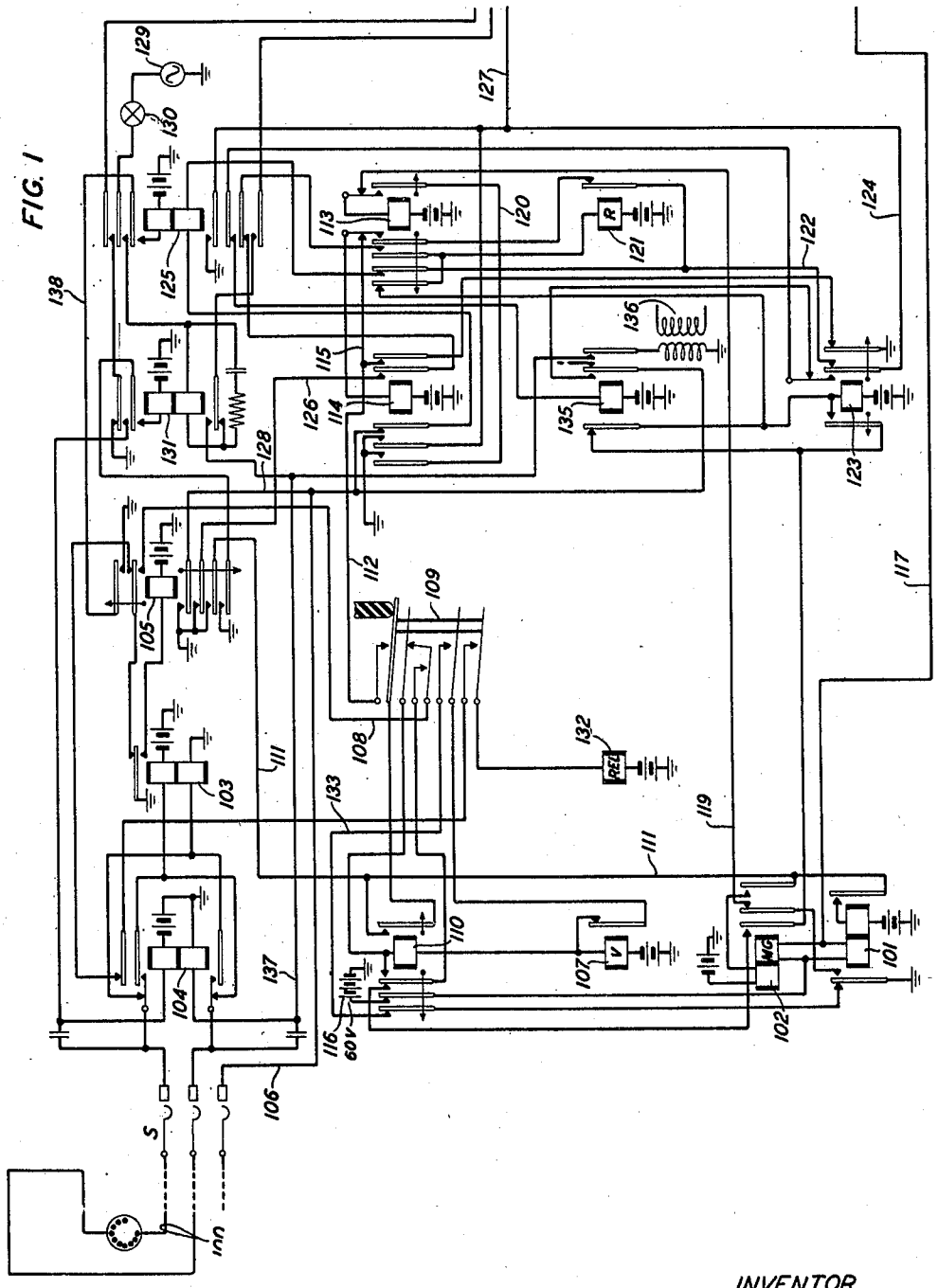
Feb. 15, 1944. F. A. HUBBARD 2,341,919

TELEPHONE SYSTEM

Filed July 25, 1942 3 Sheets-Sheet 1

FIG. 1



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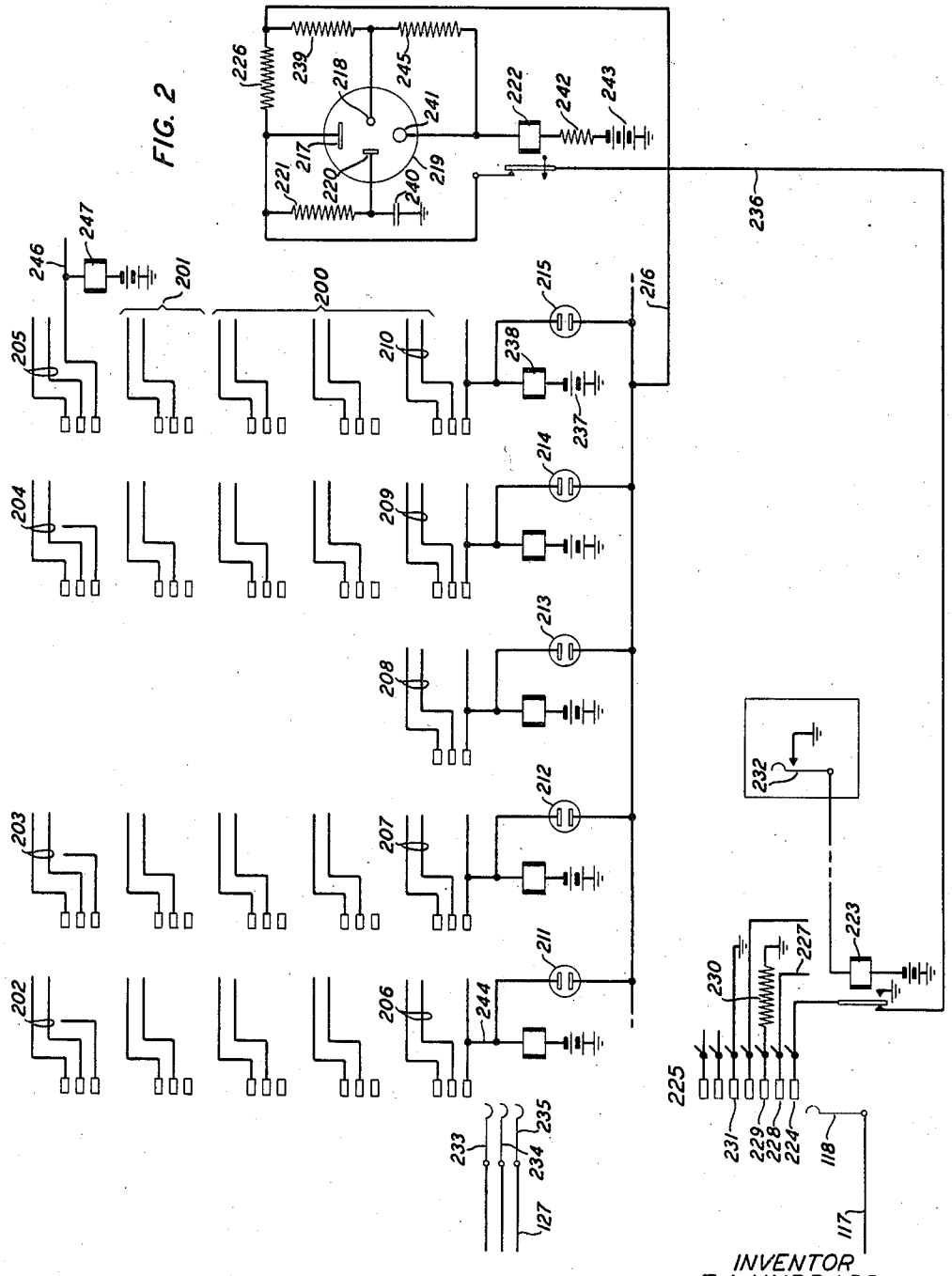
TELEPHONE SYSTEM

Filed July 25, 1942 3 Sheets-Sheet 2

FIG. 2



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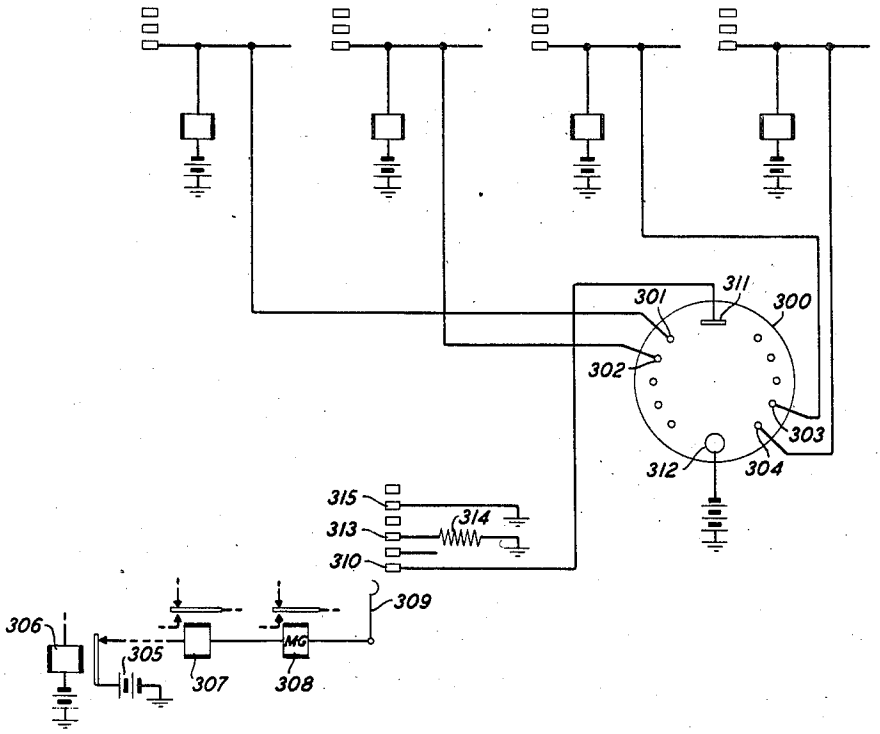
Filed July 25, 1942 3 Sheets-Sheet 3

FIG. 3



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2,341,919

UNITED STATES PATENT OFFICE

2,341,919

TELEPHONE SYSTEM

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Application July 25, 1942, Serial No. 452,303

8 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to systems in which automatic switches are used to establish connections.

The objects are to improve the testing and selecting operations of automatic switches; to decrease the time and to minimize the amount of movement required of a switch to test a group of lines, trunks, or other circuits; to make possible a wider latitude in the disposition of circuits in the switches having access to them; to make possible the temporary conversion of circuits from one use to another; and in other respects to effect improvements in the functions and operation of automatic switches.

In accordance with the present invention the foregoing objects and advantages may be realized by means of a switching system in which a connector switch has access through its levels of terminals to individual subscribers' lines and to groups of branch exchange trunks or other equivalent lines or trunks, said groups in some cases occupying two or more successive levels of terminals, and in which a test is made, following the completion of the directive primary movement of the switch to select a desired one of said levels, to determine whether the selected level is occupied by individual lines or by a group of equivalent lines, and in case the level is occupied by equivalent lines to determine the busy or idle condition thereof. More specifically, the connector switch is provided with means enabling it to perform its secondary movement automatically to hunt for an idle equivalent circuit in the selected level provided the level test discloses that the selected level is occupied by equivalent rather than individual subscribers' lines; the switch is provided with means for continuing its primary movement automatically to select the next succeeding level of terminals and to repeat the level test thereof provided the first selected level contains equivalent lines and all are busy; it is provided with means for continuing this level test of the equivalent lines of an exchange group until the last level occupied by the group is reached, at which time the switch proceeds to hunt automatically without performing the preliminary level test; and the switch is arranged to omit the level busy test in case the selected level is occupied by individual lines and to prepare itself to respond directively to select and test a desired one of the individual lines in such level. The level test of the equivalent exchange lines is made by means of a series of discharge tubes individual respectively to the lines in the level and a common discharge tube which cooperates with testing relays in the connector switch to detect a level containing individual subscribers' lines, to detect a level containing equivalent exchange lines, and to determine whether a level of equivalent exchange lines contains one or more idle lines.

A feature of the invention is a connector switch of the character discussed above in which the level test of the equivalent lines is performed by means of a single common discharge tube containing a plurality of control electrodes which are individual respectively to the lines in the level.

Another feature of the invention is a system of this character provided with means for temporarily converting any one of the levels of equivalent lines to a level of individual lines in order that an incoming call may select any desired one of these lines directively.

These and other features of the invention will be discussed more fully in the following detailed specification.

Figs. 1 and 2 of the drawings accompanying the specification disclose a portion of a telephone system incorporating features of the invention.

Fig. 1 illustrates a subscriber's line and a selective switch in conventional form and also shows in detail the controlling relays, magnets and other parts of a final selector or connector switch;

Fig. 2 shows the brushes and the terminal bank together with certain testing and controlling equipment of the connector switch; and

Fig. 3 shows a modification of the trunk group testing equipment.

The invention in its broadest aspect is not limited in its application to any particular type of automatic switch nor to any particular type of telephone or other communication system. For convenience of illustration, however, it is shown in its application to a final or connector switch of the level hunting type commonly used in automatic telephone systems of the step-by-step type. A connector switch of this general type is shown in detail in the patent to Hovland, No. 1,747,169, of February 18, 1930.

In the drawings the connector switch is accessible from calling lines, such as the subscriber's line 100, over preceding switches including the selector S, and has access to individual subscribers' lines and also to groups of equivalent lines or trunks, such as those extending to private branch exchanges.

If a switch structure of the well-known step-by-step type is assumed, the terminal bank shown in Fig. 2 consists of ten rows or levels

of terminals, each level including ten sets of terminals. Where an exchange group of equivalent lines includes more than ten circuits the group is assigned to as many successive and consecutive levels of terminals as may be required to serve the group. For example, if an exchange group 200 contains thirty lines, they may be allocated as shown to the first three levels of terminals in the terminal bank. Another group of exchange lines 201 including only ten lines may be allocated as shown to a single level of terminals. Other levels in the switch may be allotted to individual subscribers' lines, such as the fifth level, which contains the subscribers' lines 202, 203, 204, 205. Still other levels may include both individual lines and exchange lines provided the exchange line group contains less than ten lines.

The brush operating and controlling mechanism of the connector switch is designed to respond to a first directive series of impulses to select a desired level of exchange lines and then to hunt automatically in the level for an idle one of these lines or to step automatically from the level first selected to the next succeeding level of exchange lines provided all lines in the selected level are busy, to hunt in the second level provided this level contains an idle line or to step again to the next succeeding level if all lines in the second level are in fact busy, and to continue this level selecting and testing procedure, without actually entering a level in which all lines are known to be busy, until the last level of lines of the group has been reached, at which time the switch proceeds to hunt automatically and to test the exchange lines in such last level. In such a case, that is, where the first series of impulses transmitted to the switch operates it to select an exchange group, the second and final series of impulses which are usually transmitted to a connector switch are of no utility and are therefore absorbed without performing any useful function. The switch is also designed to respond to a first series of impulses transmitted thereto to step its brushes in the primary movement to select a level of terminals containing individual subscribers' lines and then to respond directively to the final series of impulses to step the brushes of the switch into the selected level to the terminals of the desired subscriber's line.

The collective test of all of the exchange lines in a level is performed after the switch has completed its primary directive movement to select the level, and without requiring the switch to participate in its secondary movement, by special testing means associated with the switch and with the exchange lines in the level. To this end each exchange line in all levels of a group, except the last level, is provided with a two-element discharge tube for testing the busy or idle condition of the line. These discharge tubes are connected to the sleeve or test conductors, and all of the tubes pertaining to a given level are connected in multiple and thence to a common discharge tube which serves to indicate the condition of any one of the lines in that level. For instance, the exchange lines 206, 207, 208, 209, 210 in the first level are provided respectively with tubes 211, 212, 213, 214 and 215 which are connected in multiple over conductor 216 to the main anode 217 and to the starting cathode 218 of the common test tube 219. The starting anode 220 of the common tube 219 is connected through resistor 221 and over the normal contacts of relays 222 and 223 to the first segment 224 of the vertical commutator 225, this segment being individual to the level of terminals in the switch occupied by the exchange lines 206, 207, 208, etc.

If an exchange line is idle, no ground potential is applied to the sleeve conductor, and the full negative potential of the battery associated with the cut-off relay is applied to one electrode of the associated individual tube. When, therefore, positive potential is applied by the switch over the commutator segment 224, as will be explained more fully hereinafter, and thence through the resistor 226 to the other electrode of the individual tube, the voltage across the tube is sufficient to ionize the same. Upon the ionization of any one of the individual tubes 211, 212, 213, etc., in this manner the resultant voltage applied across the control gap 218—220 of the common tube 219 is sufficient to ionize the common tube, with the result that a test relay 101 in the connector switch is operated to indicate the fact that the level contains at least one idle line. However, if an exchange line is busy, it has ground potential applied to the test conductor which prevents the associated individual tube from operating. If all of the exchange lines in the level are busy, none of the individual tubes operates, and the result is that the voltage applied across the control gap 218—220 of the tube 219 is insufficient to operate this tube. Therefore, the test relay 101 in the connector switch fails to operate, indicating that all lines in the selected level are busy. In like manner the second level of exchange lines of the group 200 is provided with a series of individual test utbes and a common tube similar to the tube 219 which is connected over conductor 227 to the second segment 228 of the commutator 225, and these tubes serve in the same manner to perform the collective test of the lines in the second level. Inasmuch, however, as the third level of lines is the last level in the group and is not provided with means for making the collective test, the corresponding commutator segment 229 is connected through a resistor 230 to ground. If the switch is advanced to this last level of the group, the test circuit extending through the resistor 230 permits the test relay 101 to operate, indicating that the switch should proceed automatically to hunt in the selected level for an idle circuit.

The segments of the commutator 225 representing levels in which individual lines appear are connected directly to ground. For example, segment 231 corresponding to the fifth level of terminals in which individual lines 202, 203, etc., appear is connected to ground. When, therefore, the switch is advanced to this level in its primary movement, the test circuit closed through the segment 231 permits the operation of test relay 101 and also the operation of a marginal test relay 102. The operation of relays 101 and 102 indicates that a level of individual lines has been selected, whereupon the switch is prepared to respond directively to the next series of impulses and to step into the level to seize the desired individual lines therein.

It is sometimes desirable at night to convert a level of private branch exchange trunks so that any one of them can be seized directively in the central office the same as an individual subscriber's line. To this end a key or other switch 232 is provided at the private branch exchange and while in its operated condition causes the ener-

gization of relay 223 in the central office. The relay 223 disconnects the commutator segment 224 from the common test tube 219 and connects it directly to ground. In this way the segment 224 has the same appearance to the testing circuit of the connector as a segment representing a level of individual subscribers' lines. During the night, therefore, the calling party can operate the connector switch in the central office by a tens digit and a units digit to select the first level of terminals and to step into the level in accordance with the units digit to seize a particular one of the private branch exchange lines for the purpose of calling a desired party in the private branch exchange.

A description will now be given of the operation of the system. Assume first that the subscriber of line 100 wishes to extend a connection to the private branch exchange served by the exchange group 200, occupying the first, second, and third levels of terminals in the connector switch. The calling subscriber initiates the call and dials the preliminary digits in the usual manner, causing his line to be extended over the selector switch S to the level hunting connector switch. Thereupon a circuit is closed from battery through the upper winding of impulse relay 103, normal contacts of relay 104 thence over the extended connection through the loop of subscriber's line 100 and returning over the opposite side of the connection, normal contacts of relay 104 through the lower winding of relay 103 to ground. Relay 103 operates and closes an obvious operating circuit for slow-release relay 105. Relay 105 applies holding ground potential to the sleeve conductor 106 and prepares the pulsing circuit.

When the calling subscriber transmits the next or tens series of impulses, relay 103 follows these impulses and closes a pulsing circuit for the vertical or primary stepping magnet 107. On the first impulse the circuit may be traced from ground through the back contact of relay 103, front contact of relay 105, conductor 108, closed contacts of the off-normal spring combination 109, winding of slow-release relay 110, winding of stepping magnet 107 to battery. Magnet 107 steps the brushes 233, 234, 235 vertically to a position opposite the first level of the terminals and brush 118 to segment 224, the brush shaft releases the spring combination 109, permitting the springs to assume their alternate positions, and relay 110, which is slow to release, operates and shifts the pulsing circuit so that it now extends over conductor 108, closed contact springs 109, armature and front contact and winding of relay 110 to the winding of magnet 107. Relay 110 in operating closes a circuit from ground through the contact of relay 105, conductor 111, front contact of relay 110, springs 109, conductor 112, normal contacts of relay 113, winding of relay 114 to battery. Relay 114 operates in this circuit and locks in a circuit from battery through its winding, normal contacts of relay 113, conductor 115, front contacts of relay 114 to ground at the front contact of relay 123.

Since the exchange group 200 is desired, the tens digit identifying this group is "1". Therefore, the switch takes a single step as described, the subscriber prepares to send the units digit, and relay 110 releases after a brief interval following the reoperation of the pulse relay 103. Before the next or units series of impulses arrive, however, a collective test is made of the lines 206, 207, etc., in the first level of terminals which has been selected by the positioning of the brushes 233, 234, and 235. This test is performed by the relays 101 and 102 and, as hereinbefore explained, by the individual test tubes 211, 212, 213, etc., and the common test tube 219 associated with the selected level. The test circuit is closed by the release of relay 110 and may be traced from the positive pole of battery 116, back contacts of relay 110 through the windings of relays 101 and 102 in parallel, conductor 117, commutator brush 118, segment 224, on which the brush 118 is now resting, normal contacts of relay 223, conductor 236, normal contacts of relay 222, resistor 226 to conductor 216. If any one of the lines in the first level is idle, its sleeve conductor is free from ground potential, and the negative battery potential is applied through the winding of the associated cut-off relay to the associated discharge tube. For example, if line 210 is idle, the negative potential of battery 237 is applied through the winding of cut-off relay 238 to the upper electrode of the discharge tube 215. When, therefore, the positive pole of test battery 116 is applied to the lower electrode of tube 215, the tube ionizes, and the potential drop resulting from current flow in resistor 226 is applied through the resistor 239 to the starting cathode 218 of the common tube 219. After an interval, determined by the value of resistor 221 and condenser 240, following the application of the positive potential of battery 116 to conductor 235, the full value of this positive potential is applied to the starting anode 220, and the starting gap 220—218 is ionized. As soon as the starting gap of tube 219 ionizes, a main discharge circuit is closed from conductor 236 through the main anode 217, main cathode 241, winding of relay 222, resistor 242 to the negative pole of battery 243. Relays 101 and 222 operate in this circuit, but relay 102 being marginal does not receive sufficient current to attract its armatures. Relay 101 locks in a circuit closed from battery through its winding and contact to the grounded conductor 111. Relay 222 when fully operated removes the test potential from conductor 216 and permits the tube 219 to extinguish. Relay 222 is made slow to release and retains its armature attracted to hold the test tube 219 disconnected from conductor 236 long enough to permit the connector switch to complete its hunting operation in the selected level. The reason for holding the tube 219 disconnected is to prevent another connector seeking the same level of terminals from hunting therein while the first connector is seeking an idle line in the level.

When relay 101 operates, a circuit is closed from battery through the winding of slow-release relay 113, normal contacts of relay 113, conductor 119, normal contacts of relay 102 to ground at the front contacts of relay 101. Relay 113 operates and locks in a circuit from battery through its winding and front contacts, conductor 120 to ground at the front contacts of relay 114. Relay 113 opens the original holding circuit of relay 114 but before so doing closes a new holding circuit traceable from battery through the winding of relay 114, closed contacts of relay 113, normal contacts of the rotary stepping magnet 121, conductotr 122, normal contacts of relay 123, conductor 124 to ground at the front contact of relay 114. The switch is now prepared to perform its secondary or rotary stepping movement automatically in the selected level to hunt for an idle exchange line.

The stepping circuit for the rotary magnet 121 may be traced from battery through the winding of said magnet, closed contacts of relay 113, normal contacts of relay 125, closed contacts of relay 114, conductor 126 to ground at the front contact of relay 105. Magnet 121 steps the brushes 133, 134 and 135 on to the first set of terminals in which the line 206 appears. Near the end of its stroke the magnet 121 opens its contacts, and relay 114 releases. Relay 114 in turn opens the circuit of the magnet, and it restores and prepares for the next step. If the line 206 is busy, a ground potential exists on the sleeve conductor 244, and relay 114 immediately reoperates in a circuit from battery through the winding of said relay, front contacts of relay 113, normal contacts of magnet 121, conductor 122, normal contacts of relay 123, conductors 124 and 127, brush 235 to ground on the test conductor 244. Relay 114 reoperates the magnet 121, and the brushes are stepped to the next set of terminals, whereupon relay 114 releases and in turn releases the magnet. This process continues as long as the test brush 235 encounters busy terminals. During the hunting movement relay 113 retains its armatures operated by reason of its slow-release characteristic. When the switch reaches the first idle exchange line, such as the line 210, the absence of ground potential on the sleeve conductor prevents the reoperation of the test relay 114. After an interval, therefore, the slow-release relay 113 releases its armatures and opens the circuit of the stepping magnet 121.

When relay 113 releases as above described following the seizure of the idle exchange line 210, a circuit is closed from ground through the contacts of relay 105, conductor 128, normal contacts of relay 114, lower winding of cut-through relay 125, normal contacts of relay 113, conductor 122, normal contacts of relay 123, conductors 124 and 127, brush 235 thence through the winding of cut-off relay 238 to battery. Relay 125 operates and locks in a circuit from battery through its upper winding and front contact to ground at the front contact of holding relay 105. Relay 125 extends the talking conductors through to the brushes 233 and 234 of the connector switch and prepares for the application of ringing current to the selected exchange line 210.

The ringing circuit for applying ringing current may be traced from the ringing generator 129, interrupter 130, contacts of relay 125 to the lower winding of ringing trip relay 131, normal contacts of said relay, front contacts of relay 125, brush 234 thence over the line 210 and returning over the other side of the line to brush 233, operated contacts of relay 125, normal contacts of relay 131 to ground. Relay 131 operates, serves to trip the ringing operation in the usual manner and when operated locks over its upper winding and contact to ground through the contact of hold relay 105. Relay 131 also completes the tip and ring conductors of the talking circuit. When the called party answers, the back bridge relay 104 operates in the well-known manner and reverses the direction of current flow over the connection back toward the calling line.

At the end of the conversation the calling and called parties disconnect, and relays 103 and 104 release. A circuit is now closed from battery through the winding of release magnet 132, vertical off-normal springs 109, normal contacts of relay 104, normal contacts of relays 105 and 103 to ground. Magnet 132 operates and restores the connector switch to its normal position, and the other switches in the connection are released. The restoration of the connector switch causes the release of magnet 132 by opening the off-normal contacts 109, and the release of hold relay 105 opens the holding circuits of relays 101, 125 and 131.

Assume now that all lines 206, 207, 208, etc., in the first level of the group 200 are busy at the time the connector switch positions its brushes opposite this level in response to the tens digit. All lines being busy, a ground potential exists on each of the sleeve conductors, and no one of the individual tubes 211, 212, 213, etc., operates when battery 116 is connected over the test conductors 117 and 236 to these tubes. Since no one of the individual tubes operates, the potential on electrodes 218 and 220 is the same, and the starting gap 218—220 fails to ionize. The tube 219, therefore, does not discharge its main gap, and neither of the test relays 101 and 102 nor the relay 222 is able to operate, the values of resistors 226, 239 and 245 being too high to permit operating current to flow.

Since relay 110 released following the completion of the primary movement of the switch and relay 101 fails to operate in the test circuit closed by relay 110, a circuit is prepared for the vertical magnet 107 in order that it may advance the brushes to the next level of terminals. The circuit for magnet 107 may be traced from battery through its winding and normal contacts, off-normal contacts 109, conductor 133, normal contacts of relays 110 and 101 to ground. Magnet 107 steps the brushes 233, 234, 235 to the next or second level of the terminals, interrupts its own circuit and deenergizes. As soon as the commutator brush 118 engages the segments 228 representing the second level of terminals, the test circuit is completed over conductor 227 to a common tube, similar to tube 219, for the second level and to associated individual tubes similar to tubes 211, 212, etc. If this second level contains an idle line, relay 101 operates immediately and opens the circuit of magnet 107 to prevent it from stepping the switch to the next level. The switch then proceeds as above described to hunt automatically in the second level for an idle line therein.

If on the other hand all lines in the second level are busy, this fact is determined by the collective test, and the magnet 107 operates again to step the brushes to the third and last level of the group 200. When the commutator brush 118 reaches the segment 229 representing the third level, it encounters ground potential through the resistor 230. This closed test circuit permits the flow of sufficient current to operate the test relay 101 but insufficient to cause the operation of the marginal relay 102. Relay 101 locks through its right winding and opens the stepping circuit of magnet 107 and prepares the circuits of the switch in the manner above described for the secondary or hunting movement in the level of terminals to determine whether any one of the lines in the level is idle.

Next it will be assumed that the subscriber of line 100 wishes to converse with the subscriber of the individual line 205. Since the line 205 occurs in the fifth level of terminals, the calling subscriber dials a number having the tens digit "5" and a units digit corresponding to the position of line 205 in the level. At the completion of the tens digit the brushes 233, 234 and 235 assume their position opposite the fifth level of terminals,

and the commutator brush 118 engages the corresponding segment 231. It will be seen that the segment 231 is connected directly to ground; therefore both relays 101 and 102 operate in the test circuit when slow-release relay 110 releases following the completion of the tens digit. Both relays 101 and 102 lock to the grounded conductor 111. Relay 101 opens the automatic stepping circuit for the vertical magnet 107, and test relay 102 prepares a circuit for operating the rotary magnet 121 in response to the units series of impulses. Although relay 114 operates as above described, relay 113 fails to operate in this case because its circuit is opened at the contacts of relay 102 before it has time to attract its armature to close its locking circuit.

Upon each release of the impulse relay 103 in response to the impulses of the units digit the stepping circuit is closed from ground through the back contact of relay 103, front contact of relay 105, conductor 108, off-normal springs 109, inner left back contact of relay 110, front contact of relay 102, normal contacts of test relay 135 thence in parallel through the winding of slow-release relay 123 and through the back contact of relay 113 and the winding of the rotary stepping magnet 121 to battery. Relay 123 operates on the first impulse, closes the stepping circuit through its left front contact independently of the test relay 135, opens the locking circuit of relay 114, permitting the latter to release, and maintains its armature attracted during the impulse series. At the end of the series the brushes 233, 234, 235 come to rest on the terminals of the desired line 205, and a test circuit is closed to determine the condition of said line. The test circuit may be traced from battery through the winding of test relay 135, normal contacts of relay 125, front contacts of relay 123, conductors 124 and 127, brush 235 to the sleeve conductor 246 of line 205.

If the line 205 is busy, ground potential exists on the sleeve conductor 246, and relay 135 operates in the circuit above traced. A brief interval following the completion of the rotary movement of the switch and the operation of relay 135, slow-release relay 123 releases and in so doing opens the original operating circuit for test relay 135. Relay 135, however, locks in a circuit from battery through its winding, normal contacts of relay 125, normal continuity contacts of relay 123, front contact of relay 135 to the grounded conductor 128. Relay 135 completes a circuit from the tone source 136 through the front contact of said relay to the talking conductor 137. Current from this source flows over the subscriber's line and produces a busy tone in his receiver.

On the other hand if the called line 205 is idle when seized, no ground potential exists on the sleeve conductor 246, and test relay 135 fails to operate. When thereafter relay 123 releases its armatures, a circuit is closed from battery through the winding of the cut-off relay 247 thence over the sleeve conductor 246, brush 235, conductors 127 and 124, back contacts of relay 123, conductor 122, normal contacts of relay 113, lower winding of relay 125, normal contacts of relay 114 to the grounded conductor 128. Relay 125 energizes and before opening the circuit just traced closes a locking circuit for itself traceable from battery through the upper winding and front contact of the relay, conductor 138 to ground at the contacts of the hold relay 105. Ringing current is now applied to the called line in the manner above described, the tripping relay 131 is operated to disconnect the ringing current when the called party answers, and relay 104 operates as a supervisory relay to reverse the current back over the calling loop.

When the subscribers replace their receivers at the end of conversation, relays 103, 104 and 105 release, and a release circuit for the switch is closed from battery through release magnet 132, springs 109, normal contacts of relays 104, 105 and 103 to ground. Magnet 132 restores the switch to its normal position, and all operated relays are released.

Assume now that it is desired to convert the first level of the group of private branch exchange lines 200 to individual lines in order that a calling party may select a particular one of these lines which has been previously designated for calling the private branch exchange during the night. To effect this conversation, the operator in the private branch exchange closes the key 232 thereby operating the relay 223 in the central office. Relay 223 disconnects the testing tube 219 from the commutator segment 224 and connects said segment directly to ground. If, therefore, a call is made causing the selection of the first level of lines, test relays 101 and 102 operate as above described, and the switch prepares to receive the next or units series of impulses and to step in response thereto into the level to seize the corresponding line leading to the private branch exchange. Thereupon ringing current is applied to the seized line to signal the telephone which has been connected to the line by the private branch exchange operator. Following conversation release takes place in the manner already described.

In the modification of the collective testing arrangement shown in Fig. 3 the individual tubes 211, 212 and 213 and the common tube 219 for a single level of lines are replaced by a single discharge tube 300. Tube 300 is provided with a series of starting cathodes 301, 302, 303, 304 which are connected individually to the sleeve conductors of the exchange lines in the level of the connector switch. If any one of the lines in the level is idle at the time the connector positions its brushes opposite the level, negative battery potential through the winding of the corresponding cut-off relay is applied to the individual starting cathode, and positive potential is applied from battery 305 through the contacts of relay 306, windings of the test relays 307 and 308, commutator brush 309, segment 310 to the main anode 311 of the tube. The voltage thus produced between the starting cathode and the main anode is sufficient to start the ionization of the tube, whereupon the main discharge gap, including anode 311 and main cathode 312, discharges, and sufficient current flows in the test circuit to operate relay 307. Relay 308 is marginal and does not operate. With relay 307 operated and relay 308 released, the connector switch automatically hunts in the level for the idle line.

If all lines in the level are busy, however, ground potential is applied to the corresponding starting cathode, and the tube 300 does not discharge when the test is made. Under this condition both relays 307 and 308 remain unoperated, and the connector switch is caused to take another step to position its brushes opposite the next level of lines of the group.

If all levels of the group preceding the last level are busy, the brush 309 is finally stepped to the

segment 313 corresponding to the last level of the group, and the test circuit is closed through the resistor 314. Relay 307 operates in this circuit and relay 308 remains unoperated, and the connector automatically hunts in the level for an idle line.

When the connector is driven to a level of terminals containing individual lines, such as the level corresponding to commutator segment 315, a direct ground potential is encountered, and both relays 307 and 308 operate. Under this condition the connector is prepared to respond directively to the units series of impulses to seize a desired line in the level.

What is claimed is:

1. The combination in a telephone system having an automatic selecting switch arranged to participate in a primary selecting movement and in a secondary selecting movement of a plurality of rows of terminals for said switch, a group of equivalent lines occupying one of said rows, individual lines occupying another of said rows, means for operating said switch directively in its primary movement to select any desired row of said terminals, means effective upon completion of said directive primary movement for making a test of the selected row to determine whether it contains equivalent lines or individual lines and if equivalent lines to determine their busy or idle condition, means effective if the selected row contains equivalent lines and is found to have an idle one therein for causing said switch to operate automatically in its secondary movement to test said equivalent lines individually, and means effective if the selected row contains individual lines for causing said switch to operate directly in its secondary movement to select a desired one of said individual lines.

2. The combination in a telephone system having an automatic selecting switch arranged to participate in primary and secondary selecting movements of a plurality of rows of terminals for said switch, a plurality of equivalent lines appearing in subgroups in successive rows of terminals, individual lines occupying another of said rows, means for operating said switch directively in its primary movement to select any desired row of said terminals, means for testing each row of terminals to determine whether it contains a subgroup of equivalent lines in which one is idle or all are busy or whether it contains individual lines, means effective if the selected row contains equivalent lines and has an idle one therein for causing the switch to operate automatically in its secondary movement to test the equivalent lines in the selected subgroup, means effective if the selected subgroup is busy for causing the switch to continue its primary movement automatically to select and test the subgroup of equivalent lines in the next row, and means effective if the row selected by said directive primary movement contains individual lines for causing said switch to operate directively in its secondary movement to select a desired one of said individual lines.

3. The combination in a selecting system of a selective switch having levels of terminals and arranged to operate in a primary movement to select said levels and in a secondary movement to select terminals in a level, a group of trunks occupying a plurality of levels of terminals, individual lines occupying other levels of terminals, means for operating said switch directively in its primary movement to select a desired level of terminals, means effective at the end of said primary movement for making a test of the selected level to determine if it contains trunks or individual lines, means effective if the selected level contains trunks for making a collective test of all trunks in the level and for causing the switch to hunt automatically over said trunks in its secondary movement if the level contains an idle trunk, means effective if the trunks of the selected level are all busy for moving the switch automatically to succeeding levels of said group where the collective test is repeated until the switch reaches the last level of the trunk group, means effective when said last level is reached for causing the switch to omit said collective test and to hunt automatically in the level for an idle trunk, and means effective if the level selected by the primary movement of the switch contains individual lines for causing said switch to operate directly in its secondary movement to select a desired one of said individual lines.

4. The combination in a selecting system of an automatic switch having levels of terminals and arranged to operate in a primary movement to select a level and in a secondary movement to select terminals in the level, of groups of trunks occupying certain levels of said terminals, discharge tubes individual respectively to said trunks for testing the condition thereof, means for operating said switch directively in its primary movement to select a desired level of terminals in which one of said groups of trunks appears, and means controlled by said discharge tubes for making a collective test of all of the trunks in the selected level to determine whether said level contains an idle trunk.

5. The combination in a selecting system of an automatic switch having levels of terminals and arranged to operate in a primary movement to select a level and in a secondary movement to select terminals in the level, of a group of trunks occupying two or more successive levels of said terminals, discharge tubes, one for each of the trunks in said group, for testing the condition thereof, means for operating said switch directively in its primary movement to select the first level of terminals in which said group of trunks appears, means controlled by said discharge tubes and effective at the end of said primary movement for making a collective test of the trunks in the selected level to determine whether any one of them is idle, means effective if the collective test indicates that all of the trunks in the selected level are busy for causing the switch to advance in its primary movement to the next level of terminals containing trunks of said group, means to repeat the collective test, and means effective if the collective test indicates an idle trunk in a selected level for causing the switch to operate automatically in its secondary movement to hunt for an idle trunk in such level.

6. The combination in a selecting system of an automatic switch having levels of terminals and arranged to operate in a primary movement to select a level and in a secondary movement to select terminals in the level, groups of trunks occupying certain levels of said terminals, discharge tubes individual respectively to said trunks for testing the condition thereof, common discharge tubes, one for each level of said trunks, each of said common tubes cooperating with the individual tubes of the corresponding level, means for operating said switch directively in its primary movement to select a desired level of terminals in which one of said groups of trunks appears, and a test circuit including the common

discharge tube for the selected level of terminals for making a collective test of the trunks in said level to determine the busy or idle condition thereof.

7. The combination in a selecting system of an automatic switch having levels of terminals and arranged to operate in a primary movement to select a level and in a secondary movement to select terminals in the level, groups of trunks occupying certain levels of said terminals, a common discharge tube for each level of terminals occupied by one of said trunk groups, each of said common tubes having a plurality of control electrodes individual respectively to the trunks in the associated level, means for operating said switch in its primary movement to select any desired level of terminals having one of said groups of trunks appearing therein, and means including said common discharge tube and effective at the completion of the primary selecting movement for performing a collective test of the trunks in the selected level to determine the busy or idle condition thereof.

8. The combination in a selecting system of an automatic switch having levels of terminals and arranged to operate in a primary movement to select a level of terminals and in a secondary movement to select terminals in a level, groups of equivalent lines appearing in certain of said levels, individual lines appearing in other of said levels, means for operating said switch directively in its primary movement to select either a level of equivalent lines or a level of individual lines, test means for causeing said switch to operate automatically in its secondary movement to hunt over said terminals when the selected level contains equivalent lines, means effective when said switch is operated to select a level of individual lines in its primary movement for causing it to operate directively in its secondary movement to select one of the desired individual lines in said level, and means for altering the condition of said test means to convert any desired level of equivalent lines to individual lines.

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