Aug. 20, 1929. C. E. LOMAX 1,725,152

AUTOMATIC TELEPHONE SYSTEM

Original Filed June 14, 1924 3 Sheets-Sheet 1

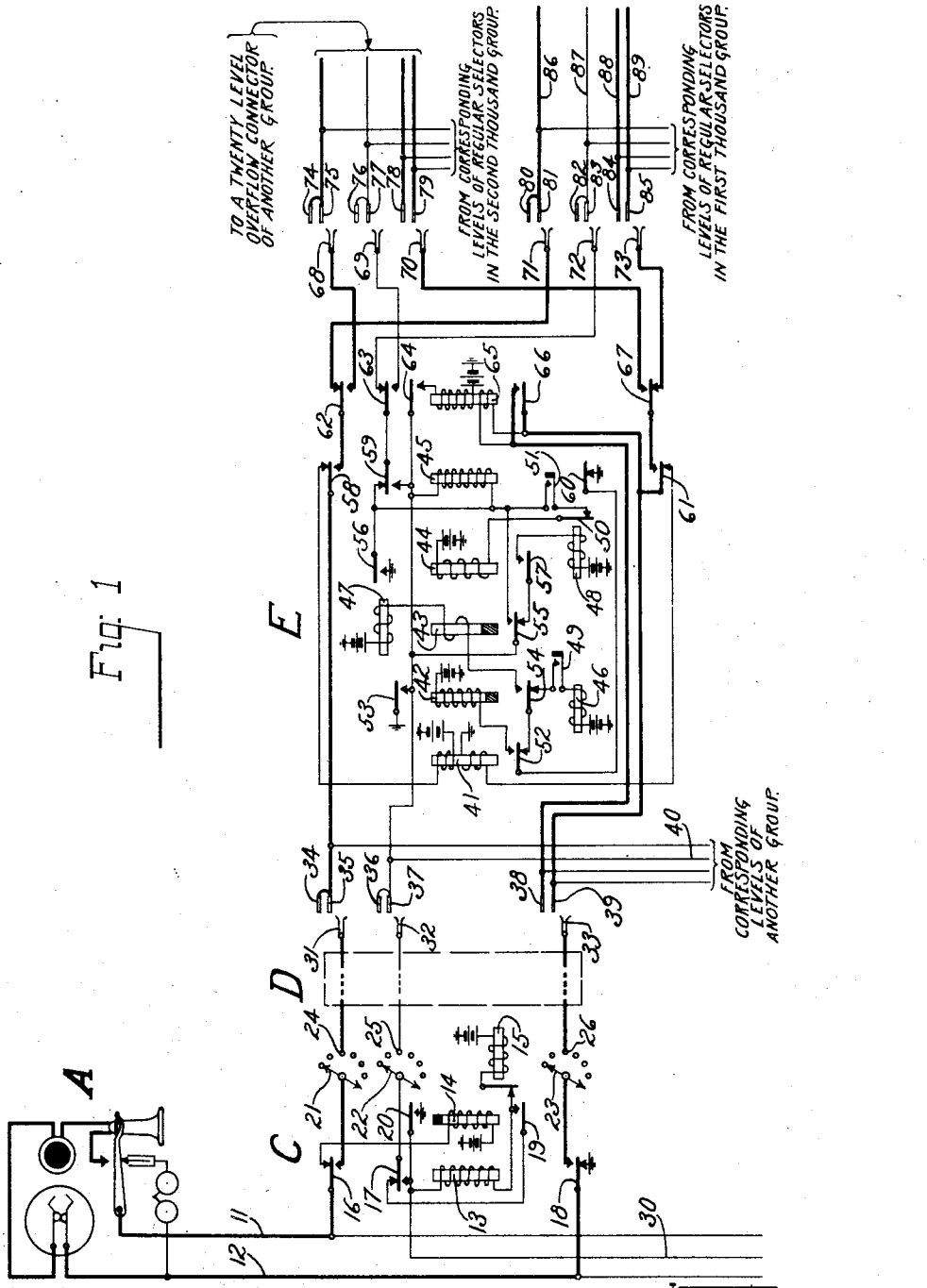

Fig. 1

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AUTOMATIC TELEPHONE SYSTEM

Original Filed June 14, 1924 3 Sheets-Sheet 2

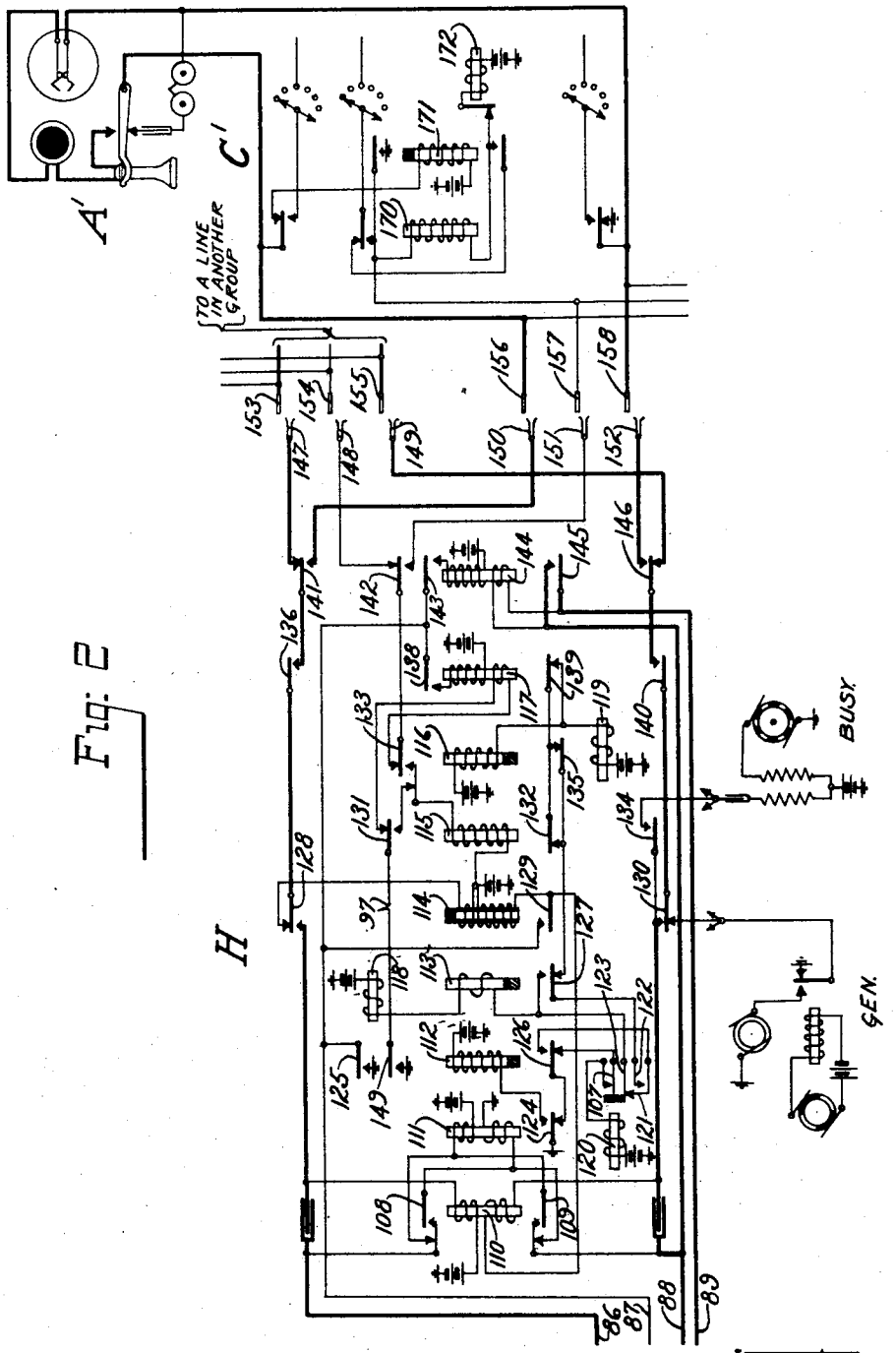

Fig. 2

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Original Filed June 14, 1924 3 Sheets-Sheet 3

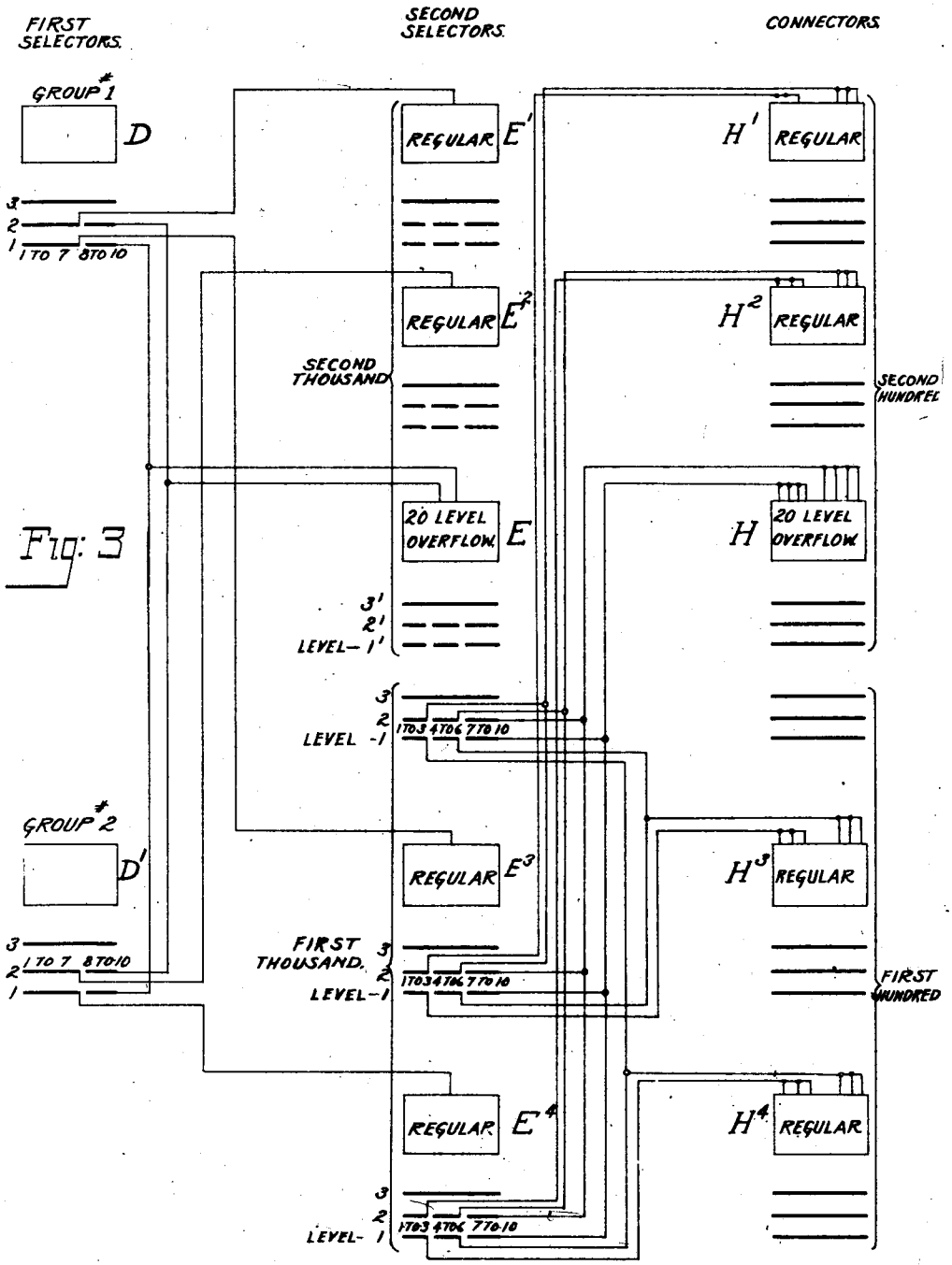

Fig. 3

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UNITED STATES PATENT OFFICE.

CLARENCE E. LOMAX, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC TELEPHONE SYSTEM.

Application filed June 14, 1924, Serial No. 719,964. Renewed May 5, 1928.

This invention relates in general to automatic telephone systems and its object, broadly stated, is to provide a new and improved arrangement of trunking using twenty level selectors and connectors as overflow switches.

More specifically, the object of the present invention is the provision of a trunking arrangement whereby a predetermined number of the last trunks of two of the same or different groups of switches are terminated in the same group of overflow switches. The overflow switches are of the twenty level type with two sets of wipers; the set to be used being determined by the level over which the call comes from the preceding switch.

The above pointed out object, together with others not specifically mentioned at this time, will be pointed out and explained more fully hereinafter, reference being had to the accompanying drawings, in which—

Fig. 1 is a circuit diagram of an automatic substation A, a rotary type line switch C, an overflow selector E of the Strowger type, and the outline of a regular selector D also of the Strowger type,

Fig. 2 is a circuit diagram of an overflow connector H of the Strowger type, a rotary type line switch C′, and an automatic substation A′,

While Fig. 3 is a schematic diagram of the trunking arrangement.

The general layout of the system will first be explained by means of the trunk diagram Fig. 3. This is a schematic drawing and is intended to show in simple form the trunking between groups of first selectors, second selectors and connectors in an automatic exchange involving the invention. For example, trunks 1–7, inclusive, of level 1 of group #1 of first selectors, such as D, extend to a group of seven regular second selectors, such as E^3, in the first thousand. Trunks 8–10, inclusive, of this same level and group extend to a group of three overflow second selectors, such as E. Trunks 1–7, inclusive, of level 2 of group #1 of first selectors extend to a group of seven regular second selectors, such as E′, in the second thousand; while trunks 8–10, inclusive, of this same level extend to the previously mentioned group of three overflow second selectors. The outgoing trunks of levels 1 and 2 in group #2 of first selectors, such as D′, are similarly extended to groups of second selectors, such as E^4, E^2, and E; trunks 8–10, inclusive, of both levels being multipled with corresponding trunks of levels 1 and 2 in group #1.

The overflow selectors, such as E, have two sets of ten level banks and wipers, the lower set being in the first thousand group of second selectors, while the upper set is in the second thousand group. The set of wipers and banks to be used depends upon the level over which the call comes from the first selectors, as will be more fully explained hereinafter in connection with the operation of the apparatus.

Trunks 1–3, inclusive, of level 1 of the lower set of banks of the group of overflow selectors E are multiplied with trunks 4–6, inclusive, of level 1 of the group of regular selectors E^4, and together with trunks 1–3, inclusive, of the latter level and group of switches extend to a group of six regular connectors, such as H^4 in the first hundred. Trunks 4–6, inclusive, of level 1 of the lower set of banks of the group of overflow selectors E are multipled with trunks 4–6, inclusive, of level 1 of the group of regular selectors E^3 and together with trunks 1–3, inclusive, of the latter level and group of switches extend to a group of six regular connectors, such as H^3. Trunks 7–10, inclusive, of level 1 of the lower set of banks of the group of overflow selectors E are multiplied with corresponding trunks of level 1 in the group of regular selectors E^3 and E^4 and extend to a group of four overflow connectors such as H.

The outgoing trunks of level 2 of the lower set of banks of the group of overflow selectors E, the group of regular selectors E^3 and the group regular selectors E^4 in the first thousand are similarly multipled and extended to groups of overflow connectors H and regular connectors H′ and H^2 in the second hundred.

The outgoing trunks of levels 1′ and 2′ of the upper set of banks of the group of overflow selectors E and the outgoing trunks of levels 1 and 2 of the groups of regular selectors E′ and E^2 in the second thousand are similarly multipled and extended to other groups (not shown) of overflow and regular connectors in the first and second hundreds.

The overflow connectors H have two sets of wipers, the same as overflow second selectors E, one set functioning with the lower ten levels which are in the first hundred group;

while the other set functions with the upper ten levels which are in the second hundred group. The set of wipers to be used depends upon the level over which the call comes from the second selectors, as already mentioned in connection with a call coming in to the twenty level overflow second selectors from first selectors. The wiring of only two levels has been indicated throughout, but it will be understood that the same general plan may be followed with levels 3 to 0, inclusive, or these other levels may be connected in the usual manner, omitting the overflow selectors, depending on the circumstances.

Having explained the trunking arrangement adopted, the apparatus shown in the circuit diagrams may now be briefly explained. Referring to Fig. 1, the substation A is an ordinary automatic telephone substation having the usual talking instrumentalities and a calling device for controlling the automatic switches. The line conductors terminate at the exchange in the individual line switch C, which is of the well known rotary type. The first selector D, represented by a rectangle, is mechanically of the usual and well known Strowger vertical and rotary type. The overflow second selector E is mechanically of the usual and well known Strowger vertical and rotary type except that it has two sets of wipers and a twenty level bank. Besides the usual relays and magnets this switch has an additional switching relay which allows the normally connected wipers to be used, or switches to the wipers not normally connected, depending upon which level of the first selector the call comes in over.

Referring now to Fig. 2, the overflow connector H is mechanically of the usual and well known Strowger vertical and rotary type, but also has two sets of wipers and a twenty level bank. Besides the usual relays and magnets, this switch has an additional switching relay which allows the normally connected wipers to be used or switches to the wipers not normally connected, depending upon which level of the second selector the call comes in over. The twenty level bank is divided into two units, one for each set of wipers, and each unit has lines extending to subscribers' stations in different hundred groups. A set of line contacts in the level of the lower bank, as shown, extend to the subscriber's station A′, which is similar to A, by way of rotary line switch C′, which is similar to C.

Having briefly explained the purpose of the invention and the apparatus involved in carrying it out, the operation of the equipment may now be explained more in detail. For the purpose it will be assumed that the subscriber at substation A desires to obtain connection with the subscriber at substation A′, accessible by way of the first selector D, twenty level overflow second selector E, and twenty level overflow connector H. In order to do this, the subscriber at substation A removes his receiver and then dials the directory number of the desired subscriber.

When the receiver is removed at substation A, line relay 14 energizes over line conductors 11 and 12. Upon energizing, line relay 14 places ground on private normal conductor 30 at armature 20, thereby making the calling line busy, and closes a circuit for switching relay 13 and stepping magnet 15 in series. As a further result of the energization of line relay 14, test wiper 22 is connected to the junction of switching relay 13 and stepping magnet 15 at armature 19.

In case the trunk upon which the wipers of the line switch are standing is idle, switching relay 13 energizes immediately. Assuming the trunk to be busy, however, switching relay 13 is short circuited by ground encountered on the busy test contact by test wiper 22 and does not energize, and the wipers are rotated step by step by the buzzer-like action of stepping magnet 15 which operates through test wiper 22. When an idle trunk is reached, which trunk, it will be assumed, is the one terminating in bank contacts 24–26, inclusive, switching relay 13, being no longer short circuited, energizes in series with stepping magnet 15. Stepping magnet 15, however, does not energize at this time on account of the high resistance of switching relay 13. Switching relay 13, upon energizing, opens a point in the test circuit and prepares the holding circuit at armature 17 and at armatures 16 and 18 disconnects line conductors 11 and 12 from the winding of line relay 14 and ground, and extends them by way of the wipers 21 and 23, bank contacts 24 and 26, to the upper and lower windings of the line relay (not shown) of the first selector D.

The line relay of the first selector D now energizes over the calling subscriber's loop and closes a circuit for the release relay (not shown). Upon energizing, the release relay places ground on the release trunk conductor, thereby closing the usual holding circuit for switching relay 13 of the line switch C before the slow-acting line relay 14 has had time to deenergize. When the calling subscriber operates his calling device in accordance with the first digit in the desired number, which in this case it will be assumed is 1, the first selector D raises its wipers 31, 32 and 33 opposite the first level of bank contacts and then selects an idle trunk in the usual well known manner. It will be further assumed that the trunk selected at this time is the one extending to the twenty level overflow selector E terminating in bank contacts numbered 35, 37 and 39.

The line relay 41 of the overflow selector E now energizes over the calling subscriber's loop and closes at armature 52 a circuit for release relay 42. Upon energizing, release

relay 42 opens a point in the circuit of release magnet 46 and prepares a circuit for vertical magnet 47 at armature 54, and at armature 53 places ground on the release trunk conductor, thereby closing the usual holding circuit for the preceding switches D and C.

When the calling subscriber operates his calling device in accordance with the second digit in the desired number, which it will be assumed is 1 in this case, the circuit of line relay 41 is opened a corresponding number of times, or once. The line relay 41 deenergizes in response to the interruption thereby produced and closes a circuit for vertical magnet 47 as follows: From ground by way of the resting contact of armature 60 and said armature, armature 52 and its resting contact, armature 54 and its working contact, relay 43, and vertical magnet 47 to grounded battery. By the operation of vertical magnet 47, the wipers 68–73, inclusive, are raised opposite the first level of bank contacts. Relay 43 is energized in series with vertical magnet 47 and, being slow acting, retains its armature attracted throughout the vertical movement. As a result of the energization of relay 43, it closes a circuit at armature 55 for stepping relay 44 by way of off normal contacts 51, which close upon the first vertical step, and interrupter contacts 50. Stepping relay 44, upon energizing, closes a locking circuit for itself at armature 56 and at armature 57 prepares a circuit for rotary magnet 48.

At the end of the vertical movement, slow acting relay 43 deenergizes and completes the circuit of rotary magnet 48 at armature 55. Rotary magnet 48, upon energizing, advances the wipers 68–73, inclusive, into engagement with the first set of bank contacts in the selected level, and, near the end of its stroke, opens the circuit of stepping relay 44 at interrupter contacts 50. Stepping relay 44, upon deenergizing, opens the circuit of rotary magnet 48 at armature 57, whereupon rotary magnet 48 deenergizes also and closes its interrupter contacts 50 again. The upper bank wipers 68, 69 and 70 are not now connected to the selector E. In case the trunk terminating in the first set of the lower bank contacts is idle, switching relay 45 energizes immediately. Assuming the trunk to be busy, however, switching relay 45 is short circuited by the ground potential encountered by test wiper 72 and stepping relay 44 energizes from this same ground potential and closes the circuit of rotary magnet 48 again, whereupon the switch wipers are rotated into engagement with the next set of bank contacts. This alternate operation of stepping relay 44 and rotary magnet 48 continues until an idle trunk is reached, which trunk, it will be assumed, is the one terminating in bank contacts 81, 83 and 85, whereupon switching relay 45, being no longer short circuited, energizes in series with stepping relay 44. Stepping relay 44, however, does not energize at this time on account of the high resistance of switching relay 45. Switching relay 45, upon energizing, opens a point in the test circuit and prepares the holding circuit at armature 59; disconnects ground from armature 52 of line relay 41 at armature 60, thereby opening the circuit of release relay 42; and at armatures 58 and 61 disconnects the line conductors from the windings of line relay 41 and extends them by way of wipers 71 and 73, bank contacts 81 and 85, and the associated trunk conductors to the windings of the line relay of the twenty level overflow connector H.

The circuit of the line relay 111 of the connector H may be traced from ground, lower winding of relay 111, normally closed contact controlled by armature 109, lower winding of relay 144, conductor 89, the calling subscriber's loop by way of selectors E and D and line switch C, conductor 86, normally closed contact controlled by armature 108, and upper winding of relay 111 to grounded battery. Relays 111 and 144 energize in series over this circuit; the former closing a circuit for the release relay 112, which, upon energizing, prepares the connector for operation in its vertical movement in the usual way and at armature 125 connects ground to the release trunk conductor. A holding circuit is thus established which maintains all the previously operated switches in operated position in the usual manner. Relay 144 disconnects the wipers 147, 148 and 149 from and connects the wipers 150, 151 and 152 to the connector H at armatures 141, 142 and 146, respectively; closes a locking circuit for itself at armature 143 by way of ground at armature 125; and closes at armature 145 a shunt for its lower winding, removing same from the talking circuit.

When the next impulse, it being assumed that a one is dialled, is transmitted over the control circuit by the calling subscriber, the line relay 111 of the connector H is momentarily deenergized once and this deenergization transmits an impulse of current to the vertical magnet 118 over a path which extends from ground by way of armature 124 and its resting contact, armature 126 and its working contact, off normal springs 121 and 123, winding of the slow acting series relay 113, and the winding of the vertical magnet 118 to grounded battery. By the operation of the vertical magnet, the wipers 147–152, inclusive, are raised one step until they stand opposite the first level of bank contacts. Relay 113 is energized in series with the vertical magnet 118 and, being slow acting, holds up continuously during the vertical operation of the switch. By the operation of this relay, the vertical magnet circuit is preserved intact notwithstanding the shifting of the off normal springs which occurs at the first vertical step

of the switch. At the end of the vertical movement, relay 113 deenergizes and transfers the operating circuit to the rotary magnet 119.

The calling subscriber now transmits the final digit of the called telephone number, which it will also be assumed is 1. Responsive to this interruption, the line relay 111 is deenergized once and now sends an impulse to the rotary magnet 119 over the following circuit: From ground by way of armature 124 and its resting contact, armature 126 and its working contact, off normal springs 121 and 122, armature 127 and its resting contact, resting contact of armature 132 and said armature, armature 139 and its resting contact, and the winding of the rotary magnet 119 to grounded battery. By the operation of the rotary magnet, the wipers 147–152, inclusive, are rotated step by step and are finally brought to rest in engagement with the particular set of bank contacts in which the line of substation A′ is terminated, these contacts being indicated in the drawings by the reference characters 156, 157, and 158. The slow acting relay 116 is energized in parallel with the rotary magnet and remains continuously energized during the rotary movement. In operated position, relay 116 connects the test wiper 151 to the winding of test relay 115 by means of its armature 133 and at armature 135 closes an alternate point in the circuit of the rotary magnet to guard against the possibility of having this circuit opened by the operation of the test relay while the test wiper 151 is passing over grounded test contacts.

The final digit has now been received and the connector wipers have been placed in connection with the terminals of the called line. If the line is busy, there will be a ground potential on the test contact 157 and the test relay 115 will be energized. When this relay operates, it prepares a locking circuit for itself at its armature 131 which is completed when the slow acting relay 116 falls back an instant later, opens the rotary magnet circuit at armature 132, and at armature 134 connects a lead from the busy signalling machine to the lower side of the line. On perceiving the signal, the subscriber will replace his receiver, thereby releasing the connector H and all previously operated switches.

Assuming now the called line is idle when connection therewith is attempted, under these circumstances there will be no ground on the test contact 157 and the test relay 115 will not be energized. Then, when the slow acting relay 116 falls back, a circuit is completed for the switching relay 117 which may be traced from the grounded conductor 97 by way of armature 131 and its resting contact, the lower winding of the switching relay 117, resting contact of armature 133 and the said armature, test wiper 151, test contact 157, switching relay 170 of line switch C′, and the stepping magnet 172. Upon the closure of this circuit relays 117 and 170 are energized in series and the latter relay is operated to disconnect the line of substation A′ from its normal battery and ground connections in the line switch. The relay 170, however, is operated only about half way due to a mechanical interlocking device controlled by line relay 171, and the line conductors are not connected through to the line switch wipers.

In the connector H, when the switching relay 117 pulls up, it establishes a locking circuit for itself at armature 138, opens the rotary magnet circuit at armature 139 and at armatures 136 and 140 connects up the two line wipers 150 and 152. By the latter operation, a signalling circuit is established, whereby ringing current from the generator GEN is intermittently projected out over the called line to operate the bridged ringer at the substation A′ to notify the called subscriber that he is wanted. The return path for the ringing current includes the upper winding of ring cut-off relay 114, and, when the called subscriber answers, this relay is operated. Upon energizing, relay 114 establishes a locking circuit for itself at armature 129, breaks the ringing circuit at armatures 128 and 130 and at the working contact of these same armatures finally completes the talking connection.

Current is now supplied to the transmitter at substation A′ through the windings of the double wound back bridge relay 110, which is accordingly energized. This relay is a reversing relay and has the well known function of reversing the incoming trunk conductors 86 and 88 or 89, depending upon which one is used, as regards their connections with the winding of relay 111. This reversing operation is a standard operation and is for the purpose of operating a subscriber's pay-station or metering apparatus and in some cases is used for supervisory purposes. The subscribers may now converse as desired.

When the subscribers are through talking they replace their receivers. The replacing of the receiver at the called substation does not produce any particular results, except that current merely stops flowing over the called line and relay 110 deenergizes to reverse the current to the calling subscriber as previously explained.

When the receiver is replaced at substation A, the circuit of line relay 111 is opened and this relay deenergizes. Upon armature 124 being retracted, the circuit of release relay 112 is opened and a circuit is prepared for release magnet 120. Upon deenergizing in response to the prolonged opening of its circuit, slow-acting release relay 112 removed ground from armature 131 of relay 115 at armature 149; disconnects ground from release trunk conductor 87 at armature 125, whereupon relays 114, 117 and 144 deener-

gize; and at armature 126 completes a circuit for release magnet 120 by way of off normal contacts 107. Upon the energization of release magnet 120, the wipers of the connector H are restored to normal position, and the circuit of release magnet 120 is opened at off normal contacts 107 by the switch shaft when the wipers reach their normal position. At the same time the wipers are restored to normal, switching relay 144 opens the circuits of the lower bank wipers and prepares the circuits of the upper bank wipers at armatures 141, 142 and 146, thus restoring the circuits of the wipers to normal conditions.

As a result of the ground potential being removed from release trunk conductor 87, switching relay 13 of the line switch C, the switching relay (not shown) of the ordinary selector D, and the switching relay 45 of the overflow selector E deenergize. The deenergization of switching relay 13 of the line switch C restores conditions in that switch to normal. The ordinary selector D is restored to normal in a manner similar to that of overflow selector E which will now be explained. The deenergization of switching relay 45 of the overflow selector E results in a circuit being closed for release magnet 46 at armature 60 and its resting contact. This circuit includes armatures 52 and 54 and their resting contacts and off normal contacts 49. The wipers of the selector E are restored to normal position in the usual manner upon the energization of release magnet 46, and the circuit of release magnet 46 is again opened at off normal contacts 49 when the switch wipers reach their normal position.

In order to explain the operation a little more in detail, it will be assumed that the first digit dialled is 2 instead of 1. The selector D raises its wipers 31, 32 and 33 opposite the second level of bank contacts and then selects an idle trunk. It will be assumed that the trunk selected at this time is the one whose bank contacts are numbered 34, 36 and 38, extending to the overflow selector E. That being the case, line relay 41 and switching relay 65 of the overflow selector E energize in series over the calling line, the circuit being traceable from ground, lower winding of relay 41, resting contact of armature 61 and said armature, lower winding of relay 65, the calling subscriber's loop by way of selector D and line switch C, armature 58 and its resting contact, and upper winding of relay 41 to grounded battery. Relay 41 closes a circuit for the release relay 42, which upon energizing prepares the selector for operation and connects ground to the release trunk conductor in the usual manner. Relay 65 disconnects the wipers 71, 72 and 73 from and connects the wipers 68, 69 and 70 to the overflow selector E at armatures 62, 63 and 67, respectively; closes a locking circuit for itself at armature 64 by way of ground at armature 53; and closes at armature 66 a shunt for its lower winding. The remaining operations are similar to those previously described except that the connection is extended via wipers 68–70, inclusive, instead of wipers 71–73, inclusive.

It will now be assumed that the subscriber at station A dials 1 as the first digit and 2 as the second digit. The first selector D raises its wipers to the first level and selects an idle trunk, which trunk it will be further assumed is the one terminating in the overflow selector E. The overflow selector E raises its wipers to the second level and selects an idle trunk, which trunk it will be assumed is the one numbered 86, 87 and 88 and terminating in the overflow connector H. When the connection is extended to the connector H the line relay 111 energizes over the subscriber's loop and performs the functions in the usual well known manner; however, the switching relay 144 is not now connected in series with the line relay and therefore does not energize to switch the wiper circuits at armatures 141, 142 and 146. Except for this the operations are the same as previously described.

The principal advantage in a system similar to the foregoing lies in the fact that the well known graded multiple scheme of trunking between groups is extended to include levels by using twenty level overflow switches, and since the economy of all graded multiple schemes is due to the fact that the peak load in all groups does not occur at the same time, the economy of the twenty level overflow switches used as hereinbefore described is apparent due to the fact that the peak load from two levels of the same switch or group of switches does not occur at the same time. It is recognized that the twenty level switch is not an economy for ordinary use due to the fact that a single call will cause a large number of bank contacts to be idle, but in this scheme only a small percentage of large banks are used and the saving effected by more efficient trunking more than offsets the use of the few large bank switches.

Having described my invention, what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What is claimed is:

1. In a telephone system, first selectors, a group of second selectors accessible from one level of said first selectors, a second group of second selectors accessible from another level of said first selectors, a group of overflow selectors accessible from both said levels, said overflow selectors having two sets of banks, the bank contacts of each set being grouped separate from the bank contacts of the other set, multiple connections between one set of the overflow selector banks and the banks of the first group of second selectors, and multiple connections between the other set of

overflow selector banks and the banks of the other group of second selectors.

2. In a telephone system, selectors, a group of connectors accessible from one level of said selectors, a second group of connectors accessible from another level of said selectors, a group of overflow connectors accessible from both said levels, said overflow connectors having two sets of banks, each of said overflow connectors having a separate set of wipers for each set of banks, multiple connections between one set of overflow connector banks and the banks of said first group of connectors, and multiple connections between the second set of overflow connector banks and the banks of the other group of connectors.

3. In a telephone system, a group of selectors, two groups of trunks accessible to said selectors, two groups of second selectors in which the said two groups of trunks terminate, respectively, except for a relatively small plurality of trunks in each group, a group of overflow selectors in which said small pluralities of trunks terminate, and banks for said overflow selectors comprising two distinct sections multipled with the banks of said two groups of second selectors, respectively.

4. In a telephone system, two groups of switches, each switch having a single set of wipers and banks, a group of overflow switches, each overflow switch having two sets of wipers and banks, and multiple connections between the two sets of overflow switch banks and the banks of said two groups of switches, respectively.

5. In a telephone system, two groups of first selectors, four groups of second selectors accessible from two levels of said two groups of first selectors, and a single group of overflow selectors accessible from both levels of both groups of first selectors.

6. In a telephone system, three groups of selectors, connectors accessible only to selectors of the first group, other connectors accessible only to the selectors of the second group, other connectors accessible only to selectors of the first and third groups, other connectors accessible only to selectors of the second and third groups, and other connectors accessible to selectors of all three groups.

7. An automatic switch having two sets of wipers, each set comprising two line wipers and a test wiper, two trunk lines extending to said switch, a line relay in said switch energized when said switch is connected with via either trunk line, and a wiper selecting relay energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines.

8. An automatic switch having two sets of wipers, two trunk lines extending to said switch, a line relay in said switch energized when said switch is connected with via either trunk line, by current flow over the two sides of the concerned trunk line in series, a wiper selecting relay energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines, and a locking circuit for maintaining said wiper selecting relay energized independent of the trunk line over which it is initially energized.

9. An automatic switch having two sets of wipers, two trunk lines extending to said switch, a line relay in said switch energized when said switch is connected with via either trunk line, a wiper selecting relay energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines, said wiper selecting relay having a winding for initially energizing it as set forth, and a second winding, a locking circuit including said second winding, and contacts on said wiper selecting relay for short circuiting its initial energizing winding.

10. In a telephone system, a group of first selectors, a group of second selectors, each second selector being accessible in a plurality of levels in the banks of said first selectors, two sets of banks for said second selectors, two groups of connectors, each connector in one group being accessible in a plurality of levels in one set of banks of said second selectors, and each connector in the other group being accessible in a plurality of levels in the other set of banks of said second selectors.

11. In a telephone system, three groups of switches of one switching stage, switches of the succeeding switching stage accessible only to switches of the first of said three groups, other switches of the succeeding switching stage accessible only to the switches of the second of said three groups, other switches of the succeeding switching stage accessible only to the switches of the first and the third of said groups, other switches of the succeeding switching stage accessible only to switches of the second and the third of said groups, and other switches of the succeeding switching stage accessible to switches of all three of said groups.

12. In a telephone system, two groups of switches, each switch of the second group being accessible to each switch of the first group in a plurality of levels, two sets of banks for each switch of the second group, a third and a fourth group of switches, each switch of the third group being accessible in a plurality of levels in one set of banks of each switch of the second group, and each switch of the fourth group being accessible in a plurality of levels in the other set of banks of each switch of the second group.

13. An automatic switch having two sets of wipers each set comprising two line wipers and a test wiper, two trunk lines extending to said switch, a line relay in said switch ener-

gized by current flow over the two sides of the trunk line in series when said switch is connected with via either trunk line, a wiper selecting relay energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines, and a locking circuit for maintaining said wiper selecting relay energized independent of the trunk line over which it is initially energized.

14. An automatic switch having two sets of wipers each set comprising two line wipers and a test wiper, two trunk lines extending to said switch, a line relay in said switch energized when said switch is connected with via either trunk line, a wiper selecting relay in said switch energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines, a winding of said wiper selecting relay for initially energizing it as set forth, a second winding of said wiper selecting relay, a locking circuit for said relay including said second winding, and contacts on said wiper selecting relay for short circuiting its initial energizing winding.

15. An automatic switch having two sets of wipers each set comprising a plurality of line wipers and a test wiper, two trunk lines extending to said switch, a line relay in said switch energized by current flow over both sides of the trunk line in series when said switch is connected with via either trunk line, a wiper selecting relay in said switch energized in series with said line relay only when said switch is connected with via a particular one of said trunk lines, a winding of said wiper selecting relay for energizing it initially as set forth, a locking circuit for said wiper selecting relay independent of said initial energizing winding, and means responsive to the energization of said wiper selecting relay for closing said locking circuit and for short circuiting said initial energizing winding.

16. In a telephone system, three groups of switches of one switching stage, a group of trunks accessible in the corresponding levels of the banks of said switches and terminating in switches of the succeeding switching stage said group of trunks providing the only means of access from said levels to switches of the succeeding switching stage, a portion of said group of trunks accessible only in the banks of the first and third groups of switches of said first switching stage, another portion of said group of trunks accessible only in the banks of the second and third groups of switches of said first switching stage, and another portion comprising the balance of said group of trunks accessible in the banks of all three groups of switches of said first switching stage.

In witness whereof, I hereunto subscribe my name this 12th day of June, A. D., 1924.

CLARENCE E. LOMAX.