

Jan. 5, 1932.

C. D. KOECHLING

1,840,109

TELEPHONE SYSTEM

Filed March 24, 1930

7 Sheets-Sheet 1

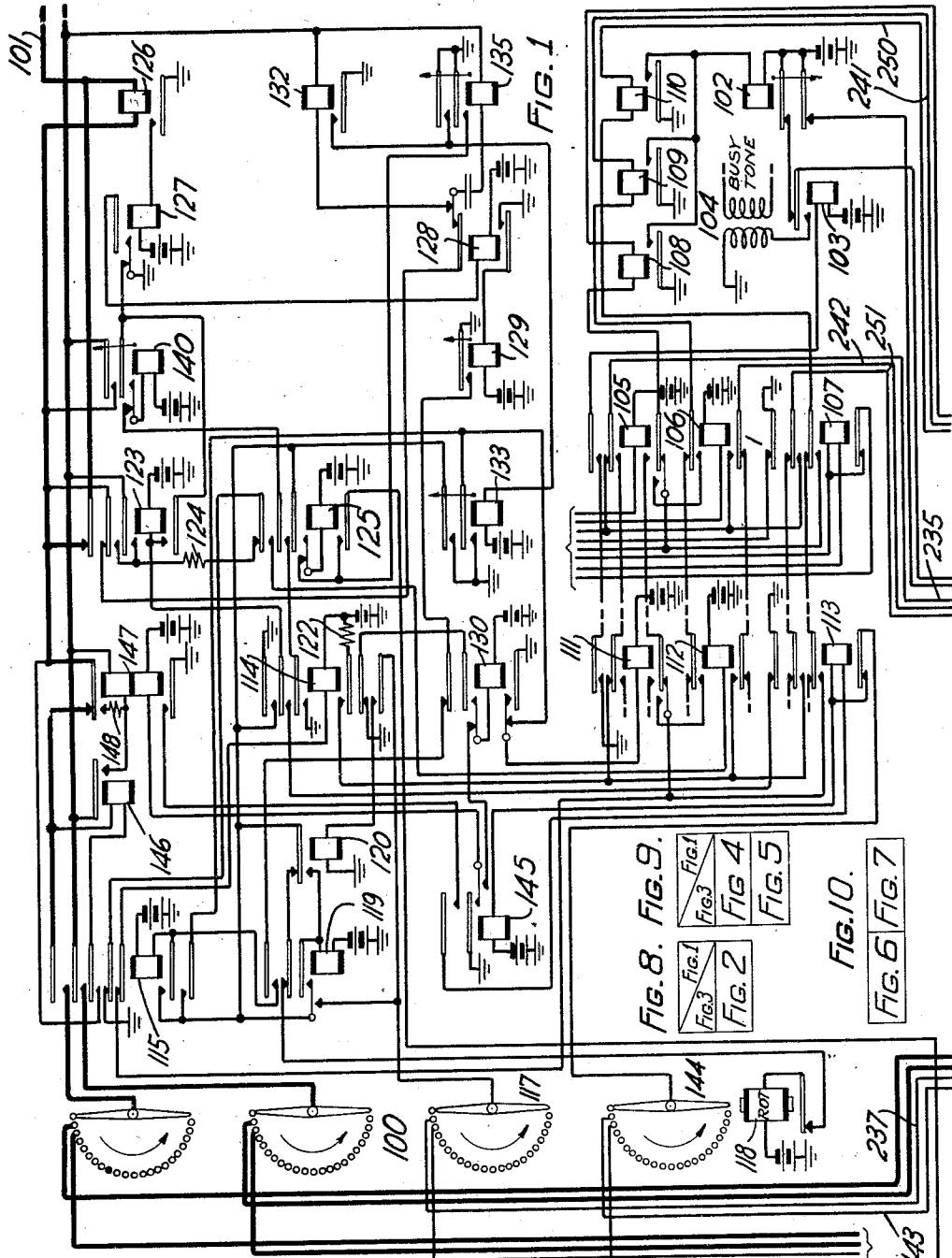


FIG. 1

FIG. 8. FIG. 9.

FIG. 1. FIG. 2.

FIG. 3. FIG. 4.

FIG. 5.

FIG. 10.

FIG. 6. FIG. 7.

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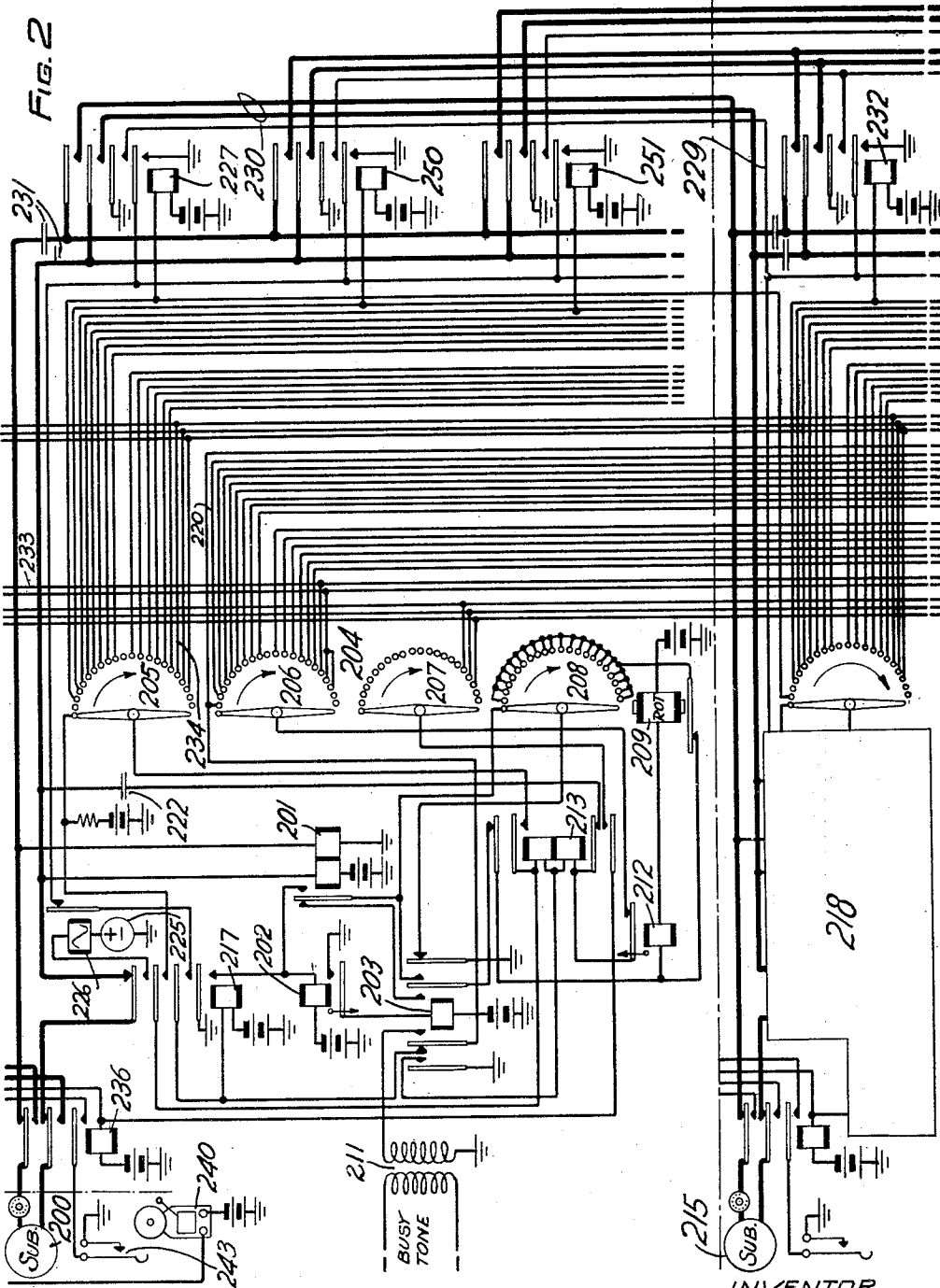
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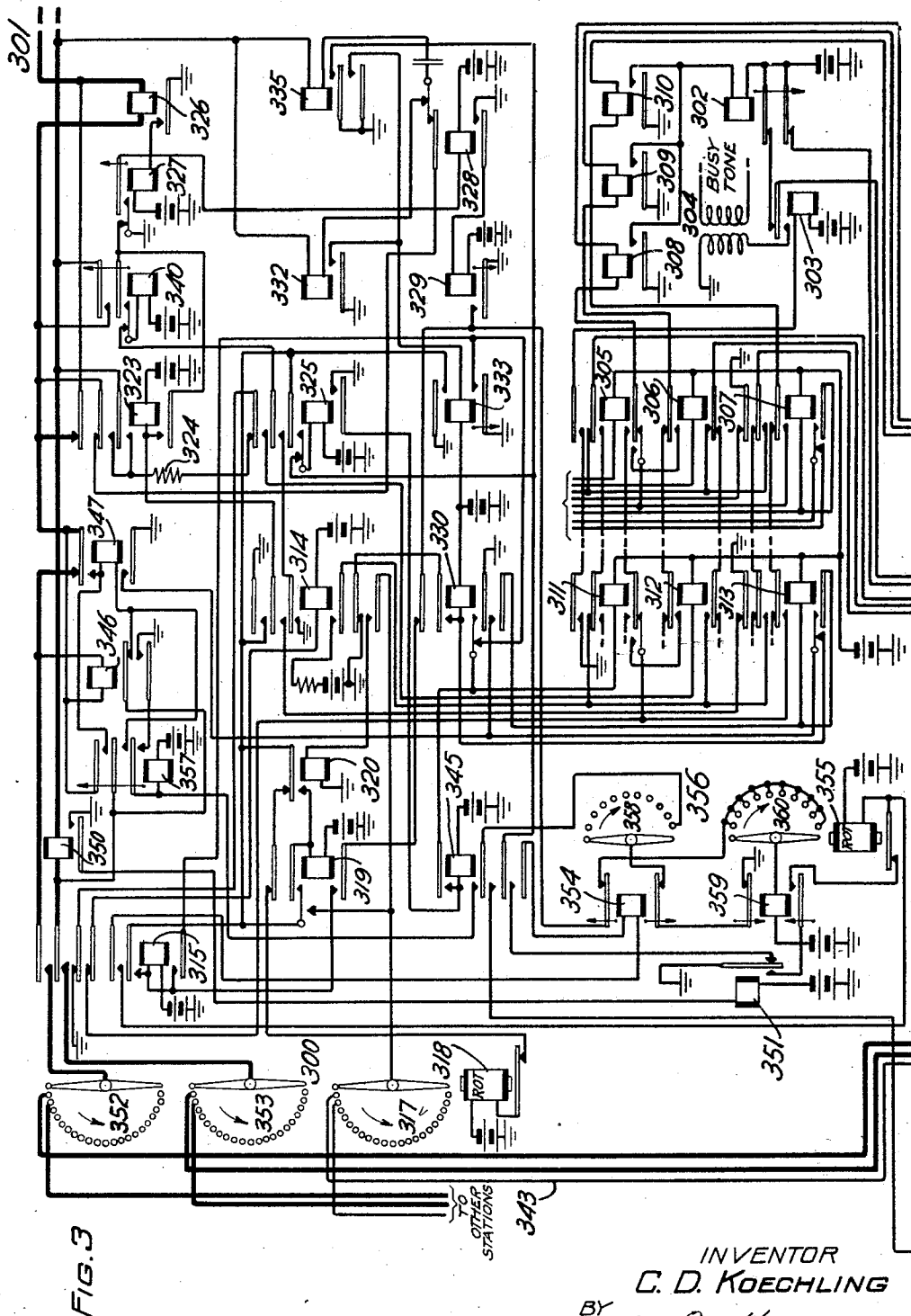


FIG. 3

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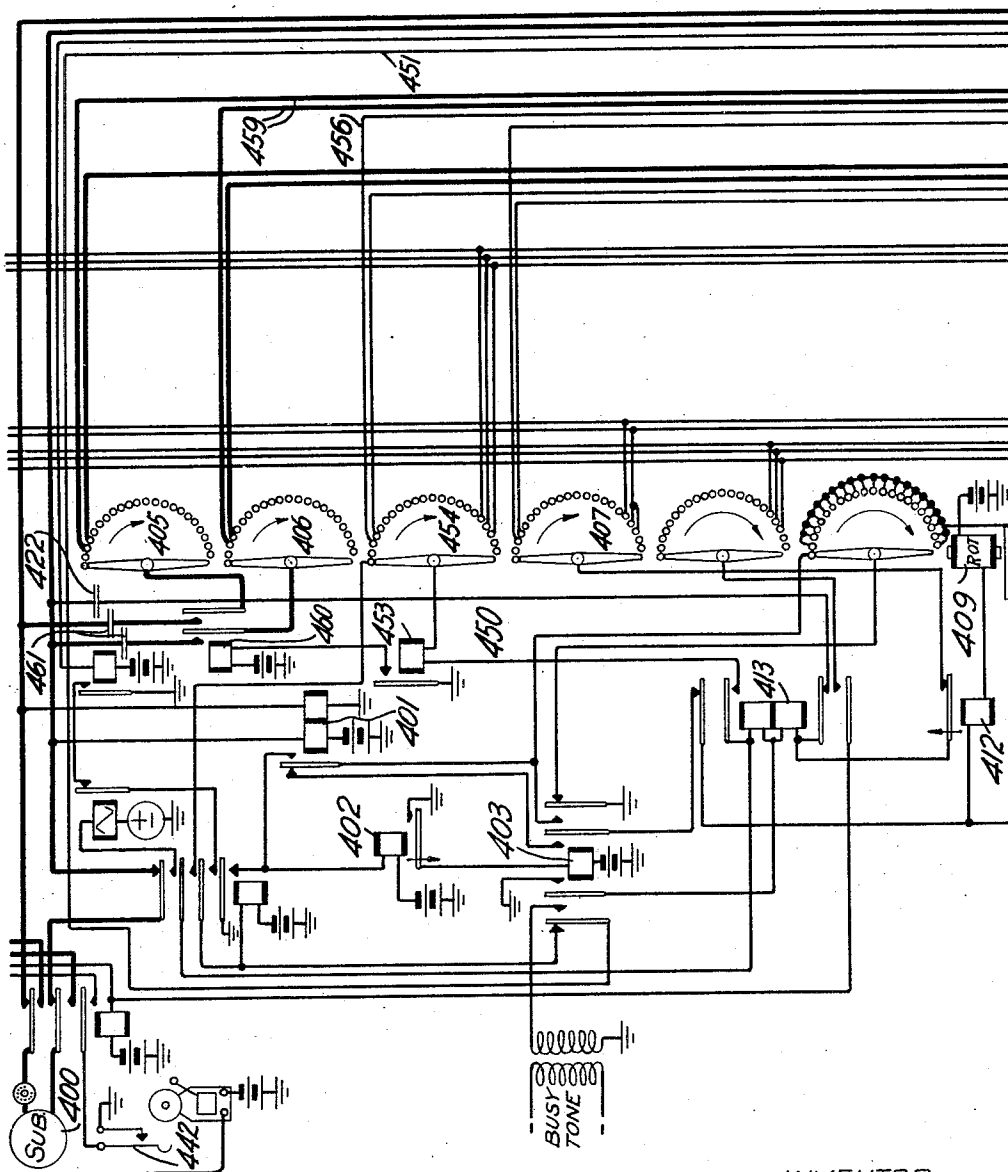
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FIG. 4



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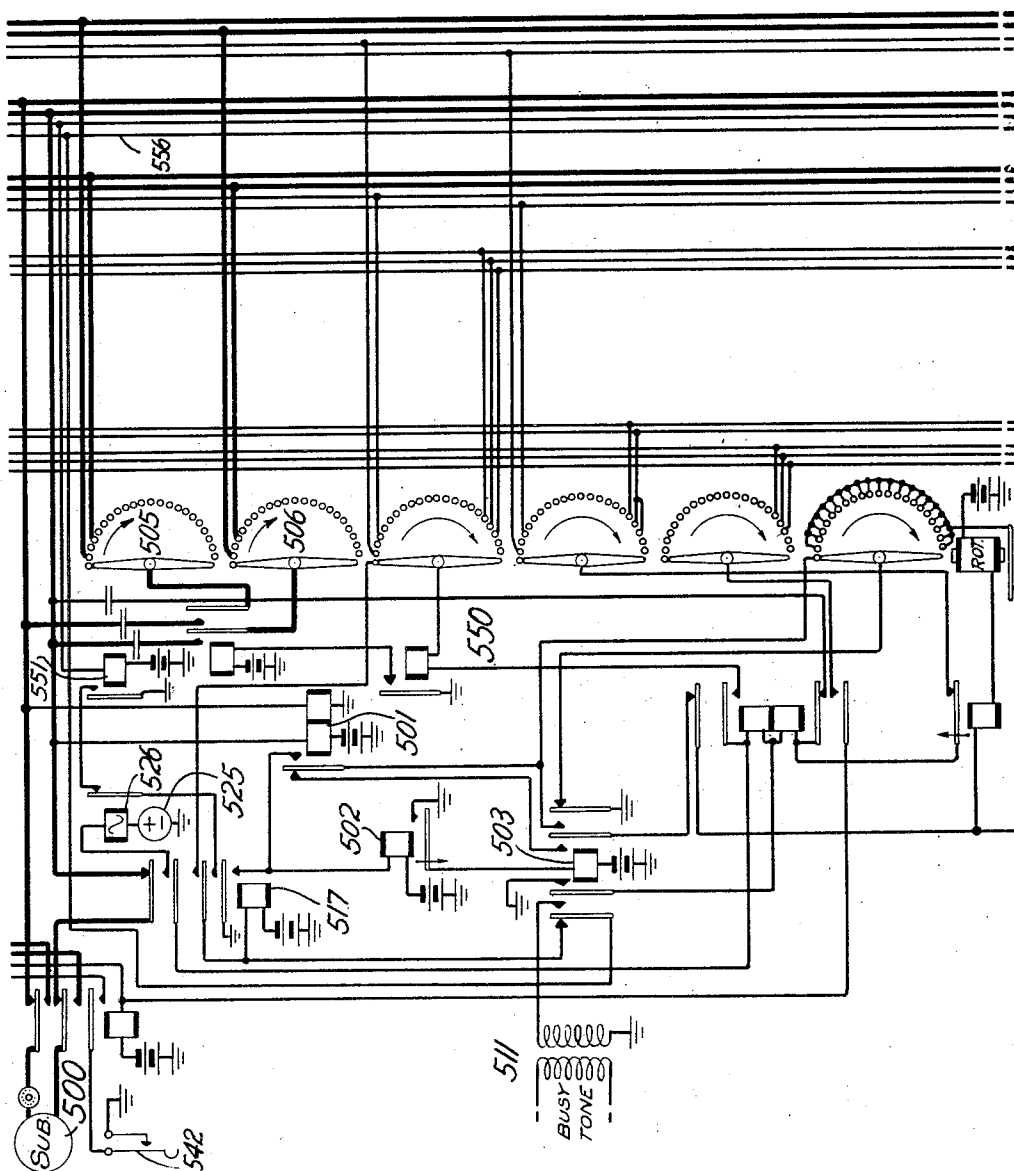
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FIG. 5



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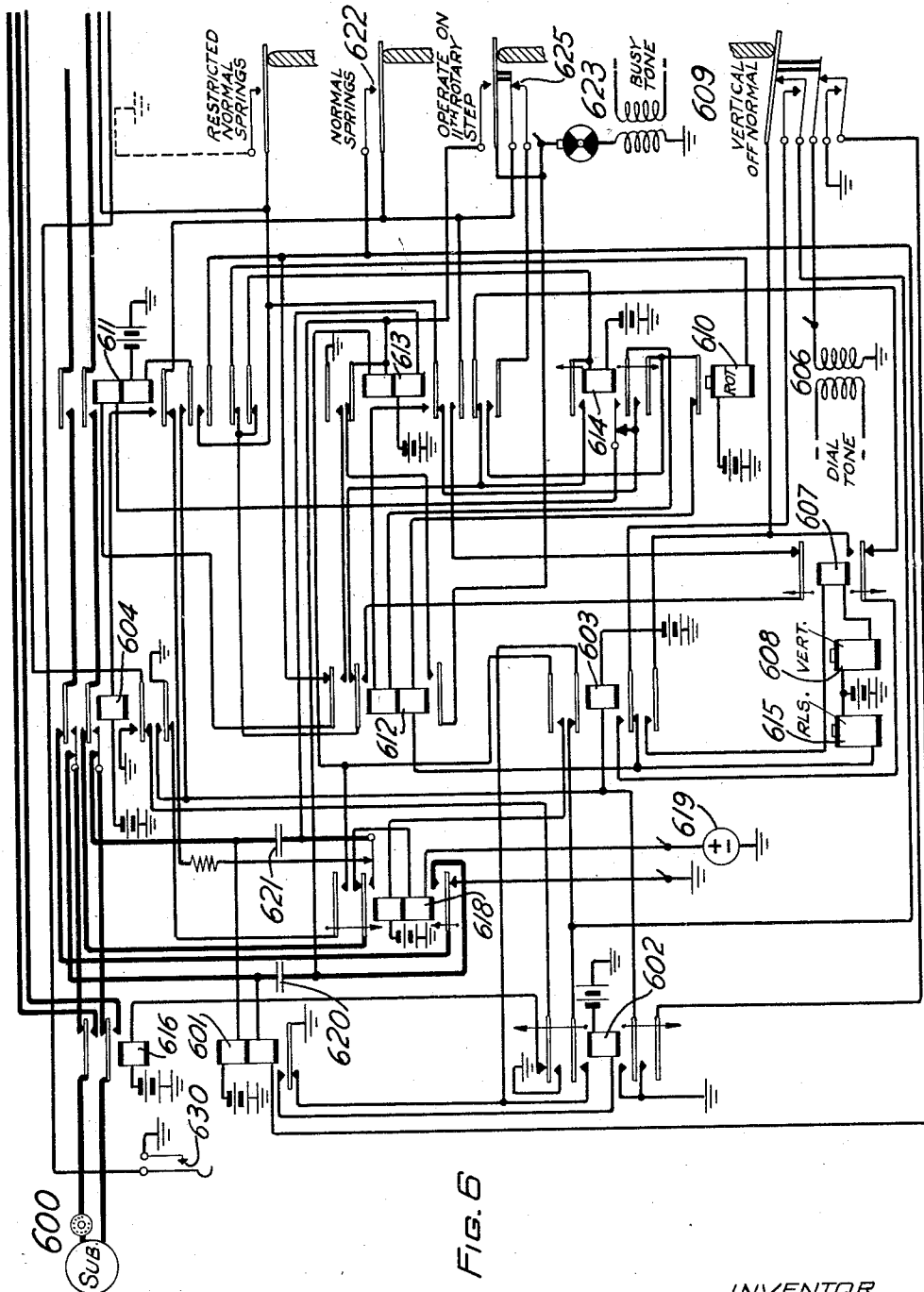


FIG. 6

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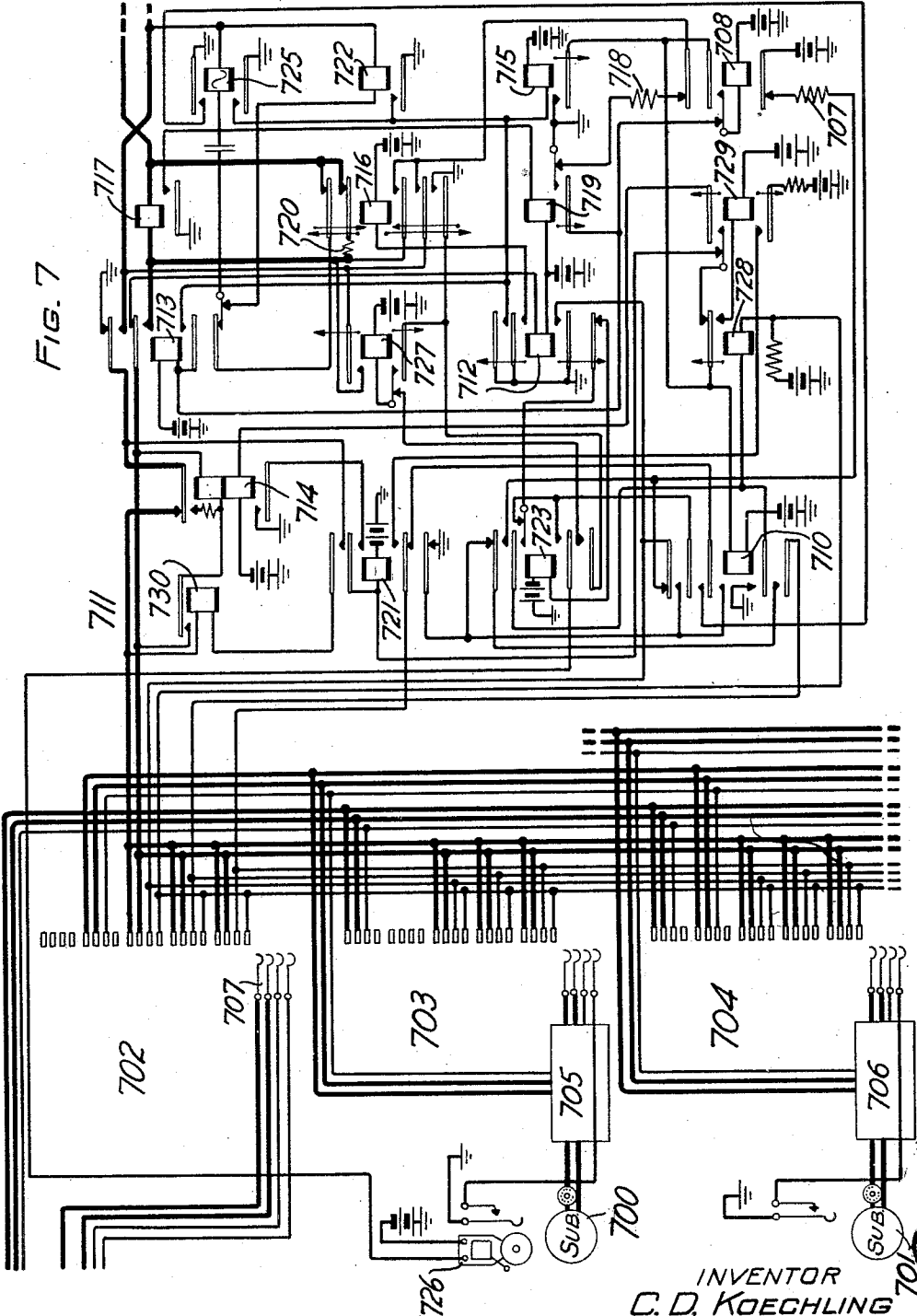
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

Application filed March 24, 1930. Serial No. 438,255.

This invention relates to telephone systems and particularly to automatic private branch exchange systems.

The object of the invention is to simplify the intercommunication between subscribers and the handling of connections with central offices.

Heretofore systems have been employed in which automatic switches may be actuated by impulses to select certain terminals and thereby cause relays to be operated to connect calling subscribers' lines with the desired subscribers' lines over paths excluding the switches. Systems have also been used in which the selection in this manner of certain terminals causes hunting switches associated with idle trunks to be actuated to establish connections between the trunks and the calling subscribers' lines over paths excluding the originally operated switches.

A feature of the present invention is a system in which a switch associated with each subscriber's line is employed as a marking switch for calls between subscribers in the private branch exchange, for calls outgoing and incoming over trunks and calls incoming over trunks originally answered by one subscriber and where this subscriber's line is released from the trunk and the call then answered by another subscriber.

Another feature is a system of this type in which, in the case of a call incoming over a trunk, the subscriber first answering the call may, either by pressing a button or by dialing a certain number, cause his line to be disconnected from this trunk and the trunk marked and held so that another subscriber may answer the call over this trunk. The second subscriber may then dial a certain number causing the switch associated with his line to select a certain terminal and thereby in turn cause a switch associated with the marked trunk to hunt for and connect the second subscriber's line with this trunk over a path excluding said second subscriber's switch.

Another feature is a system of this type in which the switch associated with a calling subscriber's line may also be employed as the actual connecting switch between two

subscribers, or between a subscriber and a trunk for the above mentioned different kinds of calls.

This invention has been illustrated in accompanying drawings where the Figures 1 to 7 may be arranged as shown in Figs. 8, 9 and 10. If the figures are arranged as shown in Fig. 8, Figs. 1 and 2 may be connected together for extension of local calls between two private branch exchange subscribers with the relay system as shown in Fig. 2, and for extension of calls of three different kinds, incoming calls, outgoing calls, and calls transferred from one subscriber to another using the transfer key at the subscriber's station from which the call is to be transferred. If Figs. 3 and 2 are connected together the same types of calls may be extended over this circuit with the exception that the transfer of a call from one subscriber to another is accomplished by means of dialing from the first called subscriber's station. If Fig. 1 or 3 is connected with Figs. 4 and 5 as shown in Fig. 9 the same types of calls may be established with the exception that the local calls are established over switches as shown in Figs. 4 and 5 instead of by means of the relay arrangement shown in Fig. 2. Figs. 6 and 7 are connected together as shown in Fig. 10 and the same types of calls may be established with the selector connector switch as shown in Fig. 6 used in place of the line switches employed in the previous circuits for marking the various kinds of connections. In these latter circuits not only the marking is done by means of the selector connector but the final connections are established over the same switch. The transfer of a call from one subscriber to another is accomplished by means of the operation of a key at the first called subscriber's station.

Detailed descriptions will now be made of these various types of calls with the drawings arranged as shown in Figs. 8, 9 and 10. Beginning with the arrangement shown in Fig. 8 with Figs. 1 and 2 connected together, the establishing of a local connection will first be described. If a subscriber at 200 takes his receiver off the hook relay 201 is actuated

over the connection established over the subscriber's loop through the tip and ring conductors. Relay 201 closes an operating circuit for relay 202 as follows: battery, winding of relay 202, armature and front contact of relay 201, normal contact and brush of bank 208 to ground at outer right hand armature and back contact of relay 203. Relay 202 in turn closes a circuit for relay 203 to prepare the pulsing circuit for the actuation of the line switch shown at 204. Relay 203 provides an obvious holding circuit for relay 202. The switch 204 has four banks 205, 206, 207 and 208 and may be of the ordinary single movement step by step type having a stepping magnet 209 for advancing the brushes over terminals one step at a time. The first effect of the operation of relay 203 will be to close a connection from a busy tone supply at 211 to the first terminal of the bank 206 to make this subscriber's line test busy to other switches associated with other subscribers' lines when they attempt to make connection with this subscriber's line.

At each interruption of the dial the relay 201 releases and operates the rotary magnet 209. Relay 212 is in series with the circuit for the rotary magnet 209 which may be traced from battery, windings of magnet 209 and relay 212 in series, upper armature and back contact of relay 213, inner righthand armature and front contact of relay 203, armature and back contact of relay 201, to ground at the outer righthand armature and front contact of relay 203. Relay 202 is slow in releasing so that this relay as well as relay 203 will remain operated during pulsing. Relay 212 is also slow to release and will remain operated during pulsing. The purpose of the operation of relay 212 is to prevent relay 213 from operating while the brushes of bank 206 pass over the terminals representing lines. The terminals of banks 205 and 206 are arranged to represent connections to the line at positions 1 to 9 and 11 to 16. When the pulsing has ceased the brushes of switch 204 are placed on terminals identifying the desired subscriber's line, which may in this case be the subscriber's line at 215, relay 212 will release and thereby close the circuit for relay 213 as follows: from battery, winding of a relay corresponding to relay 217 of the circuit equipment associated with the desired subscriber indicated by box 218, through the inner lefthand armature and back contact of a relay corresponding to relay 203 of said circuits and through the normally connected lead 220 through the second terminal and brush of bank 206, armature and back contact of relay 212, lower winding of relay 213, to ground at the outer lefthand armature and front contact of relay 203. If this subscriber's line had been busy a connection would have been established from the busy tone source corresponding to

source 211, through the inner lefthand armature and front contact of the relay corresponding to relay 203 over the lead 220, brush of bank 206, armature and back contact of relay 212, lower inner armature and back contact of relay 213, condenser 222, ring conductor to the set at 200 of the calling subscriber, to indicate that the line called was busy. Relay 213 would in this case not have been operated and the relay corresponding to relay 217 would not have been operated as the circuit therefor would have been open at the inner lefthand armature and back contact of the relay corresponding to relay 203.

Assuming that the desired subscriber's line is not busy and the relay corresponding to relay 217 operates, the desired subscriber will be signalled from the source corresponding to source 225 over a circuit established through the relay corresponding to relay 226 and the upper outer armature and front contact of the relay corresponding to relay 217 over the tip conductor to the called subscriber's station. Relay 213 in operating connects its upper winding, through its upper inner armature and front contact, to the brush of bank 205 to establish a circuit for relay 227 from battery, winding of this relay, the second terminal of bank 205 and the corresponding brush, through the upper inner armature and front contact of relay 213 and its upper winding, to ground at the outer lefthand armature and front contact of relay 203. It should be noted at this time that the relay corresponding to relay 217 at the called subscribers' circuits also caused the operation of the relays corresponding to relays 202 and 203 to connect the busy tone source to the normally connected lead 220 to make this subscriber's line test busy and that it is maintained busy by having a locking circuit prepared for the relay corresponding to relay 217 over lead 228 by the operation of relay 227. This locking circuit may be traced from ground through the second upper armature and front contact of relay 227, lead 229 through the armature and back contact of the relay corresponding to the ringing relay 226, second upper armature and front contact and winding of the relay corresponding to relay 217, to battery. Relay 227 also connects the tip and ring conductors from the calling subscriber's line at its upper armatures and front contacts through condensers 231 to leads 230 to the called subscriber's line at 215. This circuit is, however, not at present completed as the relay corresponding to relay 217 is operated to hold the connection through the tip conductor open at its upper outer armature and back contact.

When the called subscriber answers, the ringing relay corresponding to relay 226 is operated causing the release of the relay corresponding to relay 217 to establish the connection to the calling subscriber through the

tip conductor over the leads 230. Talking battery is supplied through the relay 201 and the relay corresponding to relay 201 at the called subscribers' circuits and when this latter relay is operated on the release of the relay corresponding to relay 217 the relays corresponding to relays 202 and 203 are maintained operated. Conversation between the subscribers may now take place. When the subscriber at 200 replaces his receiver on the hook at the termination of the call, relays 201, 202, 203 and 213 are released. At the called subscribers' circuits the relays corresponding to relays 201, 202 and 203 are released. At the calling subscriber's line the release of the above mentioned relays cause a circuit to be completed for the operation of rotary magnet 209 to return the switch 204 to normal. This circuit may be traced from battery, windings of magnet 209 and relay 212, armature and back contact of magnet 209 terminals of bank 208 to ground at the outer righthand armature and back contact of relay 203. This circuit is intermittently opened by the rotary magnet and thus causes it to automatically operate and release until the switch 204 is returned to normal.

If a call is to be made from the subscriber at the private branch exchange to central office this may be done by marking a point on line switch 204. This marking causes a switch such as 100 which is associated with an outgoing trunk 101 to hunt for the calling subscriber's line and connect it to the trunk. To accomplish this the calling subscriber 200 may dial a number 07 and the brushes of the switch 204 will thereby choose the circuits for an outgoing call. The operation of the circuits in Fig. 2 will be identical as hereinbefore described in regard to the operation of the switch 204. If it is assumed that the brushes have been placed at position 17 then when the relay 213 tests the terminal 17 on bank 206 it will operate from battery at the lower inner armature and back contact of relay 102 in the trunk connecting circuit shown in Fig. 1 over armature and back contact of relay 103 and lead 233. If all of the trunks are busy the relay 103 will be operated as hereinafter described and relay 213 will under these circumstances be prevented from operating. Relay 103 on the other hand applies a busy tone from the source 104 through the armature and front contact of relay 103 over lead 233 to bank 206 and over the circuit hereinbefore traced through condenser 222 to the ring side of the calling subscriber's line to indicate that all of the outgoing trunks are busy.

In regard to the outgoing trunks, each trunk is equipped with a circuit such as is shown in Fig. 1 for trunk 101 leading to switch 100 with the exception of the relays 105, 106 and 107 which are shown to indicate how another trunk connecting circuit is wired

and with the exception of the group of relays 102, 103, 108, 109 and 110 which are common to the whole trunk group. The trunk 101 is shown as being the last trunk of the group of trunks and relays 105, 106 and 107 represent a part of the connecting circuit for the first trunk in this group. It should be understood that all trunks should have corresponding relays connected between the two groups of relays 105, 106 and 107 and 111, 112 and 113.

If it is assumed that relay 213 operates as the last trunk in the group is still idle, the upper winding of this relay is connected through the brush 205 over a circuit as follows: from battery, start relay 114, upper inner armature and back contact of relay 115, lower armature and back contact of relay 111, through the lower armatures and front contacts of the corresponding relays of intermediate trunk circuits, and the lower armature and front contact of relay 105, through the winding of relay 108, conductor 234, seventeenth terminal and brush of bank 205, upper inner armature and front contact of relay 213 and upper winding of this relay, to ground at the outer lefthand armature and front contact of relay 203. Relays 108 and 114 operate in this circuit. Relay 114 in operating causes a circuit to be closed for the stepping magnet 118 as follows: battery, winding of magnet 118 and its armature and back contact, upper middle armature and back contact of relay 119, upper armature and back contact of relay 120, to ground at the upper outer armature and front contact of relay 114. This circuit caused the magnet 118 to operate and in operating it opens its own circuit and therefore continues to step the switch one step at a time over the terminals until the terminal of the calling line is reached. In this case, therefore, the switch will only take one step. The operation of relay 108 causes the relay 102 to operate and remove the battery connection from lead 233 at bank 206 and at the corresponding banks of all other line switches to prevent any other station from making a trunk call until this call is completed. Lead 235 is connected through terminal 17 on the bank 207 to relay 236 and to the lead 237 for the marking of the calling subscriber's line on switch 100. One circuit may be traced from battery through the resistance 122, lower inner armature and front contact of relay 114, inner upper armature and back contact of relay 111, through the corresponding armatures and front contacts of the corresponding relays for the intermediate trunk connecting circuits, including the upper inner armature and front contact of relay 105 (if it is assumed that the associated trunks are busy) conductor 235, terminal 17 and brush of bank 207 lower outer armature and front contact of relay 213, conductor 237, the

first terminal and brush of bank 117, lower outer armature and front contact of relay 114, winding of relay 120 to ground; and the other circuit from battery winding of relay 236 to the ground over the same circuit from conductor 237. The function of the relay 236 is to transfer the calling subscriber's conductors from the line circuit to the trunk 101 through the banks of switch 100 and to release the line switch. When the brush of bank 117 therefore comes in contact with the terminal which is connected to conductor 237, relay 120 operates over the circuit hereinbefore traced, while relay 236 will not operate as it is partly shunted by the circuit through the resistance 122 to battery at the inner lower armature and front contact of relay 114. Relay 120 in operating opens the circuit for the stepping magnet 118 at its armature and back contact and thus causes the switch to stop in this position. The relay 120 will not operate as the switch passes over the terminals of other lines as it is connected through the circuits completed to battery through the windings of the relays of these other lines corresponding to relay 236. The reason why relay 120 will not operate under these circumstances is that the resistance of these relays is too high.

Relay 120 besides stopping the switch at the proper point also causes the relay 119 to operate over a circuit from battery to the winding of this relay, armature and front contact of relay 120, upper outer armature and front contact of relay 114. Relay 119 holds the circuit for the stepping magnet 118 open and also establishes a direct connection to ground for brush 117 through the front contacts closed by its inner upper armature and the upper armature and front contact of relay 114. This direct ground connection now causes the operation of the relay 236 and the release of relay 120. The relay 119 in operating also locks itself to the ground at relay 114 over its inner upper armature and front contacts. Relay 114 also causes the operation of relay 123 over a circuit from battery winding of this relay, upper middle armature and front contact of relay 114, to ground at the upper outer armature and back contact of relay 113. Relay 123 in operating signals the central office by establishing a ground connection through resistance 124 to the tip and ring of the trunk at its upper inner and middle armatures and front contacts and through the upper outer armature and back contact of relay 125 and second upper armature and back contact of relay 115. The tip side of the trunk is open at the central office until the operator answers or if the central office is an automatic office until the apparatus at this office is ready to receive the dial pulses. The method of receiving the signal at the central office is immaterial as far as this invention is concerned but when the operator answers or the central office is ready for the reception of dial pulses, 126 will operate over the connection established through the tip and ring conductors at the central office. The operation of relay 126 causes the operation of relay 127 which in turn closes a circuit for the operation of relay 128 while relay 128 closes a circuit for the operation of relay 129. When relay 129 operates a circuit is completed for the operation of relay 115, from battery, winding of relay 115, upper outer armature and front contact of relay 119, upper outer armature and back contact of relay 130 to ground at the armature and front contact of relay 129. When relay 115 operates it indicates that the central office end of the trunk is connected and that the line calling has been found by the switch 100, as this circuit is not complete until relays 119 and 126 have operated. Relay 115 in operating connects the calling line to the central office through its two upper armatures and front contacts.

Relay 115 opens the circuit for relay 114 at its inner upper armature and back contact and relay 114 opens the marking circuit through bank 117. Relay 236, however, is maintained operated as the circuit therefor is now completed to ground at the armature and front contact of relay 129, upper outer armature and back contact of relay 130, upper outer armature and front contact of relay 119, and inner lower armature and front contact of relay 115 and inner front contacts of relay 119. This ground also holds relay 119 operated. Relay 123 releases due to the release of relay 114 to remove the connection to ground through resistance 124 for the tip and ring conductors and short circuits relay 126. Relay 126 releases relays 127, 128 and 129 but relay 128 in releasing closes a circuit for relay 132 across the tip and ring conductors prepared by the release of relay 123. Relay 132 in operating closes a circuit for relay 133 which in turn closes the ground connection for holding relays 115, 119, and 236 operated. Another relay operated by the operation of relay 115 is relay 111. The circuit for this relay may be traced originally from battery, winding of relay 111, lower make-before-break contacts of relay 130, lower armatures and front contacts of relay 115, to ground at relay 129 and later when relay 129 releases to the ground at relay 133. Relay 111 is also held operated by the holding circuit established by relay 132. Relay 111 in operating transfers the start lead 235 and the lead 234 to the next trunk, provided of course that the last trunk is not the one used. If the last trunk is used as in this case, relay 111 will close a contact in the chain of the trunk busy relay 103 circuit to ground to indicate that all the trunks are busy as hereinbefore described. Relay 103 is operated over the cir-

cuit through the upper outer armatures, and front contacts of relays such as 105 and 111 and intermediate corresponding relays to ground. It should be noted that when relay 236 operates and transfers the connection from the line circuit to the trunk circuit for the calling subscriber's line, the line switch 204 will be released and returned to normal by the release of relay 201 and the relays controlled thereby as hereinbefore described.

Referring now to calls incoming from central office over trunk 101, when the central office seizes this trunk, relay 132 operates and causes the operation of relay 133. This relay in operating causes the operation of relay 111 to prevent outgoing calls from being made over this trunk. When ringing current is applied to the trunk at central office, relay 135 operates. This relay in operating closes a circuit for the operation of relay 125 over an obvious circuit. Relay 125 closes a circuit for the trunk signaling bell 240 as follows: battery, bell 240, lower armature and front contact of relay 125, to ground at the upper inner armature and front contact of relay 135. Bell 240 may be located at any convenient place in the private branch exchange where it can be heard by any subscriber so that any subscriber may answer this call. Relay 125 also closes a circuit for relay 112 from battery, winding of relay 112, upper outer armature and front contact of relay 125, to ground at the second upper armature and back contact of relay 115. Relay 112 in operating closes connections through the trunk connecting circuits to leads 241 and 242 from the line circuit in Fig. 2 to control the switch 100 to hunt for the line of the private branch exchange subscriber that answers this call.

As stated any subscriber may answer this call and to answer it the subscriber must dial the code 08 which will operate the associated line switch 104 in case the subscriber 200 has answered the call, to cause the brushes of this switch to advance to terminal 18. The operation of the line circuit is the same as hereinbefore described except that in this case when the terminal 18 is reached relay 109 is operated with the start relay 114, instead of relay 108, over the circuit established through the lead 241, the 18th terminal of bank 205 and the contacts of relays 213 and 203. In this case the circuit from the start relay 114 to conductor 241 is established due to the operation of relays 111 and 112 and may be traced through the upper armature and front contact of relay 112 and make-before-break contacts of relay 111. The rest of the circuit is the same as hereinbefore described. The switch 100 will, due to the operation of relay 114, start to operate and hunt for the calling line 200 in the same manner as hereinbefore described. Relay 140 will operate on the operation of relay 114 from battery, winding of this relay and its make-before-break contacts, second upper armature and front contact of relay 125, upper inner armature and front contact of relay 114 to ground. Relay 140 operates simultaneously with relay 123 and closes a locking circuit for itself under control of relay 127. The tip and ring conductors are now bridged at the upper outer armature and front contact of relay 140 thus causing the ringing to be tripped in the central office. This bridge closes a circuit for relay 126 through the central office loop and causes relays 127, 128 and 129 to operate as hereinbefore described. When the switch 100 finds the calling line, relays 119 and 115 will be operated to connect the subscriber's line 200 to the trunk 101 to the central office. On the operation of relay 115, relay 112 will release so that other calls may be answered.

To transfer trunk calls from one subscriber to another subscriber, it is necessary to hold the trunk operated, call the station to whom the call is to be transferred, release the first connection and have the subscriber at this station dial a transfer code number to pick up the call on the trunk. This holding of the trunk is accomplished by operation of the holding key 243 at the connected station. The operation of this key closes a circuit for conductor 143 which is connected through brush 144 to the winding of relay 145. The circuit may be traced from battery winding of relay 145, lower armature and back contact of relay 113, brush 144, first terminal of this bank, conductor 143, upper inner armature and front contact of relay 236, key 243 to ground. Relay 145 operates in this circuit and causes the operation of relay 147. This relay in operating opens the connection for the tip conductor and bridges itself across the trunk and through its upper armature and front contact and upper winding through a resistance 148. Relay 130 also operates over an obvious circuit due to the operation of relay 145 to release relays 115, 119, 236 and 111. The connection from ground at the armature and front contact of relay 129 for these relays is opened at the upper outer armature and back contact of relay 130. When key 243 is released relay 113 operates in series with relay 145 from battery through the windings of relays 145 and 113, upper outer armature and front contact of relay 145 to ground at the lower armature and front contact of relay 147. Relay 113 closes connections for leads 250 and 251 to prepare for the seizure of trunk 101. The release of the relay 236 causes the switch 204 of the line 200 to be returned to normal.

The station for which the call was intended may now pick up the trunk by dialing the code number 09. The switch of this subscriber's line corresponding to switch 204 will then operate to connect its brushes with

its terminals 19 in the same manner as hereinbefore described. In this case, however, relay 110 will be operated in place of relay 108 or relay 109 as in the previously described calls. The start relay 114 will now cause the switch 100 to connect with the calling subscriber's line as hereinbefore described. When relay 115 operates it connects the relay 146 in series with the trunk to the station. Relay 146 is operated and closes the circuit through the upper winding of relay 147 in series with the trunk to the station, thus causing this relay to release to complete the connection through the tip to the station and the trunk and short circuit relay 146. The station and the trunk are now connected as hereinbefore described. The subscriber at this station may also transfer the call in the same manner to another subscriber. Relay 147 in releasing causes the release of relays 146 and 113. Release of 113 releases 110 and 102.

If Fig. 3 is used with Fig. 2 instead of Fig. 1 the operations of the circuits in Fig. 2 are the same for outgoing calls over trunk 301 using switch 300. Incoming calls and transfer of calls, however, are somewhat different. In case of incoming calls the only difference is that when relay 325 operates it closes a circuit for the operation of relay 345. This relay in turn closes the circuit for the trunk bell 240 from the ground at relay 335 instead of relay 125 as in Fig. 1.

In case of the transfer of a call the calling subscriber at 200 will dial 0 to hold the trunk 301 for selection by another station in picking up the trunk, and to release the switch 204. In other words, the originally calling subscriber dials a number instead of operating the key (243). When this subscriber's station is first connected to trunk 301 a circuit will be completed for the operation of relay 350. The circuit for this relay 350 is complete from the calling subscriber's loop, the tip and ring conductors through banks 352 and 353, the two upper outer armatures and front contacts of relay 315, winding of relay 350 to battery and ground at the central office over the tip and ring conductors of trunk 301. Relay 350 closes a circuit for the operation of relay 351. When now the subscriber dials the number 0 these two relays will respond to the pulses by releasing and operating. Relay 351 when first released will close a circuit for relay 354 and the rotary magnet 355 for operation of switch 356. This circuit may be traced from battery, winding of magnet 355, second upper armature and front contact of relay 315, winding of relay 354, lower outer armature and front contact of relay 351, to ground. Relay 354 operates and remains operated during the pulsing and the rotary magnet 355 in responding to the pulses advances the brushes of switch

356 to the tenth position. When the pulsing is completed relay 354 releases and causes the operation of relay 357 over a circuit from battery, winding of this relay, lower inner armature and front contact of relay 345, the tenth terminal and brush of bank 358, lower armature and back contact of relay 354, upper armature and back contact of relay 359 to ground. Relay 357 in operating closes a circuit for relay 347 over a circuit as follows: from trunk 301 over tip conductor, upper outer armature and front contact of relay 357, winding of 347, middle upper armature and front contact of relay 357 to the ring conductor back to trunk 301. Relay 347 is now bridged across the tip and ring conductors in series with relay 350 over a circuit from the tip conductor, upper armature and front contact and winding of relay 347, lower inner armature and back contact of relay 346, winding of relay 350 to the ring conductor. The trunk is hereby held for seizure by another subscriber's station. Relay 347, also opens the tip conductor for the trunk at its upper armature and back contact and closes it to the ring conductor. Relay 347 also closes a circuit for the operation of relay 330 which in turn causes the operation of relay 313 in practically the same manner as hereinbefore described in connection with Fig. 1 for the operation of the relays 130 and 113 except that in this case these relays are not controlled by relay 346 but directly by relay 347. The station 200 connection is thereby released by the opening of the connection to ground relay 236 with the consequent release of switch 204. When relay 354 was released it also closed a circuit for the operation of relay 359 from battery, winding of this relay, brush of bank 360 and the tenth terminal thereof, upper armature and back contact of relay 354, to ground at relay 329. This opened the circuit for relay 357 and causes the switch 356 to be stepped back to normal position through the circuit completed through the interrupting contacts of the stepping magnet 355, the lower armature and front contact of relay 359, to ground at the armature and front contact of relay 351. When the switch has returned to normal this circuit is opened at bank 360. It should be noted that relay 359 is slow to operate to permit the circuit for relay 357 to be closed before the switch 356 begins its return to normal and relay 357 is slow to release so that it will hold long enough to permit relay 347 to operate and lock up under control of relay 346.

Another station may now seize the trunk by dialing the proper code, that is, the code number 08. The operation of the circuit of Fig. 3 in seizing the trunk 301 by the second subscriber's station is similar to the operation of the circuits of Fig. 1 in this respect. The only exception is that when relay 346 op-

erates, relay 347 and 350 are released causing relay 351 to release. The purpose of holding relay 350 operated was to maintain relay 351 operated to complete the release pulsing circuit for switch 356. The remaining relays and apparatus in the trunk connecting circuit shown in Fig. 3 have been numbered with numerals corresponding to the numbers shown in Fig. 1 except that the hundred digits have been changed to 3 instead of 1. This will aid in tracing the circuits in connection with the previous descriptions relating to the incoming and outgoing calls.

If Figs. 4 and 5 are used as shown in Fig. 9 with Fig. 1 or 3 the operation of the circuits in establishing connections from calling subscribers at 400 or 500 to a trunk 101 or 301 or from these trunks to the subscribers are the same as when Fig. 2 is used in connection with Figs. 1 and 3. The only difference in this case is the method of extending calls between subscribers at the private branch exchange. Instead of employing relays such as relays 227, 250, 251 and 232 as shown in Fig. 2 for extending this type of connections, the step-by-step line switches 450 for the subscriber at 400 and 550 for the subscriber at 500 are employed.

A description for extending a connection between the subscribers at 400 and 500 will now be made with the subscriber at 400 as the calling subscriber. When this subscriber removes his receiver from the switchhook, relays 401, 402 and 403 are operated in the same manner as hereinbefore described in connection with Fig. 2 to prepare the pulsing circuit for the rotary magnet 409, to make the station busy by grounding the conductor 451 and to send out dial tone to the calling station through the condenser 422 over the ring conductor. During the dialing of the desired subscriber's number relay 401 follows the pulses and closes a connection to ground from the relay 403 for the operation of relay 412 and magnet 409 to advance the brushes of switch 450 over the terminals of the corresponding banks until the desired subscriber's line is found. If the subscriber at 500 is desired the switch will merely take two steps to make the connection. Relays 412 will remain operated during the dialing to keep the test circuit open and prevent the relay 413 from operating while the switch is in motion. Relay 412 releases at the end of the series of impulse and relay 413 is connected to brush 407. If the called line is idle relay 413 will be connected in series with relay 517 in the called line circuit. Both relays operate and relay 517 closes a ringing circuit from source 525 to call the subscriber at 500. Relay 413 in operating connects its upper winding through the winding of relay 453 and the brush of bank 454, over conductor 456 through the winding of relay 551 to battery. Relays 453 and 551 operate in this circuit. Relay 517

also closes a circuit for relay 502, while relay 503 connects busy tone from common source 511 to lead 556 so that the called line will test busy to other calls. Relay 551 now holds relay 517 operated through the circuit complete at its armature and front contact under control of the ringing relay 526.

When the called station answers relay 526 operates and releases relay 517 thus disconnecting the ringing causes from the tip conductor which is now completed at the upper outer armature and back contact of this relay. When relay 453 operates it closes a circuit for the operation of relay 460. This relay in operating completes the connection between the two subscribers' lines over condensers 459 through the brushes of banks 405 and 406 and condensers 461. Talking battery is supplied through the relays 401 and 501 to the calling subscribers' and the called subscribers' lines respectively. When relay 501 is operated on the release of relay 517 relay 502 is maintained operated to hold relay 503 operated for maintaining of the called subscriber's line busy.

The relays and apparatus in Figs. 4 and 5 for extending outgoing trunk calls or calls incoming from trunks have been numbered with numerals corresponding to the numeral for the same relays and apparatus in Fig. 2 with the exception of the hundred digits which have been changed, for Fig. 4 to 4 and for Fig. 5 to 5. As stated, Figs. 4 and 5 may be used with either Fig. 1 or 3 and in transferring calls if they are used with Fig. 1 the key 442 or 542 may be used or if they are used with Fig. 3 the subscriber at station 400 or 500 will dial the transfer code number to hold the trunk.

Referring now to Figs. 6 and 7 arranged as shown in Fig. 10, these circuits are equipped with a two movement switch which connects lines directly and functions as a connector for connections between two private branch exchange lines and as a selector for connections to central office trunks. For outgoing calls the first idle trunk is automatically seized by the selector connector while for incoming calls a bell at some convenient place at the private branch exchange is operated. Any station may answer the call by dialing the proper code number and in this case the trunk on which the call is waiting will be automatically seized by hunting movements of the switch. Calls may be transferred by actuating a key at the connected subscriber's station and the switch is thereby released and the trunk held. Any station may then pick up the call by dialing the proper code number and automatically select the trunk.

Referring now to the drawings, Figs. 6 and 7, three subscriber's lines have been shown at 600, 700 and 701 respectively with their associated selector connectors 702, 703 and 704 respectively. Only the circuits for

the subscriber's line 600 have been shown in detail in Fig. 6 while the circuits for the other subscribers have merely been indicated by boxes 705, 706 respectively. In Fig. 7 the circuits of one trunk line have been shown. It should be noted that in these selector connectors the first level has been assigned for seizing trunks on transfers, the second level has been assigned for seizing trunks on incoming calls and the third level has been assigned for seizing trunks on outgoing calls, while the remaining levels have been assigned for local connections.

The operation of the circuits in extending a call from one private branch exchange subscriber to another will now be described. If the subscriber at 600 removes his receiver from the hook, relay 601 is operated over a circuit completed through the subscriber's loop and the two windings of relay 601. The operation of this relay closes an obvious circuit for the operation of relay 602 and this relay in turn closes a circuit for the operation of relay 603. Relay 602 closes a connection to ground at its upper outer armature and front contact, through the lower inner armature and back contact of relay 604, to the sleeve conductor connected to the terminals of this line in the various selector connectors so as to make this line test busy. Tone from the source 606 will be transmitted to the calling subscriber to indicate that the switch is in working condition and that dialing of the desired subscriber's line may be begun. When the calling subscriber dials the first digit relay 601 follows the impulses and closes a connection to ground for the operation of relay 607 in series with the vertical magnet 608. This circuit may be traced from battery through the windings of magnet 608 and relay 607, second lower armature and front contact of relay 603, vertical off normal contacts 609, upper inner armature and front contact of relay 602, to ground at the armature and back contact of relay 601. The first step of the brushes 707, of switch 702, change the connections at the vertical off normal contacts for the pulsing circuit which now passes through the make contacts of the vertical off normal contacts, lower inner armature and front contact of relay 603 and the lower armature and front contact of the relay 607 that remains operated during the pulsing. The change in the position of the vertical off normal contacts also cuts off the dial tone.

When the first series of pulses ceases relay 607 releases and a circuit for the rotary magnet 610 will then be completed for control by the second digit impulses as follows: battery, winding of the rotary magnet 610, fourth lower armature and back contact of relay 611, upper inner armature and back contact of relay 612, third lower armature and back contact of relay 613, lower armature and back

contact of relay 607, inner lower armature and front contact of relay 603, vertical off normal contacts 609, inner upper armature and front contact of relay 602, to ground at the armature and back contact of relay 601. This circuit from ground at relay 601 is also completed through the lower outer armature and back contact of relay 611, through winding of relay 614 to battery. Relay 614 also operates on the first impulse and closes a circuit for itself through its upper armature and front contact, third lower armature and back contact of relay 613 to the ground for 601, independent of the path through armatures and contacts of relay 611. Relay 614 remains operated during this series of impulses. When relay 614 operates a testing circuit for relay 612 is closed to the sleeve brush of switch 702 from battery, winding of the release magnet 615, lower winding of relay 612, armature and back contact of rotary magnet 610, lower outer armature and front contact of relay 614, lower inner armature and back contact of relay 613 to the sleeve brush.

When the switch stops relay 612 will test the line called and if the line is idle will remain unoperated. The relay 614 will then release and the upper winding of relay 611 will be connected to the sleeve brush over a circuit as follows: from ground, lower outer armature and front contact of relay 602, upper outer armature and back contact of relay 612, upper winding of relay 611, make-before-break contacts of relay 614, lower inner armature and back contact of relay 613 to the sleeve brush. This relay 611 operates partially over this circuit in series with a relay corresponding to relay 616, in the called subscriber's circuit. The circuit for this relay may be traced from battery, winding of this relay, upper outer armature and back contact of the relay corresponding to relay 602, lower inner armature and back contact of the relay corresponding to relay 604 through the sleeve terminal on the switch 702. The partial operation of relay 611 closes a connection through its second lower armature and front contact causing it to fully operate through its lower winding over a circuit from battery through this winding, second lower armature and front contact to ground at the inner lower armature and front contact of relay 602. Relay 611 in operating fully establishes a ground connection for the sleeve and causes the operation of the relay corresponding to relay 616 in the called subscriber's circuit. The ground connection is established directly from the ground at the outer lower armature and front contact of relay 602 through the third lower armature and front contact of relay 611 to the sleeve. The operation of the relay corresponding to relay 616 closes the talking connection from the called subscriber to the tip and ring terminals of switch 702 on which the brushes 707 are rest-

ing. Ringing current is now applied to the called subscriber's line over a circuit in series with the relay 618 as follows: from the source 619, lower winding and upper inner armature and back contact of relay 618, inner upper armature and back contact of relay 604, and upper inner armature and front contact of relay 611, over the ring conductor through the bell at the called subscriber's station and back over the tip conductor through the armatures and front contacts of the relay corresponding to relay 616 of this subscriber's line, upper outer armature and front contact of relay 611, upper outer armature and back contact of relay 604, lower armature and back contact of relay 618 to ground. The calling subscriber will hear the ringing from the tone introduced in the upper winding of relay 618 over a circuit through the second upper armature and front contact of relay 603, upper winding of relay 613, condenser 620 and upper make-before-break contacts of relay 604, upper outer armature and back contact of relay 616, to the tip conductor of the calling subscriber's line.

When the called station answers this call, current through the lower winding of relay 618 causes this relay to operate and connect the lines together through the condensers 620 and 621, over the lower armature and front contact and upper inner armature and front contact of this relay. Talking battery is supplied through the windings of relay 601 for the calling subscriber's line and through the winding of relay 613 for the called subscriber's line. The circuit from battery and ground through the winding of relay 601 has already been described and the circuit from battery and ground through the winding of relay 613 are obvious. Relay 618 in operating provides a locking circuit for itself through its upper outer armature and front contact to ground at the lower outer armature and back contact of relay 604 under the control of relay 603.

When the calling subscriber hangs up his receiver, relays 601, 602 and 603 are released causing the release of relays 618 and 611 and the circuit for the release magnet 615 is closed from battery winding of magnet 615, inner lower armature and back contact of relay 603, vertical off normal contact 609, upper inner armature and back contact of relay 603 armature and back contact of relay 601 to ground. When the switch 602 has been returned to normal the vertical off normal contacts 609 open the circuit for the release magnet.

If the called station had been busy when the relay 612 made the test the sleeve terminal on the called subscriber's circuit would have been connected to ground as hereinbefore described. Relay 612 would have operated and thus prevented the operation of relay 611 when relay 614 released; and a busy

tone would have been sent to the calling station from the source 623 through the circuit completed at the lower armature and front contact of relay 612, upper inner armature and back contact of relay 613 through the condenser 620 to the calling subscriber.

To make a call to a central office the calling subscriber dials the outgoing trunk code number. In this case this number would be 3 which would bring the switch 702 to the third level. The switch will be operated as hereinbefore described in connection with the station to station call. When the brushes arrive at the third level a hunting will be started for an idle trunk to the central office. This is accomplished by having off normal springs 622 so arranged that they will be closed by the switch when the third level is reached. The closing of this switch causes relay 613 to operate over a circuit as follows: from battery lower winding of relay 613, upper make-before-break contact of relay 618, lower inner armature and back contact of relay 611, contacts 622, to ground at the lower armature and front contact of relay 602. A circuit will then be closed for the operation of relay 612 as follows: battery, winding of the release magnet 615, lower winding of relay 612, armature and back contact of the rotary magnet 610, lower outer armature and front contact of relay 613, eleventh step rotary off normal contacts 625, contacts 622, to ground at the lower outer armature and front contact of relay 602.

When the relay 607 releases after the vertical impulses have been transmitted circuits are completed for the operation of the rotary magnet 610 and relay 614. These circuits may be traced from caller through the windings of the magnet and relay in parallel through the two lower armatures and back contacts of relay 611, upper inner armature and front contact of relay 612, upper armature and back contact of relay 607, second lower armature and front contact of relay 613, contacts 622, to ground at relay 602. The operation of the rotary magnet in operating opens the energizing circuit for relay 612 which now releases. Relay 612 in releasing opens the circuit for the rotary magnet and relay 614. Rotary magnet releases and relay 614 remains operated for a short period as it is slow to release. Relay 612 is now again operated to close the circuit for the rotary magnet and maintain relay 614 operated and thus cause the brushes of switch 702 to take a second step. These operations will be continued until an idle trunk is found. Busy trunks will have ground on their sleeves supplied at the lower armature and front contact of relays such as relay 712, while idle trunks will have a connection to battery through the lower armature and back contact of relays such as relay 708, resistances such as 707 and upper outer armature and back

contact of relays such as relay 710. The switch 702 will therefore step in this manner until an idle trunk is found when the relay 612 is energized over its upper winding in the following manner: Assuming that trunk 711 is idle relay 612 will not release but will be maintained operated from the battery at relay 708 before relay 614 is released over a circuit as follows: battery, lower armature and front contact of relay 708, resistance 707, upper outer armature and back contact of relay 710, the sleeve terminal of trunk 711, sleeve brush of switch 702, lower inner armature and front contact of relay 613, upper winding of relay 612, lower inner armature and front contact of relay 614, upper winding of relay 611, upper outer armature and front contact of relay 612 to ground at the upper outer armature and front contact of relay 613. Therefore when the switch 702 finds an idle trunk having a battery connection on the sleeve the relay 612 is held operated over this circuit to prevent further stepping of the switch. Relay 611 is also partially operated over this circuit and to close the circuit through its lower winding to cause it to be fully operated as hereinbefore described. Relay 611 opens the circuit for the rotary magnet and relay 614 and closes an obvious circuit through contacts 622 for the operation of relay 604 which prevents ringing current from being connected to the trunk. Relay 604 also transfers the talking conductors of the calling station directly to the trunk through its upper armature and front contact and the trunk connection is completed through the upper armatures and front contacts of relay 611. When relay 604 operates relays 601 and 602 are released and the control ground for relays 611 and 603, is transferred to relay 604 lower outer armature and front contact. Relay 602 however releases relay 613 and this relay releases relay 612, whereas relay 604 is held from a ground connection on the sleeve established at trunk 711 as soon as the talking conductors are extended to this trunk. How this ground is applied will presently be described. Relay 604 also applies a busy ground on the sleeve conductor for the calling subscribers sleeve terminals at the selector connector switches to make this subscriber's line test busy. If all of the trunks are busy the switch will stop on the eleventh rotary step at which time the contacts 625 are operated to stop the switch by opening the rotary magnet circuit and to connect busy tone from source 623 to the calling station.

When the talking conductors are extended through to the selected trunk 711 relay 712 will operate from battery winding of this relay, upper inner armature and back contact of relay 713, over the loop completed through the calling subscriber's station back over the tip conductor through the upper armature

and back contact of relay 714 to ground at the upper outer armature and back contact of relay 713. Relay 712 in operating closes the connection for the sleeve conductor to ground at its lower inner armature and front contact to hold the switch 702 actuated by completing the circuit for relays 604 prior to the opening thereof by the release of relay 602 as hereinbefore described. This circuit may be traced from battery, winding of relay 604, lower inner armature and front contact of relay 611, contacts 622, third lower armature and front contact of relay 611 to the sleeve conductor, through the sleeve brush of switch 702, sleeve terminal of trunk 711 to ground at the lower inner armature and front contact of relay 712. The sleeve terminal of trunk 711 will therefore also be made to test busy to other switches. Relay 712 in operating closes obvious circuits for the operation of relays 715 and 716. Relay 715 in operating closes an obvious circuit for the operation of relay 710. Relay 716 in operating opens the shunt circuit for relay 717 and closes a bridge circuit for the trunk at its inner and middle lower armatures and front contacts. This bridge is also connected to ground through a resistance 718 over the upper outer armature and back contact of relay 708 and make before break contacts of relay 719 and serves to signal the central office.

When the central office answers, this signal relay 717 operates. The tip conductor of the trunk at the central office is normally opened so that relay 717 will not operate until the central office operator answers. When relay 717 operates it closes a circuit for the operation of relay 719 and this relay in operating opens the connection to ground for the trunk conductors and closes a circuit for the operation of relay 708. Relay 708 opens the original battery connection to the sleeve at the switch 702 and closes a locking circuit for itself under control of relay 715. Relay 713 is also operated by the operation of relay 719 and connects the tip and ring conductors from the calling station to the central office and opens the circuit for relay 712 which releases and in turn causes the release of relay 716. Relay 715 does not release but is held operated from the ground connected through the lower armature and front contact of relay 719 over lower inner armature and front contact of relay 713. Relay 716 in releasing closes the shunt circuit for relay 717 through resistance 720, but this resistance is of such character as to permit relay 717 to remain operated and is inserted as is well known in the art to improve the transmission characteristics of the talking circuit with the relay 717 still included therein. The ground connection for holding the switch 702 is now provided from the ground at the lower outer armature and back contact of relay 713

721 through the upper outer armature and front contact of relay 710 to the sleeve.

On incoming calls from the central office when trunk 711 is seized relay 722 is operated over the connection completed through the tip and ring conductors over the lower outer armature and back contacts of relay 713 and upper outer armature and back contact of relay 716. This relay closes an obvious circuit for the operation of relay 715 which closes a circuit for the operation of relay 710 to connect ground to the sleeve terminals of the trunk at the second level of the switches which are assigned for extension of incoming calls. This ground connection may be traced from the ground at the lower outer armature and back contact of relay 721, upper outer armature and back contact of relay 723, lower outer armature and front contact of relay 710 to the sleeve terminal of this trunk in the second level. This ground connection is also applied to the sleeve terminals of the trunk at the first and third levels to make the trunk busy. The ground for the sleeve at the first level may be traced through the upper outer armature and front contact of relay 710, and for the third level through the upper inner armature and front contact of relay 710 and the lower inner armature and back contact of relay 721. When new ringing current is applied at the central office over the tip and ring conductors the alternating current responsive relay 725 operates to provide a circuit for holding relay 715 operated and a circuit for operating relay 723. This latter circuit may be traced from battery, the winding of relay 723, lower outer armature and back contact of relay 712, make-before-break contact of relay 723, second upper armature and front contact of relay 710, to ground at the upper armature and front contact of relay 725. Relay 723 closes a holding circuit for itself through its upper inner armature and front contact to ground at the inner lower armature and front contact of relay 710. Relay 723 establishes a connection from battery, lower armature and back contact of relay 708, resistance 707, upper outer armature and front contact of relay 723, lower outer armature and front contact of relay 710 to the sleeve terminal of the trunk at the second level of each selector-connector switch. This battery connection will now identify the incoming trunk on the switch of a subscriber answering this call to cause the switch to stop and cut in on the trunk. The operation of relay 723 also closes the circuit for the private branch exchange signal 726 which may be located in any convenient place in the exchange. The circuit for this signal may be traced from battery, winding of the signal, inner lower armature and front contact of relay 723, second upper armature and front contact of re-

lay 710 to ground at the upper armature and front contact of relay 725.

When this signal is heard at the private branch exchange the subscriber at any station may answer the call by dialing the incoming central office code which in this case will be 2. The switch of the calling subscriber will now advance its brushes to this level and hunt over this level until the calling trunk is reached. It should be noted that in this case trunk 711 is provided with battery on the sleeve terminal at the second level, while the sleeve terminals of idle trunks on this level are open and busy trunks are grounded. The trunk is therefore seized by a calling subscriber in the usual manner and the usual circuit changes will take place to again apply the ground on this sleeve terminal to make the trunk test busy. Relay 712 is operated as the trunk is seized causing the operation of relay 716 as hereinbefore described. Relay 716 closes a circuit for the operation of relay 727, due to the operation of relay 723, over a circuit as follows: from battery, winding of relay 727 and its make-before-break contacts, lower outer armature and front contact of relay 723, to ground at the lower outer armature and front contact of relay 716. Relay 727 in operating connects at its upper armature and front contact, relay 717 across the tip and ring conductors towards the central office thus tripping the central office ringing after which relay 717 operates and causes the circuit to function as hereinbefore described in connection with outgoing calls. Relay 713 in operating disconnects relays 722 and 725 from the trunk and relay 715 is held operated by relay 719.

If a call is to be transferred from one subscriber's station to another the connected subscriber will operate the transfer key 630. The operation of this key establishes a connection to ground for the fourth terminal of the connecting trunk. It is immaterial whether the call has previously been transferred or not or whether it was an incoming or an outgoing call as the fourth terminal in the three levels are all connected together. The ground applied by key 630 causes the release of relay 728. It should be observed that relay 728 always operates whenever relay 710 is operated causing also the operation of relay 729 over obvious circuits. The release of relay 728 causes a circuit to be closed for the operation of relay 714, from battery lower winding of this relay, upper armature and front contact of relay 729, armature and back contact of relay 728, to ground at armature and front contact of relay 715. This circuit is possible due to the slow-to-release characteristics of relay 729. Relay 714 in operating closes its upper winding across the tip and ring conductors through its upper armature and front con-

tact and thereby maintains itself operated and holds the trunk at the central office. When relay 729 releases a connection is closed for the operation of relay 721 as follows:
 5 battery, winding of relay 721, make-before-break contacts of relay 729, upper armature and back contact of relay 728, to ground at relay 715. Relay 721 in operating provides a locking circuit for itself under control of
 10 relay 714 and opens the holding ground over the sleeve terminals for the switch of the connected subscriber's line, thereby causing the switch to release and disconnect this line from the trunk. When the holding key is
 15 restored to normal, relays 728 and 729 are again operated so that the call may be again transferred if so desired.

This trunk, it should be noted, will now have a battery connected to its sleeve terminals, at the first level, due to the operation of relay 721 and reoperation of relay 729. The trunk may therefore in the usual manner be picked up by any of the other stations by the dialing of this level and the
 25 hunting for the trunk thus identified. When the trunk is seized by another station at the private branch exchange a relay 730 is operated as the winding of this relay is now connected in series in the tip conductor
 30 through the upper outer armature and front contact of relay 720. The operation of relay 730 shunts the upper winding of relay 714 which now releases and closes the connection through the tip to the central office from the
 35 calling station. Relay 714 in releasing causes the release of relay 721 which again establishes a connection to ground for the sleeve terminals of this trunk to hold the connected switch and make itself busy.

40 While this invention has been described in connection with a limited number of circuits, it should be understood that it may be applied in many other systems without departing from the spirit thereof.

45 What is claimed is:

1. In a telephone system, subscriber's lines, trunks, means including an automatic switch for connecting a subscriber's line with a trunk, means for releasing said subscriber's
 50 line from said trunk and for marking said trunk, and means for thereafter connecting a subscriber's line with said marked trunk over said automatic switch.

2. In a telephone system, subscriber's lines, trunks, means including an automatic switch for connecting a subscriber's line with another subscriber's line or with a trunk, means for releasing a subscriber's line from a trunk to which it is connected and for marking said
 60 trunk, and means for thereafter connecting a subscriber's line to said marked trunk over said automatic switch.

3. In a telephone system, subscriber's lines, trunks, means including an automatic switch
 65 for connecting a subscriber's line with a trunk,

means for releasing said subscriber's line from said trunk, for marking said trunk and from holding it engaged and means operative due to the markings of said trunk for thereafter
 70 connecting a subscriber's line with said marked trunk over said automatic switch.

4. In a telephone system, subscriber's lines, trunks, automatic switching means for causing the connection of a subscriber's line with another subscriber's line or with a
 75 trunk over a path excluding said automatic switching means, means for opening the path connecting said subscriber's line and said trunk and for marking said trunk, and automatic switching means for thereafter
 80 causing the connection of any subscriber's line with said marked trunk over a path excluding said last mentioned automatic switching means.

5. In a telephone system, a first and a second office, subscriber's lines terminating at the first office, trunks connecting said offices, automatic switching means for connecting a
 85 subscriber's line with a trunk seized at the second office, means for opening the connection between said subscriber's line and said trunk and for marking said seized trunk at the first office, and an automatic switching means for thereafter connecting any sub-
 90 scriber's line with said marked trunk.

6. In a telephone system, a first and a second office, subscriber's lines terminating at the first office, trunks connecting said offices, means responsive to the setting of the switch at any subscriber's line for connecting said
 95 line to an idle trunk or to a trunk seized at the second office, means for releasing a subscriber's line from a seized trunk and for marking said trunk and means responsive to the setting of the switch of any subscriber's
 100 line for connecting said line with a marked trunk.

7. In a telephone system, a first office and a second office, subscriber's line terminating at the first office, a switch associated with each
 105 subscriber's line, trunks connecting said offices, means responsive to dialing impulses received from a subscriber's line for setting the corresponding switch to cause the connection of said subscriber's line over a path ex-
 110 cluding said switch with another subscriber's line or with an idle line or with a trunk seized at the second office, means for releasing a connection to a seized trunk and marking said trunk and means responsive to dialing im-
 115 pulses received from a subscriber's line for setting the corresponding switch to cause the connection of said subscriber's line over a path excluding said last mentioned switch with said marked trunk.

8. In a telephone system, a first office and a second office, subscriber's lines terminating at the first office, a switch associated with each subscriber's line, trunks connecting said
 120 offices, means responsive to dialing impulses
 125

received from a subscriber's line for setting the corresponding switch to cause the connection of said subscriber's line over a path excluding said switch with another subscriber's line or with an idle trunk or with a trunk seized at the second office, means for releasing a connection to a seized trunk and marking said trunk responsive to dial impulses from the connected subscriber's lines and means responsive to dialing impulses received from a subscriber's line for setting the corresponding switch to cause the connection of said subscriber's line over a path excluding said last mentioned switch with said marked trunk.

9. In a telephone system, a first office, a second office, subscriber's lines terminating at the first office, a switch associated with each subscriber's line, trunks connecting said offices, means for actuating the switch of any subscriber's line to connect said subscriber's line with another subscriber's line through said switch for setting said switch to cause a connection of said subscriber's line over paths excluding said switch with an idle trunk or with a trunk seized at the second office, means for releasing the connection to said seized trunk and marking said trunk and means for setting the switch of any subscriber's line to cause a connection to be established over a path excluding said last mentioned switch between said subscriber's line and said marked trunk.

10. In a telephone system, a first office and second office, subscriber's lines terminating at the first office, a switch associated with each subscriber's line, trunks connecting said offices, means responsive to dialing impulses received from a subscriber's line for actuating the corresponding switch to connect said subscriber's line with another subscriber's line through said switch or for setting said switch to cause the connection of said subscriber's line over paths excluding said switch with an idle trunk or with a trunk seized at the second office, means responsive to impulses received from a subscriber's line connected to a seized trunk for releasing said connection and marking said trunk and means responsive to dialing impulses from any subscriber's line for setting the corresponding switch to cause a connection to be established over a path excluding said last mentioned switch between said subscriber's line and said trunk.

11. In a telephone system, subscriber's lines, a switch for each line, trunks, a switch for each trunk, means responsive to the setting of the switch of any subscriber's line for actuating the switch of an idle trunk or of a seized trunk to connect said trunk to said subscriber's line, means for releasing the connection between a subscriber's line and a seized trunk and from marking said trunk and means responsive to the setting of the

switch of any subscriber's line for actuating the switch of said marked trunk to connect said trunk to the last mentioned subscriber's line.

12. In a telephone system, calling subscriber's lines a line switch for each line, trunks, a switch associated with each trunk, means responsive to the selection of certain terminal points on the line switch by dial impulses received over the associated subscriber's line for actuating the switch of an idle trunk to connect said trunk with said subscriber's line or for actuating the switch of a seized trunk to connect said trunk with said subscriber's line, means for marking said seized trunk and for releasing it from said subscriber's line and means responsive to the selection of a certain other terminal point on the line switch of another subscriber's line by dialing impulses received over said other subscriber's line for actuating the switch of said marked trunk to connect said trunk to said other subscriber's line.

13. In a telephone system, a first office and a second office, subscriber's lines terminating at the first office, trunks connecting said offices, a connector switch for each subscriber's line, means responsive to the actuation of the switch of any subscriber's line for connecting the corresponding subscriber's line through said switch with another subscriber's line or with an idle trunk or with a trunk seized at the second office, means for releasing a connection to a seized trunk and marking said trunk and means responsive to the actuation of the switch of any subscriber's line for connecting the corresponding subscriber's line through said switch with a marked trunk.

14. In a telephone system, a first office and a second office, subscriber's lines terminating at the first office, trunks connecting said offices, a selector connector switch for each line, means for actuating a switch of a subscriber's line to connect said subscriber's line with another subscriber's line or with an idle trunk or with a trunk seized at the second office through said switch, means for releasing a connection to a seized trunk and marking said trunk and means operable by the subscriber of a line for actuating the switch of said subscriber's line to connect the corresponding subscriber's line with a marked trunk through said last mentioned switch.

15. In a telephone system, a first office and a second office, subscriber's lines terminating at the first office, trunks connecting said offices, a selector connector switch for each line, means responsive to dialing impulses received from a subscriber's line for actuating the corresponding switch to connect said subscriber's line with another subscriber's line or with an idle trunk or with a trunk seized at the second office, through said switch, means responsive to dialing impulses received from a subscriber's line connected to a seized

trunk for releasing said trunk and marking it and means responsive to dialing impulses received from a subscriber's line for actuating the corresponding switch for connecting
5 said subscriber's line with a marked trunk through said last mentioned switch.

16. In a telephone system a subscriber's line, trunks, means including a hunting switch for connecting a subscriber's line with
10 a trunk, means for releasing said subscriber's line from said trunk and for marking said trunk, and means for thereafter connecting a subscriber's line with said marked trunk over said hunting switch.

17. In a telephone system, subscribers' lines, trunks, means for connecting a subscriber's line with a trunk, means including a key for releasing said subscriber's line from
15 said trunk and for marking said trunk and means for thereafter connecting a subscriber's line with said marked trunk.

18. In a telephone system, subscribers' lines, trunks, means for connecting a subscriber's line with a trunk, means for releasing said subscriber's line from said trunk
20 for marking said trunk and for establishing a bridge across the conductors of said trunk and means operative due to the marking of said trunk for thereafter connecting a subscriber's line with said marked trunk and removing the bridge.

19. In a telephone system, a first office and a second office, subscribers' lines terminating at the first office, trunk connecting said office, a selector-connector switch for each
25 line, means for actuating a switch of a subscriber's line to connect said subscriber's line with another subscriber's line or with an idle trunk or with a trunk seized at the second office to said switch, means including
30 a key for releasing a connection to a seized trunk and for marking said trunk and means for actuating the switch of a subscriber's line to connect the corresponding subscriber's line with a marked trunk through said last
35 mentioned switch.

In witness whereof, I hereunto subscribe my name this 21 day of March, 1930.

CHARLES D. KOECHLING.

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