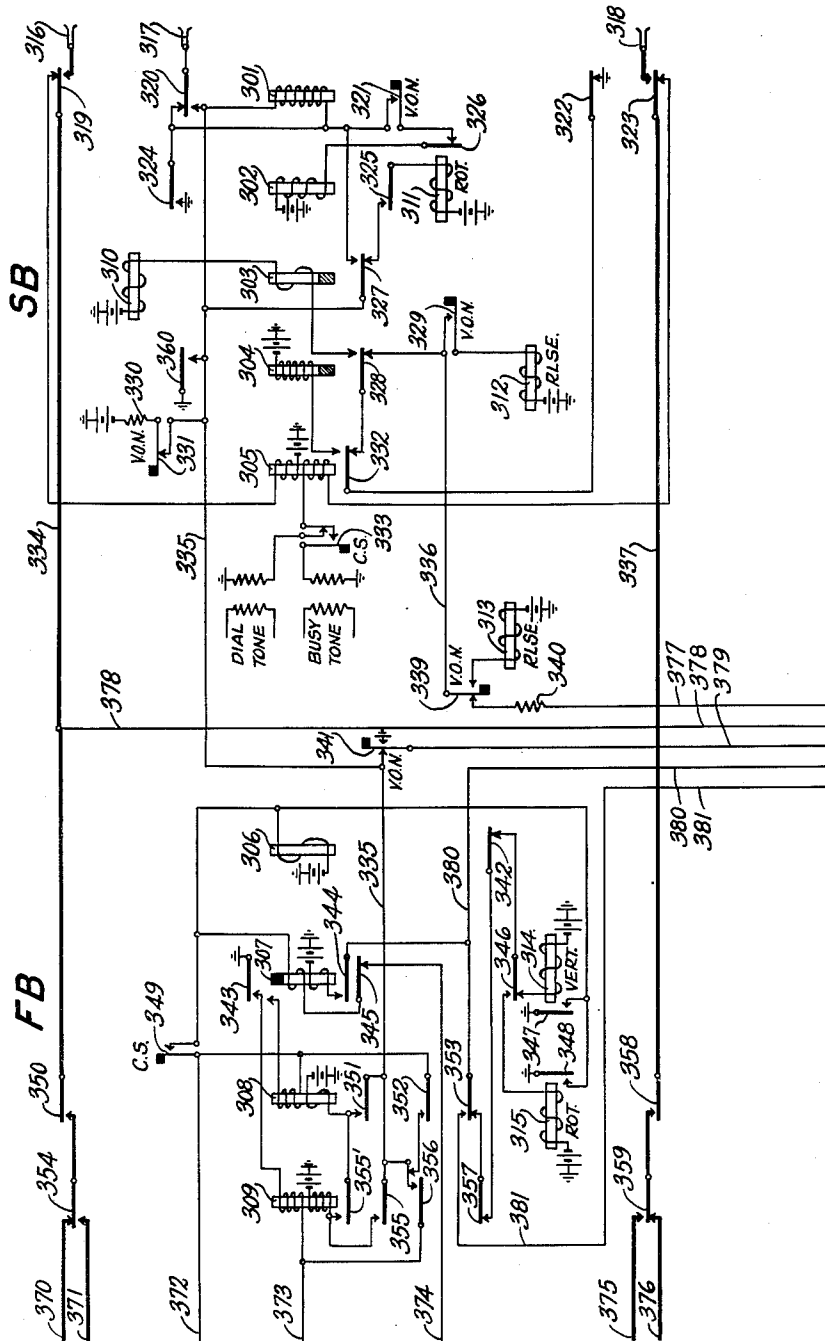
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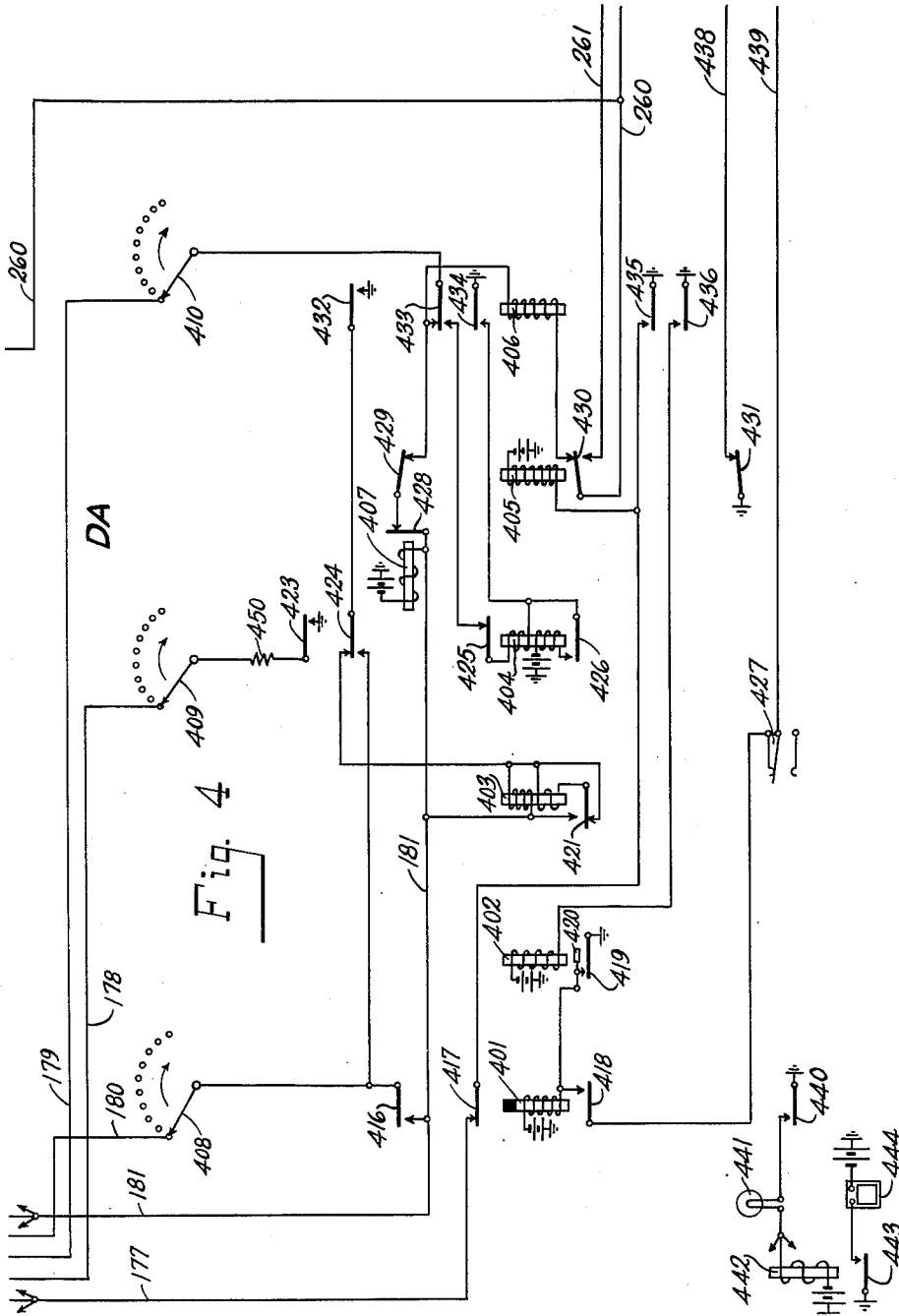
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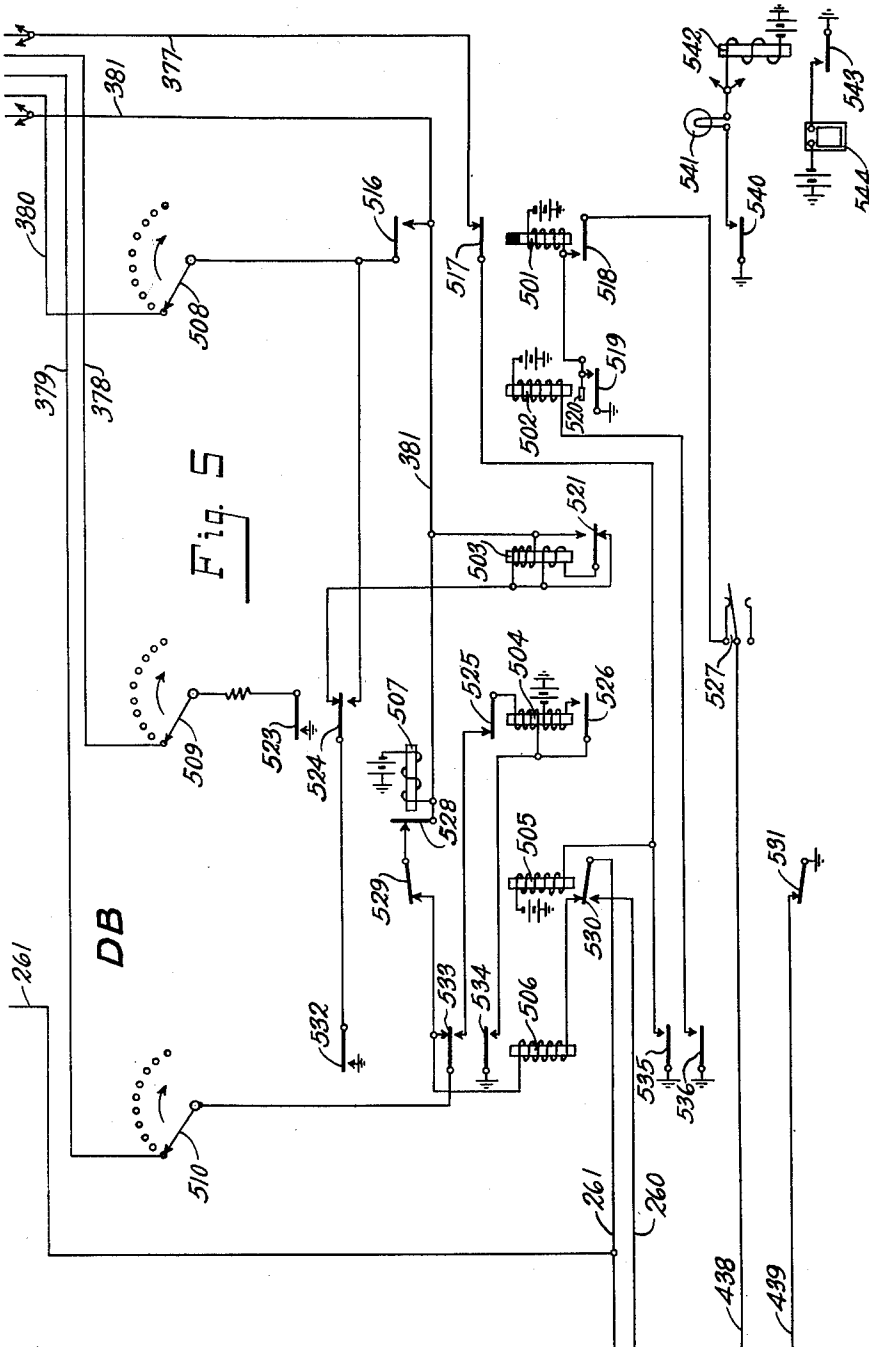
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5 Sheets-Sheet 5



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AUTOMATIC TELEPHONE SYSTEM

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The present invention relates in general to automatic telephone systems, but more particularly to such systems in which line finders are employed to connect an idle selecting switch with a calling line; and the principal object of invention, briefly stated, is the production of new and improved circuit refinements in finder switch systems, the improvement tending to make the system more reliable, to give uniform high quality service, and to make it cheaper to install and maintain.

As a further object of the invention, a new and improved allotter or distributor is provided which tests for a certain potential before the preselected finder-selector link is taken into use responsive to a call and which allotter, in case such potential is not found due to the finder-selector link being off-normal or faulty, causes a new finder-selector link to be selected.

As a further object, the allotter is provided with a timing device which operates within a predetermined time, in case the allotter fails to kick-off and select a new finder-selector link, to operate a supervisory alarm signal, to lock the allotter out of service until the exchange attendant operates a key, and to transfer calls normally handled by this allotter to its associated allotter in the other group.

As a further object, a new and improved circuit is provided for simultaneously testing two sets of contacts, the improvement insuring a positive stopping on a set of contacts if one of the lines of the set is calling even though the other is not calling.

Further objects not specifically mentioned here will best be understood from reading the detailed description and claims which follow.

The drawings comprising Figs. 1 to 5, inclusive, when arranged with Figs. 1, 2, and 3 from left to right in a straight line, with Figs. 4 and 5 placed beneath, and with correspondingly numbered lines in alignment, show sufficient details to enable a clear understanding of this invention.

Referring now to Fig. 1 in more detail, the selector SA shown on the left-hand side is of the old and well known type of Strowger selector to be included in a finder-selector

link. The finder switch FA is of the Strowger vertical and rotary type, having wipers 230 to 235, inclusive, which are moved first in a vertical direction and then in a rotary direction to select the contacts of a calling line. The wipers of the finder are shown on the left-hand side of Fig. 2. Since in the present embodiment of this invention a finder switch of two-hundred line capacity is being used, the switch FA is provided with two sets of wipers, the wipers 230 to 232, inclusive, forming one set of wipers and the wipers 233 to 235, inclusive, the second set. The finder switch FA is also equipped with a vertical test wiper 262, shown in the lower left-hand corner of Fig. 2.

In Fig. 2 is shown the subscribers' lines S and S', it being assumed for the purpose of illustration that the subscriber's S line number is 125, and that the subscriber's S' line number is 295. Associated with each line are the usual line and cut-off relays, the circuit of which have been modified in accordance with the objects of the present invention. The normal connections from the connector banks are also shown extending to the line and cut-off relays associated with the subscribers' lines S and S'. In the lower part of Fig. 2 is shown the vertical banks VA and VB, which together with the wipers 262 and 263 determine the vertical designation to which the finder switches are to be operated.

In Fig. 3, there is shown the finder switch FB and selector SB, both switches being duplicates of those shown in Fig. 1 and, therefore, need not be explained in detail at this time.

In Fig. 4, there is shown the finder allotter DA comprising the stepping magnet 407 and wipers 408 to 410, inclusive, which allots the finders of the A group, that is the group containing the finders, such as finder FA, for use one at a time. Associated with this finder allotter are the control relays 401 to 406, inclusive, the functions of which will be best understood from the description which follows.

In Fig. 5, there is shown the finder allotter DB comprising the stepping magnet 507, the wipers 508 to 510, inclusive, and associated

relays 501 to 506, inclusive. This allotter is a duplicate of that shown in Fig. 4, and allots the finders of the B group for use one at a time.

Throughout the drawings, I have shown a plurality of batteries to avoid unnecessary complications. In actual installation there would be but one battery, preferably with its positive pole grounded.

In order to enable a clear understanding of the invention it will now be assumed that the subscriber S initiates a call, and it will be further assumed that the finder FA has been preselected by the finder allotter DA in readiness to handle the call. Responsive to the removal of the receiver from the switch hook at the substation S, line relay 201 associated with line S is energized to mark that line busy in the connector bank terminals, to mark the line calling in the finder banks to render it selectable by placing a battery potential thereon through the winding of the cut-off relay 202, and to place ground upon the start conductor 250. The grounding of conductor 250 places ground on the second contacts in the banks VA and also closes a circuit for the start relay 406 in the finder allotter DA. In case both the selector SA and the finder FA are in normal position the relay 404 in the finder allotter DA is energized to complete the start circuit for the finder FA whereupon the finder is started in its vertical movement to hunt for the marking ground placed on the vertical banks VA. Since the calling line S has a finder bank designation of 125 and, since the present call is assumed to be handled by the finder group to which that line is first choice, it will be necessary for the finder to take two vertical steps to reach the level containing the calling line. The placing of ground on conductor 250 and the consequent marking of ground potential on the second bank contacts of the bank VA, will cause the finder FA to stop on the second level, at which time its wipers will be rotated into that level to pick out the contacts of the line S. When the wipers are rotated into the level, tests will be made simultaneously by both sets of wipers, the lower set of wipers comprising wipers 233 to 235, will test the line upon which they are resting, in this case line 121, and at the same time the upper set of wipers comprising 230 to 232, inclusive, will test the line upon which they are resting, in this case line 221, and if neither one of these lines are calling both sets of wipers will be stepped on to the next contacts where the test will be repeated. When the line S is encountered, the battery potential applied to the test contacts associated with that line will render it selectable, thereby causing the finder FA to stop thereon and switch through so that the calling line will be connected through to the selector SA.

When the finder switches through to the calling line the switching relay in the finder

operates and connects ground to the kick-off lead 181 extending to the allotter, whereupon the allotter stepping magnet 407 is operated to cause the allotter to preselect another idle finder-selector link.

The above general operation just described explains the normal operation of the finder and allotter. It may happen in some instances when a finder-selector link, such as that shown in Fig. 1, has been preselected by an allotter and a call is initiated by a calling subscriber, such as S, that the selector SA may be in an off-normal condition or the finder-selector link may be faulty. In this case when the start relay 406 in the allotter is energized responsive to the call the test relay 404 in the allotter will not find negative battery on the guard lead 179 and this relay, therefore, will not energize to close the start circuit through to the finder-selector link. Relay 403 in the allotter energizes in this case and closes a circuit through its lower winding for operating the stepping magnet of the allotter to step the allotter off of this finder-selector link to select a new finder-selector link, after which the call may be proceeded with in the same manner as described.

In some instances due to fault, the finder may fail to switch through and free the allotter so that the allotter may preselect another finder link. In case the finder fails to switch through within a predetermined time, a vibrating relay 402 in the allotter is initiated in its operation responsive to the energization of the start relay to prepare a circuit for the supervisory lock-out relay 401. The supervisory lock-out relay 401 is a slow-to-operate relay and, therefore, does not energize until the vibrating springs 419 and 420 stop vibrating and are permanently closed. It may be mentioned that this permanent closure is not completed until a sufficient time has been allowed for the finder to switch through and release the start relay 406 to open the circuit of the vibrating relay 402. However, in case the finder due to some fault does not switch through properly, the supervisory lock out relay is energized to bring in a supervisory alarm so as to call the attention of the attendant at the exchange to the trouble. In addition this supervisory lock-out relay temporarily renders the allotter DA and the finder-selector links, such as SA and FA, inoperative until the trouble or fault is corrected by the attendant or until such time as all of the finder-selector links, such as SB and FB, become busy, in which case the supervisory relay 401 is permitted to release and restore the allotter DA for use.

In the normal operation of this system the allotter DA and the finder-selector links, such as SA and FA in the A group, normally handle all of the calls from the subscribers in the A group, that is the subscribers, such as S in the A group, to which the finders, such as

FA, have first choice. In case, however, all of the finder-selector links in the A group become busy the busy common relay 405 in the allotter DA is deenergized and the allotter DB and the finder-selector links, such as SB and FB, handle the calls for the subscribers in the A group.

The operation of the allotter DB and the finder-selector link, such as FB and SB of the B group, are similar to the general operations just described for the A group finder-selector links and allotter.

Having described the general operation of the system, a detailed description of its operation will now be explained.

Line S initiates a call

Assume now that the line S initiates a call. Responsive to the removal of the receiver a circuit may be traced from ground at springs 206, conductor 254, through the switch hook, receiver, transmitter and calling device of substation S, conductor 255, contacts 209, and through the winding of line relay 201 to battery.

Line relay 201, upon energizing over the above traced circuit, at armature 207 applies a battery potential to the finder test contacts through the right-hand low wound winding of cut-off relay 202. The application of this battery to the best contacts of line 125 renders the line selectable to the finders, such as finder FA, which are of the battery searching type, that is the finders search for a battery potential to cut through instead of testing for an absence of ground or guarding potential. At armature 205 line relay 201 connects ground to conductor 250 to ground the second vertical bank contact in the bank VA and to complete a circuit extending from conductor 250 by way of resistance 251, conductor 260, armature 430 and its working contact of normally energized busy common relay 405, winding of start relay 406, working contact of armature 429 and said armature, through interrupter contacts 428 of the stepping magnet 407, and through the winding of relay magnet 407 to battery. Due to the high resistance of start relay 406 the stepping magnet 407 is not energized over this circuit. Start relay 406, upon energizing over the above traced circuit, at armature 432 closes a circuit for slow to operate relay 403, which relay, however, is not energized at this time unless the test relay 404 fails to energize. At armature 433 start relay 406 opens a point in the preselecting stepping circuit of magnet 407 at its resting contact and at its working contact closes a circuit through the upper winding of test relay 404; at armature 434 closes another point in the circuit of test relay 404; at armature 435 closes a circuit for maintaining the busy common relay 405 energized; and at armature 436 closes a circuit for the vibrating relay 402. Relay 402 ener-

gizes and starts the vibratory spring 420 in operation preparatory to completing the circuit for energizing the supervisory lockout relay 401 in case the finder does not switch through and open the circuit of start relay 406.

The operation of test relay 404 depends upon whether the finder-selector link in Fig. 1 is at normal. In this instance it will be assumed that the finder-selector link is at normal and that a circuit is completed for the test relay 404 in the allotter as follows: from ground by way of armature 434, upper winding of relay 404, armature 425, working contact of armature 433 and said armature, guard wiper 410, guard conductor 179, finder vertical off-normal springs 141 and its resting contact, conductor 135, selector vertical off-normal contact 131, and through the resistance 130 to battery. Relay 404, upon energizing over the above traced circuit, at armature 423 closes a circuit for operating the line relay 105 of selector SA; at armature 424 and its resting contact opens the energizing circuit of relay 403 before slow-to-operate relay 403 has had time to energize, and at the working contact of armature 424 completes the start circuit for the vertical magnet 114 of the finder. At armature 426 relay 404 completes a locking circuit for itself from armature 434 before armature 425 opens its original energizing circuit through its upper winding. The circuit for energizing the line relay 105 of selector SA may be traced as follows: from ground by way of armature 423, resistance 450, operate wiper 409, operate conductor 178, negative line connector 134, armature 119 and its resting contact, and through the upper winding of line relay 105 to battery. Line relay 105, upon energizing, at armature 132 disconnects ground from finder release conductor 136, and also from busy common conductor 177 at its resting contact and at its working contact completes a circuit for the slow to release relay 104. Release relay 104, upon energizing, at armature 160 connects ground to release trunk conductor 135; at armature 128 and its working contact prepares a circuit for the vertical series relay 103 and vertical magnet 110, and at the resting contacts of armature 128 opens another point to finder release conductor 136. The operation of armature 128 maintains the circuit of the release magnet 112 of the selector and the release magnet 113 of the finder open to prevent such magnets from energizing when the vertical off-normal springs in both the selector and finder operate on the first vertical step of such switches.

When relay 404 at armature 424 completes the start circuit for vertical magnet 114, the vertical magnet is operated over the following circuit: from ground by way of armature 432, armature 424 and its working contact, start wiper 408, start conductor 180, armature 136

153 and its resting contact, armature 157, armature 142, armature 146 and its resting contact, and through the winding of vertical magnet 114 to battery. Vertical magnet 114 operates and raises the wipers 230 to 235, inclusive, and vertical test wipers 252 one vertical step. Vertical magnet 114, upon energizing, and armature 147 completes a circuit for energizing stepping relay 106. Vertical test wiper 262 in Fig. 2 is now in engagement with the first vertical test contact of the vertical bank VA and since there is no ground potential on this first vertical bank contact no circuit is completed for changeover relay 107. Stepping relay 106 energizes and at armature 142 interrupts the circuit to the vertical magnet 114 whereupon the magnet releases and in turn opens the circuit to stepping relay 106. Stepping relay 106, upon deenergizing, at armature 142 again completes the circuit for the vertical magnet whereupon the vertical magnet raises the wipers another vertical step and at armature 147 again completes the circuit for the stepping relay 106. When vertical magnet 114 releases responsive to the energization of relay 106 a circuit is completed for the changeover relay 107 which may be traced as follows: from ground by way of armature 205, common conductor 250, second vertical test contact in vertical bank VA, vertical test wiper 262, conductor 174, armature 145, through the upper winding of changeover relay 107, and through the winding of stepping relay 106 to battery. Stepping relay 106 is held energized in series with changeover relay 107 until such time as changeover relay 107 is fully energized. Changeover relay 107, upon energizing, at armature 143 prepares the rotary testing circuit by way of switch through relay 108 and wiper switching relay 109; at armature 144 completes a locking circuit for itself to grounded start conductor 180; at armature 145 opens the original energizing circuit of changeover relay 107, as well as opening the circuit of relay 106 thereby permitting the stepping relay 106 to deenergize; and at armature 146 transfers the start conductor 180 from the vertical magnet 114 to the rotary magnet 115. Stepping relay 106, upon deenergizing, at armature 142 closes an energizing circuit for rotary magnet 115 as follows: from grounded start conductor 180, armature 153 and its resting contact, armature 157, armature 142, armature 146 and its working contact, and through the winding of rotary magnet 115 to battery. Rotary magnet 115, upon energizing, advances the wipers 230 to 235, inclusive, into engagement with the first contacts in the second level and also rotates the vertical test wiper 262 out of engagement with the contacts of the vertical bank VA. At armature 148 rotary magnet 115 completes the circuit for stepping relay 106, whereupon that relay energizes. Fur-

ther rotation of the wipers of the finder FA are now dependent upon whether the test wipers 231 and 234 encounter a negative battery potential or not. In case negative battery potential is not on either of the test contacts with which the test wipers 231 and 234 are now in engagement neither the switch through relay 108 or the wiper switching relay 109 will be energized. Therefore, when the rotary magnet 115 energizes the stepping relay 106 in addition to stepping the wipers and the stepping relay 106 in turn opens the circuit of the rotary magnet at 142, the rotary magnet in turn will open the circuit of the stepping relay 106, whereupon the stepping relay deenergizes and again closes the circuit for the rotary magnet 115. This cycle of operation continues until one of the test wipers 231 or 234 encounters a negative battery potential.

Assuming that no other line in the second level of the finder bank terminals is calling, except subscriber S, then when the test wipers 231 and 234 are rotated in engagement with the fifth set of contacts test wiper 234 will encounter a negative battery potential which is applied through the right-hand winding of cut-off relay 202. When wiper 234 encounters this battery potential, wiper switching relay 109 energizes over the following circuit: ground by way of armature 143 and its upper working contact, upper winding of wiper switching relay 109, conductor 173, test wiper 234, the test contact engaged thereby, test conductor 256, armature 207, and through the right-hand low resistance winding of cut-off relay 202 to battery. Wiper switching relay 109 and cut-off relay 202 energize in series over the above traced circuit. The cut-off relay 202, at armatures 206 and 209 disconnects the line relay 201 and the normal battery and ground connections from the subscriber's line conductors; and at armature 208 prepares a circuit a holding circuit for the cut-off relay 202 including both of its windings and also prepares a circuit for guarding the line from intrusion by way of the connector banks. Line relay 201, upon deenergizing, at armature 207 opens the original energizing circuit of the cut-off relay 202 and permits the holding circuit, including both windings of cut-off relay 202, to become effective; and at armature 205 removes ground from conductor 250.

Returning now to the finder FA and when wiper switching relay 109 energizes in series with the cut-off relay 202, it should be stated that armature 157 operates before the other armatures and breaks the circuit to the rotary magnet so that there is no possibility of the rotary magnet operating to step the wipers an extra step after the calling potential has been encountered by test wiper 234. At armatures 154 and 159 wiper switching relay 109 disconnects the upper set of wipers

230 to 232, inclusive, and connects up the lower set of wipers 233 to 235, inclusive. At armature 155 switching relay 109 completes a locking circuit for itself from grounded release trunk conductor 135; at armature 155' completes an energizing circuit for switch through relay 108 from grounded release trunk conductor 135; and at armature 156 connects said grounded release trunk conductor 135 to conductor 173 thereby shunting out the upper winding of wiper switching relay 109 and connecting guarding potential by way of wiper 234 and the bank contact with which it is associated. conductor 256, armature 208, and through the two windings of the cut-off relay 202 to battery for maintaining the cut-off relay in energized position and also by way of armature 208 and its make contact through the test terminal of line S in the connector banks in order to guard against any connector from seizing the line S at this time. The circuit for energizing the switch through relay 108 may be traced as follows: grounded release trunk conductor 135, armature 155, armature 155' and through the lower winding of switch through relay 108 to battery. It may also be mentioned at this time that the break springs of armature 153 are adjusted to break before any of the other armatures are operated in order to insure the opening of the rotary magnet circuit to prevent an extra step in case the test wiper 231 was the only wiper encountering a calling potential. At armatures 150 and 158 switch through relay 108 connects the line conductors of lines S through to line conductors 134 and 137 of the finder-selector link; at armature 151 closes a locking circuit through its lower winding; at armature 152 prepares a guarding circuit which at this time is ineffective because wiper switching relay has been energized and opened this guarding circuit at the normally closed springs controlled by armature 156; and at the working contact of armature 153 connects the starting ground through to the common kick-off conductor 181 for energizing the stepping magnet 407 of the allotter DA. The circuit for energizing the stepping magnet 407 may be traced as follows: from ground by way of armature 432, armature 424 and its working contact, start wiper 408, start conductor 180, armature 153 and its working contact, common kick-off conductor 181, and through the winding of magnet 407 to battery.

When the switch through relay 108 connects the line conductors of the calling line S to conductors 134 and 137 dial tone is connected by way of normally closed cam springs controlled by cam spring 133, through the lower winding of line relay 105, resting contact of armature 123 and said armature, and by way of conductor 137 and the wipers of the finder through the receiver of the calling subscriber S. When calling subscriber S hears the well known dial tone, such subscriber will know that the finder has found and connected with his line, and that he may now proceed to set up the desired connection to the called party. It will be noted at line relay 105, that the upper and lower windings of line relay 105 are included in a loop circuit including both the line conductors of line S and the substation calling device. The calling subscriber S now operates his substation calling device in accordance with the digits of the called number. When the first digit is dialled, the circuit of the line relay 105 is intermittently interrupted to cause the line relay to fall back a correspondingly number of times. Each time it falls back, line relay 105 opens the circuit of slow-to-release relay 104 and closes a circuit through the armature 132 and its resting contact, armature 128 and its working contact, through series relay 103, and through the winding of vertical magnet 110 to battery. Release relay 104 is maintained energized during impulsing. By the operation of the vertical magnet 110, the wipers 116 to 118, inclusive, are raised opposite the desired level of bank contacts. Series relay 103 operates upon the first impulse of current transmitted to the vertical magnet and it remains operated throughout the vertical movement. Upon operating, relay 103 prepares a circuit for stepping relay 102, which is closed at the vertical off-normal contact 121, interrupter contact 126 of rotary magnet 111 as soon as the switch moves from its normal position. At armature 124, relay 102 closes a short-circuit around switching relay 101 and at armature 125 prepares a circuit for rotary magnet 111. At armature 124 relay 102 also closes a locking circuit for itself independent of armature 127 of relay 103.

When relay 103 falls back at the end of the vertical movement, it completes the rotary magnet circuit from grounded release trunk conductor 135 by way of armature 127 and its resting contact, armature 125, and the winding of rotary magnet 111 to battery. When the rotary magnet operates it advances the wipers into engagement with the first set of bank contacts in the selected level, and, at the end of its stroke, it opens the circuit of relay 102. Relay 102 thereupon falls back and opens the magnet circuit and a further point in its own locking circuit. The rotary magnet falls back when this happens, and again connects up the stepping relay. If the first trunk line is busy, the stepping relay operates again by way of grounded contacts engaged by test wiper 117, armature 120 and its resting contact, off-normal springs 121, interrupter spring 126, and the winding of stepping relay 102 to battery. This same ground also maintains the switching relay 101 short-circuited to prevent it from switch-

ing through on a busy trunk. Stepping relay 102 again closes the circuit of the rotary magnet whereupon the buzzer like action between stepping relay 102 and rotary magnet 111 continues until an idle trunk is reached, an idle trunk line being characterized in this case by the absence of ground potential. When an idle trunk is reached, relay 102 does not reoperate as no further ground potential is encountered; and relay 101, which has been short-circuited heretofore by the ground potential on the test wiper 117, energizes from the grounded release trunk conductor 135 in series with relay 102 by way of off-normal contact 121, and contacts 126. Relay 102 does not operate in series with switching relay 101, owing to the relatively high resistance of relay 101. Switching relay 101 upon energizing, switches the call through to the next switch in the train from where the call is extended in a well known manner. It should be mentioned, however, that the switching relay 101 is maintained for the duration of this connection and, therefore, said relay at armature 122 removes the ground potential from conductor 136 so that the selector SA and finder FA will not release when the line and release relays 105 and 104 deenergize when the selector SA switches through. This selector circuit is a well known circuit with the addition of vertical off-normal spring 131 for maintaining battery potential on release trunk conductor 135 only during the time switch SA is in normal position. It also contains a finder release conductor 136 for completing the circuit to the release magnet 115 of the finder when the switching relay 101 is released at the end of a conversation. Returning now to the allotter shown in Fig. 4, and at a time when the stepping magnet 407 was energized responsive to the switch through relay 108 of the finder operating to connect ground to the common kick-off conductor 181, magnet 407, upon energizing, at its interrupter springs 428 opens the circuit of start relay 406 whereupon start relay 406 deenergizes. At armature 432 relay 406 removes ground from a start wiper 408 thereby opening the circuit of stepping magnet 407 to cause it to deenergize; at armature 433 closes a stepping circuit for magnet 407, at armature 434 opens the locking circuit of test relay 404 whereupon the latter relay deenergizes; at armature 435 opens one point in the circuit of busy common relay 405 which relay, however, is maintained in energized position as long as an idle finder-selector link maintains ground on the busy common lead 177; and at armature 436 opens the circuit extending to the vibrating relay 402 before the vibratory springs 420 have permanently closed to prevent the supervisory lock-out relay 401 from energizing at this time. Stepping magnet 407, upon deenergizing,

advances its wipers 408 to 410, inclusive, into engagement with its next set of bank contacts leading to the succeeding finder-selector link similar to the finder-selector link shown in Fig. 1. In case said finder-selector link is in an off-normal position and is busy the vertical off-normal springs corresponding to vertical off-normal springs 141 are operated to connect ground to the guarding conductor, such as guarding conductor 179, which in this case will extend through the second bank contacts with which the test wiper 410 is now in engagement. This ground connection will extend by way of start wiper 410, armature 433 and its resting contact, armature 429, interrupter springs 428, and through the winding of stepping magnet 407 to battery. Magnet 407 operates in a buzzer like manner as long as wiper 410 encounters busy ground potentials, however, as soon as wiper 410 encounters a guard conductor leading to an idle finder-selector link the wipers of the allotter come to rest in corresponding positions to preselect this idle finder-selector link for the next calling party. The finder allotter DA, therefore, preselects another idle finder-selector link as soon as the finder with which it is associated has switched through and established connection with the calling line.

Since the finder FA is a 200 point finder and, therefore, has two sets of wipers it may so happen that the test wiper 231 instead of test wiper 234 may encounter the negative battery calling potential of a calling line, while the test wiper 234 does not. In this case the finder is operated in the same manner as previously described, and when wiper 231 encounters the negative battery potential on the test contacts associated with the calling line a circuit will be completed for operating the switch through relay 108 alone as follows: from ground by way of armature 143 and its lower make contact, upper winding of switch through relay 108, conductor 172, and through test wiper 231 to negative battery. The circuit extending through the upper winding of wiper switching relay 109 is ineffective at this time because the test wiper 234 does not encounter a battery potential. Switch through relay 108, upon energizing, at armatures 150 and 158 connects the conductors 134 and 137 through to the upper set of line wipers 230 and 232 and to the line conductors of the calling subscriber. At armature 151 switch through relay 108 completes a locking circuit for itself from grounded release trunk conductor 135 through its lower winding; at armature 152 connects the grounded release trunk conductor 135 to test wiper 231 by way of normally closed springs controlled by armature 156, armature 152, conductor 172, and through test wiper 231 and its associated test contact with which it is in engagement

and through the two windings of the associated cut-off relay to maintain such cut-off relay in energized position and by way of the connector terminals of the associated line for maintaining this calling line busy to connector switches having access thereto. At armature 153 switch through relay 108 opens the circuit to the rotary magnet, as previously described, and also connects ground to the common kick-off conductor 181 for causing the allotter to preselect another idle finder-selector link, as previously described. The calling subscriber may now complete the connection to the desired called subscriber in the well known manner.

After conversation and responsive to the calling subscriber replacing the receiver ground is removed from the holding conductor of the connector switch in the well known manner whereupon the circuit of the switching relay 101 of the selector is opened. Switching relay 101, upon deenergizing, at armature 122 completes a circuit for release magnet 112 of the selector SA and release magnet 113 of the finder FA as follows: from ground by way of armature 122, armature 132 and its resting contact, armature 128 and its resting contact, conductor 136, and by way of vertical off-normal springs 129 of the selector and off-normal springs 139 of the finder to release magnet 112 of the selector and release magnet 113 of the finder to battery. The operation of the release magnet 112 of the selector causes the selector SA to return to its normal position and at vertical off-normal springs 131 again connects negative battery by way of resistance 130 and normally closed off-normal springs 141 to guarding conductor 179 so that the test relay 404 in the allotter may be energized to complete the start circuit for the finder on another call. The operation of the release magnet 113 of the finder closes another point in the circuit for relay 404 through vertical off-normal springs 141 and also closes a circuit extending by way of grounded armature 122, armature 132, armature 128, conductor 136, vertical off-normal springs 139, resistance 140, to busy common conductor 177 for maintaining the busy common relay 405 in energized position. The circuits of both the release magnets are opened at their respective vertical off-normal springs when the switches are fully restored.

The foregoing explains the normal operation of the apparatus in completing calls. However, due to a calling subscriber abandoning calls after completion of the vertical movement of the finder or due to some possible fault the finder FA may operate its wipers in its rotary movement beyond the contacts of any of the subscriber's line. In this case when the wipers 230 to 235, inclusive, are rotated beyond the bank contacts, cam springs 149 are closed and a circuit may be

traced for energizing the switch through relay 108 as follows: from ground by way of armature 143 and its lower make contact, upper winding of switch through relay 108, cam springs 149, and through the winding of stepping relay 106 to battery. The only function of switch through relay 108 at this time to operate armature 153 which opens the circuit to the rotary magnet 115 at its working contact and which closes a circuit from grounded start conductor 180 to the common kick-off conductor 181 by way of its working contact for causing the allotter to kick-off and preselect another idle finder-selector link. In case the call was not abandoned this new preselected finder-selector link is taken into operation and the connection completed in the same manner as previously described.

Referring again to the allotter shown in Fig. 4, and at a time when the start relay 406 has been energized responsive to a call, it will now be assumed that negative battery is not connected to guard conductor 179 because the selector SA or finder FA is in an off-normal position or because of some fault. Under these circumstances the circuit for test relay 404 will not be completed and, therefore, the slow-to-operate relay 403 will have had time to fully operate. The circuit for energizing relay 403 may be traced as follows: from ground by way of armature 432, armature 424 and its resting contact, through the upper winding of relay 403, kick-off conductor 181, and through the winding of stepping magnet 407 to battery. Stepping magnet 407 does not energize in the above traced circuit on account of the relatively high resistance of the upper winding of relay 403. However, relay 403 upon energizing, at armature 421 and its resting contact opens the short-circuit around the lower winding of relay 403 and at its working contact closes a circuit for energizing the stepping magnet 407 as follows: ground by way of armature 432, armature 424 and its resting contact, through the lower low resistance winding of relay 403, armature 421 and its working contact, and through magnet 407 to battery. It may be stated that enough current flows through the windings of relay 403 to maintain it in energized position at this time. Stepping magnet 407, upon energizing, at armature 428 opens the circuit of start relay 406 whereupon the start relay deenergizes. Start relay 406, upon deenergizing, at armature 432 opens both the circuits of relay 403 and magnet 407 whereupon relay 403 and the magnet deenergize. The deenergization of the magnet advances the wipers 408 to 410, inclusive, to the bank contacts of the next finder-selector link. In case this finder-selector link is busy, wiper 410 will encounter a ground potential thereby causing magnet 407 to operate in a buzzer like manner until an ungrounded contact is engaged by wiper 410.

This same ground connected by way of wiper 410 maintains the start relay 406 in short-circuited condition. As soon as wiper 410 loses ground start relay 406 energizes and
 5 prepares the test circuit for test relay 404. The same operation just described takes place in case wiper 410 is engaged with a guarding conductor having no battery potential thereon. In case wiper 410 engages a contact
 10 which terminates a guard conductor having battery potential thereon switching relay 404 is energized before relay 403 to complete the start circuit in the same manner as previously described.

15 Another condition which may arise is that the finder may not switch through within a predetermined time due to some fault. Considering the cause now in which a finder has been seized and operated but has failed to
 20 switch through within a predetermined time and, therefore, the allotter has not kicked off and has not opened the circuit to the vibrating relay 402. Under these conditions the vibrating spring 420 after a predetermined
 25 time stops vibrating and is maintained in contact with armature 419 whereupon the supervisory lockout relay 401 is energized. When this occurs relays 401, 402, 404, 405 and 406 are in energized position. At armature
 30 418 relay 401 completes a locking circuit for itself extending by way of armature 531 of busy common relay 505 of allotter DB, conductor 439, key 427 in operated position, armature 418, and through the winding of
 35 401 to battery. At armature 417 relay 401 opens a point in the circuit of busy common relay 405 so that this relay will deenergize when start relay 406 is later deenergized; and at armature 416 completes a circuit for oper-
 40 ating the stepping magnet 407 as follows: ground by way of armature 432, armature 424 and its working contact, armature 416, kick-off conductor 181, and through the winding of stepping magnet 407 to battery. Step-
 45 ping magnet 407, upon energizing, at armature 428 interrupts the circuit of start relay 406 whereupon the start relay deenergizes. At armature 432 relay 406 opens the circuit of the stepping magnet 407 to cause the wipers
 50 of the allotter to be advanced to the next finder-selector link, at armature 433 prepares the preselecting circuit of the allotter, at armature 434 opens the locking circuit of test relay 404 which deenergizes; opens the circuit
 55 of busy common relay 405 at armature 435 thereby causing the busy common relay to release; and at armature 436 opens the circuit to the vibrating relay 402. Busy common relay 405, upon deenergizing, at armature 429
 60 opens the circuit of start relay 406 as well as the preselecting circuit, previously referred to; at armature 430 and its working contact, opens a further point in the circuit of start relay 406 and at its resting contact connects
 65 the conductor 260 to conductor 261 so that

this particular call and further calls from the subscribers in the A group will be taken care of by the allotter DB and the finder-selector links in the B group. In addition relay 401 at armature 440 closes an alarm circuit for operating the alarm lamp 441 associated with the allotter DA and for operating the common alarm relay 442 to operate a common alarm to call the exchange attendant's attention to the fact that a fault has occurred and that the allotter DA is locked out of service. The switchboard attendant may correct the fault or may operate key 427 to release the supervisory lock-out relay 401 whereupon the busy common relay 405 is again operated over the busy common lead in case there are any idle finder-selector links. The operation of the busy common relay 405 again renders the allotter available for use. Assuming now that the attendant does not immediately free the allotter DA for use and further assuming that all of the finder-selector links in the B group, such as the finder-selector link FB and SB become busy then the busy common relay 505 of the allotter DB in Fig. 5 will deenergize. Busy common relay 505, upon deenergizing, at armature 530 transfers the calling conductor 261 to conductor 260 so that all of the calls originating in the B group may be handled through the A group comprising the allotter DA and the finder-selector links such as FA and SA. At armature 531 relay 505 also opens the locking circuit of supervisory lock-out relay 401, thereby causing relay 401 to deenergize and prepare the allotter DA for use in the same manner as previously described.

From the foregoing it will be seen that normally calls from the line S are handled by the finder FA, and that in case all the finders in the group A are busy, calls from the lines in the A group, such as S, can be handled by the finder FB.

Assume now that at the time the substation S initiated a call, all of the finders in the group containing the finder FA are busy, in which case the call will be handled by the finders in the group containing finder FB, provided no call is in progress at the time in the B group. It will be noted that the placing of ground on conductor 250 and the contact 2 of the vertical bank VA also places ground upon contact 9 of the vertical bank VB. It will also be noted that the banks of the finders are slipped between group A and group B, so that the lines appearing in the lower half of the bank of group A appear in the upper half of the bank of group B. Responsive to the grounding of conductor 250, and in case all of the finder-selector links, such as FA and SA, are busy the busy common relay 405 will be in deenergized position and, therefore, the start relay 506 in the allotter DB is energized to start a finder in

group B, for example finder FB, which operates in a vertical direction until the vertical wiper 263 encounters the marked bank contact, in this case the ninth bank contact in the vertical bank of VB. The wipers of the finder are stopped at this level and rotated in a horizontal direction into engagement with the bank contacts of the calling line. Since the allotter DB and the finder-selector link FB and SB are identical with the allotter DA and finder-selector link FA and SA it is, therefore, believed that no detailed description is necessary to explain this operation.

In a similar manner calls from the line S' have as its first choice the finders in the B group, such as the finder FB, in which its line terminals appear in the second level, so that the wipers of FB are moved vertically two steps to engage the level containing the calling line S1'. If, however, the group containing the finder FB is busy at the time that S1 makes a call, that call will start the finder FA, provided there are no calls in progress at this time in the A group, and the line S' will be picked up by the finder FA, which at this time must take nine vertical steps to reach the level containing the calling line S'. It will be noted that the second bank contacts of the vertical bank VB is multiplied to the ninth bank contact to the vertical bank VA, so then when the conductor 252 is grounded responsive to the energization of the line relay 203, level 2 of the vertical bank VB and level 9 of the bank VA are marked calling, so that whichever finder is started the call will stop on the proper level when reached.

Having described the invention what is considered new and is desired to have protected by Letters Patent will be set forth in the following claims:

1. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter for preselecting an idle one of said finders, a timing device associated with said allotter, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder and said timing device, means for operating said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of the finder for operating said allotter to preselect another idle finder in the group and for restoring said timing device, means for completely operating the timing device in case said operated finder does not switch-through within a predetermined time, and means responsive to the completed operation of said timing device for rendering said allotter and finders inoperative to extend further calls.

2. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter for preselecting an idle one of said finders, a timing device associated with said allotter, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder and said timing device, means for operating said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of the finder for operating said allotter to preselect another idle finder in the group and for restoring said timing device, means for completely operating the timing device in case said operated finder does not switch-through within a predetermined time, means responsive to the completed operation of said timing device for advancing said allotter to the next finder in the group and for rendering said allotter and finders inoperative to extend further calls, a key associated with said allotter, and means responsive to the operation of said key for restoring said timing device whereby said allotter and finders are again available for use.

3. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter for preselecting an idle one of said finders, a timing device associated with said allotter, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder and said timing device, means for operating said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of the finder for operating said allotter to preselect another idle finder in the group and for restoring said timing device, means for completely operating the timing device in case said operated finder does not switch-through within a predetermined time, a second group of finders having access to said lines and a second allotter associated with said second group finders, and means responsive to the completed operation of said timing device for advancing said first allotter to the next finder in the first group of finders, for rendering said first allotter and the first group finders inoperative to extend further calls, and for transferring the incomplete call of the calling line to the second allotter and second finder group.

4. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter for preselecting an idle one of said finders, a timing device associated with said

allotter, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder and said timing device, means for operating said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of the finder for operating said allotter to preselect another idle finder in the group and for restoring said timing device, means for completely operating the timing device in case said operated finder does not switch through within a predetermined time, a second group of finders having access to said lines and a second allotter associated with said second group of finders, means responsive to the completed operation of said timing device for advancing said first allotter to the next finder in the first group of finders, for rendering said first allotter and the first group of finders inoperative to extend further calls, and for transferring the incompleted call of the calling line to the second allotter and second finder group, means in said second allotter operative in case all the finders in said second group are busy for restoring the said timing device in the first allotter, and means responsive to the restoration of said timing device for again rendering said first allotter and said first group finders available for use by calling subscribers.

5. In an automatic telephone system, a group of subscribers' lines divided into two sub-groups, two groups of finders, each group having access to said lines, means including an allotter for each group of finders for preselecting an idle finder in its associated group, means whereby the first sub-group of lines are first choice to the first finder group and allotter and are normally served thereby and the second sub-group of lines are first choice to the second finder group and allotter and are normally served thereby, a timing device associated with each of said allotters, means in each allotter responsive to the initiation of a call in its associated sub-group of lines for initiating the operation of its associated preselected finder and for initiating the operation of its associated timing device, means for continuing the operation of said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of said finder for operating the associated allotter to preselect another idle finder in the same group and for restoring the associated timing device before such device is completely operated, means for completing the operation of said timing device in case said operated finder does not switch-through within a predetermined time, means responsive to the operation of said timing device for advancing said allotter to the next finder in the said same group of finders, for rendering said allotter and said same group of finders inoperative to extend further calls, and for transferring the incompleted call of the said calling line to the other allotter and the other finder group, means in said other allotter operative when all the finders in said other group are busy for restoring the said operated timing device, and means responsive to the restoration of said timing device for again rendering said inoperative allotter and finder group available for use by calling subscribers.

7. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter having a motor magnet for preselecting an idle one of said finders, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder, means for continuing the operation of said finder to find the calling line, means responsive to the

through within a predetermined time, and means responsive to the operation of said timing device for advancing said allotter to the next finder in the said same group of finders, for rendering said allotter and said same group of finders inoperative to extend further calls, and for transferring the incompleted call of the said calling line to the other allotter and the other finder group.

6. In an automatic telephone system, a group of subscribers' lines divided into two sub-groups, two groups of finders, each group having access to said lines, means including an allotter for each group of finders for preselecting an idle finder in its associated group, means whereby the first sub-group of lines are first choice to the first finder group and allotter and are normally served thereby and the second sub-group of lines are first choice to the second finder group and allotter and are normally served thereby, a timing device associated with each of said allotters, means in each allotter responsive to the initiation of a call in its associated sub-group of lines for initiating the operation of its associated preselected finder and for initiating the operation of its associated timing device, means for continuing the operation of said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, means responsive to the switch-through operation of said finder for operating the associated allotter to preselect another idle finder in the same group and for restoring the associated timing device before such device is completely operated, means for completing the operation of said timing device in case said operated finder does not switch-through within a predetermined time, means responsive to the operation of said timing device for advancing said allotter to the next finder in the said same group of finders, for rendering said allotter and said same group of finders inoperative to extend further calls, and for transferring the incompleted call of the said calling line to the other allotter and the other finder group, means in said other allotter operative when all the finders in said other group are busy for restoring the said operated timing device, and means responsive to the restoration of said timing device for again rendering said inoperative allotter and finder group available for use by calling subscribers.

7. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter having a motor magnet for preselecting an idle one of said finders, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder, means for continuing the operation of said finder to find the calling line, means responsive to the

finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, a common kick-off conductor extending from all said finders direct to the motor magnet of said allotter, means responsive to the switch-through operation of the finder for operating said magnet over said conductor, and means in said allotter controlled by the operation of said magnet for causing said allotter to preselect another idle finder.

8. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter having a motor magnet for preselecting an idle one of said finders, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder, means for continuing the operation of said finder to find the calling line, means responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, a common kick-off conductor extending from all said finders direct to the motor magnet of said allotter, means responsive to the switch-through operation of the finder for operating said magnet over said conductor, means in said allotter controlled by the operation of said magnet for causing said allotter to preselect another idle finder, cam springs in said finder, means for operating said springs in case said finder fails to find the calling line and is operated beyond the lines of said group, and means for causing said finder to switch-through and release responsive to the operation of said springs.

9. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, means including an allotter having a motor magnet for preselecting an idle one of said finders, means in said allotter responsive to the initiation of a call on one of said lines for initiating the operation of said preselected finder, means including a stepping relay in said finder for operating said finder to find the calling line, cam springs in said finder, a switch-through relay in said finder, means for operating said cam springs in case said finder fails to find the calling line and the finder is operated beyond said group of lines, means responsive thereto for energizing said relays in a series circuit including said operated springs, means responsive to the operation of said switch-through relay for releasing said finder and for operating the magnet of said allotter, and means in said allotter responsive to the energization of said magnet for selecting another idle finder.

10. In an automatic telephone system, a group of subscribers' lines, a group of finders having access to said lines, an allotter having access to said finders, a start conductor individual to each of said finders and terminat-

ing in said allotter, means including the motor magnet of said allotter for operating said allotter to preselect an idle one of said finders, means in said allotter responsive to the initiation of a call on one of said lines for connecting a potential to the individual start conductor of the preselected finder, means in said finder responsive to this potential for operating said finder to find the calling line, means in said finder responsive to the finder finding the calling line for causing said finder to switch-through and extend the connection from the calling line, a common kick-off conductor extending from all said finders direct to said motor magnet, means responsive to the switch-through operation of the finder for operating said magnet over a circuit including said individual start conductor and said common kick-off conductor in series, and means in said allotter responsive to the operation of said magnet for causing said allotter to preselect another idle finder.

11. In an automatic telephone system, a group of subscribers' lines, a group of finders, the finders thereof having access to said lines, means including an allotter for preselecting an idle one of said finders, a start relay in said allotter, means responsive to the initiation of a call on one of said lines for energizing said start relay, a test relay in said allotter energized responsive to the energization of said start relay only in case the preselected idle finder is in normal position, and means responsive to the operation of said test relay for starting the finder in the preselected link to find the calling line.

12. In an automatic telephone system, a group of subscribers' lines, a group of finders, the finders thereof having access to said lines, means including an allotter for preselecting an idle one of said finders, a start relay in said allotter, means responsive to the initiation of a call on one of said lines for energizing said start relay, a test relay in said allotter energized responsive to the energization of said start relay only in case the preselected idle finder is in normal position, a third relay in said allotter energized responsive to the energization of the start relay only in case said test relay fails to operate, and means controlled by the energization of the third relay for causing said allotter to select another idle finder-selector link.

13. In an automatic telephone system, a group of subscribers' lines, a group of finders, the finders thereof having access to said lines, means including an allotter for preselecting an idle one of said finders, a start relay in said allotter, means responsive to the initiation of a call on one of said lines for energizing said start relay, a test relay in said allotter energized responsive to the energization

of said start relay only in case the preselected idle finder is in normal position, means responsive to the operation of said test relay for starting the finder in the preselected finder to find the calling line, a third relay in said allotter energized responsive to the energization of the start relay only in case said test relay fails to operate, a motor magnet in said allotter for operating the wipers thereof, means controlled by the operation of said third relay for energizing said motor magnet, means controlled by said magnet for deenergizing said start relay, means controlled by the deenergization of said start relay for deenergizing said third relay and said magnet, and means controlled by the deenergization of said magnet to step the wipers of said allotter to the next finder and to reenergize said start relay in case such finder is idle.

14. In an automatic telephone system, a group of subscribers' lines, a group of finders, the finders thereof having access to said lines and having guarding conductors, an allotter having access to said finders by way of said guard conductors, idle ones of said finders characterized by a distinct potential applied to their associated guard conductors while the busy ones of said finders are characterized by a different potential applied to their associated guard conductors, means in said allotter for preselecting a finder dependent upon the absence of said different potential on its associated guard conductor, means in said allotter responsive to the initiation of a call on one of said lines for testing for the presence of said distinct potential on the guard conductor of the preselected finder, and means in said allotter operative only in case no said distinct potential is found on the guard conductor of the preselected finder for operating said allotter to select another finder for use by the calling subscriber.

15. In an automatic telephone system, a group of subscribers' lines, a group of finders, the finders having access to said lines and having guarding conductors; an allotter having access to said finders by way of said guard conductors, idle ones of said finders characterized by a definite potential applied to their associated guard conductors while the busy ones of said finders are characterized by a different potential applied to their associated guard conductors, and means in said allotter for first testing for an absence of said different potential on the guard conductors of the finders to preselect one of them, and then testing for said definite potential on the guard conductor of the preselected finder before seizing a finder for use by a calling one of said subscribers' lines.

16. In a telephone system, a finder switch having vertical and rotary motions to find a calling line, a vertical magnet in the finder for operating the finder in its vertical movement, a rotary magnet in the finder for oper-

ating the finder in its rotary movement, means for closing a circuit to the vertical magnet to energize it, a single wound pulse ending relay in said finder, means controlled by the vertical magnet in its energized position for energizing the pulse ending relay to open the circuit to the vertical magnet, a changeover relay in said finder, means for energizing the changeover relay in series with said pulse ending relay, means controlled by the energization of the changeover relay for deenergizing said pulse ending relay and for changing said circuit from the vertical magnet to the rotary magnet to energize it, means controlled by the rotary magnet in its energized position for energizing the pulse ending relay to open the circuit to the rotary magnet, two test relays in said finder, means for energizing either one of said relays independent of said pulse ending relay, and means controlled by the energized test relay independent of said pulse ending relay for opening the circuit of the rotary magnet to stop the finder on the calling line.

17. In a telephone system, a finder switch having a normally connected and a normally disconnected set of wipers, and having vertical and rotary hunting movements to find a calling line in a group of lines, a vertical magnet, a rotary magnet, and a stepping relay in said finder, means responsive to a call and including said relay and vertical magnet for operating the wipers of the finder step-by-step in its vertical movement in search of the group of lines containing the calling line, means in the finder responsive to the finder finding the calling group for stopping the wipers opposite such group and for closing a circuit for said rotary magnet, means including said circuit and said relay for operating the rotary magnet to rotate the wipers step-by-step over the contacts of said group in search of the contacts associated with the calling line, a test wiper in each of said sets of wipers, a wiper switching relay in said finder, means responsive to one of said test wipers engaging the test contact of the calling line for energizing said wiper switching relay, and means controlled by said wiper switching relay for disconnecting the normally connected set of wipers and for connecting up said normally disconnected set, and contacts on said wiper switching relay for opening the circuit to the rotary magnet to stop the wipers on the calling line.

18. In a telephone system, a finder switch having a primary hunting movement and a secondary hunting movement to find a calling line in a group of lines, a normally connected set of wipers and a normally disconnected set of wipers in said finder, means responsive to a call for associating a definite potential with the group of lines containing the calling line, for associating a different potential with the test contact of the calling line, and for in-

itiating the operation of said finder, means for operating said finder in its primary movement in search of said definite potential, means responsive to said finder encountering
 5 said definite potential for stopping the primary movement of said finder, a wiper switching relay in said finder, a secondary magnet in said finder, a circuit for said magnet, means for operating said magnet over said
 10 circuit to operate the finder in its secondary movement in search of said different potential, said wiper switching relay energizing responsive to the finder finding said different potential for disconnecting said normally
 15 connected set of wipers and for connecting up said normally disconnected set, and contacts on said wiper switching relay for opening the circuit to the secondary magnet to stop the wipers on the contacts of the calling
 20 line.

19. In an automatic telephone system, a subscriber's line, a finder having access thereto, a primary test contact associated with said line and normally maintained at
 25 battery potential, a secondary test contact associated with said line and normally maintained at zero potential, a cut-off relay associated with said line having two windings one of which is of low resistance, means re-
 30 sponsive to the initiation of a call on said line for applying a battery potential through the low resistance winding of the cut-off relay to said secondary contact and for applying ground potential to said primary contact
 35 to mark said line calling, wipers on said finder having access to said contacts, means in said finder controlled through said wipers to select said marked contacts and to establish a connection to said line, and means re-
 40 sponsive to the establishment of said connection for energizing said cut-off relay to complete a holding circuit for itself including both of its windings in series.

20. In a telephone system, a group of subscribers' lines, a group of finders having
 45 access to said lines, a timing device common to the finders, means responsive to a call on one of said lines for operating an idle one of said finders to automatically hunt for and
 50 find the calling line and for initiating the operation of said timing device, means responsive to the finder finding the calling line for causing said finder to switch through and extend the connection from the calling line,
 55 means responsive to the switch-through operation of said finder for restoring said timing device, and means for completely operating said timing device to operate an alarm in case said operated finder does not switch-
 60 through within a predetermined time.

21. In a telephone system, a group of subscribers' lines, a group of finders having
 65 access to said lines, a timing device common to the finders, means responsive to a call on one of said lines for operating an idle one

of said finders to automatically hunt for and find the calling line and for initiating the operation of said timing device, means responsive to the finder finding the calling line
 70 for causing said finder to switch through and extend the connection from the calling line, means responsive to the switch-through operation of said finder for restoring said timing device, means for completely operating
 75 said timing device to operate an alarm in case said operated finder does not switch-through within a predetermined time, and means responsive to the completed operation of said timing device for rendering said group of finders inoperative to extend further calls.

22. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, a timing device common to the finders, means responsive to a call on
 85 one of said lines for operating an idle one of said finders to automatically hunt for and find the calling line and for initiating the operation of said timing device, means responsive to the finder finding the calling line for causing said finder to switch through and extend the connection from the calling line,
 90 means responsive to the switch-through operation of said finder for restoring said timing device, means for completely operating said timing device to operate an alarm in case said operated finder does not switch-through within a predetermined time, a second group of finders having access to said lines, and means responsive to the completed
 95 operation of said timing device for rendering said first group finders inoperative to extend further calls and for transferring the incompleting call of the calling line and other calls to the second finder group.

23. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, a timing device common to the finders, means responsive to a call on
 105 one of said lines for operating an idle one of said finders to automatically hunt for and find the calling line and for initiating the operation of said timing device, means responsive to the finder finding the calling line for causing said finder to switch through and extend the connection from the calling line,
 110 means responsive to the switch-through operation of said finder for restoring said timing device, means for completely operating said timing device to operate an alarm in case said operated finder does not switch-through within a predetermined time, a second group of finders having access to said lines, means responsive to the completed operation of said timing device for rendering
 115 said first group finders inoperative to extend further calls and for transferring the incompleting call of the calling line and other calls to the second finder group, means operative in case all said second group finders be-
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come busy for automatically restoring said timing device, and means responsive to the restoration of said timing device for again rendering said first group finders available for use by calling subscribers.

24. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, an allotter having access to said finders, a motor magnet in said allotter, a common kick-off conductor extending from all the finders in the group direct to said motor magnet, means for initially operating said magnet over said conductor, and means in said allotter responsive to said initial operation of said magnet for thereafter operating said magnet and allotter to preselect an idle one of said finders.

25. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, an allotter having access to said finders, a motor magnet in said allotter for operating said allotter to preselect idle ones of said finders, a common kick-off conductor extending from all said finders direct to said motor magnet, a start conductor individual to each finder and terminating in said allotter, means for connecting a potential to one of said individual start conductors, and means for operating said magnet over a circuit including said individual start conductor having said potential thereon and said common kick-off conductor in series.

26. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, an allotter having access to said finders, a motor magnet in said allotter for operating the wipers of said allotter, a common kick-off conductor extending from all said finders in the group direct to said motor magnet, a test conductor individual to each finder terminating in said allotter, a test wiper in said allotter for successively engaging said individual test conductors, two circuits for operating said magnet, the first circuit including said common conductor and the second circuit including said individual test conductors, means for operating said magnet over said first circuit to operate the wipers of said allotter one step, and means responsive thereto for thereafter operating said magnet over said second circuit to operate said allotter an indefinite number of steps in search of an idle one of said finders.

27. In a telephone system, a group of line finders, a finder allotter having a test wiper, a start relay, and a motor magnet, a common kick-off conductor extending from all said finders direct to said motor magnet, a circuit including said test wiper and motor magnet for intermittently operating said magnet to operate said allotter step-by-step to preselect an idle one of said finders, means for energizing said relay to open said circuit by disconnecting said magnet from said wiper, means for thereafter operating said mag-

net over another circuit including said common conductor, and said relay deenergized responsive to the operation of said magnet over said common conductor for reestablishing said first circuit.

28. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, a guarding conductor for each finder, an allotter having access to said finders, means in said allotter for making a first test over said guarding conductors to preselect an idle one of said finders, and means in said allotter responsive to a call on one of said lines for then making a second test over the guarding conductor of the preselected finder to seize and operate said finder in case such finder is in normal condition.

29. In a telephone system, a group of subscribers' lines, a group of finders having access to said lines, a guarding conductor for each finder, an allotter having access to said finders, means in said allotter for making a first test over said guarding conductors to preselect an idle one of said finders, means in said allotter responsive to a call on one of said lines for then making a second test over the guarding conductor of the preselected finder to seize and operate said finder in case such finder is in normal condition, and means in said allotter responsive to the failure of said second test over said guarding conductor for operating said allotter to select another idle one of said finders.

30. In a telephone system, a group of subscribers' lines, a group of finders, said finders having access to said lines, an allotter having access to said finders, means in said allotter for making a first test to preselect an idle one of said finders, a relay in said allotter, means for energizing said relay responsive to a call on one of said lines, and means in said allotter responsive to the energization of said relay for then making a second test to seize and operate said preselected finder in case said finder is in normal condition.

31. In a telephone system, a group of subscribers' lines, a group of finders, said finders having access to said lines, an allotter having access to said finders, means in said allotter for making a first test to preselect an idle one of said finders, a relay in said allotter, means for energizing said relay responsive to a call on one of said lines, means in said allotter responsive to the energization of said relay for then making a second test to seize and operate said preselected finder in case said finder is in normal condition, and means in said allotter responsive to the failure of said second test in case said finder is not in normal condition for operating said allotter to select another idle one of said finders.

32. In an automatic telephone system, an automatic subscriber's line circuit including the subscriber's individual line, an individual line relay, and a cut-off relay having contacts

normally connecting said line relay to the subscriber's line and having two windings, means for initially energizing said cut-off relay over a circuit including only one of its windings to disconnect said line relay from said line, and means operated responsive to the energization of said cut-off relay for closing a locking circuit for itself including both said windings in series.

33. In an automatic telephone system, a subscriber's line, a cut-off relay individual to said line having two windings, a finder having bank contacts, wipers on said finder having access to said line by way of said contacts, means responsive to the initiation of a call on said line for marking said line calling in the bank of said finder and for starting said finder, means in said finder controlled through said wipers for finding the marked line to establish a connection, and means responsive to the establishment of said connection for energizing said cut-off relay over only one of its windings to complete a holding circuit for itself including both its windings in series.

In witness whereof, I hereunto subscribe my name this 20th day of January, A. D. 1930.

NORMAN H. SAUNDERS.