

Oct. 14, 1930.

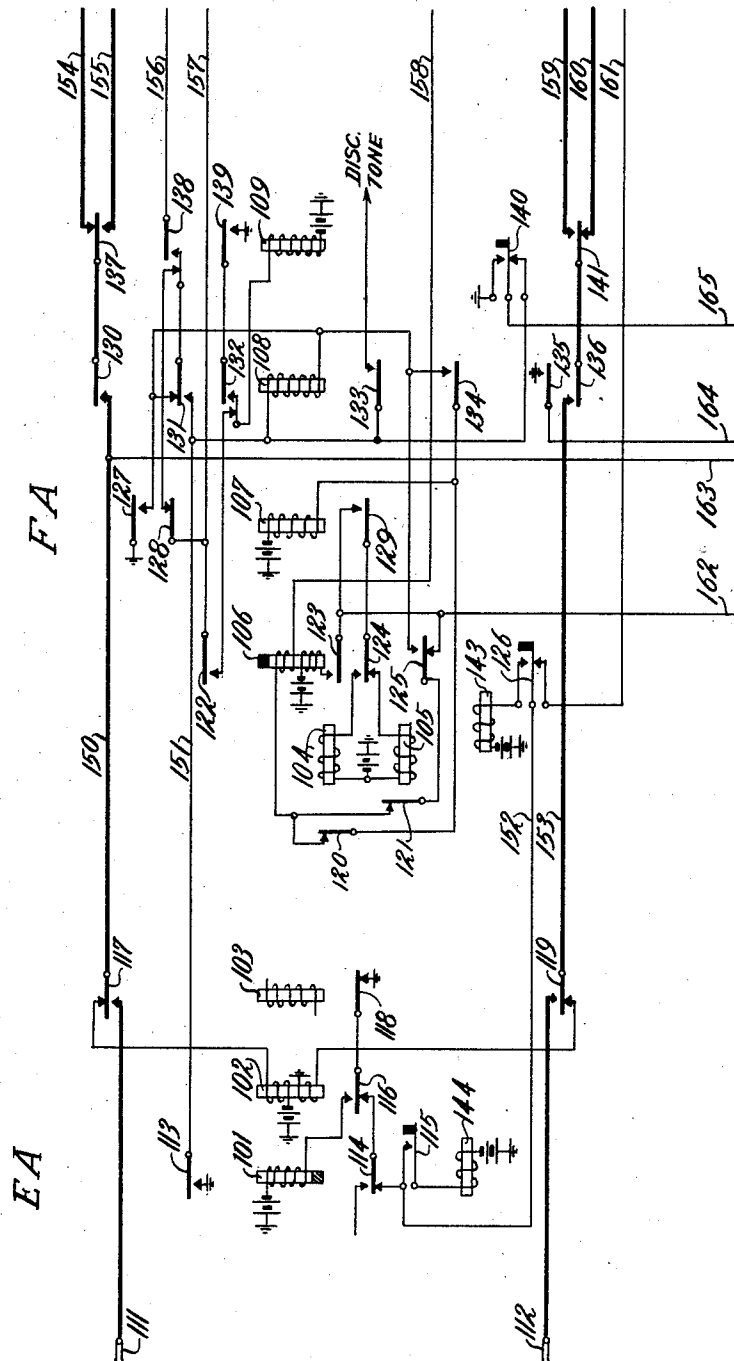
N. H. SAUNDERS

1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927 6 Sheets-Sheet 1

Fig: 1



—Inventor—
Norman H. Saunders

John H. Owen Atty:

Oct. 14, 1930.

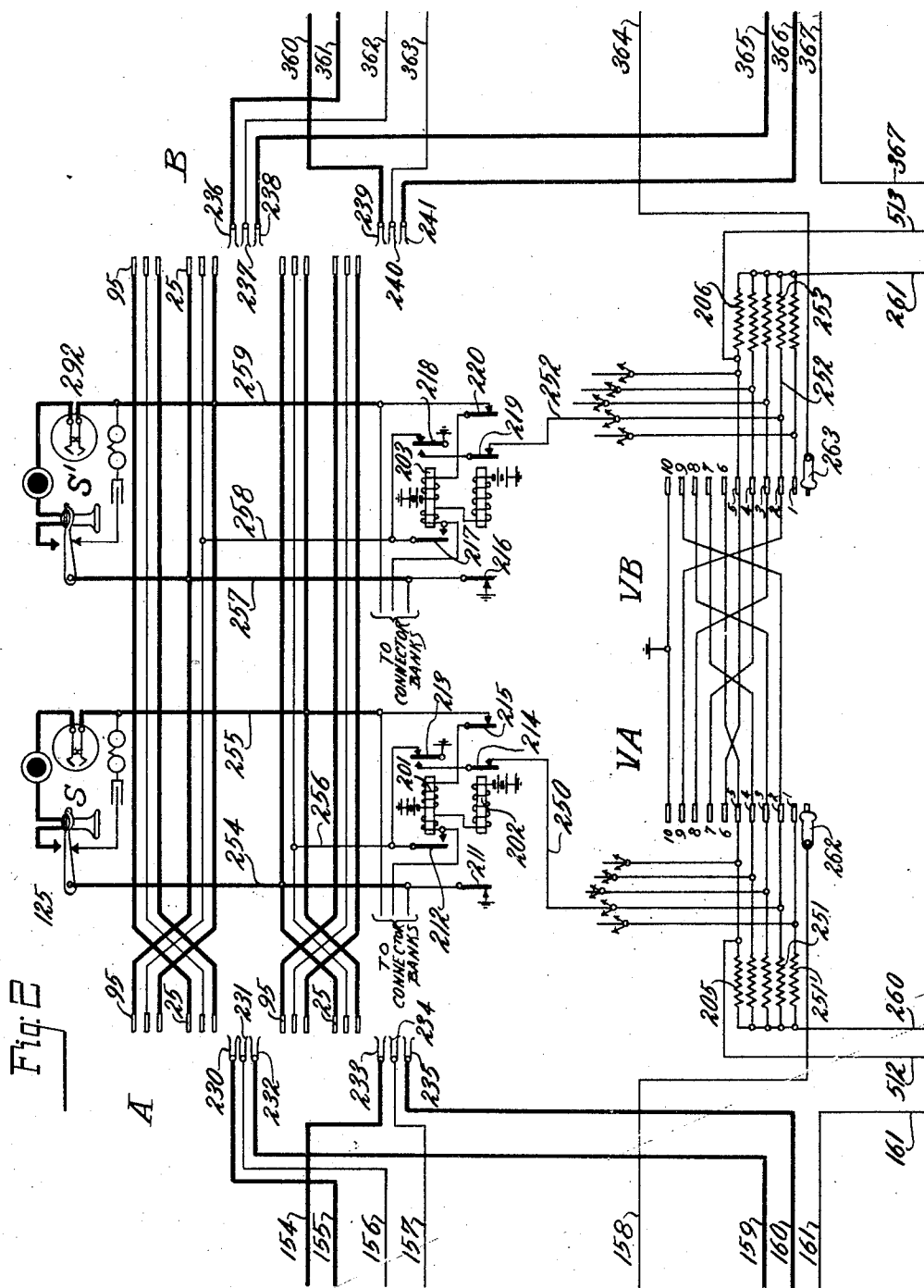
N. H. SAUNDERS

1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927

6 Sheets-Sheet 2



— Inventor —
Norman H. Saunders

Norman H. Saunders

Pr. Walter Davis, Atty.

Oct. 14, 1930.

N. H. SAUNDERS

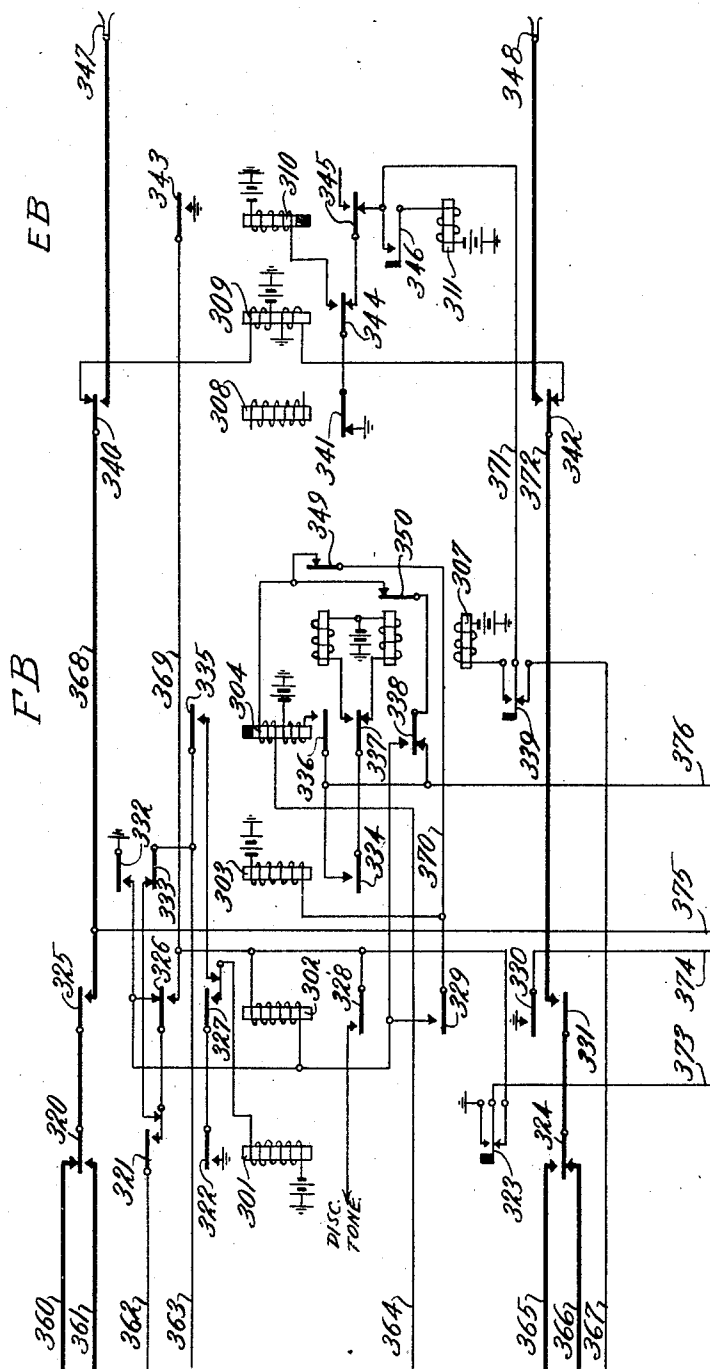
1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927

6 Sheets-Sheet 3

Fig. 3



Inventor
Norman H. Saunders

Wm. H. Curry Att'y

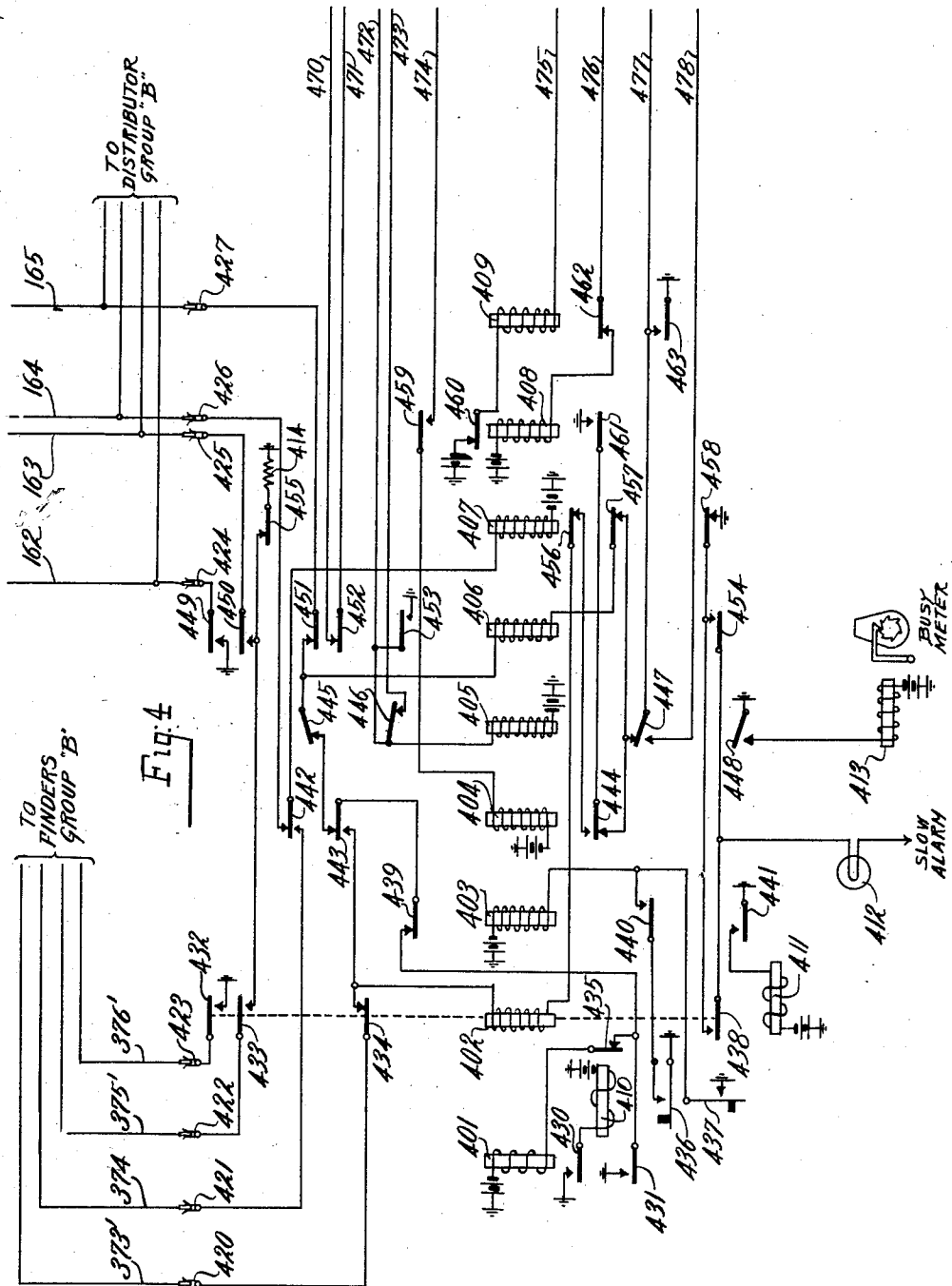
Oct. 14, 1930.

N. H. SAUNDERS

1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927. 6 Sheets-Sheet 4



Inventor
Norman H. Saunders
Wm. H. Curry, Atty.

Oct. 14, 1930.

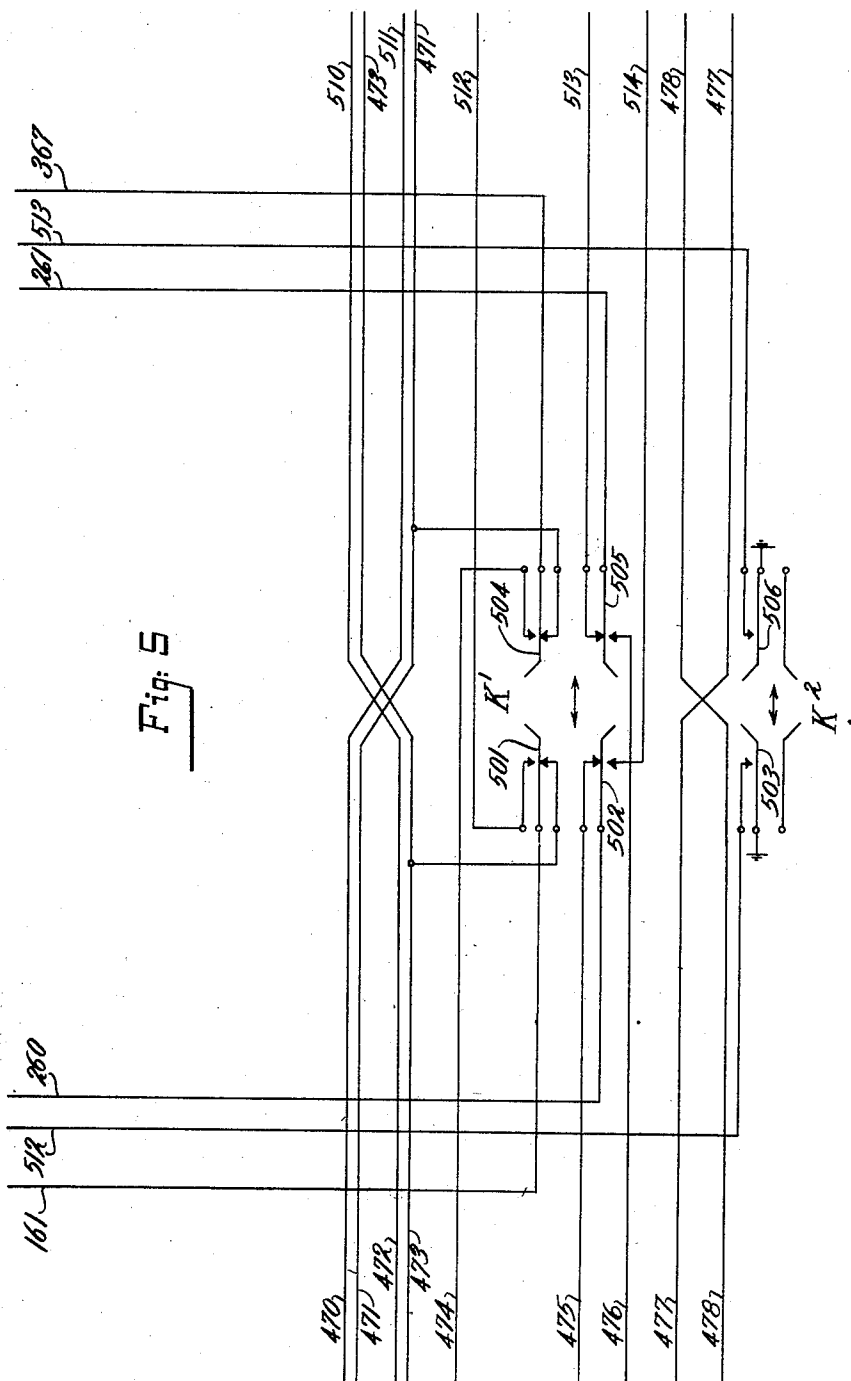
N. H. SAUNDERS

1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927

6 Sheets-Sheet 5



Inventor
Norman H. Saunders

Wm. Walter Owen, Atty.

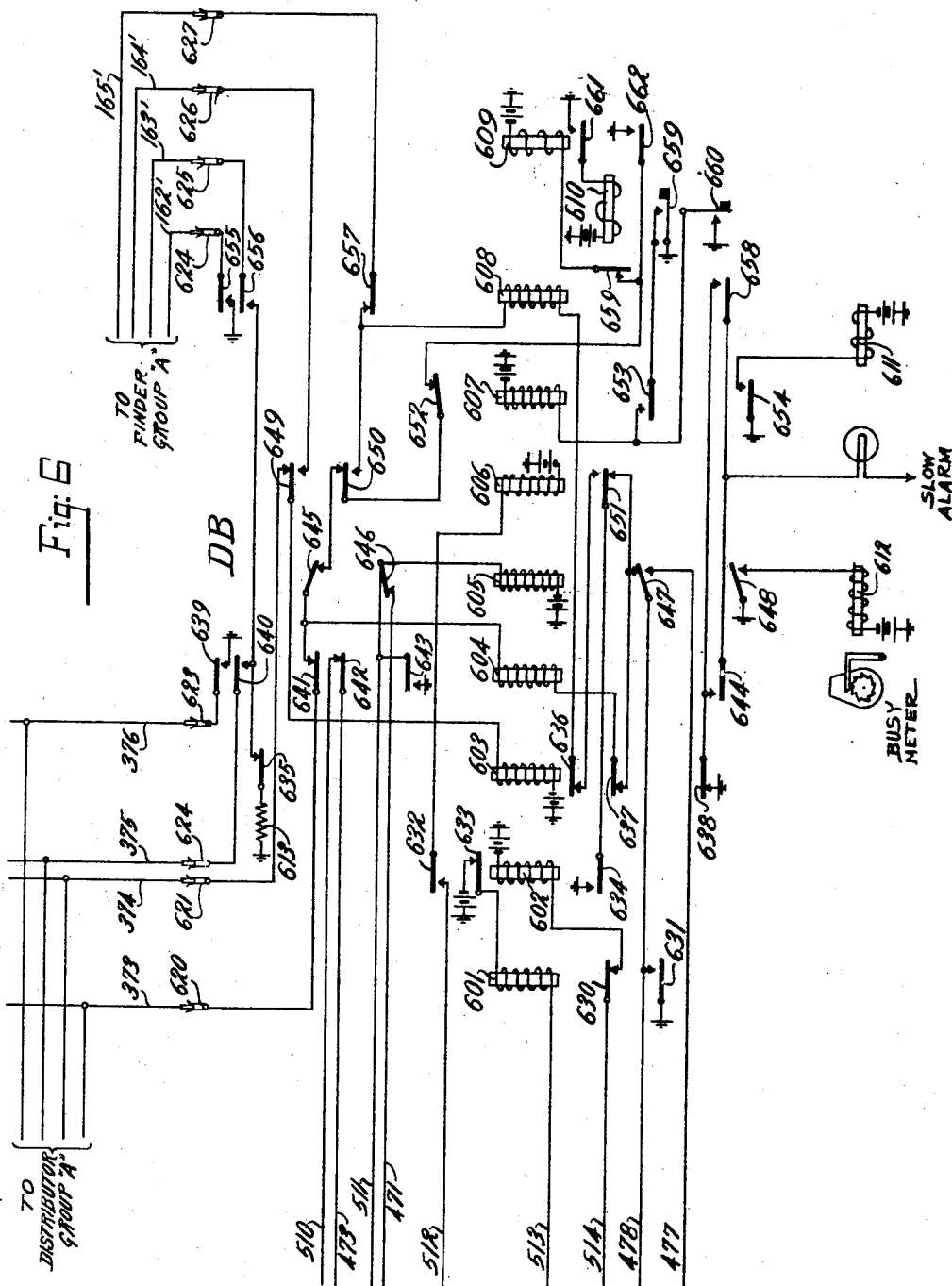
Oct. 14, 1930.

N. H. SAUNDERS

1,778,230

AUTOMATIC TELEPHONE SYSTEM

Original Filed Sept. 17, 1927 6 Sheets-Sheet 6



Inventor
Norman H. Saunders
Wm. H. Owen, Atty.

UNITED STATES PATENT OFFICE

NORMAN H. SAUNDERS, OF HOMEWOOD, ILLINOIS, ASSIGNOR TO RESERVE HOLDING COMPANY, OF KANSAS CITY, MISSOURI, A CORPORATION OF DELAWARE

AUTOMATIC TELEPHONE SYSTEM

Application filed September 17, 1927, Serial No. 220,160. Renewed March 20, 1930.

The present invention relates in general to automatic telephone systems, 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 the invention, briefly stated, is the production of a new and improved finder switch system, the improvements tending to make the system more reliable, to give uniform high quality service, and to make it cheaper to install and maintain.

The present invention relates more specifically to a searching type finder system, in which the finder switches move under their own power and control in search of a calling line. In systems of this type, two basic groups of lines are grouped together and made available to the two groups of finder switches, but in the normal operation of the system each group of finder systems handles the calls from only one basic line group. In order to give a more uniform service, finder switch systems of this kind are arranged to give preferential service, that is certain subgroups of lines are grouped together and made first choice to one group of finders while other subgroups are grouped together and make first choice to another group of finders. By this arrangement, a minimum travel of the finder switch is secured, and thereby the time required for the finder switch to pick up a calling line is materially reduced. In systems of this type, devised heretofore and of which I am aware, in case of an emergency, such as an all finder busy condition or trouble in one finder group, the preferential service was discontinued, that is, the remaining finder switches were called upon to pick up calls from the two basic line groups irrespective of the position of those lines in the banks of the finders, consequently a longer period of time was required on an average to pick up a calling line.

As a further object of the present invention, I provide a new and improved distributor switch, which will maintain the preferential service arrangement even when the two groups of finders are thrown together as one large group and operated responsive to calls from either basic line group.

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

The drawings comprising Figs. 1 to 6, inclusive, when arranged with Figs. 1, 2 and 3 from left to right in a straight line, with Figs. 4, 5, and 6 right directly beneath, and with corresponding lines in alignment, show sufficient details to enable a clear understanding of my invention.

Inasmuch as the present invention may be considered as improvement upon the patent of Lomax and Saunders, No. 1,688,588, issued Oct. 23, 1928, I am using the finder and line equipment arrangement shown in that application. Thus it will be seen that Figs. 1, 2 and 3 are identical with Figs. 1, 2 and 3 of the foregoing patent. In Fig. 1, I show a finder and a selector switch assumed to be in the group A, Fig. 2 I show two line equipments, the finder bank multiple and the vertical banks for controlling the finder switches of group A and group B, Fig. 3, I show a finder and a selector switch assumed to be in the group B.

In Fig. 4, I show a distributor DA, through the operation of which the finders of group A are preselected and taken for use by calling lines. The distributor DA differs from the distributors in finder switch systems devised heretofore, in that it employs a Strowger switch mechanism, instead of a rotary line-switch mechanism, with the circuits of that Strowger switch mechanism modified to meet the needs of a distributor switch and in accordance with the objects of the present invention. The distributor DA is provided with two sets of wipers, one normally used, having access to the finder switches of the group A. The other group of wipers, which are used under alternate circumstances, have access to the finders of the group B, for a purpose which will be apparent hereinafter. Inasmuch as the groups A and B of finder switches will not exceed ten switches per group, it is not necessary to use the entire Strowger switch mechanism, but it is possible to simplify that mechanism by omitting the vertical magnet and mechanical arrangements associated therewith. The switch shaft

of this Strowger switch mechanism, is moved in a rotary direction only, under the control of the rotary magnet, and released from its set position by the usual release magnet arrangement. The details of this operation will be brought out hereinafter.

In Fig. 5, I show the key arrangement, through the operation of which the switch room attendant may throw the two groups of finders A and B into one group, thereby permitting the distributor DA, for example, to have access to the finder switches of both groups.

In Fig. 6, I show a distributor switch DB which is identical in structure and circuits to that shown in Fig. 4, the switch DB having normal access to the finders of the group B.

The operation of the finder switch system shown in the present invention is identical with that shown in the above mentioned copending application, with the exception of the operation of the distributor switches. Briefly, responsive to the initiation of a call on the line, a preselected finder switch is started, in the group having first choice access to that line searching in a vertical direction for the level containing the calling line, and when that level is found, switching over and searching in a horizontal direction for the contacts of the calling line. When the calling line is found, the finder is switched through to connect it with a selector switch, and a kick off ground is returned to the distributor switch. This kick off ground releases the distributor switch from the finder that has just been operated, and operates the motor magnet of the distributor to step the wipers over the bank contacts in search of another idle finder in the same group.

In case the finder which has just operated happens to be the last idle finder of the group the distributor switch is not operated, since there are no other idle finders in the group for it to find. The all finder busy relay falls back, and the start circuit is connected through to the other finder groups, operating that group distributor to control its finders to pick up calls in the first line group.

In case of a fault in the group B distributor, the despatcher may hold that equipment out of service by operating the key K¹ thereby extending the start circuit of both groups of lines to the distributor DA. The distributor under this circumstance, operates to find an idle finder in the A group responsive to the initiation of a call on an A group line, and operates to find an idle finder in the B group responsive to the initiation of a call on a B group line. It is only when this key is thrown that the distributor DA has access to the finders of the group B, and then it has access to those finders only in response to calls in the group B lines. The distributor pre-selects an idle finder in the group A, and

when it is started responsive to the initiation of a B call, it is a post selecting distributor, that is, it picks out an idle finder in the group B after the call has been initiated.

Similarly, operating the key in the opposite direction will disconnect the distributor DA, and route all calls to the distributor DB, giving that distributor access to the finders of group B responsive to calls originating in the group B line, and access to finders of group A responsive to the calls initiating in the group A line.

Having thus described my invention in general, I will now proceed with a detailed description of its operation.

Line S initiates the call

Assuming now that the line S initiates a call, a circuit may be traced from ground at springs 211, conductor 254, through the hook switch, receiver, transmitter and calling device of the substation S, conductor 255, springs 215, through the right hand winding of relay 201 to battery, energizing relay 201. At spring 213 and its break contact, relay 201 removes ground from the private conductor 256, associated with the line S and the banks of the finder switches, to render the line calling. Relay 201 also closes at spring 213 and its make contact a circuit from ground through that spring and spring 214 to the start conductor 250, thereby placing ground potential upon the second bank contact of the vertical bank VA, and upon the ninth bank contact of vertical bank VB, for a purpose which will be brought out hereinafter. The ground conductor 250 completes a circuit through the resistance 251, conductor 260, the spring 502 and its break contact, conductor 475, through the winding of start relay 409, through springs 460, to battery. Relay 409 energizes over this circuit to start the preselected group A finder in search of the calling line. The energization of relay 409, opens at spring 462 a point in the circuit of relay 408, to prevent the energization of that relay during the process of setting the instant call. At springs 463, relay 409 closes a circuit from ground over conductor 477, through springs 447, springs 457, through the winding of relay 406, springs 445, spring 443 and its break contact, springs 439, springs 435, through the winding of relay 401 to battery. Relay 406 energizes in this circuit, but because of the high resistance of that relay, relay 401 does not energize at this time. The energization of relay 406, closes a circuit from ground through spring 453, through the winding of all finders busy relay 405, to maintain that relay energized throughout the setting of the instant call even though the instant call may use the last idle finder in the group A. Relay 406, at spring 454 closes a circuit from ground on spring 458 through the supervisory lamp 412 and the slow alarm

device, not shown, to battery. The lamp 412 lights to indicate that a call is being set by the finder control by distributor DA, and the slow alarm device is started operating. This device, which may be any well known slow acting device, does not operate during the normal process of setting a call, however, if because of some fault in either the finder or the distributor, the circuit of the slow alarm device is maintained closed for longer than a definite time, that device will operate, to call the station attendant's attention to the trouble. Relay 406 at springs 452 opens a point in the all-finder's busy circuit of the group B, for a purpose which will be explained hereinafter. At springs 451, relay 406 opens a point in the circuit of wiper 427, to prevent the operation of the distributor DA over circuits controlled through that wiper until the present call has been set. At springs 450, relay 406 closes a circuit from ground through resistance 414, springs 455, springs 450, wiper 425 now in engagement with the contact to which conductor 163 is connected, connector 163, negative trunk conductor 150, spring 117 of the selector EA, through the upper winding of line relay 102 of the selector EA to battery. The line relay 102 energizes over this circuit, and at springs 116 closes the obvious circuit for the release relay 101. The release relay 101 energizes, and at springs 113 places ground on release trunk conductor 151, for a purpose which will be explained hereinafter. Relay 406 upon operating springs 449 closes a circuit from ground through the wiper 424 now in engagement with the contact to which the conductor 162 is connected, through the conductor, spring 125 and its break contact, springs 121, springs 120, through the winding of stepping relay 107 of the finder FA to battery. Relay 107 energizes over this circuit, to start the finder FA in operation.

Operation of finder FA

The operation of the finder in the present invention is the same as that described in detail in the above mentioned patent, and for that reason will only be briefly described in the present specification. Responsive to the energization of relay 107, a circuit is closed from conductor 162 through springs 129, spring 124 and its break contact to the winding of the vertical magnet 125 to battery. The vertical magnet energizes over this circuit, elevates the shaft containing the wipers of the finder FA one step, and opens the springs 121, to open the previously traced circuit for the relay 107. Relay 107 falls back, and spring 129 opens the circuit just traced for the vertical magnet 105. This interaction of relay 107 and magnet 105 continues as long as the vertical wiper 262 of the finder FA fails to pick up ground potential. Since the calling line S has a finder

number of 125, the vertical magnet 105 will be operated twice, at which time the wiper 262 will complete a circuit from spring 213 and its make contact, springs 214, conductor 250, the second bank contact of the vertical bank VA, wiper 262, conductor 158, through the upper winding of relay 106, springs 120, through the winding relay 107 to battery. Relay 106 energizes over this circuit, and relay 107 which was in energized position when the circuit was closed, remains in its energized position. The energization of relay 106 transfers the impulsing circuit from the vertical to the rotary magnet, that circuit being closed through springs 129 and spring 124 and its make contact, through the winding of magnet 104 to battery. The rotary magnet 104 energizes, and moves the shaft containing the wipers of the finder FA one step in the rotary direction, and opens at springs 120 the above traced circuit for the relay 107. Relay 107 falls back, opens the circuit for magnet 104, permitting that magnet to fall back and again close the circuit of relay 107. Assume now that the first contact in the second level is the contact of an uncalling line, the test wiper 234 will pick up ground potential, completing the circuit through conductor 157, spring 122, spring 132, through the wiper switching relay 109 to battery. Wiper switching relay 109 energizes over this circuit, at spring 138 connects the test wiper 231 through conductor 156, springs 138, springs 131, spring 125 and its make contact, spring 121, spring 120, through the winding of relay 107 to battery. If the test wiper 231 is engaging an uncalling line, relay 107 energizes over this circuit, again closing a circuit for the rotary magnet 104 which energizes and advances the wipers another step. This interaction of relays 107, 109, and 104 continues until one of the other of the test wipers 231 and 234, engages an ungrounded contact associated with a calling line. During the stepping of the switch FA, the switch through relay 108 has been short circuited, ground being applied to the upper terminal from the release trunk conductor 151, and to the lower terminal from spring 127 when relay 107 is energized, and from conductor 156 through springs 138 and 131 when relay 107 is deenergized. Since the line S appears in the banks to which wipers 233 to 235, inclusive, have access, wiper 234 will lose ground potential when the contacts associated with line S are encountered. Relay 109, will deenergize, during the interval that relay 107 is deenergized at the last rotary step. The deenergization of relay 109 opens the circuit from wipers 231 to the relay 107, to prevent the energization of that relay even though that wiper is engaging a grounded contact. Relay 108 is therefore no longer short circuited, and energizes over a circuit from grounded release trunk conductor 151

through the winding of the relay 108, spring 125 and its make contact, spring 121, spring 120, through the winding of relay 107 to battery. Because of the high resistance of the winding of relay 108, the relay 107 does not energize over this circuit. The energization of relay 108 switches the finder through to the calling line thereby connecting that line to the selector EA, permitting the calling subscriber to dial the digits of the wanted number in the usual manner. The energization of relay 108 closes spring 135, to thereby start the distributor DA in search of another idle finder.

15 *Distributor DA searches for idle finder*

The ground placed upon conductor 164 by springs 135 completes the circuit for relay 407, traceable through wipers 426, springs 442, through the winding of relay 407 to battery. Relay 407 energizes, and at spring 457 opens the circuit previously traced for relay 406. At springs 458, relay 407 opens the circuit previously traced through the alarm lamp 412 and the slow alarm device, to de-energize those devices. The deenergization of relay 406, closes a circuit from ground through off-normal springs 140 of the finder FA, conductor 165, wiper 427 of the distributor DA, springs 451, springs 445, spring 443 and its break contact, springs 439, spring 435, through the winding of relay 401 to battery. Relay 401 energizes over this circuit, and at spring 431 prepares a locking circuit for itself, that circuit including the interrupter springs 435. At spring 430, relay 401 closes the obvious circuit for the rotary magnet 410, causing that magnet to energize and advance the wipers one step. If the next finder of the group A is busy, the wiper 427 will pick up ground potential, reclosing the previously traced circuit for relay 401, which again energizes, locks itself through the interrupter springs, and closes the circuit for the rotary magnet 410, energizing that magnet to cause the wipers of the switch DA to be moved on to the next contact set. This procedure will continue as long as the wiper 427 encounters grounded contacts, associated with busy finders. When an idle finder is encountered, the wiper 427 will fail to pick up ground, and the finder DA will come to rest upon the contacts associated with that finder, pre-selecting it in readiness for the next call.

55 The Strowger switch mechanisms, such as is used for the distributor DA have a normal capacity of ten contacts in each row, so when the wipers 420 to 427, inclusive, have been stepped ten steps it is necessary to release them and to return them to their normal positions before additional steps can be taken. For this purpose the cam spring 437 is provided, and after the wipers have been stepped off of the last contact in their banks, that is after the eleventh step, cam springs 437 close,

closing a circuit for the relay 403. Relay 403 energizes, and at springs 440 locks itself through off normal springs 436, thereby insuring that it will remain in its energized position until the distributor DA is returned to its normal position. At springs 439, relay 403 opens a point in the circuit of relay 401 and wiper 427 to prevent the energization of that relay even though the wiper 427 encounters ground potential upon its return to normal. The energization of relay 403 closes springs 441, thereby closing a circuit for the release magnet 411 to energize that magnet. The release magnet upon energizing withdraws the holding pawls from the shaft, containing the wipers 420 to 427, thereby releasing the distributor DA to normal in the well known manner. The wipers of the distributor DA are mounted on a shaft in such a position that when the shaft is in its normal position, the wipers will encounter the first contact set in the bank, rather than encounter no contacts as is customary in a Strowger switch. The off-normal spring 436 opens just before the switch reaches its normal position, to unlock the circuit of relay 403, to permit that relay to restore and open the circuit of the release magnet and prepare the circuit of the stepping relay 401. If the first finder of the group, upon whose contacts the distributor DA is now resting, is busy, wiper 427 will pick up a ground potential, and the circuit of relay 401 will be completed, energizing that relay to step the distributor DA off of that contact set. The testing operation will continue until an idle finder is found, at which time wiper 427 will lose its ground potential and the distributor will come to rest.

Line S¹ initiates a call

The operation of the group B equipment is similar to the operation of that just described, and responsive to the initiation of a call on a group B line, for example line S¹, ground is placed up on the start conductor 261 through one of the level marking resistances, in this case resistance 253, to complete a circuit for relay 601 of the distributor DB. Relay 601 energizes over this circuit, opening the circuit of relay 602 at spring 630, and closing a circuit for the start relay 601 at spring 631 traceable from ground through those springs and spring 647 is make contact, springs 637, through the winding of relay 604, springs 645, spring 615 and its break contact, interrupter springs 659, relay 609 to battery. Relay 604 energizes over this circuit, and, because of the resistance of that relay, relay 609 is prevented from operating. The energization of relay 604 closes the alarm circuit at springs 644; closes a holding circuit for all finder busy relay 605 at springs 643; opens a point in the testing circuit at springs 641; opens a point in the

all finders busy circuit of the group A at springs 642; and closes a circuit for the line relay 309 of the selector EB at springs 640, that circuit being traceable from ground through resistance 613, spring 635, spring 640, wiper 622, conductor 375, conductor 368, spring 340 and its break contact, through the upper winding of relay 309 to battery. At springs 639, relay 604 closes a circuit through wiper 623 to conductor 376, thereby completing a circuit through springs 338, springs 350, springs 349, conductor 370, through the winding of relay 303 of the finder FB to battery. Finder FB operates, first in a vertical direction to find the level containing the calling line, and then in a horizontal direction to find the calling line, and at the end of that operation switch through relay 302 energizes to connect the calling line with the idle selector. The energization of relay 302 closes springs 330, thereby placing ground on conductor 374, that ground being picked up by wipers 621 to complete a circuit through springs 649 and the winding of relay 603 to battery. Relay 603 energizes, and at springs 635 opens the circuit over which relay 309 of the selector EB was initially energized, to prevent the resistance ground from interfering with the operation of that relay during impulsing. Relay 603, at springs 637 opens a point in the circuit of relay 604, permitting that relay to deenergize. At spring 638, relay 603 opens the circuit through the alarm lamp and slow alarm device to prevent further operation of those devices at this time. Relay 604, falls back, and at springs 641 completes a circuit for the stepping relay 609, that circuit being traceable from ground through off-normal spring 303 of the finder FB, conductor 373, wiper 620, springs 641, springs 645, springs 650, springs 652, interrupter springs 659, through the winding of relay 609 to battery. Relay 609 upon energizing closes springs 662, thereby completing a locking circuit for itself in series with interrupter springs 659. At springs 661 relay 609 closes the obvious circuit for the rotary magnet 610, energizing that magnet to advance the wipers 620 to 627 of the distributor DB one step. The operation of the rotary magnet opens the circuit of relay 609, permitting that relay to deenergize to open the circuit of the rotary magnet. If the next finder of the group is busy, wiper 620 again finds ground potential and the same cycle of operations is repeated, continuing until the wiper 620 encounters an ungrounded contact associated with an idle finder. When eleven steps have been taken by the rotary magnet, cam springs 660 operate, closing a circuit for relay 607, which energizes. Relay 607 locks itself to springs 653 through off-normal spring 659, to insure that it will remain in an energized position until the distributor DB returns to its normal po-

sition. Relay 607 opens the springs 652 thereby opening a point in the circuit of relay 609 to prevent that relay from energizing even though the wiper 620 encounters grounded contacts. Relay 607, at springs 654 closes a circuit for release magnet 611, that magnet operating to release the switch to normal. When the switch reaches its normal position, off-normal spring 659 opens, relay 607 is unlocked and restored and the testing operation continues, it being remembered that the normal position of the distributor DB is on the first contact set of the bank.

All finders busy condition

Assume now that all the finders in group A become busy, when the last finder of the group goes off-normal, ground is removed from the all-finders busy, conductor 161 at off-normal springs 126 of that finder, thereby opening the circuit for normally energized relay 405 of the distributor DA. This relay falls back, and at springs 445 opens a point in the testing circuit through wiper 427 and relay 401, to prevent a needless operation of the distributor DA. At springs 447, relay 405 closes a point in the start circuit, controlled by relay 409, so that responsive to a call in the A group of lines, a B finder will be started. When relay 409 is energized responsive to the initiation of a call on a group A line, it closes springs 463, thereby closing a circuit from ground over conductor 477 through spring 447 and its break contact, conductor 478, springs 647 of the distributor DB, springs 637, through the winding of relay 604, hence over the previously traced circuit to relay 609 to battery. Relay 604 energizes over this circuit, to start the finder switch preselected by the distributor DB to operating in the usual manner. Since the calling line S appears in the upper half of the bank of the finder switches of group B, it will be necessary that the selected finder take more than five steps, in this case nine steps, to reach the level containing the calling line. The operation of the finder under this circumstance is identical to that already explained and will not be repeated at this time.

Similarly if all the finders in the group B become busy, all finder busy relay 605 is deenergized when the last finder of the group is taken for use and ground is removed from conductor 367. If any line in the group B line initiates a call by placing ground on start conductor 261 through the associated level resistance, the relay 601 of the distributor DB is energized as before. The ground which is placed on conductor 478 by springs 631 of the relay 601, now traverses a circuit through spring 647 and its break contact, conductor 477, springs 447 of the distributor DA, springs 457, relay 406, thence over the

previously traced circuit through relay 401 to battery, energizing the relay 406. The energization of relay 406 starts the finder preselected by the distributor DA, in search of the calling line in group B. Since the group B line appears in the upper half of the bank of the finders of group A, it will be necessary for the finder switch to take more than five steps in a vertical direction to find the contacts of the calling line.

It will be noted that the relay 405 of the distributor DA is maintained energized over parallel branches, the one through springs 446, conductor 473 to the all finder busy common 161, and the other from that common through conductor 473 and the springs 642 of the relay 604 of the distributor DB, conductor 510, springs 501, thence through the conductor 472 to the relay 405. It will be noted that when the relay once falls back, the direct locking circuit to the all finders busy common is broken at springs 446 and that the parallel path for the relay 405 is open whenever the relay 604 of the distributor DB is energized. If then, while the distributor is sending a call from a line in either group, a finder in the group A becomes idle thereby placing ground on conductor 161, all finders busy relay 405 will not be energized immediately but rather will remain de-energized until the relay 604 of the distributor DB restores at the completion of the setting of the call. By this arrangement, the idle finder in the group A is prevented from stealing the call from a group B finder. If it were not for this provision, if the group B finder were setting a call in one of the lower levels of the A line group, which levels appear as the uppermost levels of the group B finders, a finder in the A group becoming idle after the group B finder has been started, might be started and connected with the calling line before the group B finder would reach the contacts of the calling line, thereby causing an unnecessary operation of the group B finder. By holding the all finder busy relay 405 open until the distributor DB comes to rest at the end of a call, this stealing of a call is prevented. Similarly the all finders relay 605 of the distributor DB is maintained energized over two circuits one of which is broken when the relay falls back at springs 646, and the other held open by spring 452 of the relay 406, of the distributor DA, this similar arrangement preventing the stealing of a call from an A group finder by a B group finder.

The operation of key K¹

It may happen that because of some trouble in one of the distributors, the switch room attendant may find it advisable to remove that distributor from service for repairs. To do this he operates the key K¹, which alters the start circuits so that calls from both line

groups are handled by the one remaining distributor, which selects an idle finder in accordance with the group containing the line which originated the call. That is when one distributor, for example DA, is handling all of the traffic in the two line groups, calls originating in the A line group will be handled by a finder in the A group, if there is an idle finder in that group, and calls originating in the B line group will be handled by a group B finder, if there is an idle finder in that group. It will be noted that the bank contacts accessible to the wipers 424 to 427 of the distributor DA are multiplied to the bank contacts accessible to the wipers 624 to 627 inclusive, of the distributor DB. Similarly the contacts accessible to the wipers 420 to 423, inclusive, of the distributor DA, are multiplied with the contacts accessible to the wipers 620 to 623 of the distributor DB. In the normal course of operation, wipers 424 to 427 of the distributor DA are the wipers used, and have direct access to the finders of the group A. Wipers 620 to 623, inclusive, of the distributor DB are normally used and have direct access to the finders of the group B. When the key is thrown, the wiper sets to be used by the distributors, depends upon the start relay energized by the initiation of a call. That is each line group start wire terminates in a different start relay in the distributor, so that when the A group start relay is energized, the distributor selects an idle finder in the A group from its normal set of wipers. When the B group start relay is energized the distributor selects a finder in the B group through its alternate set of wipers.

Assume now that the attendant operates key K¹ to the left to operate springs 501 and 502. This operation removes the distributor DA from service, and routes the calls to the distributor DB. The operation of spring 501 away from its break contact, opens the group busy common 161 from the all finder busy relay 405 of the distributor DA, permitting said relay to restore to normal. The busy common conductor 161 is now connected through spring 501 and its make contact, conductor 512, to the spring 632 of the relay 602 in the distributor DB, this spring being open at the present time. The operation of spring 502 disconnects the start wire 260 from the group A and connects it to conductor 514 leading through springs 630 to the relay 602 of the distributor DB. When a line in the A group initiates a call and places ground on the start conductor 260, relay 602 is energized. At springs 632, relay 602 extends the all finder busy common ground of group A through those springs to the winding of relay 606, completing a circuit for that relay to energize it. At springs 633, relay 602 opens the circuit of relay 601, so that a call originating in the B group will have to wait until the distributor DB has finished with the instant call.

At springs 634, relay 602 closes a circuit from ground through spring 651 and its make contact, springs 636, through the winding of lay 608 through spring 650, through interrupter springs 659 through the winding of relay 609 to battery. It will be remembered that in the foregoing description of the operation of distributor DB the control of the distributor when searching for an idle finder is through the wiper 620, which operated the distributor until that wiper found an ungrounded contact, associated with an idle finder in the B group. It may happen therefore that the wipers of the distributor DB at this time are standing upon the contacts of a busy finder in the A group, in which case wiper 627 will pick up a ground potential, which is projected through springs 657 to the upper terminal of relay 608. If this is the case, relay 608 will not energize immediately but will be short circuited, and relay 609 will energize from the direct ground picked up by wiper 627 and applied to the circuit of relay 609 at a point excluding the winding relay 608. Relay 609, upon operating, closes the circuit of the rotary magnet as hereinbefore described, to step the wipers of the distributor DB in search of an idle finder in the A group. When that finder is found, wiper 627 loses its ground potential and the short circuit is thereby removed from relay 608. Relay 608 then energizes through relay 609. Relay 609 does not pull up to again close the circuit of the rotary magnet, because of the high resistance of the winding of relay 608. Relay 608 upon pulling up, opens at springs 657 the testing circuit through wiper 627, so that the distributor DB will not step off the selected finder when the guard conductor of that finder is grounded. At springs 658, relay 608, closes a circuit from ground through spring 638 to the alarm lamp and slow alarm device, for the purpose which has been previously described. At springs 656, the relay 608 closes a circuit from ground through resistance 613, spring 635, spring 656, wiper 625, conductor 163', conductor 163, trunk conductor 150, spring 117, through the upper winding of the line relay 102 of the selector EA, energizing that relay to seize the selector and finder in the manner hereinbefore pointed out. At springs 655, relay 608, closes a circuit from ground through wiper 624 to the start conductor 162' which is connected through start connector 162 of the finder FA, that ground operating the relay 107 to start the finder in the manner hereinbefore pointed out. The finder FA now operates in the manner which has already been described, finally positioning its wipers upon the contacts of the calling line and energizing relay 108 through the established connection therewith. At spring 135, the kick off ground is applied to conductor 164 as before, ground now being picked up by wiper 626, completes a circuit through spring 649 and its make con-

tact, through the winding of relay 603 to battery. Relay 603 energizes, and at spring 638 opens the alarm and signal circuits to prevent further operations of those devices at this time. At springs 637, relay 603 opens a point in the circuit of relay 604, however since that relay is not energized this operation serves no useful purpose. At spring 636, relay 603 opens a circuit of relay 608, permitting that relay to fall back to normal. The restoration of relay 608 closes at springs 657 a point in the circuit of the distributor DB through which that distributor seeks an idle finder in the A group. If another call is waiting in the A group, conductor 260 will be still grounded, and start relay 602 will remain operated. Relay 606 will also remain operated if there is an idle finder in the group A, and the distributor DB will test through wiper 627 to connect with that idle finder. If however the instant call was the only call pending in the group A, relay 602 deenergizes when the cut off relay 202 of the calling line is operated, because that relay removes ground from the start conductor 260. Relay 606 will thereupon be deenergized, and the distributor DB will test for an idle finder in the B group under the control of the testing circuit through wiper 620, in the manner already pointed out.

Thus it will be seen that when the key K¹ is operated, calls in the A line group are handled by an A group finder under the control of the distributor DB. Since the operation of the key K¹ has no effect upon the handling of a B line call by a B finder under the control of the B distributor that operation will not be repeated at this time.

If there are no idle finders in the A group at the time the key K¹ is thrown, conductor 512 will not be grounded, therefore when relay 602 is energized, relay 606 will remain deenergized. The circuit closed from ground through springs 634 will now extend through spring 651 and its break contact, springs 637, relay 604 thence over the previously traced circuit through relay 609 to battery, operating the relay 604 to start the preselected B finder in the same manner as through relay 604 was operated over a circuit through spring 631 of the start relay 601. The B finder will pick up the A line code, making more than five vertical steps to reach the level containing the calling line.

If the key K¹ is thrown to the right to operate springs 504 and 505 the distributor DB is removed from service and all calls are handled by the distributor DA. The operation of spring 504, opens the circuit from the busy common conductor 367 to permit the relay 605 to fall back. The operation of springs 505 extends the group B start conductor 261 through those springs to conductor 476, preparing a circuit through springs 462 and relay 408 to battery. When a group B line

initiates a call, relay 408 is energized, preparatory to starting the distributor DA in search of an idle finder in the B group. The operation of spring 594 extends the all finder busy common 367 through conductor 474 thereby preparing the circuit which is completed when relay 408 energizes to energize the relay 404. Relay 404 transfers the control of the control of the distributor DA from the normal set of wipers to the alternate wipers 420 to 423, inclusive. If the wiper 420 is standing on the contacts of a busy finder, a circuit for relay 401 will be completed through that wiper, springs 434, spring 443 and its make contact, spring 439, interrupter spring 435 to the winding relay 401 to battery. Relay 401 will energize, lock itself, and close a circuit to the rotary magnet 410. The rotary magnet will advance the wipers and open the circuit of relay 401, this interaction of the magnet and relay continuing until wiper 420 encounters an ungrounded contact. Relay 402 will then be energized from ground through springs 461 of the relay 408, spring 444 and its make contact, spring 456, through the winding of relay 402, spring 443 and its make contact, springs 439, through the interrupter springs 435, through the winding of relay 401 to battery. Relay 402; at springs 438, closes a circuit for the signal alarm lamp and the slow alarm device; at spring 434 opens a point in the circuit of the wiper 420 to insure that the circuit of DA will not step off of the contacts of the preselected finder when that finder is made busy by the present call: At springs 433, relay 402 closes a circuit from ground through resistance 414, springs 455, through the wiper 420 through the conductor 375', to seize the line relay of the selector EB in the manner hereinbefore pointed out. At spring 432, relay 402 applies ground through the wiper 423 and conductor 376' to the start conductor 376 of the finder FB, to start that finder operating in search of the calling line. When the finder FB is on the calling line and relay 302 is energized, kick off ground will be placed on conductor 374 by the springs 330, that ground being picked up by the wiper 421 to complete the circuit through spring 442 and its make contact through the relay 407 to battery. Relay 407 energizes to restore the distributor DA to normal and to complete the circuit preparatory to selecting another idle finder. If there is another idle finder in the B group and another call waiting in the B line group, the selection will be through the wiper 420, and will be accomplished in the manner just pointed out.

The operation of the key K¹ does not in any way effect the control of the distributor DA by a call in the A group so that operation will not be repeated at this time.

Having thus described my invention, what I consider new and desire to have protected

by Letters Patent is pointed out in the appended claims.

What is claimed is:—

1. In a telephone system, subscribers' lines, a distributor switch having a plurality of wipers, a group of contact sets accessible to each of said wipers, a finder switch associated with each of said contact sets, a trunk line individual to each finder, means in the finder for connecting the individual trunk line to a calling one of said subscribers' lines, means for making each of said finders busy to said distributor, means for stepping said wipers over said contact sets in search of an idle finder, means operated after the wipers have been stepped off the last contact set of the group for releasing them and returning them to the first contact set, and means for stopping said wipers when an idle finder is found.

2. In a telephone system, subscribers' lines, a group of finder switches, a trunk line individual to each finder, means in the finder for connecting the individual trunk line to a calling one of said subscribers' lines, a distributor switch having a plurality of positions corresponding to said finders, means for operating said distributor from position to position to test the busy or idle condition of said finders one at a time, and means in said distributor, operated after the last finder of the group has been tested, for releasing said distributor and returning it to the position from which it tests the first finder of said group.

3. In a telephone system, subscribers' lines, a group of finder switches, a trunk line individual to each finder, means in the finder for connecting the individual trunk line to a calling one of said subscribers' lines, a distributor switch having a plurality of positions corresponding to said finders, means for operating said distributor from position to position to test the busy or idle condition of said finders one at a time, means in said distributor, operated after the last finder of the group has been tested, for releasing said distributor and returning it to the position from which it tests the first finder of said group, and means for preventing the performance of said testing while said distributor is returning to said latter position.

4. In a telephone system, a distributor switch having wipers, a group of finder switches accessible through normal ones of said wipers; a second group of finders accessible through alternate ones of said wipers, means in said distributor operated through said normal wipers to preselect an idle finder in the group accessible through the normal wipers, a key, means responsive to the operation of said key for conditioning said first means for operation through said alternate wipers, and means responsive to a call for operating said first means to select

an idle one of the finders accessible through the alternate wipers.

5. In a telephone system, a plurality of groups of lines, a plurality of groups of finder switches having access to said lines, a distributor switch for each of said finder groups and normally operated to select idle finders in that group, means for giving said distributors access to the finders of the other finder group, means for combining said lines into one group by removing one of said distributors from service and means then responsive to the initiation of a call on one of said lines for operating said other distributor to select and start a finder in the group having access to that line.

6. In a telephone system, a first and a second group of lines, a first and a second group of finders having access to said lines respectively, first and second distributor switches for allotting said finders for use, means responsive to the initiation of a call on a line of the first group for operating said first distributor to start a preselected finder of the first group in search of said line, means for giving said first distributor access to said second group finders, means responsive to the initiation of a call on a line in said second group to start said first distributor in search of an idle finder in said second group, and means in said first distributor operated responsive to the finding of said second group finder for starting it in search of said calling line.

7. In a telephone system, a first and a second group of lines, a first and a second group of finders having access to said lines respectively, first and second distributor switches for allotting said finders for use, means responsive to the initiation of a call on a line of the first group for operating said first distributor to start a preselected finder of the first group in search of said line, means for giving said first distributor access to said second group finders, means responsive to the initiation of a call on a line in said second group to start said first distributor in search of an idle finder in said second group, means in said first distributor operated responsive to the finding of said second group finder for starting it in search of said calling line, and means in said first distributor responsive to the finding of said second group line for operating said distributor to preselect an idle finder of said first group.

8. In a telephone system, a first and a second group of lines, a first and a second group of finders having access to said lines respectively, first and second distributor switches for allotting said finders for use, means responsive to the initiation of a call on a line of the first group for operating said first distributor to start a preselected finder of the first group in search of said line, means for giving said first distributor access to said

second group finders, means responsive to the initiation of a call on a line in said second group to start said first distributor in search of an idle finder in said second group, means in said first distributor operated responsive to the finding of said second group finder for starting it in search of said calling line, and means in said first distributor responsive to the finding of said second group line for operating said distributor to select another idle second group finder if another line in that group has initiated a call meanwhile.

9. In a telephone system, a first and a second group of lines, a first and a second group of finders having access to said lines respectively, first and second distributor switches for allotting said finders for use, means in said distributors for preselecting idle finders in their respective groups, means for giving said first distributor access to said second group lines, and means responsive to said last means for maintaining said distributor preselecting with respect to said first group finders and post selecting with respect to said second group lines and finders.

10. In a telephone system, a first and a second group of lines, a first and a second group of finders having access to said lines respectively, first and second distributor switches for allotting said finders for use, means in said distributors for preselecting idle finders in their respective groups, means for giving said first distributor access to said second group lines, and means responsive to said last means for maintaining said distributor preselecting with respect to said first group finders and for starting it in search of an idle finder in said second group responsive to the initiation of a call by a line of said second group.

11. In a telephone system, two groups of telephone lines, a group of finder switches for each of said line groups, a distributor switch for each finder group, each distributor having access to the finder of its corresponding group through normal wipers and to the finders of the other group through alternate wipers, means in said distributors for preselecting idle finders through the normal wipers, a relay in said distributors, a start wire for each line group terminating in the relay of the respective distributor, means responsive to the initiation of a call on one of said lines for energizing said relay over said start wire to start the preselected finder of the corresponding group, a key, a second relay in said distributors, means responsive to the operation of said key for disconnecting one of said start wires from its relay and connecting it to the second relay of the other distributor, means responsive to the initiation of a call on one of the lines associated with said one start wire for energizing said second relay and means responsive to the energization of said second relay for operat-

ing said distributor to select and start a finder through its alternate wipers.

12. In a telephone system, subscribers' lines, a group of finders having access to said lines, a distributor switch having a plurality of wipers, a group of contact sets accessible to each of said wipers through which contacts said distributor has access to said finders, means responsive to the initiation of a call on one of said lines for operating one of said finders to establish a connection with said line, means for making each of said finders busy to said distributor, means responsive to the establishment of said connection for stepping said wipers over said contact sets in search of an idle finder, means operated after the wipers have been stepped off the last contact set of the group for releasing them and returning them to the first contact set, and means for stopping said wipers when an idle finder is found.

13. In a telephone system, a plurality of subscribers' lines divided into groups, two groups of finders having access to said lines, the first finder group having first and second choice access to the first and second line groups respectively and the second finder group having first and second choice access to the second and first line groups respectively, a distributor switch for each finder group normally operative to control the finders of that group to establish connections with the lines to which those finders have first choice access, means for removing one of said distributors from service, means then operated responsive to a call on one of said lines for operating said remaining distributor to select and operate a finder of the group having first choice access to said line to establish a connection to that line.

14. In a telephone system in which subscribers' lines are arranged in groups which are preferentially served by groups of finders each controlled by a distributor individual to that group, means for removing one of said distributors from service and for thereby giving the other distributor access to all finders, and means in said distributor responsive to the initiation of a call on a line for selecting and operating a finder which gives preference to the group containing that line to establish a connection with that line.

15. In a telephone system, a distributor switch having a connected set and a disconnected set of wipers, a group of finders accessible through said connected set of wipers, a second group of finders accessible through said disconnected set of wipers, means in said distributor for operating the normally-connected set of wipers to preselect an idle finder in the first group, a key, means responsive to the operation of said key for preparing said normally-disconnected set of wipers for connection, and means responsive to the initiation of a call on one of said lines for com-

pleting the prepared connection and for operating said distributor to select another idle finder through said normally-disconnected wipers and to start such other finder to find the calling line.

16. In a telephone system, a group of lines, a group of finders having access to said lines, a distributor having access to said finders, means responsive to a call on one of said lines for operating said distributor to start a preselected finder in search of the calling line, means in said distributor responsive to the finding of said line for operating said distributor to preselect another idle finder, means for changing said distributor from a preselecting distributor to a post-selecting distributor whereby said distributor searches for a third idle one of said finders responsive to the initiation of a call on a second one of said lines to start such third finder to find the second calling line.

17. In a telephone system, a group of subscribers' lines, finders having access to said lines, a distributor having access to said finders, means for operating said distributor to preselect an idle one of said finders, and means responsive to the initiation of a call on one of said lines for operating said distributor to select another idle finder and to start such other finder to find the calling line.

18. In a telephone system, a group of subscribers' lines, finders having access to said lines, a distributor having access to said finders, means for operating said distributor to preselect an idle one of said finders, and means responsive to the initiation of a call on one of said lines for operating said distributor from connection with said preselected finder into connection with another idle one of said finders and to start said other finder to find the calling line.

In witness whereof, I hereunto subscribe my name this 13th day of September, A. D. 1927.

NORMAN H. SAUNDERS.