

May 6, 1924.

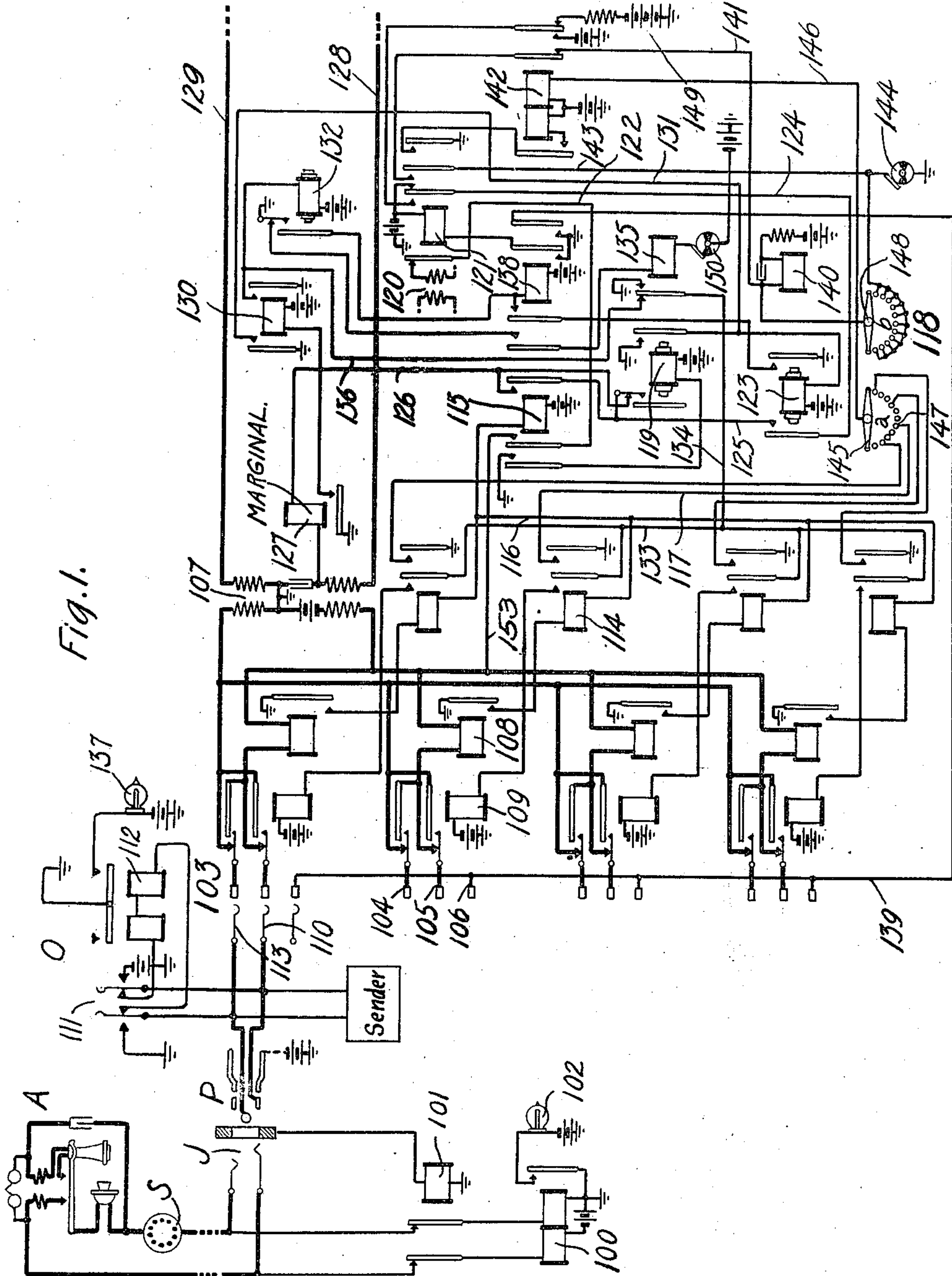
1,492,868

J. F. TOOMEY

TELEPHONE SYSTEM

Filed Dec. 17, 1920

3 Sheets-Sheet 1



by

Inventor:
John F. Toomey
J. F. Toomey
Att'y

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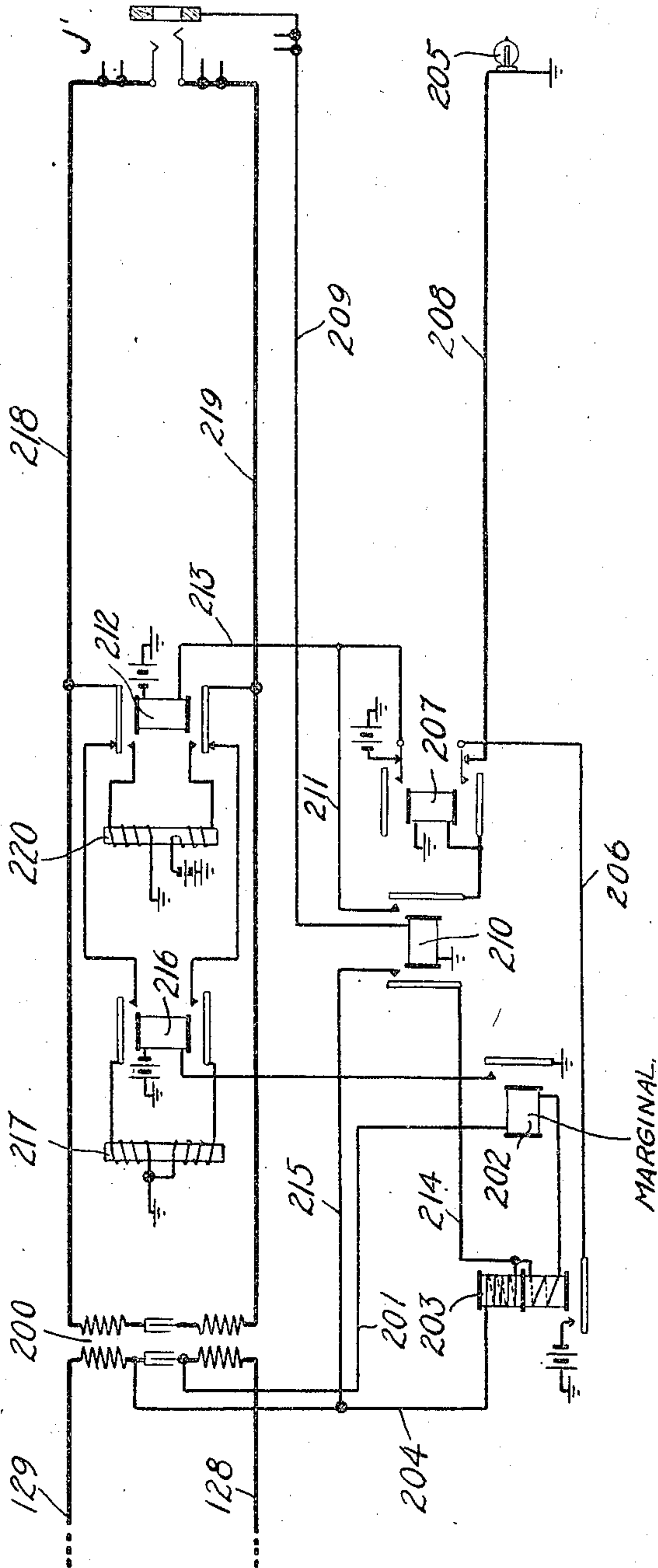
J. F. TOOMEY

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Fig. 2.



Inventor
John F. Toomey
by *Geo. F. Toomey* Att'y.

May 6, 1924.

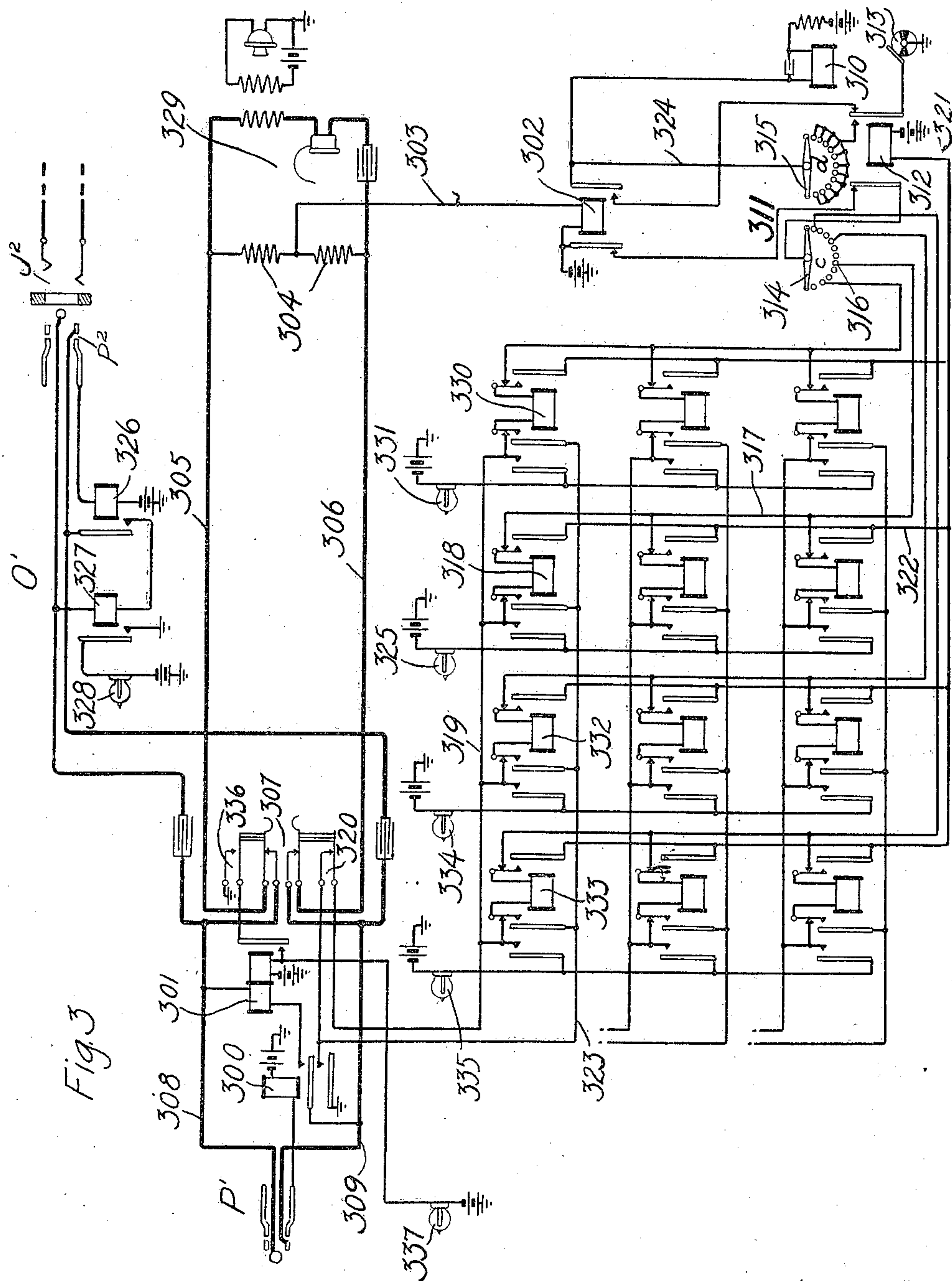
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J. F. TOOMEY

TELEPHONE SYSTEM

Filed Dec. 17, 1920

3 Sheets-Sheet 3



Inventor
John F. Toomey

by

York

Att'y

UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed December 17, 1920. Serial No. 431,425.

To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems and more particularly to systems in which trunk lines are employed for connecting different switchboards or operators' positions.

It is the customary practice in telephone exchange systems to trunk connections for toll service from the originating switchboard or "A" operator's position to a recording toll operator's position over recording trunk lines. The recording operator answers the call incoming upon the toll trunk and records upon a ticket the details of the call as given by the calling subscriber and notes, if necessary, the class of the calling subscriber's line. Upon the completion of the recording, the recording operator dismisses the calling subscriber and immediately releases the recording trunk. When the trunk is released, the "A" operator receives a peremptory disconnect signal and disconnects regardless of the calling subscriber's supervisory signal. The recording operator then secures the calling subscriber's line over a toll switching trunk, enters the number of the trunk on the ticket and forwards the ticket to the toll operator at the toll-line position. She will then hold the trunk until the toll operator has taken up the trunk. The established connection then extends from the calling subscriber's line over the toll switching trunk, through the toll operator's cord circuit and thence over the toll line to the desired distant point, and the "A" operator and recording operator are free to perform other duties.

In order that the operator at the recording toll position may have complete data for recording the toll call upon her ticket, it is necessary to transmit to her information regarding the class of service to which the calling subscriber is entitled. Heretofore in exchanges, in which calling subscribers have access to recording toll trunks through an "A" operator's position, the "A" operator has identified the class of service to

which the calling subscriber is entitled by means of a distinctive lamp cap on the calling lamp associated with the jack of the subscriber's line and has advised the toll operator in case the call is from a coin box line or a line to which a toll connection should be refused.

To relieve the "A" operator of the necessity of advising the toll operator of the class of service to which the calling subscriber is entitled, it has been proposed to employ groups of recording trunks for each class of service, these trunks being equipped at the recording position with different lamp caps so that the "A" operator can select a recording trunk corresponding to the class of service indicated by the cap at the calling subscriber's line lamp and thereby call the toll operator in upon the connection through the signal displayed by the trunk lamp. Thus the recording toll operator may readily determine from the lamp cap of the trunk, the class of service to which the calling subscriber is entitled. This arrangement obviously involves the employment of a greater number of recording trunks than is necessary to adequately handle the maximum volume of traffic and, since the toll position may be, and often is located at a distant office of the exchange, the employment of several groups of trunks may prove to be an expensive item in the cost of installation and maintenance of the system.

It is therefore the purpose of the invention to obviate this difficulty by the employment of a single group of trunk lines over which an indication of the class of service may be selectively transmitted to the recording operators' positions. This is accomplished by terminating each trunk line at the originating operator's position or switchboard in separate multiples for each class of subscribers and providing mechanism associated with each trunk line, for controlling the operation of class of service signals at the recording position in accordance with the multiple terminal of the trunk line which is employed to establish the connection. In the system illustrated each trunk line terminates in four multiples, the first for lines which are not entitled to originate

toll calls, the second for lines which are entitled to toll service and which are billed for this service in the regular way, the third for lines equipped with coin boxes, and the
 5 fourth for attended pay station lines.

An object of the invention is therefore to reduce the number of toll trunk lines required between switch-boards or operators' positions.

10 A further object is the provision of means for selectively operating one of a plurality of signaling devices over a trunk line in accordance with the particular terminal employed for connection with the trunk line.

15 A further object is the provision of a selective signaling device at an operator's position associated with and common to the cord circuits of the position which is selectively operated over a trunk circuit extending to an originating switch-board or
 20 operator's position.

In accordance with one feature of the invention each recording trunk line is terminated in four sets of multiple terminals appearing in the terminal bank of the semi-mechanical operator's district selector at the
 25 originating office, and in multiple jacks at the recording operators' positions. Each trunk line is equipped at its out-going end with a step-by-step selective switch which becomes positioned in accordance with the particular multiple terminal over which the
 30 trunk line is taken for use. At each recording operator's position and common to the cord circuits of the position, a second step-by-step selective switch is provided which is adapted to be positioned corresponding to the setting of the first switch, for selectively operating one of a plurality
 35 of class of service signals.

Further features of the invention will appear from the following description taken in connection with the accompanying drawings in which Fig. 1 shows the out-going
 45 end of a toll trunk line together with the associated apparatus for transmitting class of service signals over the trunk line, a calling subscriber's line and a diagrammatic representation of the circuits of a
 50 semi-mechanical operator's position for extending a connection from the subscriber's line to the toll trunk; Fig. 2 shows the incoming end of the toll trunk; and Fig. 3 shows a cord circuit of a recording toll operator's position together with associated
 55 class of service signals and switching apparatus for selectively operating said signals.

The apparatus at the semi-mechanical operator's position O may be of the general type well known in the art. In order to simplify the disclosure, the calling subscriber's line A has been shown as terminating directly in a jack at the semi-mechanical
 60 operator's position O. In practice, how-

ever, the subscriber's line would terminate in a full mechanical switch-board and the subscriber would have access to the semi-mechanical operator's position through either a line switch or line finder switch
 70 and a district selector, the district selector being controlled to establish the connection with a trunk circuit extending to the operator's position, through the operation of a central office register sender. The subscriber
 75 in order to obtain a connection with the operator therefore dials three code digits on his sender S thereby setting the district selector upon the trunk circuit extending to the operator's position. The apparatus for
 80 accomplishing this may be of the type disclosed in the patent to F. A. Stearn and F. J. Scudder, No. 1,395,977, issued November 1, 1921.

It is believed that a clearer understanding
 85 of the invention may be had from the following description of the method of extending a call from the line of subscriber A to the recording toll operator's position O'. The calling subscriber A to initiate a
 90 call removes his receiver from its switch-hook thereby closing the circuit of the line relay 100, this circuit extending from grounded battery through the left hand winding of relay 100, the outer armature
 95 and back contact of cut-off relay 101, thence over the subscriber line loop and back through the inner armature and back contact of relay 101 to ground through the right hand winding of relay 100. Relay
 100 energizing in this circuit closes an obvious circuit for the line lamp 102. This line lamp is provided with a distinctive lamp cap which enables the answering operator to determine the class of service to
 105 which the calling subscriber is entitled. In the present case it will be assumed that the calling subscriber is entitled to regular toll service.

The semi-mechanical operator upon noting the illumination of lamp 102 inserts the answering plug P of an idle cord circuit at her position, in the jack J of the calling
 110 line, whereupon a circuit is established over the sleeve contacts of the plug and jack for the cut-off relay 101 which at its armature contacts opens the circuit of line relay 100 thereby extinguishing the lamp 102.
 115

The operator now obtains from the calling subscriber the nature of the connection
 120 which the calling subscriber desires and assuming that the subscriber desires a toll connection she proceeds to set up upon her key board the necessary code for setting the brushes of the district selector 103, in
 125 which her cord circuit terminates, upon the terminals of a toll trunk line extending to the toll recording position O'. The code which the semi-mechanical operator sets up upon her key board is also determined by
 130

the class of service to which the calling subscriber is entitled, and therefore the district selector 103 will not only be set by the semi-mechanical sender upon the terminals of the toll trunk line, but upon a particular set of multiple terminals of the toll trunk line for causing transmission over the toll line of a special distinctive signal for apprising the toll operator of the class of service to which the calling subscriber is entitled.

For this purpose each toll trunk line terminates at the terminal bank of the district selector 103 in four sets of terminals. In the case assumed the brushes of the district selector 103 will be set upon the second set of terminals 104, 105 and 106. A circuit is thereupon established which may be traced from battery, through the lower left hand winding of repeating coil 107, the winding of relay 108, the break contacts of the lower armature of reversing relay 109, terminal 105, brush 110, the normally closed right hand contacts of key 111, the windings of polarized supervisory relay 112, the normally closed left hand contacts of key 111, brush 113, terminal 104, the break contacts of the upper armature of relay 109, and thence to ground through the upper left hand winding of repeating coil 107.

Relay 108 energizes in this circuit and at its armature and front contact closes a circuit for relays 114 and 115 which may be traced from grounded battery through the winding of relay 115, conductor 116, the winding of relay 114 and thence to ground at the armature and front contact of relay 108. Relay 114 at its outer armature and front contact connects ground over conductor 117 to contact 147 of the terminal bank of the step-by-step selector switch 118 and at its inner armature and front contact prepares a circuit for the reversing relay 109 which circuit is later closed in a manner to be hereinafter described. Relay 115 at its outer left hand armature and front contact establishes a circuit for the slow-to-release relay 119 extending from grounded battery, through the winding of this relay thence to ground at the armature contact of relay 115, and at its inner left hand armature and front contact relay 115 establishes a connection from the source of tone current 120 to the operator's cord circuit at position O. This circuit may be traced from the source 120 through the left hand armature and back contact of relay 121, conductor 122, the inner left hand armature and front contact of relay 115, conductor 153, the winding of relay 108, the normally closed break contacts of the lower armature of relay 109, terminal 105, brush 110 thence through the cord circuit over the subscriber's line loop 113, terminal 104, the normally closed break contacts of the upper armature of relay 109 and

thence to ground through the upper left hand winding of repeating coil 107. This source of tone current is maintained connected to the subscriber's line until after the response of the toll recording operator and serves as a signal to indicate that the recording operator is being signalled.

Relay 119 upon energizing closes a circuit for the slow-to-release relay 123, extending from grounded battery through the winding of relay 123 and thence to ground through the right hand armature and front contact of relay 119, and at its left hand armature opens contacts which normally shunt the right hand armature contacts of relay 115. Slow-to-release relays 119 and 123 are designed slow-to-release for a purpose which will be described hereinafter. Relay 123 upon energizing attracts its armatures, the right hand armature establishing a circuit which is without function at this time, and the left hand armature establishing a circuit which may be traced from grounded battery through the inner right hand armature and back contact of relay 121, conductor 124, the left hand armature and front contact of relay 123, conductor 125, the right hand armature and front contact of relay 115, conductor 126, the winding of marginal relay 127, the lower right hand winding of repeating coil 107, ring conductor 128 of the toll trunk, the lower left hand winding of repeating coil 200, conductor 201, the winding of marginal relay 202, the windings of line relay 203, conductor 204, the upper left hand winding of repeating coil 200, the tip conductor 129 of the toll trunk, and thence to ground through the upper right hand winding of repeating coil 107. Since the battery which is connected to this circuit is of only 24 volts potential, and since both windings of relay 203 are included in the circuit, neither marginal relay 127 nor marginal relay 202 receive sufficient current to energize at this time. Line relay 203, however, does energize and establishes a circuit for the trunk lamp 205 which may be traced from grounded battery through the armature and front contact of relay 203, conductor 206, the normally closed break contacts of the lower armature of relay 207, conductor 208, and thence to ground through the lamp 205.

The operator at the recording toll position upon noting the illumination of the trunk lamp 205 inserts the answering plug P' of an idle cord circuit at her position in the multiple jack J' of the toll trunk corresponding to the illuminated lamp 205. A circuit is thereupon established extending from grounded battery, through the winding of sleeve relay 300, the sleeve contacts of plug P' and jack J', conductor 209, and thence to ground through the winding of cut-off relay 210. Sleeve relay 300 energizes in this circuit and at its upper armature and front

contact establishes a circuit for bridging the supervisory relay 301 across the tip and ring conductors of the cord circuit, but since the circuit of relay 301 is not completed at this time relay 301 does not energize. Relay 300 at its lower armature and front contact prepares a circuit for operating class of service signals which will be described hereinafter.

Cut-off relay 210 upon energizing in the circuit previously traced, establishes a circuit for relay 207 which may be traced from grounded battery through the normally closed contacts of the upper armature of relay 207, conductor 211, right hand armature and front contact of relay 210 and thence to ground through the winding of relay 207. Relay 207 energizes in this circuit opening at the normally closed contacts of its lower armature the circuit previously traced through the trunk lamp 205, and establishes at the make contacts of its lower armature a locking circuit for itself which may be traced from grounded battery, through the armature and front contact of relay 203, conductor 206, and thence to ground through the make contacts of the lower armature and winding of relay 207. The trunk lamp 205 now becomes extinguished. Relay 207 upon energizing also disconnects battery at its upper armature contacts from its initial energizing circuit. Upon the energization of relay 210, a circuit is also established for relay 212, extending from grounded battery through the winding of relay 212, conductor 213, conductor 211, the right hand armature and front contact of relay 210 and thence to ground through the winding of relay 207. Relay 212 does not energize in this circuit, however, since its winding is shunted by a direct connection to ground through grounded battery, first at the upper armature contacts of relay 207 prior to the energization of relay 207, and later by grounded battery at the armature contacts of relay 203 following the energization of relay 207.

At its left hand armature and front contact relay 210 also establishes a shunt around the high resistance winding of relay 203, which shunt may be traced from the mid-point between the windings of relay 203, over conductor 214, the left hand armature and front contact of relay 210 and thence over conductor 215 to conductor 204 and the other terminal of the high resistance winding of relay 203, and causes such a reduction in the resistance of the circuit previously traced extending through the winding of marginal relay 127 as to cause the energization of this relay. Relay 127 at its armature and front contact establishes a circuit for relay 130 which circuit extends from grounded battery through the winding of relay 130 and thence to ground through armature and front contact of re-

lay 127. Relay 130 upon energizing establishes a new energizing circuit for slow-to-release relay 123 extending from grounded battery through the winding of relay 123, conductor 131, and thence to ground through the left hand armature and front contact of relay 130. At its right hand armature and front contact, relay 130 establishes an obvious circuit for the slow-to-release relay 132, and completes the circuit of reversing relay 109. The circuit of reversing relay 109 may be traced from grounded battery through the winding of relay 109, the front contact and inner armature of relay 114, conductor 133, conductor 134, the armature and back contact of peremptory disconnect relay 135, conductor 136, and thence to ground at the right hand armature and front contact of relay 130. Reversing relay 109 energizes in this circuit reversing the connection of battery and ground through the left hand windings of repeating coil 107 to the tip and ring conductors of the cord circuit at position O, thereby reversing the direction of the current flowing through the windings of polarized supervisory relay 112. Supervisory relay 112 now attracts its armature in such a direction as to open the circuit which was previously established through the supervisory lamp 137 upon the initial extension of the connection from the cord circuit to the left hand windings of repeating coil 107. The darkening of lamp 137, at this time, is not of any importance as the semi-mechanical operator does not attend further to the connection, unless she is recalled by the calling operator, until she receives a disconnect signal.

The calling subscriber may now transmit to the recording toll operator the necessary information concerning the desired toll connection.

Relay 132 which becomes energized upon the energization of relay 130 following the response of the toll recording operator, establishes a circuit for relay 138 which may be traced from grounded battery through the winding of relay 138 and thence to ground through the armature and make contact of relay 132. Relay 138 at its inner left hand armature and front contact establishes a locking circuit for itself extending, as previously described, to the right hand armature and front contact of relay 123. Since relay 123 is maintained energized over two circuits, one indirectly under the control of relay 108 in the out-going end of the toll trunk and the other indirectly under the control of relay 210 at the in-coming end of the toll trunk, the locking circuit of relay 138 is therefore maintained as long as the trunk is held in service at either of its ends, and therefore ground potential is maintained at the multi-

ples of test terminal 106 appearing in all district selectors having access to the outgoing end of the toll trunk. This ground potential is connected to the test terminals over a circuit extending over conductor 139 from ground at the outer right hand armature and front contact of relay 138. The toll trunk is thus made unavailable to other out-going calls until after it has been released at both of its ends.

Relay 138 also establishes a circuit for relay 121 extending from grounded battery through the winding of relay 121 and thence to ground at its inner right hand armature and front contact, and at its outer left hand armature and front contact prepares a circuit for the peremptory disconnect relay 135 which, however, is functionless so long as the slow-to-release relay 132 is maintained energized.

Relay 121 upon energizing opens the previously traced circuit from the tone source 120 at its left hand armature and back contact and at its intermediate right hand armature and front contact establishes a stepping circuit for advancing the step-by-step selective switch 118. This stepping circuit may be traced from grounded battery through the winding of motor magnet 140, conductor 141, the inner right hand armature and back contact of stop relay 142, the front contact and intermediate right hand armature of relay 121 conductor 143, and thence to ground through the interrupter 144. Under the influence of motor magnet 140, the wipers 145 and 148 of switch 118 are advanced over the contacts of the terminal banks *a* and *b*, with which they are associated, until the wiper 145 engages the contact 147 in the bank —*a*— to which ground potential has been connected over conductor 117 and the outer armature and front contact of relay 114, when a circuit is established for the stop relay 142, which may be traced from grounded battery through the right hand winding of relay 142, conductor 146, wiper 145, contact 147, conductor 117, and thence to ground of the armature contact of relay 114. Relay 142 energizes in this circuit establishing a locking circuit for itself extending from grounded battery through its left hand winding and its left hand armature and front contact and thence to ground at the outer right hand armature and front contact of relay 121, and at its inner right hand armature and back contact opens the previously traced circuit extending through the winding of motor magnet 140. The initial energizing circuit of magnet 140 is now open but magnet 140 continues to be intermittently energized over a circuit which may be traced from grounded battery through the winding of magnet 140, wiper 148, the contacts of bank —*b*—, conductor 143 and thence to ground through

the interrupter 144, and the wipers of switch 118 therefore continue to advance until they are again in their normal positions when the circuit just traced for magnet 140 is opened and the wipers are arrested in their forward movement.

At the time relay 121 energizes to close the starting circuit of selective switch 118, the initial energizing circuit previously traced through the windings of relays 127, 203 and 202 is opened at the inner right hand armature and back contact of relay 121 and a new energizing circuit for these relays is established extending from the grounded pole of the 48 volt battery 149, the outer right hand armature and back contact of relay 142, the inner right hand armature and front contact of relay 121 and thence over the circuit previously traced, through the windings of relay 127 and 203 and marginal relay 202. Since current is now supplied to this circuit from the 48 volt battery 149, sufficient current flows through the winding of marginal relay 202 to cause its energization and relay 202 continues to remain energized until the wiper 145 of switch 118 encounters the contact 147 to close the energizing circuit of relay 142 as previously described.

Relay 202 upon energizing closes a circuit for relay 216 which may be traced from grounded battery through the winding of relay 216 and thence to ground at the armature and contact of relay 202. Relay 216 upon energizing connects the windings of retardation coil 217 to the tip and ring conductors 218 and 219 of the in-coming end of the toll trunk line thereby establishing a simplex circuit which may be traced from grounded battery through the winding of relay 302, conductor 303, thence in parallel through the retardation coils 304, conductors 305 and 306, normally closed contacts of the talking key 307, tip and ring strands 308 and 309 at the answering end of the cord circuit, tip and ring contacts of the plug *P'* and jack *J'*, trunk conductors 218 and 219, the armatures and back contacts of relay 212, the armatures and front contacts of relay 216 and thence to ground at the midpoint between the windings of retardation coil 217. Relay 302 energizes in this circuit and at its right hand armature and front contact establishes a starting circuit for the motor magnet 310 of the step-by-step selective switch 311, which circuit may be traced from grounded battery through the winding of motor magnet 310, the right hand armature and front contact of relay 302, the armature and back contact of stop relay 312 and thence to ground through the interrupter 313. Under the influence of interrupter 313, the motor magnet 310 advances the wipers 314 and 315 over the contacts of the terminal banks *c*, *d*. During the advance

of the wipers of the switch and so long as relay 302 remains energized battery potential is disconnected from the wiper 314 at the left hand armature and back contact of relay 302.

When the wiper 145 of the selective switch 118 engages the contact 147 which corresponds to the second set of switching terminals over which the semi-mechanical operator has seized the toll trunk, relay 142 energizes in the manner previously described and at its outer right hand armature and back contact disconnects the 48 volt source of current 149 from the circuit of relay 202 and substitutes a 24 volt source of current therefor, whereupon relay 202 deenergizes opening the circuit of relay 216 and thereby opening the simplex circuit extending through the winding of relay 302 at the toll operator's cord circuit. Relay 302 therefore deenergizes immediately upon the setting of the selective switch 118 in a position corresponding to the particular set of switching terminals over which the toll trunk was seized and opens the stepping circuit of motor magnet 310 to arrest the movement of wipers 314 and 315. The wiper 314 will now be in contact with the contact 316 and a circuit is established extending from grounded battery through the left hand armature and back contact of relay 302, the left hand armature and back contact of relay 312, wiper 314, contact 316, conductor 317 the normally closed break contacts of the right hand armature of relay 318, the winding of relay 318, the normally closed break contacts of the inner left hand armature of relay 318, conductor 319, contacts 320 of the talking key 307, and thence to ground at the lower armature and front contact of relay 300. Relay 318 energizes in this circuit and establishes a locking circuit for itself independent of the wiper 314 and contact 320 of key 307 which locking circuit may be traced from grounded battery through the winding of stop relay 312, conductor 321, conductor 322, the right hand armature and make contact of relay 318, winding and left-hand armature and make contact of relay 318, conductor 323, and thence to ground at the lower armature of relay 300.

Relay 312 energizes in this locking circuit and at its armature opens the initial circuit of motor magnet 310 and closes a new circuit for continuing the advance of the wipers 311 into their normal positions, which circuit may be traced from grounded battery through the winding of motor magnet 310, conductor 324, wiper 315, the contacts of terminal bank —d—, the armature and front contact of relay 312 and thence to ground through the interrupter 313. During the advance of the wipers to normal position battery is disconnected from wiper

314 at the left hand armature of relay 312. As soon as the wipers reach their normal positions, the advancing circuit just traced through motor magnet 310 is opened at the wiper 315 of the switch, and the advance of the switch wipers is thereupon arrested.

Upon the energization of relay 318, a circuit was also established for the class of service pilot lamp 325 which may be traced from grounded battery through lamp 325, the outer left hand armature and front contact of relay 318, conductor 319, contacts 320 of talking key 307, and thence to ground at the armature and front contact of relay 300. The lamp 325 will be provided with a lamp cap which is distinctive of all calls incoming to the toll operator's position which are entitled to regular toll service, and the toll operator, noting the illumination of this lamp, and upon receiving instructions from the calling subscriber as to the toll connection desired, will thereupon make out a suitable ticket for billing the connection to the calling subscriber. She will then dismiss the calling subscriber and immediately release the recording trunk by withdrawing plug P' from the jack J'.

After having obtained the necessary information from the calling subscriber, the recording toll operator may disconnect her set from the cord circuit which she has employed by throwing the key 307 to its intermediate position. The contact 320 of the key is now opened and the circuit previously traced through lamp 325 is opened and the lamp is extinguished. If at any time, while the plug P' is in the jack J', the operator desires to relight the lamp 325 to check up the class of service to which the calling subscriber is entitled, she may do so by operating the key 307 to the talking position thereby reestablishing the circuit of lamp 325 at key contact 320.

It is to be noted that four relays comprising a group of which 318 is a part are provided for each cord circuit at the operator's position, the relays of each group controlling the circuits of a single common group of class of service pilot lamps. The several groups of relays are under the control of a single step-by-step selective switch 311, which is common to all of the cord circuits of the operator's position.

If the calling subscriber had not been entitled to toll service, the semi-mechanical operator at position O would have set the district selector 103 upon the first set of terminals of the terminal bank, and selective switches 118 and 311 would have advanced to such positions as to have caused the energization of relay 330 at the operator's position O' and the consequent illumination of pilot lamp 331. Similarly, if the third or fourth set of switching terminals had been selected, relays 332 or 333 at the toll record-

ing operator's position would have been selected to cause illumination of either lamp 334 or 335.

Upon withdrawal of the plug P' from the jack J', the circuit of relays 210 and 300 is opened. Relay 300, upon deenergizing, opens the locking circuit of relay 318, and relay 210 opens at its right hand armature and front contact the initial energizing circuit previously traced through the winding of relay 207, and at its left hand armature and front contact, opens the shunt around the high resistance winding of relay 203. The current flowing over the trunk circuit is now reduced to such a strength that marginal relay 127 at the out-going end of the toll trunk does not receive sufficient current to maintain its energization, whereupon the circuit of relay 130 is opened, in turn opening the circuit of reversing relay 109 and the circuit of slow-to-release relay 132. Relay 132 upon deenergizing opens at its armature and front contact the initial energizing circuit of relay 138, but relay 138 is maintained energized at this time over a circuit extending to ground at the right hand armature and front contact of relay 123. At the normally closed contacts of its armature, relay 132 establishes a circuit extending from grounded battery through the interrupter 150, the winding of preemptory disconnect relay 135, the outer left hand armature and front contact of relay 138 and thence to ground at the armature contacts of relay 132. Relay 135 now being intermittently energized closes intermittently a circuit for reversing relay 109 extending over the circuit previously traced to the armature of relay 135 and thence to ground at the front contact of this armature. Relay 109 is now intermittently energized to reverse the current flowing over the out-going end of the toll trunk through the windings of polarized relay 112 whereupon relay 112 causes the flashing of supervisory lamp 137.

The semi-mechanical operator noting the flashing of lamp 137 removes the plug P from the jack J of the calling line thereby restoring the calling line to its initial condition and causing the restoration of the district selector switch 103. Following the restoration of switch 103, the circuit previously traced through the winding of relay 108 is opened thereby opening the circuit of relays 114 and 115. Relay 115 upon deenergizing opens the circuit of relay 119, which in turn opens the circuit of relay 123, and since at this time the auxiliary holding circuit of relay 123 previously traced over conductor 131 is open at the armature contact of relay 130, the trunk having been released at this time at its in-coming end, relay 123 deenergizes opening at its right hand armature contacts the holding circuit of re-

lay 138, which in turn opens the circuit of relay 121 and removes busy ground potential from the conductor 139 and the multiple terminals of the toll trunk. Relay 121 upon deenergizing opens the locking circuit of relay 142. The circuits at the out-going end of the toll trunk are now in their normal position.

Relay 115 upon deenergizing also opens the circuit previously traced extending over the toll trunk and through the windings of relays 203 and 202 and relay 203 now deenergizes opening the locking circuit of relay 207. Relay 210 being at this time deenergized, the deenergization of relay 207 is not effective to again close its own energizing circuit previously traced from grounded battery through its upper armature contacts and over conductor 211. The apparatus at the in-coming end of the toll trunk is now in its normal position and all of the apparatus employed for the establishment of the connection is now restored.

The recording toll operator having released the recording trunk proceeds to secure a connection in the usual manner with the calling subscriber's line A over a toll switching trunk (not shown), and having obtained the calling subscriber's line holds the connection by inserting the plug of a holding cord circuit (not shown) into the jack of the switching trunk and records the number of the switching trunk on the ticket which she previously made out. She then transmits the ticket in the routine manner to the regular toll line operator who has access to multiples of switching trunks and to toll lines. The toll line operator after receiving the ticket proceeds to obtain the desired toll connection and upon getting the connection, connects the calling subscriber to it over a multiple of the switching trunk. As soon as the connection is established, the toll recording operator receives a disconnect signal at her holding cord and proceeds to take it down. Inasmuch as this invention does not involve a consideration of the establishment of connection beyond the recording operator's position, the other circuits employed in the complete establishment of toll connection have not been disclosed or described in detail herein.

The recording toll operator also has access to tie lines extending to the information desk, rate-quoting desk and other traffic desks of the office and may when requested by the calling subscriber complete connections to such tie lines by inserting the plug P² in the jack J² of such a line. Upon the insertion of plug P² in the jack J², a circuit is established for sleeve relay 326 which may be traced from grounded battery through the winding of relay 326 and thence to ground through the sleeve contacts of the plug and jack. Relay 326 upon ener-

gizing establishes a circuit for bridging supervisory relay 327 across the strands of the cord circuit, which relay controls the circuit of lamp 328 in the usual manner.

5 If for any reason, the toll recording operator at position O' desires to recall the semi-mechanical operator at position O, she may do so by temporarily withdrawing and inserting the plug P' from the jack J'.
 10 Upon each temporary withdrawal of the plug from the jack, the circuit of sleeve relay 210 is opened to remove the shunt from around the high resistance winding of relay 203, thereby decreasing the strength
 15 of the current flowing over the conductors of the toll trunk and through the winding of marginal relay 127. Relay 127 therefore deenergizes upon each withdrawal of the plug P' from the jack J' and at its
 20 armature contacts opens the circuit of relay 130 which in turn opens the circuit previously traced through the winding of slow-to-release relay 132 and reversing relay 109. Relay 132, however, being slow-to-release
 25 does not have sufficient time to restore its armature contacts to their initial position between the successive deenergizations of relay 127, and therefore the circuits which are established by relay 132 are maintained
 30 in their operated condition. Relay 109, however, responds to each deenergization of relay 130 and at its armature contacts reverses the current flowing through the windings of polarized supervisory relay 112
 35 at the semi-mechanical operator's position O. The current now flowing through the windings of relay 112 is in such a direction as to cause the closure of the circuit through lamp 137, and lamp 137 thereupon flashes
 40 in synchronism with the intermittent withdrawal of the P' from the jack J'.

In response to this flashing signal, the semi-mechanical operator reconnects her set with the semi-mechanical cord and is
 45 then in communication with the recording toll operator.

The semi-mechanical operator may recall the recording toll operator by throwing the key 111 to its alternate position in which
 50 position the windings of relay 112 are disconnected from the strands of the semi-mechanical cord circuit and battery and ground are connected respectively to the ring and tip conductors of the out-going
 55 end of the toll trunk. Therefore upon the operation of the key 111, the circuit of relay 108 is rendered ineffective thereby opening the circuit previously traced through the windings of relays 114 and 115. Relay
 60 115 upon deenergizing opens at its outer left hand armature the circuit previously traced for the slow-to-release relay 119 but since relay 119 is slow-to-release it does not have sufficient time to release its armature
 65 during the operation of the key. Should

relay 119, however, release its armatures to open the circuit of slow-to-release relay 123, the relay 123 being slow-to-release would not open at its armature contacts the circuit previously traced through the windings
 70 of relays 127, 203 and 202 during the operation of key 111. Relays 119 and 123 therefore afford a slow acting means for holding the circuit of relay 127, 203 and
 75 202 closed at the armature contacts of relay 123 during the operation of key 111. Upon the deenergization of relay 115 the circuit previously traced through the winding of relay 203 is opened at the right hand
 80 contacts of relay 115 and relay 203 deenergizes, and at its armature contacts opens the shunt previously traced around the winding of relay 212. Relay 212 thereupon energizes to connect battery and ground through the windings of retardation coil 220 to the
 85 ring and tip conductors 219 and 218 respectively of the toll trunk.

In response to the connection of battery and ground to the conductors of the incoming end of the toll trunk, a circuit is
 90 established for the bridged relay 301, which circuit may be traced from grounded battery through the lower winding of retardation coil 220, the lower armature and front contact of relay 212, conductor 219,
 95 ring contacts of jack J' and plug P', conductor 309, the upper armature and front contact of sleeve relay 300, left hand winding of relay 301, conductor 308, tip contacts of plug P' and jack J', tip conductor
 100 218 of the trunk circuit, the upper armature and front contact of relay 212 and thence to ground through the upper winding retardation coil 220. Relay 301 upon energizing closes a locking circuit for itself extending from grounded battery through its
 105 right hand winding, armature and front contact, and to ground at contact 336 of the talking key 307, the talking key 307 being at this time in its intermediate position in
 110 which the operator's set 329 is disconnected from the strands of the cord circuit. Relay 301 also closes a circuit from ground at contacts 336 through the recall lamp 337 to grounded battery. The operator noting the
 115 illumination of lamp 337 is advised of the fact that the semi-mechanical operator is trying to recall her and she thereupon operates the key 307 to the talking position in which position the circuit of lamp 337
 120 is opened and the locking circuit of relay 301 is disestablished. At the semi-mechanical operator's position, upon the restoration of the recall key 111 to its initial position, the circuits of relays 108, 114 and 115 are
 125 again established.

If the calling subscriber abandons the call before the extension of the connection to the recording operator's cord circuit and
 130 before the recording operator releases the

recording trunk, the semi-mechanical operator at position O in response to the usual supervisory signal proceeds to withdraw the plug P from the jack J whereupon the calling subscriber's line is restored to its normal condition and the district selector 103 is restored. Upon the restoration of the district selector, the circuit previously traced extending through relay 108 is opened and relay 108 upon deenergizing opens the circuit of relays 114 and 115. Relay 115 upon deenergizing opens the circuit of relay 119 which in turn opens the circuit of relay 123. Relay 123, however, does not deenergize until after the trunk circuit is released at its incoming end. Relay 115, upon deenergizing, momentarily opens the circuit previously traced through the windings of relays 127, 203 and 202 and these relays deenergize. The deenergization of relay 203 opens the shunt around the winding of relay 212 and relay 212 thereupon energizes connecting battery and ground through the windings of retardation coil 220 to the ring and tip conductors 218 and 219 of the trunk circuit as previously described. A circuit is now established for supervisory relay 301 at the recording toll operator's cord circuit in the manner previously described for establishing the circuit for the recall lamp 337. The recording operator noting the illumination of lamp 337 proceeds to take down the connection by withdrawing the plug P' from the jack J'.

Upon the withdrawal of plug P' from the jack J', the circuit of sleeve relay 300 of the cord circuit and relay 210 of the trunk circuit is opened. The deenergization of relay 300 opens the locking circuit of relay 318 and opens the circuit of supervisory relay 301. The circuits of the toll operator's cord circuit are now in normal condition.

Relay 210 upon deenergizing opens the locking circuit of relay 207 extending to grounded battery through the winding of relay 212, and these relays become deenergized thereby restoring the circuits at the incoming end of the trunk circuit to normal position. The deenergization of relay 210 also removes the shunt from around the high resistance winding of relay 203 thereby decreasing strength of the current flowing through the winding of relay 127 at the outgoing end of the trunk circuit to such an extent that relay 127 deenergizes opening the circuit of relay 130, which relay in turn opens the circuit of relay 132. Relay 130 upon deenergizing also opens the locking circuit of relay 123 which thereupon deenergizes, opening the circuit previously traced extending over the trunk circuit through the windings of relay 127 and 203. Relay 203 then becomes deenergized. Upon the deenergization of relay 123, the locking circuit of relay 138 is opened and this relay

deenergizes opening the circuit of relay 121 and disconnecting ground potential from the multiples of test terminal 106 whereby the toll trunk is made available for other calls. Relay 121 upon deenergizing opens the locking circuit of relay 142. All the circuits which have been employed in the establishment of the connection are now restored to their normal position.

While the invention has been illustrated in connection with a semi-mechanical operator's position, it is to be understood that the invention is equally applicable to connections established in a full mechanical manner from calling subscribers' lines to recording trunks. If connections are established in a full mechanical manner, the calling subscriber will dial a code to set a district selector upon the outgoing terminals of the toll trunk and a set of switching terminals of the toll trunk corresponding to the class of service to which the particular calling subscriber is entitled will be automatically selected in any suitable manner. Full mechanical connections to the toll trunk could be established in substantially the same manner as shown and described in the patent to F. A. Stearn and F. J. Scudder hereinbefore referred to.

The calling trunks may also terminate in a plurality of multiple jacks at manual operators' positions in the manner disclosed in my copending application Serial No. 431,424, filed December 17, 1920.

It is, of course, obvious that should it be desirable to operate a larger group of class of service pilot signals at the toll operator's position, it would only be necessary to supply more sets of switching terminals at the outgoing end of the toll trunk and to equip the step-by-step selective switches 118 and 311 with a number of selective positions corresponding to the number of switching terminals and to the desired number of pilot signals.

What is claimed is:

1. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said switching apparatus, a plurality of signalling devices, switching apparatus associated with the incoming end of said trunk circuit and operative in accordance with said first named switching apparatus for operating one of said signalling devices and means at the incoming end of said trunk circuit for causing the operation of said first named switching apparatus.

2. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said switching apparatus, a plurality of pilot lamps corresponding in number to said sets of switching terminals, switching apparatus associated with the incoming end of said trunk circuit and operative in accordance with the setting of said first named switching apparatus for operating one of said pilot lamps and means at the incoming end of said trunk circuit for causing the operation of said first named switching apparatus.

3. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said switching apparatus, a cord circuit for connection with the incoming end of said trunk circuit, a plurality of signaling devices and switching apparatus associated with said cord circuit and operative in accordance with said first named switching apparatus for operating one of said signaling devices.

4. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals a connecting circuit, switching apparatus associated with the trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said switching apparatus, a cord circuit for connection with the in-coming end of said trunk circuit, a plurality of pilot lamps corresponding in number to said sets of switching terminals and switching apparatus associated with said cord circuit and operative in accordance with said first named switching apparatus for operating one of said pilot lamps.

5. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, a step-by-step selective switch associated with the outgoing end of said trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said con-

necting circuit with a set of switching terminals for controlling said selective switch, a cord circuit for connection with the incoming end of said trunk circuit, a plurality of signaling devices corresponding in number to said sets of switching terminals and a step-by-step selector switch operative in accordance with said first named switch for operating one of said devices, said devices and said latter switch being associated with said cord circuit.

6. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, a step-by-step selective switch associated with the outgoing end of said trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said selective switch, a plurality of cord circuits for connection with the in-coming end of said trunk circuit, a plurality of signaling devices corresponding in number to said sets of switching terminals and a step-by-step selective switch operative in accordance with the said first named switch for operating one of said devices, said devices and said second named switch being common to said plurality of cord circuits.

7. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, a step-by-step selective switch associated with the outgoing end of said trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said selective switch, a plurality of cord circuits for connection with the in-coming end of said trunk circuit, a plurality of signaling devices corresponding in number to said sets of switching terminals and common to said cord circuits, a plurality of responsive devices associated with each cord circuit for operating said signaling devices and a step-by-step selective switch common to said cord circuits and operative in accordance with the said first named switch for operating one of said responsive devices.

8. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a connecting circuit, a step-by-step selective switch associated with the outgoing end of said trunk circuit having selective positions corresponding in number to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said selective switch, a plurality

of cord circuits for connection with the incoming end of said trunk circuit, a plurality of signaling devices corresponding in number to said sets of switching terminals and
 5 common to said cord circuits, a group of locking relays associated with each cord circuit for operating said signaling devices and a step-by-step selective switch common to said cord circuit and operative in accordance
 10 with said first named switch for operating one of such relays.

9. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching
 15 terminals, a connecting circuit terminating in a selector switch, means for causing such selector switch to connect with a particular set of said switching terminals, switching apparatus associated with the out-going end
 20 of said trunk circuit having selective positions corresponding to said sets of switching terminals, means operative upon the connection of said connecting circuit with a set of switching terminals for controlling said
 25 switching apparatus, a cord circuit for connection with the in-coming end of said trunk circuit, and a plurality of signaling devices and switching apparatus associated with said cord circuit and operative in accordance
 30 with the said first named switching apparatus for operating one of said signaling devices.

10. A plurality of classes of telephone lines, a trunk circuit, means for connecting
 35 any one of said lines to one end of said trunk circuit, signaling means, and a step-by-step automatic switch responsive to the seizure of the other end of said trunk for operating said signaling means to indicate the
 40 class of telephone line associated therewith.

11. A plurality of classes of telephone lines, a trunk circuit, means for connecting any one of said lines to one end of said trunk circuit, signaling means for each of

said classes of lines, a cord circuit for con- 45
 nection with the other end of said trunk circuit, and a selective switch in said cord circuit responsive to the connection of said trunk circuit with said cord circuit for
 50 operating said signaling means to indicate the class of telephone line associated with said trunk circuit.

12. A plurality of classes of telephone lines, means for similarly supplying said
 55 lines with operating current, a trunk circuit, means for connecting any one of said lines to one end of said trunk circuit, signaling means for each of said classes of lines, a step-by-step switch, and means responsive
 60 to the seizure of the other end of said trunk circuit for operating said step-by-step switch to actuate said signaling means to indicate the class of telephone line associated with said trunk.

13. In a telephone system, a plurality of 65
 lines of different classes, signaling means for each of said classes of lines, a trunk line, a connecting means at one end of said trunk line for each class of lines, two automatic
 70 switches, one for each end of said trunk line, and means for moving said two switches to actuate a signal corresponding to the class of the line connected.

14. In a telephone system, a plurality of
 75 lines of different classes, signaling means for each of said classes of lines, a trunk line, means for connecting any one of the lines of said classes to said trunk line, a cord circuit, two automatic switches, one for said trunk
 80 line and one for said cord circuit, and means for moving said two switches to actuate a signal corresponding to the class of the line connected, operative when said cord circuit is connected to said trunk line.

In testimony whereof, I have signed my 85
 name to this specification this 15th day of December 1920.

JOHN F. TOOMEY.