April 10, 1928.

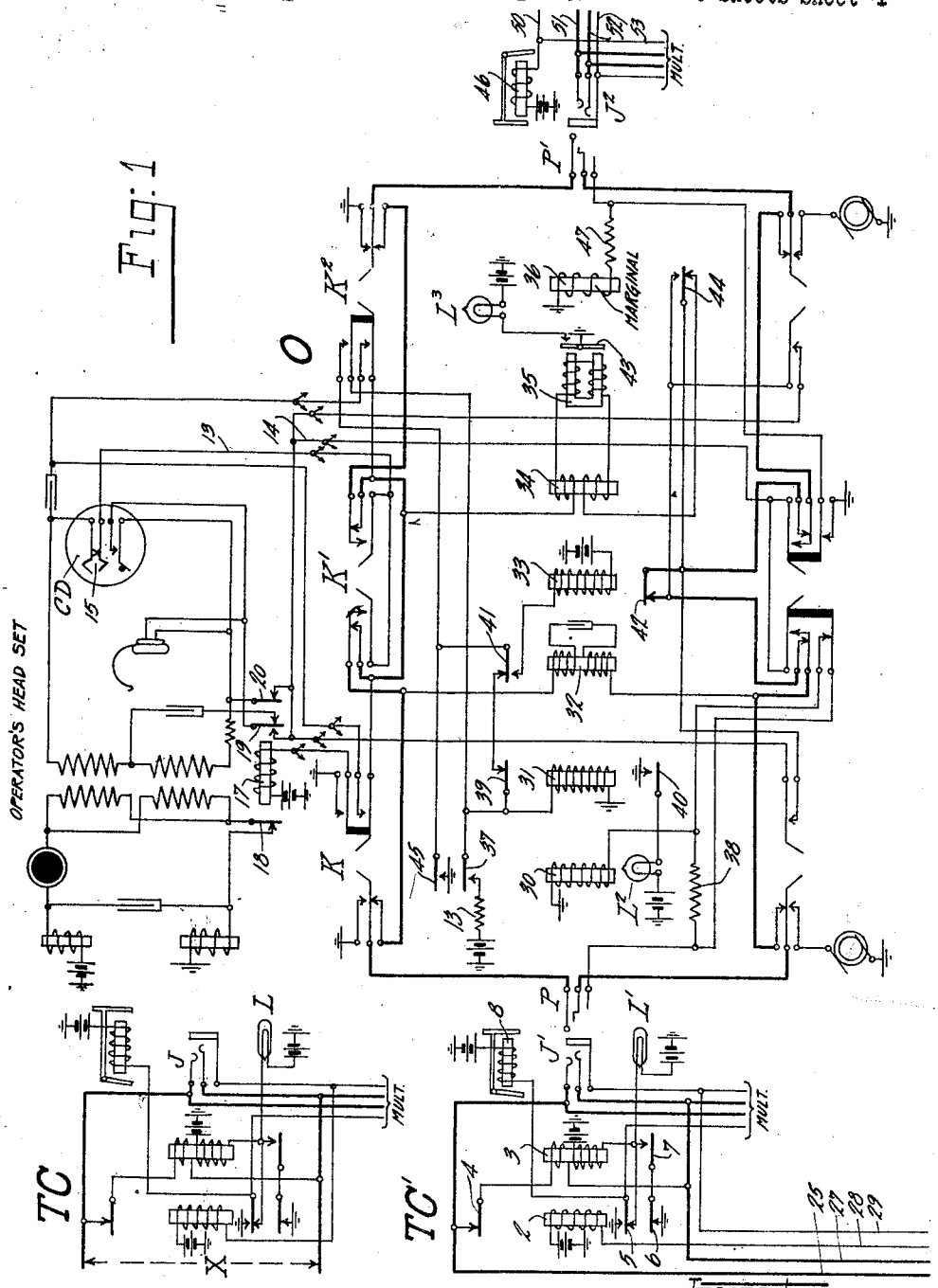
1,665,489

J. WICKS

TELEPHONE SYSTEM

Original Filed Aug. 25, 1922 5 Sheets-Sheet 1

Fig. 1



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TELEPHONE SYSTEM

Original Filed Aug. 25, 1922 5 Sheets-Sheet 2

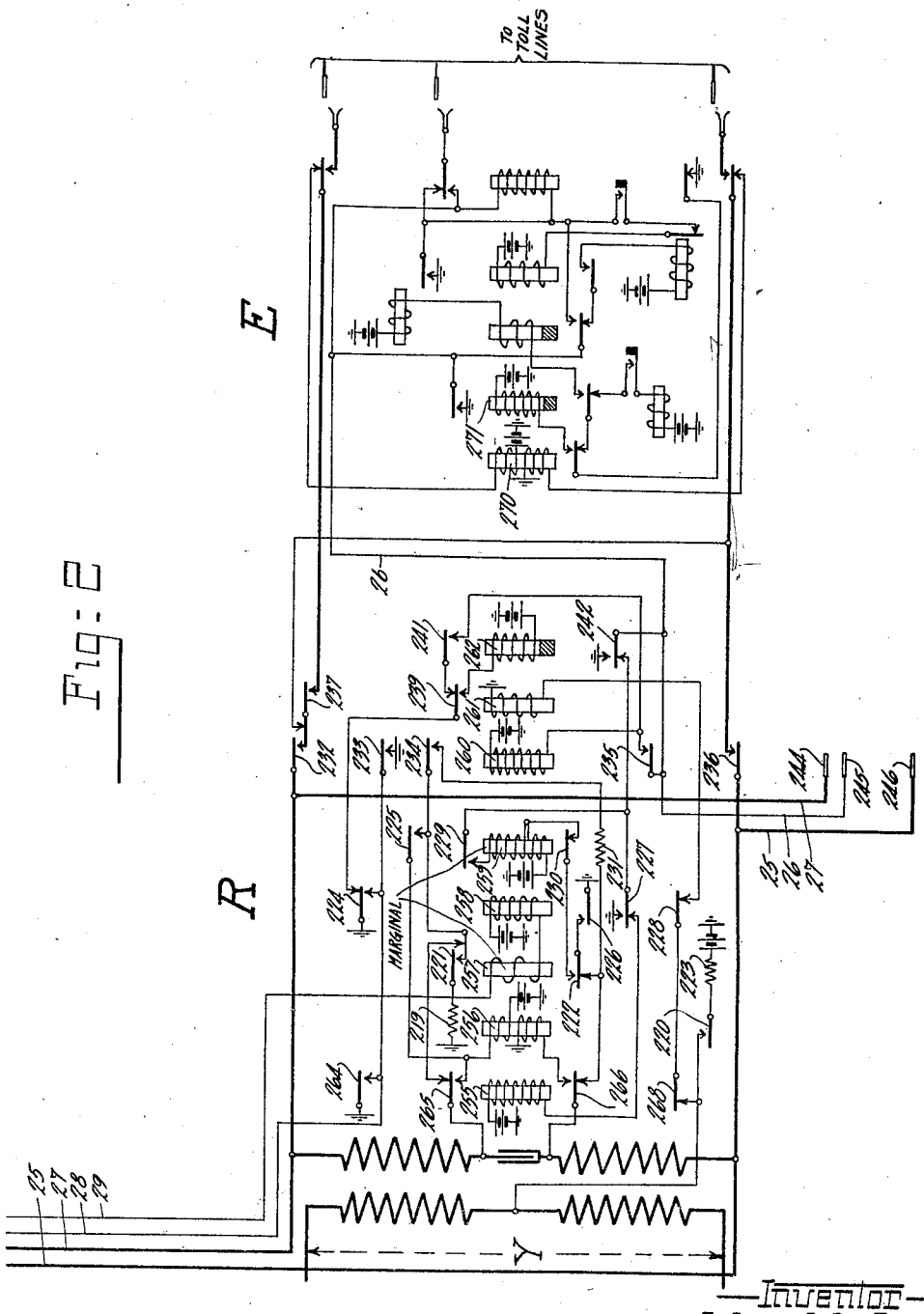

Fig. 2

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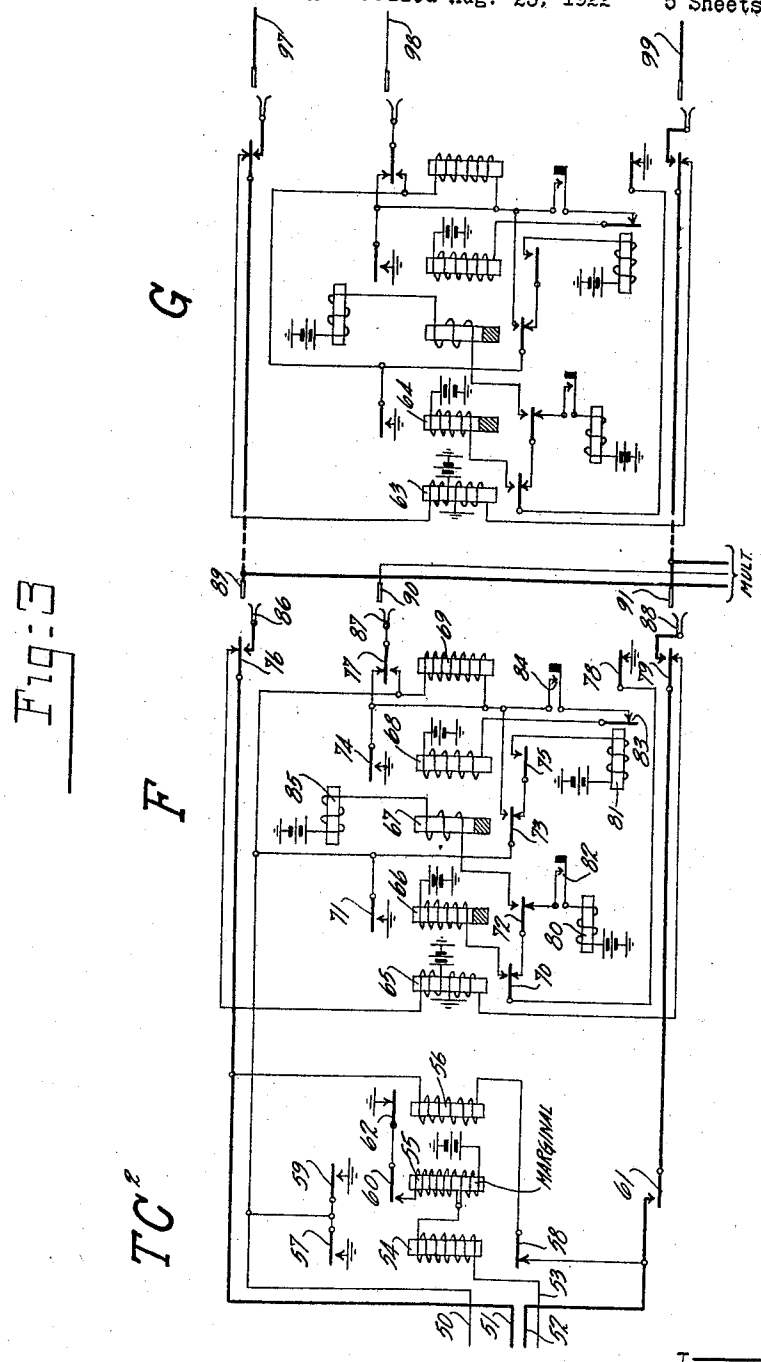

Fig: 3

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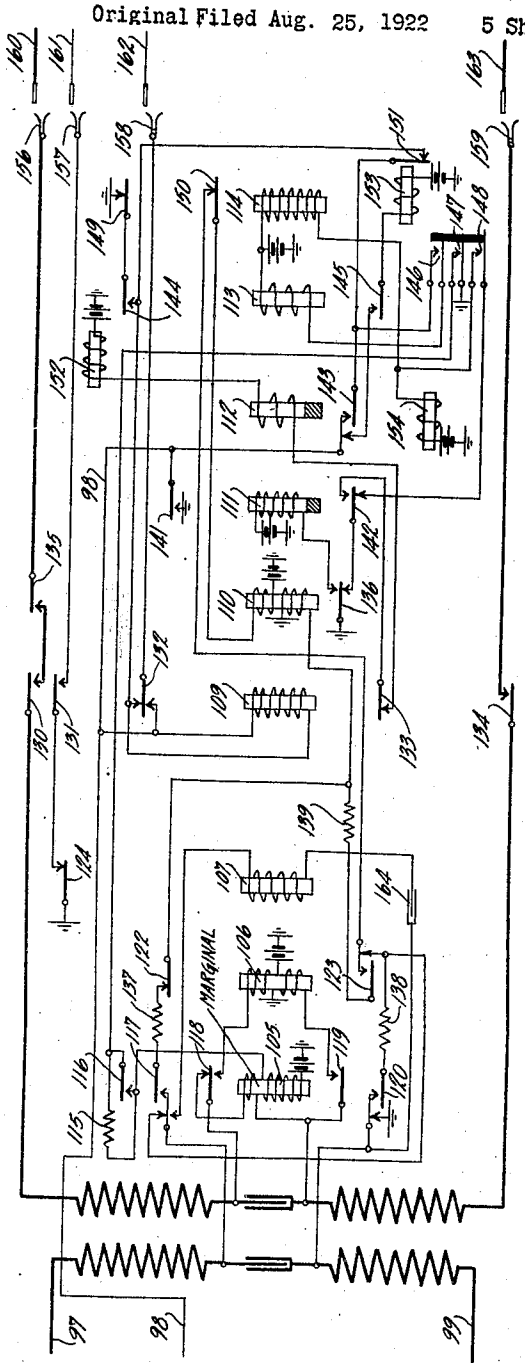

Fig. 4

H

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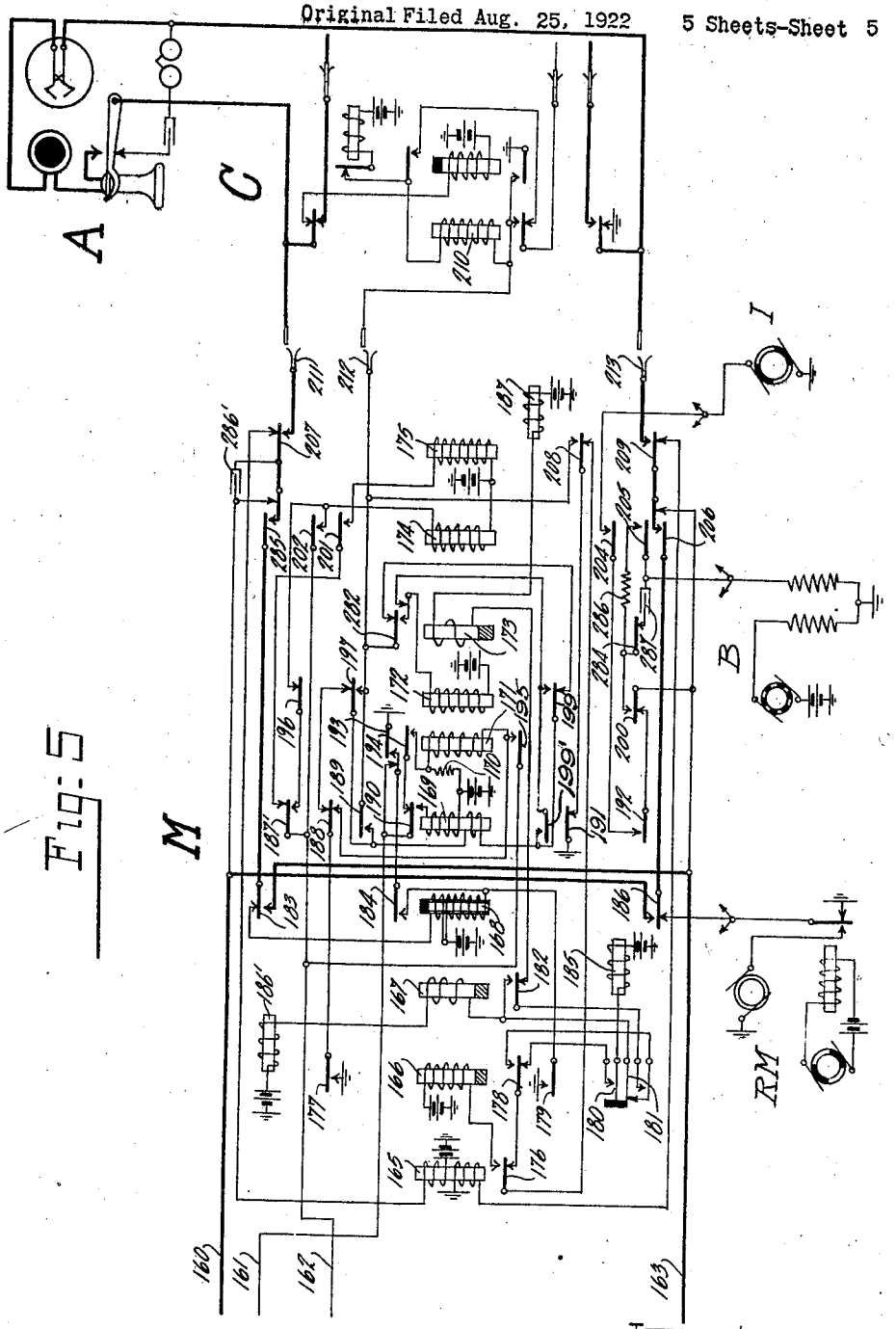

Fig: 5

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1,665,489

UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed August 25, 1922, Serial No. 584,214. Renewed December 8, 1927.

The present invention relates to telephone systems in general, but is concerned more particularly with methods of establishing toll or long distance connections; and the principal object, briefly stated, is the production of a new and improved universal cord circuit for use in interconnecting manual and automatic toll lines with each other or with toll service trunks.

Another object is the provision of a new and improved toll connector in which the seizing of the called line after the number is dialled is under the control of the operator, and in which the operator is given a distinctive indication when the called line is ready to be seized. These objects, together with such others as are not specifically mentioned above, will be explained fully hereinafter, reference being had to the accompanying drawings, comprising Figs. 1–5, inclusive.

Referring now to the drawings, they can be understood best when Figs. 1, 3, 4, and 5 are laid out in order with the corresponding lines at the ends thereof in alignment, and with Fig. 2 under Fig. 1 with the corresponding interconnecting lines in alignment. When laid out thus, Figs. 3, 4, and 5 represent a train of toll service switches in a multi-office telephone system by means of which a toll operator may extend a connection to a subscriber's line; Fig. 1 represents the improved cord circuit, together with certain other apparatus at the toll operator's position; and Fig. 2 represents a repeater and a selector associated with an automatic toll line Y.

The apparatus shown on Figs. 1 and 2, together with the trunk circuit TC^2 and the selector F, Fig. 3, is assumed to be in the toll office, while the selector G, Fig. 3, together with the switching mechanism shown in Figs. 4 and 5, is assumed to be any one of the other offices in the system.

The automatic switches comprising the selectors E, F, G, and H, and the connector M are of the well-known vertical and rotary type. Accordingly, the bank contacts are arranged in horizontal rows or levels. The individual line switch C associated with the line of substation A, Fig. 5, is of the well-known rotary type, in which the wipers have no normal position and move in a forward direction only.

The system, having been described in general, will now be described in connection with a detailed description of the apparatus shown. For this purpose, it will be assumed first that a call comes in over the automatic toll line Y. When the distant toll operator plugs in, battery is placed on the toll line Y through the midpoint of the two windings of the repeating coil bridged across the distant end thereof. When this occurs, line relay 261 of the repeater R energizes over the following circuit: From ground by way of relay 261, resting contact of armature 228 and said armature, armature 268 and its resting contact, upper and lower left-hand windings of the associated repeating coil in multiple, and the upper and lower conductors of the trunk line Y to battery in the distant toll office. Line relay 261, upon energizing, closes a bridge across the conductors leading to the selector E at armature 237, and at armature 239 closes a circuit for release relay 262. Release relay 262, upon energizing, disconnects the release trunk conductor 26 from relay 255 and connects it to ground at armature 242, and at armature 241 prepares a circuit for relay 260. The placing of ground on release trunk conductor 26 renders the toll line Y busy to the automatic switches having access to it by way of conductors 25, 26, and 27.

The operator in the distant toll office now operates her ringing key, thereby projecting ringing current out over the toll line Y. This ringing current is repeated through the windings of the repeating coil associated with the repeater R and operates the bridged ring-up relay 3 in the trunk circuit TC′, Fig. 1. Relay 3, upon energizing, closes a locking circuit for its lower winding at armature 7, at the same time closing a circuit for the line lamp L′. A branch of this circuit extends by way of the resting contact of armature 5 and said armature to the visual busy signal 8 and its multiples in front of the other operators.

The operator, upon noting the lighted condition of the lamp L′, inserts the plug of an idle cord circuit, the plug P of the cord circuit O for example, into the jack J′. When the sleeve of the plug comes into engagement with the sleeve contact of the jack, relay 30 of the cord circuit O and relays 257 and 258 of the repeater R energize in series over the following circuit: From ground by

way of relay 30 of the cord circuit O, lower left-hand pair of contacts of the key K′, sleeve of the plug P, corresponding contact of the jack J′, sleeve conductor 29, relay 257, and relay 258 to battery. Relay 258, upon energizing, places ground on the resting contact of armature 242 of release relay 262 at armature 227, and at armature 224 opens the circuit of relese relay 262, whereupon release relay 262 deenergizes and at armature 242 shifts release trunk conductor 26 to ground by way of armature 227 and its working contact. As a further result of its energization, relay 258 disconnects line relay 261 at armature 228, whereupon line relay 261 deenergizes and opens the bridge across the trunk leading to the selector E at armature 237. A still further result of the energization of relay 258 is that it prepares a circuit for relay 259 at armature 226, and at armature 224 places ground on conductor 28, thereby closing a circuit for cut-off relay 2 of the trunk circuit TC′. Relay 2, upon energizing, opens the circuit of the visual busy signal 8, the circuit of the lower winding of relay 3, and the circuit of the lamp L′ at armature 6, and at armature 5 disconnects the visual busy signal 8 and its multiples at the other positions from the lamp L′ and the lower winding of relay 3 and grounds them again. Relay 3 now deenergizes and the lamp L′ becomes extinguished.

Relay 257 in the repeater R, upon energizing, in series with relay 258, closes at armature 222 a circuit for the lower winding of relay 259 by way of armature 230 and its resting contact. Relay 259, being marginally adjusted, energizes enough to operate its lightly adjusted armature 229 but not enough to operate the more stiffly adjusted armatures 225 and 230. Armature 229, upon coming into engagement with its associated contact, places ground on the upper winding of relay 259 by way of armature 227 and its working contact. No current flows through this upper winding at this time, however, for the reason that it is grounded at both terminals.

In the cord circuit O, relay 30, upon energizing in response to the plug P being inserted into the jack J′, closes a circuit for relay 31 at armature 37 by way of the resistance 13. Relay 31 does not energize at this time, however, owing to the fact that it is short circuited by ground by way of the working contact of armature 45 and said armature, armature 41 and its resting contact, and the resting contact of armature 39 and said armature.

The operator, after plugging in, throws her key K² into listening position, thereby operating the left-hand springs thereof so as to connect up the listening taps of her head set. She now converses with the distant operator and finds out the desired number. Assuming that the distant operator desires the connection to be extended to the line of substation A, the operator inserts the plug P′ of the cord circuit O into the jack J², the associated trunk being idle as denoted by the unoperated condition of the visual busy signal 46. When the sleeve contact of the plug P′ comes into engagement with the corresponding contact of the jack J², a circuit is closed over sleeve conductor 53 through relay 36 and resistance 47 of the cord circuit O in series with relay 54 and the lower winding of relay 55 of the trunk circuit TC. Relays 36 and 55, however, being marginally adjusted, do not energize at this time. Relay 54, upon energizing, disconnects relay 56 from in bridge of the line conductors 51 and 52 of the jack J² at armature 58, and at armature 57, places ground on conductor 50, thereby closing a circuit for the visual busy signal 46 and its multiples in front of the other operators.

The operator now restores her listening key K² and throws her calling device key K′ in such a direction as to operate the right-hand springs thereof. The lower right-hand pair of springs of the key K′ place direct ground on the sleeve of the plug P′, whereupon the marginally adjusted relay 55 in the trunk circuit TC² energizes; closes a locking circuit for itself at armature 60; places a multiple ground on conductor 50 at armature 59; and at armature 61 connects up the lower line conductor of the selector F to conductor 52. When this occurs, line relay 65 of the selector F energizes over conductors 51 and 52, the corresponding conductors of the cord circuit O, and the operator's calling device taps 13 and 14 which are connected up to the upper and lower strands of the cord circuit by the springs of the key K′. The operator's call-device taps 13 and 14 are connected together through the control contacts 15 of the calling device CD, right-hand winding of the operator's induction coil, and armature 20 and its resting contact.

Line relay 65 of the selector F, upon energizing, closes a circuit for release relay 66 at armature 70. Release relay 66, upon energizing, places a multiple ground upon conductor 50 at armature 71, and at armature 72 opens a point in the circuit of release magnet 80 and prepares a circuit for vertical magnet 85.

The operator now turns the calling device CD in accordance with the first digit of the desired number, thereby interrupting the circuit of line relay 65 of the selector F a corresponding number of times at contacts 15. Upon each deenegization of line relay 65 thereby produced, a circuit is closed for vertical magnet 85 as follows: From ground by way of the resting contact of armature

78 and said armature, armature 70 and its resting contact, armature 72 and its working contact, relay 67, and vertical magnet 85 to battery. By the operation of vertical magnet 85, the shaft and wipers of the selector F are raised step by step until the latter stand opposite the desired level of bank contacts. Slow acting relay 67 is energized in series with vertical magnet 85 and retains its armature attracted throughout the vertical movement. Upon the closure of off normal contacts 84, which occurs at the end of the first vertical step, a circuit is closed for stepping relay 68. This circuit includes armature 71 and its working contact and interrupter contacts 83. Relay 68, upon energizing, closes a locking circuit for itself at armature 74 and at armature 75 prepares a circuit for rotary magnet 81. At the end of the vertical movement, relay 67 deenergizes and completes the circuit of rotary magnet 81. Upon energizing, magnet 81 advances the wipers 86–88, inclusive, into engagement with the first set of bank contacts in the level opposite which they are raised, and at interrupter contacts 83 opens the circuit of stepping relay 68. Relay 68, upon deenergizing, opens a point in its previously established locking circuit at armature 74, and at armature 75 opens the circuit of rotary magnet 81. Rotary magnet 81, upon deenergizing, closes its interrupter contacts 83 again.

If the trunk terminating in the first set of bank contacts is idle, switching relay 69 energizes immediately after the closure of interrupter contacts 83 upon the deenergization of rotary magnet 81. However, if the first trunk is busy, switching relay 69 is short circuited by the ground potential which is present on the test contact thereof and stepping relay 68 energizes again, whereupon rotary magnet 81 energizes also and steps the wipers into engagement with the next set of bank contacts. This alternate operation of stepping relay 68 and rotary magnet 81 continues until an idle trunk is reached, which trunk it will be assumed is the one extending to the selector G, whereupon switching relay 69, being no longer short circuited, energizes in series with stepping relay 68 upon the deenergization of rotary magnet 81, after the latter has stepped wipers 86–88, inclusive, into engagement with bank contacts 89–91, inclusive. Stepping relay 68, however, is not energized at this time on account of the high resistance of switching relay 69. Relay 69, upon energizing, opens the test circuit and places ground on test wiper 87 at armature 77, so as to make the seized trunk busy immediately to the other switches having access to it; disconnects ground from armature 70 of line relay 65 at armature 78, thereby opening the circuit of release relay 66; and at armatures 76 and 79 disconnects the line conductors from the windings of line relay 65, and extends them by way of the line conductors of the seized trunk to line relay 63 of the selector G in the distant office. Line and release relays 63 and 64 of the selector G now energize and prepare the switch for operation in the usual manner.

In response to the calling of the second digit in the desired number, the selector G operates in the same manner as the selector F to raise its wipers to the desired level and select an idle trunk, which trunk it will be assumed is the one comprising conductors 97–99, inclusive, and extending to the transmission selector H, Fig. 4.

When the trunk extending to the selector H is seized, line relay 110 energizes over the calling loop, the circuit being as follows: From ground by way of the normally closed contacts controlled by armature 120 of relay 106, lower left-hand winding of the associated repeating coil, the calling loop, upper left-hand winding of the associated repeating coil, normally closed contacts controlled by armature 117, normally closed contacts controlled by armature 123, resting contact of armature 150 and said armature, and the upper winding of line relay 110 to battery. Line relay 110, upon energizing, connects up wiper 156 at armature 135, and at armature 136 closes a circuit for release relay 111. Release relay 111, upon energizing, opens a point in the circuit of release magnet 154 and prepares a circuit for vertical magnet 152 at armature 142, and at armature 141 places ground on the release trunk conductor 98, thereby establishing the usual holding circuit for the switching relay of the selector G before release relay 64 has had time to deenergize.

The operator now operates her calling device in accordance with the third digit in the desired number, thereby producing a corresponding number of interruptions in the circuit of line relay 110 of the selector H. Each time line relay 110 deenergizes in response to one of these interruptions, it closes a circuit for vertical magnet 152 as follows: From ground by way of armature 136 and its resting contact, armature 142 and its working contact, armature 133 and its resting contact, relay 112, and vertical magnet 152 to battery. By the operation of vertical magnet 152, the wipers of the selector H are raised to the desired level of bank contacts. Slow acting relay 112 is energized in series with vertical magnet 152 and retains its armature attracted throughout the vertical movement. Upon the closure of off normal contacts 146, a circuit is closed for stepping relay 113 by way of armature 143 and its working contact. Relay 113, upon energizing, closes a locking circuit for itself at armature 144, and at armature 145 pre-

pares a circuit for rotary magnet 153. Off normal spring 148, upon coming into engagement with its associated contact, prepares a circuit for release magnet 154 and off normal spring 147, upon coming into engagement with its associated contact, closes a circuit for the lower winding of relay 105 by way of resistance 115. Relay 105, however, being marginally adjusted, does not energize at this time on account of the high resistance 115. At the end of the vertical movement, relay 112 deenergizes and completes the circuit of rotary magnet 153. Magnet 153, upon energizing, advances the wipers 156–159, inclusive, into engagement with the first set of bank contacts in the level opposite which they are raised, and at interrupter contacts 151 opens the circuit of stepping relay 113. Stepping relay 113, upon deenergizing, opens the circuit of rotary magnet 153 at armature 145. Rotary magnet 153, upon deenergizing, closes its interrupter contacts 151 again. If the trunk terminating in the first set of bank contacts is idle, switching relay 109 energizes immediately in series with stepping relay 113, but if the trunk is busy, switchiing relay 109 is short circuited by the ground potential which is present on the test contact thereof and stepping relay 113 is energized again, whereupon rotary magnet 153 energizes also, and steps the switch wipers into engagement with the next set of bank contacts. This alternate operation of stepping relay 113 and rotary magnet 153 continues until an idle trunk is reached, which trunk it will be assumed is the one comprising conductors 160–163, inclusive. Stepping relay 113, however, does not energize over this circuit on account of the high resistance of switching relay 109. Switching relay 109, upon energizing, opens a point in the circuit of vertical magnet 152 at armature 133; opens the test circuit and prepares the holding circuit at armature 132, thereby grounding release trunk conductor 162 of the connector M and making the seized trunk busy; places ground on wiper 157 at armature 131, thereby preparing a locking circuit for relays 168 and 169 of the connector M; and at armatures 130 and 134 connects up the line wipers 156 and 159. Since line conductors 160 and 163 of the connector M extend to the upper and lower windings of line relay 165 by way of the normally closed contacts controlled by armatures 285 and 206 of relay 174, and armatures 207 and 209 and their resting contacts, line relay 165 energizes over a local bridge across line wipers 156 and 159 in the selector H. This bridge includes the working contact of armature 134 of switching relay 109 and said armature, lower-right-hand winding of the associated repeating coil, upper winding of relay 105, resting contact of armature 118 and said armature, upper right-hand repeating coil winding, armature 130 and its working contact, and the working contact of armature 135 and said armature. Relay 105, the upper winding of which is included in this bridge, does not energize at this time for the reason that the current flow in the upper winding is in a direction opposite to the current flow in the lower winding.

In the connector M, line relay 165, upon energizing, closes a circuit for release relay 166 at armature 176, which circuit includes armature 191 of relay 169 and its resting contact and armature 208 and its resting contact. Release relay 166, upon energizing, opens a point in the circuit of release magnet 185 and prepares a circuit for vertical magnet 186′ at armature 178, and at armature 179 closes a circuit for ring-cut-off relay 168. Relay 168, upon energizing, locks itself to the grounded conductor 161 at armature 184 by way of the normally closed contacts controlled by armature 193, and at armatures 183 and 186 disconnects armatures 285 and 206 from its own upper winding and the common ringing lead and connects them to conductors 163 and 160, respectively.

In response to the calling of the next digit in the desired number, the circuit of line relay 110 of the selector H is opened the desired number of times. Each time the said relay 110 deenergizes, it opens the circuit of line relay 165 of the connector M at armature 135. Each time the line relay 165 deenergizes, it sends an impulse of current to vertical magnet 186′ the first impulse of current being sent over the following circuit: From ground by way of armature 191 and its resting contact, armature 208 and its resting contact, armature 176 and its resting contact, armature 178 and its working contact, contact of off normal spring 181 and said spring, relay 167, and vertical magnet 186′ to battery. By the operation of vertical magnet 186′, the shaft and wipers of the connector M are raised step by step until the latter stand opposite the desired level of bank contacts. Slow acting relay 167 is energized in series with vertical magnet 186′ and retains its armature attracted throughout the vertical movement, thereby maintaining its own circuit and that of vertical magnet 186′ intact after the off normal springs shift as they do upon the first vertical step. At the end of the vertical movement, slow acting relay 167 deenergizes and transfers the operating circuit from the vertical to the rotary magnet.

When the operator manipulates her calling device for the next and final digit in the desired number, line relay 165 is deenergized the desired number of times and, upon each deenergization, closes a circuit for rotary magnet 187 as follows: From ground by way

of a circuit previously traced to the working contact of armature 178 and thence by way of the normally open contacts controlled by off normal spring 181, armature 182 and its resting contact, relay 173, and rotary magnet 187 to battery. By the operation of rotary magnet 187, the wipers 211–213, inclusive, are advanced into engagement with the desired set of bank contacts, which, in this case, is the set of bank contacts in which the line of substation A terminates. Slow acting relay 173 is energized in series with rotary magnet 187 and retains its armature attracted throughout the rotary movement. Upon energizing, relay 173 disconnects test wiper 212 from the lower winding of relay 169 and connects it to busy relay 172 at armature 282, and at armature 284 disconnects the lead which comes from the busy signalling machine B.

Assuming that the called line is busy the test contact thereof is grounded, consequently, busy relay 172 is energized through test wiper 212 when the wipers of the switch arrive upon the contacts of the called line. Busy relay 172, upon energizing, opens a point in the circuit of relay 174 at armature 196; prepares a locking circuit for itself through the lower winding of relay 169 at armatures 197 and 199; and at armature 200 prepares the busy signalling circuit. Relay 173, upon deenergizing at the end of the rotary movement, opens the initial circuit of and completes a locking circuit for busy relay 172 in series with the lower winding of relay 169 at armature 282; and at armature 284 connects up a lead from the busy signalling machine B to the lower heavy talking conductor through the working contact of armature 200 and said armature. This sends an audible busy tone back to the calling operator to inform her that the desired line is, for the time being, inaccessible. Relay 169 energizes in series with busy relay 172 over the following circuit: From ground by way of test wiper 212, working contact of armature 197 and said armature, lower winding of relay 169, armature 199 and its working contact, normally closed contacts controlled by armature 282, and busy relay 172 to battery. Upon energizing, relay 169 locks itself to control conductor 161 at armature 190; removes ground from armature 176 of line relay 165 at armature 191, thereby opening the circuit of release relay 166; closes a circuit for relay 171 at armature 188; prepares a circuit for connecting a lead from the interrupter I to the lower talking conductor at armature 192; places a shunt around armatures 197 and 199 of busy relay 172 and their working contacts at armatures 189 and 199′; and at armature 187′ opens a point in the circuit of relay 175 and prepares a circuit for switching relay 174. Relay 171, upon energizing, closes a locking circuit for itself at armature 195; prepares its release circuit at armature 194; and at armature 193 disconnects the locking circuit of ring-cut-off relay 168 from conductor 161 and places direct ground thereon. Release relay 166, upon deenergizing in response to the removal of the ground potential from armature 176 of line relay 165 by armature 191 of relay 169, opens the initial circuit of relay 171 at armature 177; opens the initial energizing circuit of ring-cut-off relay 168 at armature 179, and at armature 178 opens a point in the magnet operating circuit and prepares a circuit for release magnet 185.

The operator, upon hearing the busy tone, which is sent back by the connector M as previously explained, knows that the desired line is busy. In case she desires to wait for the line to become idle, the operator merely restores her calling device key K′ to normal position, whereupon impedance 34 and relay 35, in series with armature 44 and its resting contact, are bridged across the strands of the cord circuit, and the operator's calling device taps 13 and 14 are disconnected. At the same time, direct ground is removed from the sleeve conductor of the plug P′ at the lower right-hand contacts of the key K′. This latter operation, however, does not produce any particular result at this time. When the bridge including the polarized relay 35 is placed across the talking conductors of the cord circuit, current begins to flow through this bridge and polarized relay 35 is energized, but in such a direction as to move armature 43 still further away from its associated contact.

Assuming now that the line of substation A becomes idle, busy relay 172 deenergizes when the ground potential is removed from the test contact of the called line, and opens a point in its previously established locking circuit at armature 197 and another at armature 199. These points, however, are bridged by armatures 189 and 199′ of relay 169 and their working contacts. As a further result of the deenergization of relay 172, it disconnects the lower talking conductor from the busy lead and connects it to armature 204 of relay 174 by way of armature 192 and its working contact and at armature 196 completes a circuit for relay 174, which circuit includes release trunk conductor 162 and armature 187′ and its working contact. Relay 174, upon energizing, locks itself to conductor 162 at armature 202; closes a point in the circuit of wiper connecting relay 175 at armature 201; shunts resistance 286 around armature 284 and its resting contact and condenser 287 at armature 205; and at armatures 285 and 206 reverses conductors 160 and 163 as regards their connection with the windings of line relay 165, the line relay current passing through armatures 183 and 186 of ring-

cut-off relay and their working contacts after the reversal. When this reversal occurs, the marginally adjusted polarized relay 105 in the transmission selector H energizes on account of the fact that the current flowing through its upper winding assists the current flowing through its lower winding at this time. Upon energizing, relay 105 places a shunt around resistance 115 at armature 116 so as to maintain the relay energized independent of its upper winding; disconnects its upper winding from in bridge of the condenser associated with the right-hand repeating coil windings and connects up battery feed relay 106 at armatures 118 and 119. When this occurs, line relay 165 of the connector M deenergizes because it is so poled at this time, as regards relay 106, that no current flows through either relay 165 or relay 106. Upon deenergizing, line relay 165 opens a still further point in the circuit of release relay 166 and closes a point in the circuit of release magnet 185 at armature 176. As a still further result of the energization of relay 105 in the transmission selector H, it reverses the direction of current flow in trunk conductors 97 and 99 at armatures 117 and 120, at the same time including the lower winding of line relay 110 and resistances 137 and 138 in the circuit extending back to the operator. As a further result of the energization of relay 105, it bridges relay 107 in series with condenser 164 across the condenser associated with the left-hand repeating coil winding at the normally open contacts controlled by armature 117.

In the cord circuit O, Fig. 1, relay 35 responds to the reversal of current brought about by relay 105 of the transmission selector H by bringing armature 43 into engagement with its associated contact, whereupon the supervisory lamp L^3 becomes lighted.

Returning now to the connector M, as a still further result of the energization of relay 174, a lead from the interrupter I is connected to the lower talking conductor at armature 204. Consequently, each time the common interrupter lead is grounded, relay 165 of the connector M is energized through its upper winding, and relay 106 of the transmission selector H is energized through its lower winding in multiple with the upper winding of line relay 165. The operation of line relay 165 of the connector M is merely incidental and does not produce any particular result at this time. Relay 106, in the selecetor H, upon energizing, disconnects line relay 110 from conductors 97 and 99 at armature 122 and the normally closed contacts controlled by armature 123, and at armature 123 and its working contact closes a local circuit for line relay 110 by way of resistance 139, thereby maintaining relay 110 energized. In the cord circuit O, supervisory relay 35 retracts its armature and extinguishes the lamp L^3.

When ground is removed from the lead of the interrupter I, Fig. 5, line relay 165 of the connector M and battery feed relay 106 of the selector H deenergize. Relay 106, upon deenergizing, connects up line relay 110 to conductors 97 and 99 again, at the same time opening the local circuit of line relay 110. When this occurs, supervisory relay 35, in the cord circuit O, attracts its armature 43 again, whereupon the lamp L^3 again becomes lighted. This operation is repeated each time the lead associated with interrupter I is grounded, thereby causing the supervisory lamp L^3, associated with the cord circuit O, to flash intermittently so as to give the operator a distinctive signal that the line, upon which the connector M is camped, has become idle.

The operator may now seize the line of substation A and make it busy in a manner to be explained subsequently. Assuming however, that the operator does not seize the line of substation A immediately, for example, because she is at the moment otherwise occupied or because the distant operator has informed her that the calling subscriber will not be at the telephone for several minutes, and assuming also that the line of substation A again becomes busy in the meantime, busy relay 172 again energizes from ground by way of test wiper 212, armature 189 and its working contact, lower winding of relay 169, armature 199′ and its working contact, and the normally closed contacts controlled by armature 282. Upon energizing, busy relay 172 disconnects the lower talking conductor from the interrupter I at armature 200 and connects it to ground, by way of resistance 286, the working contact of armature 205 and said armature, and the right-hand winding of the transformer of the busy machine B. In case relay 106 of the selector H is energized at this time, it remains energized through the busy lead and supervisory lamp L^3 of the operator's circuit O remains extinguished but if the relay 106 happens to be deenergized at this time, it immediately energizes, whereupon the lamp L^3 becomes extinguished. The operator, upon noting that the lamp L^3 has stopped flashing and is extinguished, knows that the line of substation A has become busy again. In case she desires to verify this indication, she may do so by throwing her listening key, whereupon the busy tone supplied by the busy machine B to the lower talking conductor will be heard.

When the line of substation A becomes idle again, busy relay 172 deenergizes, whereupon it disconnects the lower talking conductor 163 from the busy machine B and connects it to the interrupter I again.

When this occurs, the supervisory lamp L^3 in the cord circuit O starts to flash again.

Assuming now that the operator desires to seize the line of substation A and make it busy she throws her key K^2 into ringing position, thereby applying ringing current to conductors 97 and 99. This ringing current energizes the alternating current relay 107 in the transmission selector H, Fig. 4. Relay 107, upon energizing, disconnects ground from wiper 157 and consequently from conductor 161 at armature 124, thereby opening the locking circuit of relay 169 in the connector M. Relay 169, upon deenergizing, disconnects the interrupter I from conductor 163 at armature 192, and closes a circuit for release magnet 185 at armature 191, the said circuit including armature 208 and its resting contact, armature 176 and its resting contact, armature 178 and its resting contact, and off normal contacts 180. As a further result of the deenergization of relay 169, it closes a circuit for relay 175 at armature 187', the said circuit including armature 201 and its working contact. Consequently, release magnet 185 and relay 175 start to energize simultaneously. Relay 175, however, upon energizing, opens the circuit of release magnet 185 at armature 208 before release magnet 185, which magnet has a comparatively heavy armature, is able to operate its armature. As a further result of the energization of relay 175, it places ground on test wiper 212 at armature 208, thereby making the called line busy to the other switches having access to it. When this occurs, cut off relay 210 of the line switch C energizes in series with the associated stepping magnet and clears the called line of its attachments. Relay 210, however, owing to the usual mechanical interlocking device (not shown) between its armature and that of the associated line relay, operates only about half way at this time. Consequently, the wipers of the line switch are not connected up. The stepping magnet of the line switch C, through which relay 210 is energized, is not operated at this time on account of the high resistance of relay 210. As a still further result of the energization of relay 175, the talking conductors are disconnected from the windings of line relay 165, and are connected up to the line wipers 211 and 213 at armatures 207 and 209.

When the operator restores her ringing key, relay 107 in the transmission selector H deenergizes and replaces ground on conductor 161. This ground potential extends by way of armature 190 of relay 169, Fig. 5, and its resting contact, and armature 194 and its working contact to the junction of resistance 170 and relay 171, thereby short circuiting relay 171 and allowing it to deenergize. Upon deenergizing, relay 171 opens its locking circuit at armature 195; disconnects conductor 161 at armature 194; and at armature 193 shifts the locking circuit of ring cut off relay 168 back to conductor 161. The operator has now caused the line of substation A to be seized. However, ringing current is not yet applied to the called line.

Assuming now that the operator learns that the calling subscriber is ready to converse, she operates her ringing key again, whereupon relay 107 in the selector H is again energized, thereby opening the locking circuit of ring-cut-off relay 168 in the connector M. Ring-cut-off relay 168, upon deenergizing, disconnects the wipers 211 and 213 from conductors 160 and 163 and connects them to its own upper winding and to the common ringing lead at armatures 183 and 186, respectively, and at armature 184 opens a further point in its previously established locking circuit. Ringing current is now applied to the called line intermittently by the ringing machine RM. The small condenser 286' allows enough ringing current to flow back over the upper talking conductor to give the operator a ringing signal. When the operator restores her ringing key, relay 107 in the transmission selector H deenergizes and replaces ground on conductor 161.

When the called subscriber responds to the ringing of his bell by removing his receiver, ring-cut-off relay 168 in the connector M energizes through its upper winding, whereupon it closes a locking circuit for itself at armature 184, and at armatures 183 and 186 disconnects its own upper winding and the common ringing lead from the line wipers and connects the latter to the talking conductors 160 and 163. Battery feed relay 106 in the transmission selector H now energizes over the called line, whereupon it disconnects the line relay 110 from conductors 97 and 99, at the same time closing a local circuit for line relay 110 through resistance 139. When this occurs, supervisory relay 35, in the cord circuit O, deenergizes and extinguishes the lamp L^3, thereby giving the operator answering supervision. Assuming that the line of the calling subscriber is connected up by the distant operator to the distant end of the toll line Y, Fig. 2, the calling and called subscribers may now converse with each other in the usual manner, the talking circuits that are shown, being outlined by the heavy conductors and talking battery being supplied to the called subscribers from the transmission selector H.

Upon the termination of the conversation, the two subscribers replace their receivers. When the receiver is replaced at substation A, the circuit of battery feed relay 106 in the selector H is opened. Relay 106, upon deenergizing, connects line relay 110 to conductors 97 and 99 again at armatures 122 and 123, at the same time opening the local

circuit of line relay 110. When this occurs, relay 35, in the cord circuit O, is energized again, whereupon lamp L^3 becomes lighted, thereby giving the operator a disconnect signal.

When the distant operator receives a disconnect signal from the calling subscriber, she rings out on the toll line Y, Fig. 2, and then pulls down the connection. The ringing current coming in over the toll line Y operates the alternating current relay 32 in the cord circuit O. Relay 32, upon energizing, removes ground from the junction of relay 31 and resistance 37 and closes a circuit for relay 33 at armature 41. Relay 33, upon energizing, opens the lower talking conductor of the cord circuit at armature 42, so as to prevent the ringing current from passing through to relay 107 in the transmission selector H. In case relay 107 energizes momentarily, it falls back again before ring-cut-off relay 168, in the connector M, has had time to deenergize. Relay 31, upon energizing in response to the removal of the short circuit from around its winding at armature 41, disconnects itself from the resting contact of armature 41 at armature 39, and at armature 40 closes a circuit for the lamp L^2, whereupon the lamp L^2 becomes lighted, thereby giving the operator a second disconnect signal.

The operator, upon noting the lighted condition of the lamps L^2 and L^3, may first throw her listening key K^2, so as to find out whether or not the distant operator has anything to say to her, and, assuming that she gets no response, she then pulls down the connection. When the plug P is removed from the jack J', relay 30 deenergizes and opens the circuit of relay 31 at armature 37. Relay 31, upon deenergizing, opens the circuit of the lamp L^2, whereupon the said lamp L^2 becomes extinguished. In the repeater R, relay 258, upon deenergizing, connects up line relay 261 again at armature 228; connects relay 255 back to release trunk conductor 26 at armature 227; opens the circuit of relay 259 at armature 226, whereupon relay 259 deenergizes; and at armature 224 removes ground from conductor 28, whereupon cut-off relay 2 deenergizes. Upon deenergizing, cut-off relay 2 connects the upper winding of relay 3 in bridge of the line conductors of the jack J' at armature 4, and at armature 5 opens the circuit of the visual signal 8 and its multiples.

When the plug P' of the cord circuit O is removed from the jack J^2, relay 35 deenergizes and the lamp L^3 becomes extinguished. Relay 54 in the trunk circuit TC^2, upon deenergizing, removes ground at one point from release trunk conductor 50 of the selector F at armature 57, and at armature 58 connects relay 56 in bridge of the talking conductors. Relay 56, upon energizing in series with line relay 110 in the selector H, opens the locking circuit of relay 55. Relay 55, upon deenergizing, opens another further point in its locking circuit at armature 60; disconnects the lower talking conductor at armature 61, thereby opening the circuit of relay 56 and line relay 110 of the selector H at armature 61; and at armature 59 removes ground from release trunk conductor 50 of the selector F. In response to the removal of the ground potential from release trunk conductor 50, the visual busy signal 46 and its multiples in front of the other operators become deenergized, and switching relay 69 in the selector F deenergizes and closes a circuit for release magnet 80 at armature 78. This circuit includes armatures 70 and 72 and off normal contacts 82. Release magnet 80, upon energizing, restores the shaft and wipers of the selector F to normal, the circuit of release magnet 80 being opened at off normal contacts 82 by the switch shaft when the latter reaches normal position.

In the transmission selector H, Fig. 4, line relay 110, upon deenergizing in response to the opening of this circuit at armature 61 of relay 55 in the trunk circuit TC^2, Fig. 3, opens the circuit of release relay 111 at armature 136. Release relay 111, upon deenergizing, removes ground from release trunk conductor 98 at armature 141, thereby removing ground from release trunk conductor 162 of the connector M also. When this occurs relay 109 deenergizes. As a further result of the deenergization of release relay 111, it closes a circuit for release magnet 154 by way of armatures 136 and 142 and their respective resting contacts, and off normal contacts 148. Release magnet 154, upon energizing, restores the shaft and wipers of the selector H to normal in the usual manner. When the off normal springs are opened by the switch shaft, the circuit of release magnet 154 is opened at off normal contacts 148; a point in the circuit of stepping relay 113 is opened at off normal contacts 146; and the circuit of relay 105 is opened at off normal contacts 147, whereupon relay 105 deenergizes. Relay 114, it may be stated, is maintained energized in multiple with release magnet 154 during the release of the switch. This relay maintains the locking circuit of stepping relay 113 open at armature 149, and at armature 150 maintains the upper winding of line relay 110 disconnected so as to prevent an accidental energization of relay 110 due to the kick of the condensers associated with the repeating coil.

In the connector M, relays 174 and 175 deenergize in response to the removal of ground from release trunk conductor 162 by release relay 111 of the selector H, and ring-cut-off relay 168 deenergizes in response to the removal of ground from the control conductor 161 by switching relay 109 of the

selector H. Relay 175, upon deenergizing, disconnects the line wipers of the switch at armatures 207 and 209 and at armature 208 removes ground from test wiper 212 and closes a circuit for release magnet 185 as follows: From ground by way of armature 191 and its resting contact, armature 208 and its resting contact, armature 176 and its resting contact, armature 178 and its resting contact, off normal contacts 180, and release magnet 185 to battery. By the operation of release magnet 185, the shaft and wipers of the connector M are restored to normal position in the usual manner.

In the preceding example, it was assumed that the line of substation A was busy when called, and that the operator waited for the line to become idle. The operations accompanying the seizing of the line of substation A when the line is idle when called will now be outlined briefly. It will be remembered that series relay 173 is maintained energized during the rotary movement of the switch. Assuming that the line of substation A is idle, as above noted, busy relay 172 is not energized when the wipers of the connector M come to rest upon the contacts of the called line, and series relay 173, upon deenergizing, completes a circuit for the lower winding of relay 169 as follows: From ground, by way of working contact of armature 177 and said armature, armature 188 and its resting contact, resting contact of armature 197 and said armature, lower winding of relay 169, armature 199 and its resting contact, resting contact of armature 282 and said armature, test wiper 212, and thence to battery by way of the cut-off relay and rotary magnet of the line switch of the called line. Relays 210 and 169 energize in series over this circuit. Relay 169, upon energizing, closes a locking circuit for itself at armature 190 and at armature 188 opens its initial circuit and that of relay 210 and closes the usual circuit for relay 171. When this occurs, relay 210 deenergizes, but relay 169 is maintained energized over its locking circuit. As a further result of the energization of relay 169, it opens the circuit of release relay 166 at armature 191; connects busy relay 172 with test wiper 212 at armatures 199′ and 189 so as to enable the busy relay to energize in case the called line becomes busy before it is seized; and at armature 187′ closes the usual circuit for relay 174. Relay 174, upon energizing, reverses the current flow in conductors 160 and 163 at armatures 285 and 206, thereby causing relay 105 in the selector H to become energized as hereinbefore described, and at armature 204 connects up the lead controlled by the interrupter I. The operator now gets the flash supervision to indicate that the called line is idle and that she has not yet cut through to seize the line. She may now seize the line or wait.

It will be noted that relay 169 is energized at this time over a circuit which extends from ground in the connector M to battery in the line switch C, and it will be remembered that relay 169 was energized in the previously described case over a circuit which extended from ground on the test contact of the called line to battery through busy relay 172. However, the current is made to flow in the same direction through the lower winding of relay 169 in both cases by the reversing operation of armatures 197 and 199 of busy relay 172, which armatures are attracted in one case and are normal in the other case.

It will be assumed now that the operator on the distant end of the automatic toll line Y, Fig. 2, desires to extend a connection to one of the other toll lines which is accessible to the selector E, Fig. 2. That being the case, the operator seizes the distant end of the toll line Y in the usual manner, whereupon line relay 261 of the repeater R is energized by battery coming over the two conductors of the toll line in parallel. Upon energizing, line relay 261 closes a circuit for release relay 262 and the latter relay, upon energizing, places ground upon release trunk conductor 26 at armature 242, and at armature 241 prepares a circuit for relay 260. As a further result of the energization of line relay 261, it closes at armature 237 a bridge across the conductors extending to the selector E, whereupon line and release relays 270 and 271 energize, thereby preparing the switch for operation in the usual manner.

In response to the calling of the digit assigned to the desired group of trunks, line relay 261 is deenergized a corresponding number of times and, upon each deenergization, opens the circuit of line relay 270 of the selector E at armature 237. As a result, the wipers of the selector E are raised opposite the desired level of bank contacts by the operation of the associated vertical magnet which is controlled by line relay 270. At the end of the vertical movement, the wipers of the selector E are rotated into engagement with an idle trunk, whereupon the connection is extended through in the usual manner.

In the repeater R, relay 260 is energized upon the first deenergization of line relay 261 and closes a locking circuit for itself at armature 235; completes a bridge around the condenser associated with the right-hand winding of the repeating coil at armature 234; and at armatures 232 and 236 connects up the conductors of the selector E to the right-hand windings of the repeating coil, at the same time disconnecting the direct

bridge at the normally closed contacts controlled by armature 232. As a further result of the energization of relay 260, it places ground at armature 233 on conductor 28 leading to the trunk circuit TC′, whereupon cut-off relay 2 energizes and closes a circuit for the visual signal 8 and its multiples at armature 5, and at armature 4 disconnects the upper winding of relay 3 from in bridge of conductors 25 and 27.

The toll operator on the distant end of the toll line Y, having extended the connection to the desired other toll line, may now signal the operator on the distant end thereof by ringing, or she may dial still another digit in case she desires to extend the connection automatically through the toll office in which the distant end of the seized toll line terminates. In any event, when the connection is finally completed and the conversation terminated, the operator on the distant end of the toll line Y pulls down the connection, whereupon line relay 261 of the repeater R deenergizes, opens the bridge across the conductors of the selector E at armature 237 and at armature 239 opens the circuit of release relay 262. Relay 262, upon deenergizing, opens the circuit of relay 260 at armature 241 and at armature 242 removes ground from release trunk conductor 26, thereby rendering the toll line Y accessible to the automatic switches having access to it, opening the locking circuit of relay 260, and allowing the selector E to release. Relay 260, upon deenergizing, removes ground from conductor 28, whereupon cut-off relay 2 deenergizes and opens the circuit of the visual signal 8 and its multiples.

It will be assumed now that the operator on the distant end of the toll line Y signals the local toll operator by projecting ringing current out over the toll line Y. That being the case, the line lamp L′, Fig. 1, becomes lighted in the hereinbefore described manner. The operator, upon noting the lighted condition of the lamp L′, responds by inserting the plug of an idle cord circuit, the plug P of the cord circuit O, for example, into the jack J′, whereupon the line lamp L′ becomes extinguished in the usual manner. The operator nows throws her listening key K^2 and converses with the calling operator, and assuming that she learns that the connection is to be extended to the operator on the distant end of the toll line X, she inserts the plug P′ of the cord circuit O into a jack associated with an idle toll line in the proper group, the jack J for example. When this occurs, the marginally adjusted sleeve relay 36 energizes in series with resistance 47 and the sleeve relay of the jack J. Relay 36, upon energizing, disconnects the bridge including supervisory relay 35 from across the talking strands of the plug P′ and places a shunt around armature 42 and its resting contact at armature 44. The cut-off relay in the trunk circuit TC, upon energizing, closes a circuit for the associated visual busy signal and its multiples, and removes the upper winding of the associated ring-up relay from in bridge of the toll line X.

The operator now rings out on the toll line X by operating her key K^2, thereby signalling the distant operator, after which she restores her key K^2 to normal and allows the originating operator to proceed with the call.

After the connection is completed and the conversation terminated, the originating operator rings out on the toll line Y, thereby operating the ring-up relay 32 in the cord circuit O, whereupon relay 31 becomes energized and lights the lamp L^2. Relay 33 energizes at this time but does not produce any effect owing to the fact that its contacts are shorted by armature 44 of sleeve relay 36. Accordingly, the ringing current passes through the cord circuit O and out over the toll line X to signal the operator at the distant end thereof.

The switching operator, upon noting the lighted condition of the disconnect lamp L^2, pulls down the connection.

Assuming now that the repeater R, Fig. 2, is seized at bank contacts 244–246, inclusive, by a selector such as E, associated with a similar repeater, ground is placed on release trunk conductor 26 by way of test contact 245 by the seizing selector, upon the seizure of the trunk. This ground potential extends by way of armature 242 and its resting contact, armature 227 and its resting contact, to relay 255. Relay 255, upon energizing, diconnects line relay 261 at armature 268; places ground on conductor 28 at armature 264; and at armatures 265 and 266 connects the upper and lower windings of line relay 256 in bridge of the condenser associated with the right-hand repeating coil winding. Line relay 256, upon energizing over the following loop, places battery on toll line Y at armature 220 by way of resistance 223 and through the two left-hand windings of the repeating coil in parallel, thereby energizing the line relay of the repeater on the distant end of the toll line. It will be noted that no arrangement is made for holding up the seizing switch from the repeater R. The seizing selector, however, is held up by the repeater with which it is associated in the same manner that the selector E is held up by the repeater R when a connection is extended through the latter by way of the former. As a result of the ground potential being placed on conductor 28, cut-off relay 2 in the trunk circuit TC′ is energized and closes a circuit for the visual signal 8 and its multiples.

The operator who extended the connec-

tion to the toll line Y may now signal the distant operator by ringing, or she may dial a digit and extend the connection through the distant office, the impulses being repeated at armature 220 of the line relay 256.

When the calling operator pulls down the connection, line relay 256 deenergizes and opens the circuit of the distant line relay at armature 220, and when ground is removed from release trunk conductor 26, relay 255 deenergizes and removes ground from conductor 28, whereupon the cut-off relay 2 deenergizes and opens the circuit of the visual signal 8 and its multiples.

It will be assumed now that the operator on the distant end of the manual toll line X desires to signal the operator on the near end of the said toll line X. That being the case, the distant operator plugs in on the toll line X and rings in the usual manner, whereupon the line lamp L becomes lighted. When this occurs, the operator plugs in with an answering plug of an idle cord circuit, the plug P of the cord circuit O, for example, whereupon the two sleeve relays energize in series with each other and the lamp L becomes extinguished. The operator now throws the key K^2 to listening position and converses with the calling operator. In case the calling operator desires the connection to be extended to a local subscriber, such as the subscriber at substation A, the local toll operator inserts the plug P′ into the jack of an idle trunk circuit, such as the jack J^2, and extends the connection to the desired subscriber in the hereinbefore described manner. In this case, however, it will be assumed that the distant operator desires the connection to be extended to the exchange reached by way of the group of trunks of which the toll line Y is one. That being the case, the operator inserts the plug P′ of the cord circuit O into the jack J′, the associated trunk being idle as denoted by the unoperated condition of the signal 8. When this occurs, sleeve relay 36 of the cord circuit O and relays 257 and 258 of the repeater R energize in series. Relay 258, upon energizing, places ground on conductor 28 at armature 224, whereupon the visual signal 8 and its multiples become operated by the energization of cut-off relay 2. As a further result of the energization of relay 258, it disconnects line relay 261 at armature 228; prepares a circuit for relay 259 at armature 226; and at armature 227 places ground on release trunk conductor 26, thereby rendering the repeater R busy to the automatic switches having access to it. Relay 257, upon energizing, prepares a circuit for the upper winding of line relay 256 at armature 221, and at armature 222 closes a circuit for the lower winding of the marginally adjusted relay 259. Relay 259 energizes just far enough to operate armature 229. The operator now throws her ringing key K^2, thereby signalling the operator on the distant end of the toll line Y.

The distant operator now responds and converses with the operator on the distant end of the toll line X, and completes the connection according to the direction of the latter operator and when the conversation is terminated, the operator on the distant end of the toll line X pulls down the connection and projects ringing current over the toll line. This ringing current operates ring-up relay 32 of the cord circuit O, whereupon relay 31 energizes and lights the supervisory lamp L^2. This ringing current also passes out over the toll line Y and operates the disconnect signal at the distant end thereof. The local operator now takes down her cord circuit O.

Assuming now that the operator on the distant end of the toll line X signals the local operator, and that the latter responds by inserting the plug P into the jack J, and that the local operator learns that the distant operator desires the local operator to extend the connection to the exchange on the distant end of the toll line Y, and thence to a third exchange reached by way of the distant exchange, the local operator removes the plug P from the jack J and inserts the plug P′ into the jack J instead. The operator now inserts the plug P into a jack such as the jack J′, the associated toll line being idle as denoted by the unoperated condition of the visual signal 8, whereupon relays 30, 257, and 258 energize in series and produce the hereinbefore described results. The operator now throws her calling device key K′ in such a direction as to operate the left-hand springs thereof. The lower left-hand pair of springs of the key K′, upon being operated, remove the shunt from around resistance 38, whereupon the marginally adjusted relay 257 in the repeater R, deenergizes and removes the shunt from around the upper winding of relay 259 at armature 222. Relay 259 now energizes and disconnects its windings from the working contact of armature 222 at armature 230, and at armature 225 connects the upper winding of line relay 256 to conductor 27 by way of the normally closed contacts controlled by armature 221, the resting contact of armature 265 and said armature, and the upper right-hand winding of the repeating coil. Since conductor 25 is grounded by way of armature 226 and its working contact, armature 222 and its resting contact, the resting contact of armature 266 and said armature, and the lower right-hand winding of the repeating coil, relay 256 energizes over conductors 25 and 27, through the talking strands of the cord circuit O, and through the operator's calling device key K′. The line relay 256, upon energizing, places bat-

tery on the toll line Y at armature 220, whereupon the line relay of the repeater on the distant end of the toll line Y energizes and prepares the associated selector for operation in the usual manner.

The local toll operator now operates her calling device CD in accordance with the digit, or digits, necessary to extend the connection to the point desired by the calling operator, the interruptions being repeated at armature 220 of line relay 256, and then restores her key K' to normal.

As regards the establishing of connections which originate in the local toll office, it is thought that the detailed operation accompanying the establishing of such connection will be readily comprehended in view of the foregoing detailed description of the operation accompanying the establishing of the various other connections. Briefly, however, the operation is as follows: The toll recording operator receives calls from subscribers desiring toll connections and passes them over to the correct toll operator, which operator may first extend the connection to the distant subscriber and then, after the distant operator responds, signal the calling subscriber again, and tell him that the connection is completed.

In establishing such connections, the use of connectors such as the connector K, Fig. 5, permits the toll operator to handle the traffic much more economically than heretofore, for the reason that the toll operator can set up the local connection completely over the toll service trunking system while she is waiting for the distant subscriber to respond and at the same time not tie up the line of the originating subscriber from receiving and making local calls of short duration. This arrangement permits the toll operator to dial the local number during a time when she has a few moments to spare, and at a time when she can do so without neglecting any of her other duties.

Referring now particularly to the selector E, Fig. 2, it may be said that, although the bracket which is placed around the bank contacts of the selector E is labeled "To toll lines", several levels of selector E may be multipled with the corresponding levels of the local first selectors, and that one level, the tenth for example, may extend to a group of toll switchiing selectors, which selectors rather than the selector E have access to the toll lines. This arrangement, if used, permits the operator on the distant end of the toll line Y to complete connections automatically to the local subscribers if desired, instead of extending the connections through the local operator as desired hereinbefore.

What is claimed is:

1. In a telephone system, a trunk terminating in a jack, a line relay for said trunk, a cord circuit, a plug associated therewith and adapted to be inserted into said jack, a circuit for said relay including a conductor of said trunk, contacts of said jack, contacts of said plug, and a conductor of said cord circuit in series, a pair of normally open contacts in said trunk conductor, a manually operable key associated with said cord circuit for changing the current flow over the sleeve conductor of said plug, and means responsive to the actuation of said key and the resulting current change for closing said contacts.

2. In a telephone system, a trunk terminating in a jack, a line relay for said trunk, a cord circuit, a plug associated therewith and adapted to be inserted into said jack, a circuit for said relay including a conductor of said trunk and a conductor of said cord circuit in series, a pair of normally open contacts in said trunk conductor, a manually operable key associated with said cord circuit, and normally inoperative means for closing said contacts, said means being rendered effective by an increase in the current flow over the sleeve conductor of said plug responsive to the actuation of said key.

3. In a telephone system, a trunk terminating in a jack, a line relay for said trunk, a cord circuit, a plug associated therewith and adapted to be inserted into said jack, a circuit for said relay including a conductor of said trunk, contacts of said jack, contacts of said plug, and a conductor of said cord circuit in series, a pair of normally open contacts in said trunk conductor, a manually operable key associated with said cord circuit for changing the current flow over the sleeve conductor of said plug, means responsive to the actuation of said key and the resulting current change for closing said contacts, and means controlled by the first named means for maintainiing said first named means effective independent of direct control over said sleeve conductor.

4. In a telephone system, a trunk terminating in a jack, a line relay for said trunk, a cord circuit having a plug adapted to be inserted in said jack to connect the conductors thereof with the conductors of said cord circuit, a circuit for said line relay including a conductor of said trunk and a conductor of said cord circuit in series, an open point in said trunk conductor, a manually operable key associated with said cord circuit, means responsive to the actuation of said key for energizing said relay by closing said open point, and means responsive to the restoration of said key for maintaining said relay energized independent of said cord circuit conductor by closing a local circuit therefor.

5. In a telephone system, a plug ending cord circuit, two jacks, a manual trunk terminating in one jack and an automatic trunk terminating in the other jack, a marginal

sleeve relay associated with said cord circuit, a direct current holding bridge, and contacts controlled by said relay through the medium of which said bridge is placed across the talking strands of said cord circuit when said plug is inserted into said other jack and disconnected from across said talking strands when said plug is inserted into said one jack.

6. In a telephone system, a cord circuit terminating in a plug, two jacks, a manual trunk terminating in one jack and an automatic trunk terminating in the other, a conductor of said cord circuit extending to said plug, a pair of normally closed contacts in said conductor, means for applying ringing current to said plug by way of said conductor and said contacts, means controlled by said ringing current for opening said contacts to cut off said current from said plug, and means controlled over the sleeve conductor of said cord for rendering the opening of said contacts effective in case said plug is inserted into said one jack, the last named means being inoperative in case said plug is inserted into said other jack.

7. In a telephone system, a connector switch having wipers, remote controlled means for bringing said wipers into engagement with the terminals of a desired line, means in said connector for seizing the desired line only in case it is idle and for making it busy, and means in said connector for applying ringing current to the desired line, said means for seizing said line and said means for applying ringing current being separately controlled from a distant point.

8. In a telephone system, a connector switch having wipers, remote controlled means for bringing said wipers into engagement with the terminals of a desired line, means in said connector for seizing the desired line only in case it is idle and for making it busy, means in said connector for applying ringing current to the desired line, said means for seizing said line and said means for applying ringing current being separately controlled from a distant point, and a supervisory signal at a distant point controlled by said connector to indicate distinctively as regards the busy or idle conditions of a desired line and whether or not said connector has seized said line.

9. In a telephone system, two lines, a cord circuit connecting said lines, and means in said cord circuit responsive to ringing current received over one of said lines for preventing ringing current from reaching the other of said lines via said cord circuit.

10. In a telephone system, two lines, a cord circuit connecting said lines, means in said cord circuit responsive to ringing current received over one of said lines for preventing ringing current from reaching the other of said lines via said cord circuit, and a relay having contacts for opening a conductor of said cord circuit constituting said means.

11. In a telephone system, two lines, a relay connected to one of said lines and responsive to ringing current, a cord circuit connecting said lines, and means in said cord circuit responsive to ringing current received over the other of said lines for preventing such ringing current from operating said relay.

12. In a telephone system, two lines, a cord circuit connecting said lines, a signal individual to said cord circuit, a second signal individual to one of said lines, means for projecting ringing current over the other of said lines to operate the said cord circuit signal, and means responsive to such ringing current for preventing the operation of said line signal.

13. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, a controlling device at the operator's switchboard, a wiper connecting relay in said switch responsive to the actuation of said device, and a ringing relay in said connector responsive only to a second actuation of said device.

14. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, a wiper connecting relay and a ringing relay in said connector, and means whereby the operator can control said relays separately.

15. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, open contacts at said connector in the conductors leading to the wipers thereof, a relay controlled by the operator at will for closing said contacts, and a second relay controlled at the will of the operator thereafter for signalling the called subscriber.

16. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, a wiper connecting relay in said switch, means whereby the operator can energize said relay at will any time after the switch is operated and before it is released, a ring cut-off relay in said switch energized automatically, and operator controlled means operative any time after said wiper connecting relay has energized for deenergizing said ring cut-off relay to signal the called subscriber.

17. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, and means for automatically signalling the operator in case a connection is established with said line by way of another switch.

18. In a telephone system, an automatic connector switch controlled by an operator

for selecting a subscriber's line, said line remaining in idle condition, means in said switch controlled by the operator at will for making the selected line busy, and means for automatically signalling the operator in case said line is connected with at another point before the said busying means is operated.

19. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, means in said switch controlled by the operator at will for making the selected line busy, and means for automatically signalling the operator in case the subscriber on said line busies his line by making a call before the busying means in said switch is actuated.

20. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, means controlled by the operator at will to make said line busy, other means for connecting with said line and for making it busy, and means for giving the operator a different signal in each case.

21. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, a signal at the operator's switchboard, means for operating said signal in a distinctive way to indicate that the line is idle, means controlled by the operator at will for making said line busy, and means for then operating said signal in a different way.

22. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, means for signalling the operator to advise her that the line is idle, means controlled by the operator thereafter to make the line busy, other means for making the line busy, and means for giving the operator a different busy signal in each case.

23. In a telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, said line remaining in idle condition, means for signalling the operator to advise her that the line is idle, means controlled by the operator thereafter to make the line busy, and means for then signalling the operator to indicate the changed condition of the line.

24. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, a wiper connecting relay in said switch, means whereby the operator can energize said relay at will, and means for signalling the operator in different ways before and after said relay is energized.

25. In an automatic telephone system, an automatic connector switch controlled by an operator for selecting a subscriber's line, a test relay in said switch, means for signalling the operator to notify her whether said relay is energized or deenergized, a wiper connecting relay controlled by the operator if said test relay fails to energize, and means for signalling the operator when said connecting relay energizes.

26. In a telephone system, a connector switch and means for operating the same to select a subscriber's line, a relay energized automatically when the operation of the switch is completed, a locking circuit for said relay, means for subsequently unlocking said relay provided the selected line is idle, and means responsive to the deenergization of said relay for making the selected line busy.

27. In a telephone system, a connector switch and means for operating the same to select a subscriber's line, a relay energized automatically when the operation of the switch is completed, a locking circuit for said relay, means for subsequently unlocking said relay provided the selected line is idle, a wiper connecting relay, and a circuit for the said connecting relay closed by the deenergization of said first relay.

28. In a telephone system, a connector switch and means for operating it to connect with a called subscriber's line, a cut-off relay for the said line, a relay in said connector initially energized in series with said cut-off relay, a locking circuit for said connector relay, and means for opening the initial energizing circuit to deenergize the said cut-off relay while maintaining the switch in selective position.

29. In a telephone system, a connector switch and means for operating it to connect with a called subscriber's line, a cut-off relay for the said line, a relay in said connector initially energized in series with said cut-off relay, a locking circuit for said connector relay, means for opening the initial energizing circuit to deenergize the said cut-off relay while maintaining the switch in selective position, and means controlled by the calling party for closing another energizing circuit for said cut-off relay.

30. In a telephone system, a connector switch and means for operating it to connect with a called subscriber's line, a cut-off relay for the said line, a wiper connecting relay in said connector, a busy test relay in said connector, a relay controlling the circuit of said wiper connecting relay, a circuit for energizing said last mentioned relay in series with said cut-off relay if the line is idle, and another circuit for energizing said last mentioned relay in series with said test relay if the line is busy.

31. In a telephone system, a link circuit, lines, means including said link circuit for setting up connections between pairs of said

lines, and means in said link circuit responsive to ringing current received over one connected line for preventing such ringing current from reaching the other connected line, the last named means being effective or not depending upon the identity of the last-named line.

32. In a telephone system, a link circuit, lines of two different classes, means for connecting the outgoing end of said link circuit with lines of both classes, means for applying ringing current to the incoming end of said link circuit, and means in said link circuit for permitting said ringing current to pass through or not according to the class of the line to which the connection is made.

33. In a telephone system, a link circuit, means for setting up a telephone connection including said link circuit, discriminating means in said link circuit, blocking means in said link circuit, means for applying ringing current to one end of said link circuit, and means responsive to the ringing current for operating said blocking means to block the passage of the ringing current through said link circuit or not depending upon the action of said discriminating means.

34. In a telephone system, a conductor, means for setting up a telephone connection, means for applying ringing current to one end of said conductor, and means for permitting said ringing current to pass or for blocking said ringing current depending upon the class of the connection set up.

35. In a telephone system, an operator's switchboard, an automatic switch, a spring jack at said switchboard, a trunk line extending from said spring jack to said automatic switch, a normally open point in said trunk line, an operator's cord circuit having a plug adapted to cooperate with said spring jack, a calling device at said switchboard for controlling said automatic switch to extend a connection to a desired line, means for connecting said calling device to said cord circuit after the same has been connected to said trunk line through said plug and jack, and means responsive to the connection of said calling device to said cord circuit for closing the normally open point in said trunk circuit.

36. In a telephone system, an automatic switch, an operator's switchboard, a trunk line extending from said switchboard to said switch, means in said switchboard for extending a connection to said trunk line, the last named means including a plug ending cord circuit, a calling device, means for connecting said calling device to a talking strand of said cord circuit, means responsive to the last named means for closing a control circuit for said automatic switch including a conductor of said trunk line, a strand of said cord circuit, and said calling device in series, said automatic switch being responsive to the operation of said calling device to further extend said trunk line, and means responsive to the disconnection of said calling device from the cord circuit to close a local holding circuit for said automatic switch independent of said cord circuit.

37. In a telephone system, an automatic switch, an operator's switchboard, a trunk line extending from said switchboard to said switch, means in said switchboard for extending a connection to said trunk line, the last named means including a plug ending cord circuit, a calling device, means for connecting said calling device to a talking strand of said cord circuit, means responsive to the last named means for closing a control circuit for said automatic switch including a conductor of said trunk line, a strand of said cord circuit and said calling device in series, said automatic switch being responsive to the operation of said calling device to further extend said trunk line, means responsive to the disconnection of said calling device from the cord circuit to close a local holding circuit for said automatic switch independent of said cord circuit, and means responsive to the breaking down of the said connection at the switchboard for opening said holding circuit.

38. In a telephone system, a connector switch having a release magnet and a release relay for controlling the circuit of said magnet, means for operating the switch to extend a connection to a desired line, contacts forming a part of the circuit of said release magnet and also a part of the circuit of said release relay, and means for opening said contacts responsive to the said operation of said switch.

In witness whereof, I hereunto subscribe my name this 22d day of August, A. D., 1922.

JOHN WICKS.