

April 1, 1924.

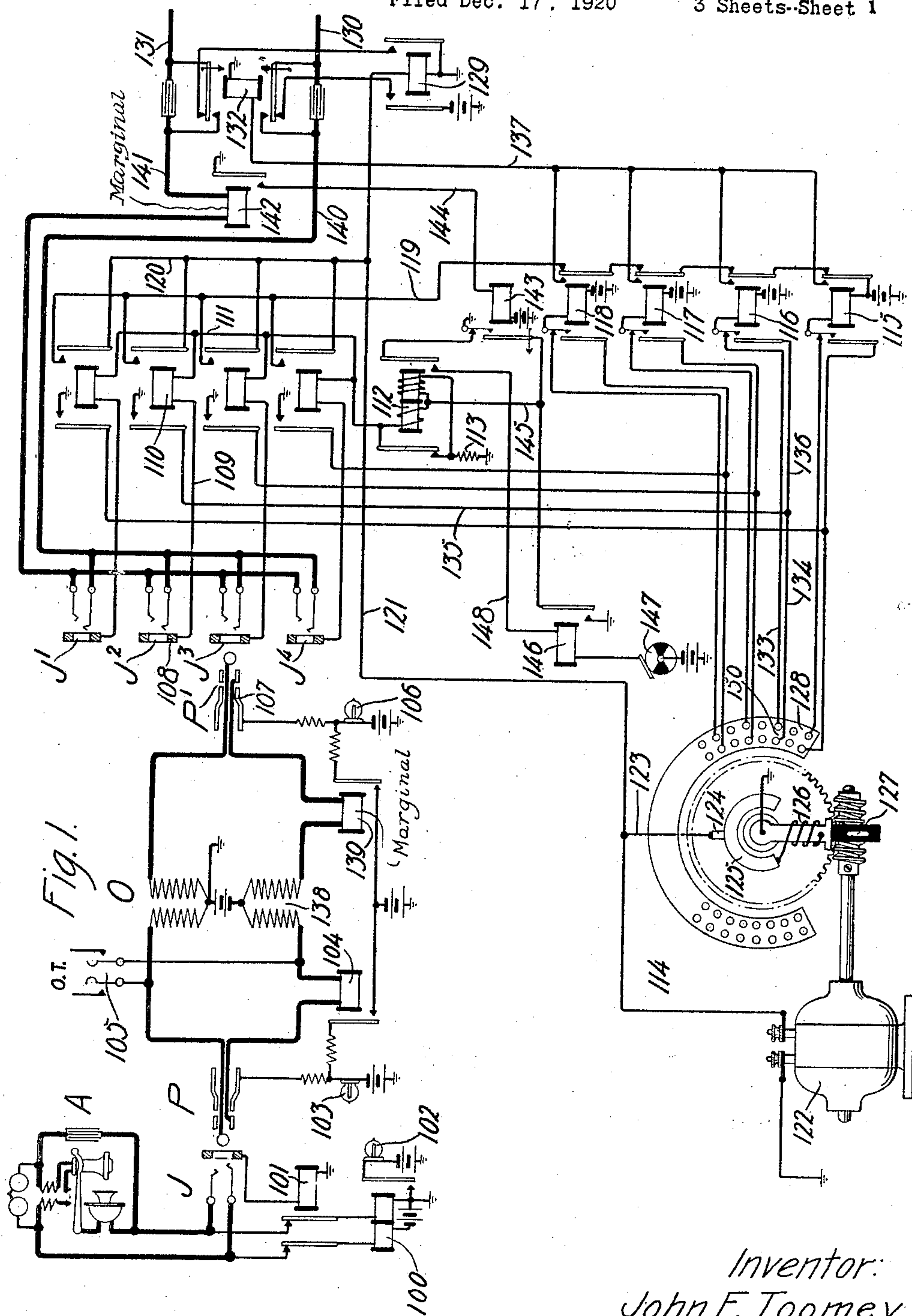
1,488,847

J. F. TOOMEY

TELEPHONE SYSTEM

Filed Dec. 17, 1920

3 Sheets--Sheet 1



Inventor:
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by *g e zoll* Att'y.

April 1, 1924.

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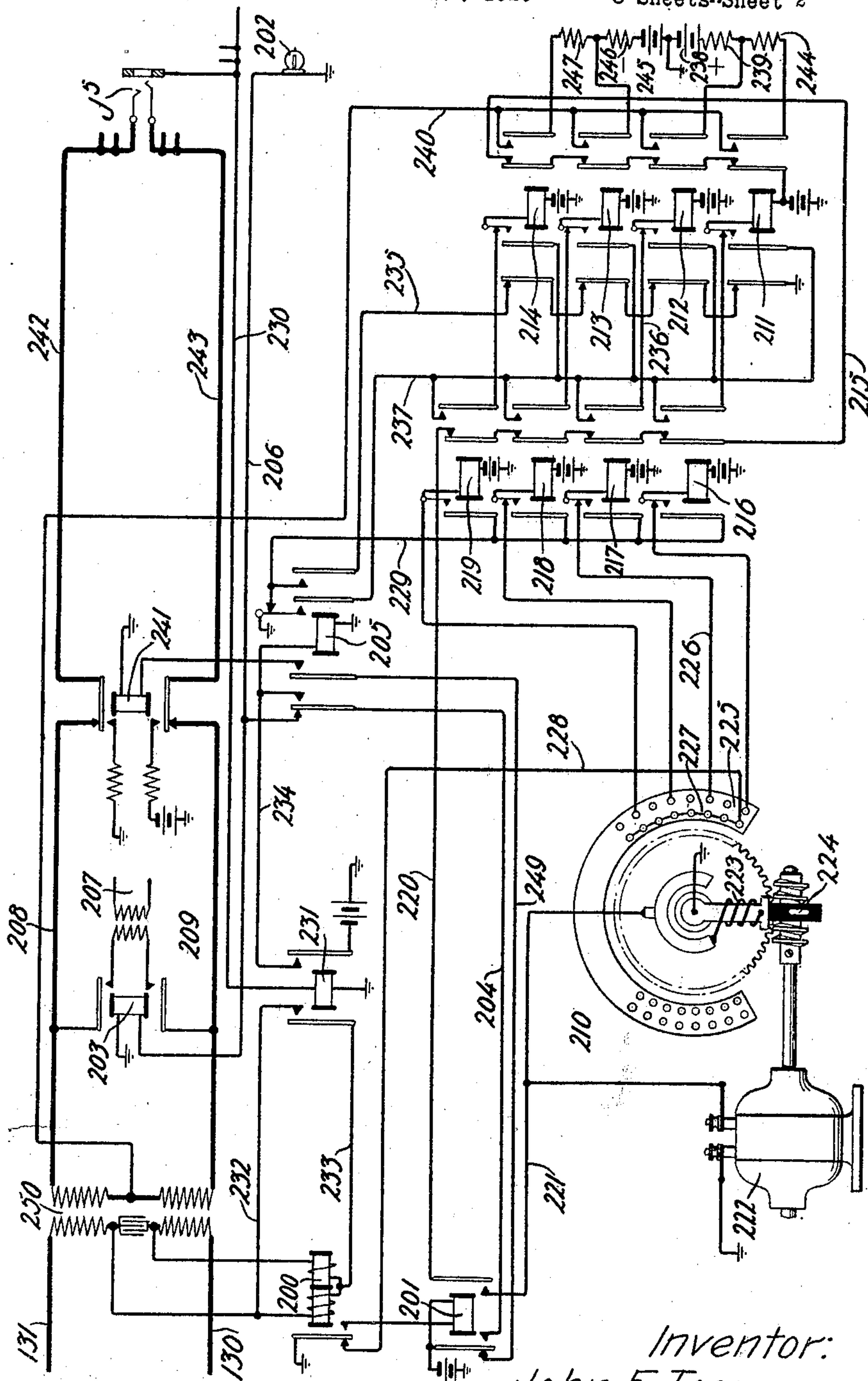
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3 Sheets--Sheet 2

Fig. 2.



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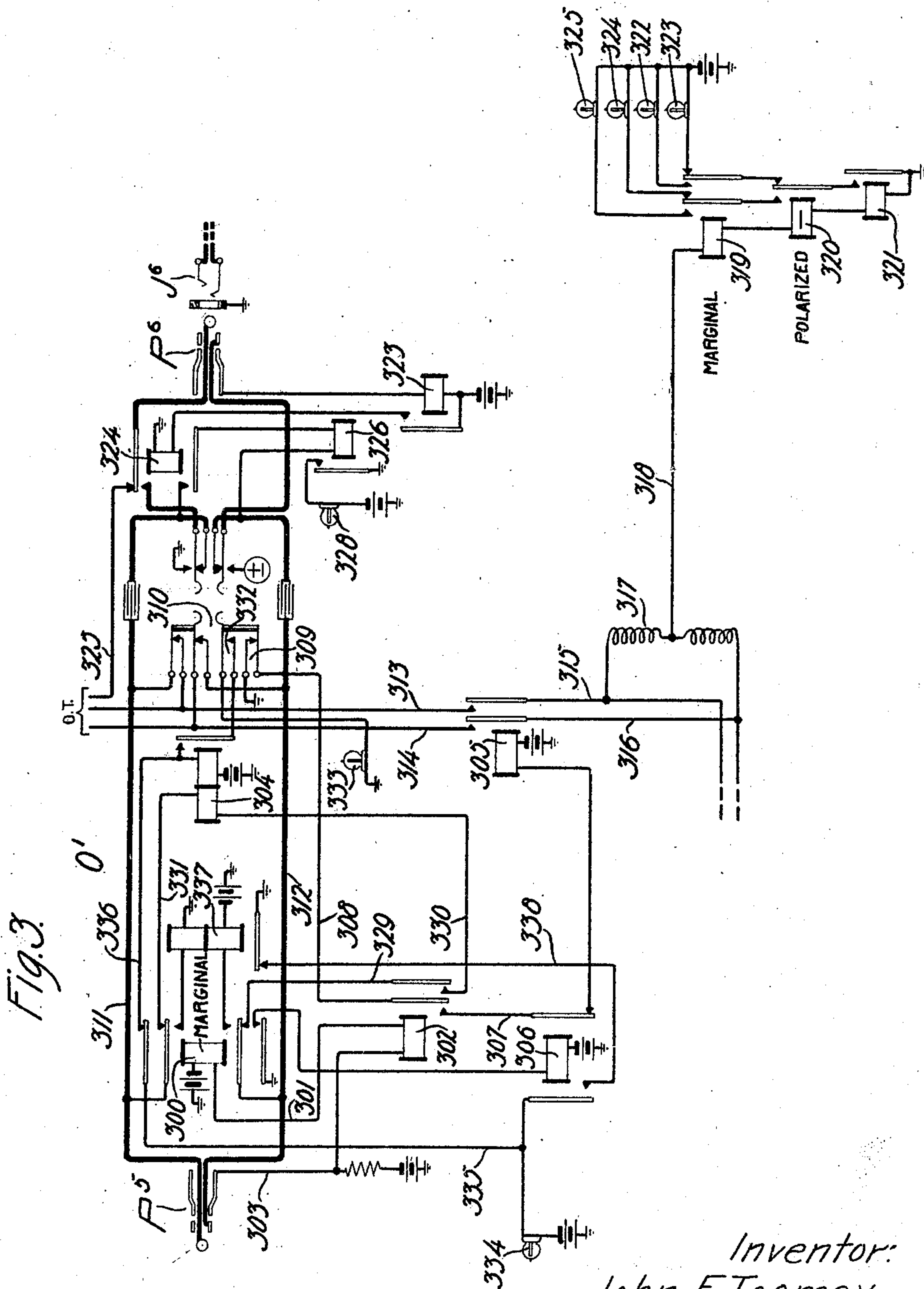
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1- TELEPHONE SYSTEM

Filed Dec. 17, 1920

3 Sheets-Sheet 3



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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. 431,424.

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 employed on the ticket and forwards the ticket to the toll operator at the toll line position. The recording operator then holds the trunk until the toll operator connects with 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 distant toll 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 subscribers have access to recording toll trunks through an "A" op-

erator'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 from a line to which the 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 toll position with distinctive lamp caps so that the "A" operator could select a recording trunk corresponding to the class of service indicated by the calling subscriber's line lamp and thereby call the recording operator in upon the connection through the trunk signal displayed at the incoming end of the toll trunk. The recording toll operator may thus readily determine from the lamp cap associated with 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 situated in a distant office of the exchange, the employment of several groups of trunks may prove to be an expensive item in the cost 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 trunks over which indications of the class of service may be selectively transmitted to the recording operators' positions. This is accomplished by terminating each trunk line in the "A" operators' positions 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 toll position in accordance with the multiple terminal of the trunk line which the "A" operator employed to establish the connection. In the system illustrated each trunk line terminates

in four sets of multiples, the first for lines which are not entitled to toll service, the second for lines which are entitled to originate toll calls and which are billed for this service in the regular way, the third for lines equipped with coin boxes, and the fourth for attended pay-station lines.

An object of the invention is therefore to reduce the number of trunk circuits required between different switchboards or operators' positions.

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.

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 a second operator's position or switch-board.

In accordance with one feature of the invention each recording trunk is terminated in the "A" operators' positions in four sets of multiple terminals and in multiple jacks in the recording operators' positions. At the incoming end of each trunk line a plurality of responsive devices corresponding in number to the sets of multiple terminals are provided which are selected and operated over the trunk line by synchronously operating switching devices associated respectively with the opposite ends of the trunk line.

A further feature of the invention resides in the provision of a plurality of signaling devices associated with and common to the cord circuits of a recording operator's position, which correspond in number to said switching terminals and are selectively operated by the responsive devices upon connection of a recording operator's cord circuit with the incoming end of a trunk line.

Further features of the invention will appear from the following description taken in connection with the accompanying drawings in which Figure 1 shows the out-going end of a toll trunk line together with associated signal transmitting apparatus, the cord circuit of an originating "A" operator and the line of a calling subscriber; Fig. 2 shows the incoming end of a toll line together with associated apparatus; and Fig. 3 shows the cord circuit at a recording toll operator's position and signaling apparatus associated therewith and common to the cord circuits of the position.

It is believed that a clearer understanding of the invention may be had from the following description of the method of extending a connection from the line of subscriber A, Fig. 1 to the recording toll operator's position O₁, Fig. 3. Subscriber A, upon ini-

tiating a call, removes his receiver from its switch hook thereby establishing a circuit through the windings of the line relay 100, which circuit may be traced from grounded battery through the left-hand winding of the relay, the outer left-hand armature and back contact of cut-off relay 101, thence over the substation line loop and back through the inner armature and back contact of cut-off relay 101, to ground through the right hand winding of line relay 100. Line relay 100 energizes in this circuit closing at its armature and front contact a circuit for the line lamp 102.

The operator at position O upon noting the illumination of the subscriber's line lamp 102, picks up the plug P of an idle cord circuit at her position and inserts it in the jack J of the line with which the lamp 102 is associated. A circuit is now established from grounded battery through the supervisory lamp 103, over the sleeve contacts of plug P and jack J and thence to ground through the winding of cut-off relay 101. The cut-off relay 101 energizes in this circuit disconnecting the windings of line relay 100 from the conductors of the subscriber's line whereupon the circuit of line lamp 102 is opened and the lamp extinguished. The supervisory lamp 103 does not become illuminated in the circuit previously traced since upon the insertion of plug P in the jack J the answering supervisory relay 104 becomes energized over the calling subscriber's line loop in the well-known manner closing at its armature and front contact a circuit in shunt of supervisory lamp 103.

The operator upon establishing a connection with the line of the calling subscriber throws her listening key 105 to connect her set (not shown) indicated by the letters O.T. with the strands of the cord circuit and ascertains from the calling subscriber the nature of the connection which the calling subscriber desires. In the case assumed the calling subscriber requests a toll connection. It will be further assumed that the calling subscriber is entitled to regular toll service.

The operator having noted from the lamp cap of the line lamp 102 that the calling subscriber is entitled to regular toll service inserts the calling plug P' of the cord circuit in the jack J².

Upon the insertion of plug P' in the jack J² a circuit is established from grounded battery through the calling supervisory lamp 106, sleeve 107 of plug P', sleeve 108 of jack J², conductor 109, winding of relay 110, conductor 111, the left-hand armature and back contact of relay 112 and thence to ground through resistance element 113. Lamp 106 is illuminated in this circuit and relay 110 is energized. Relay 110 upon energization establishes a circuit for the

switching apparatus or rotary time relay 114 which may be traced from grounded battery through the right hand armatures and back contacts of relays 115, 116, 117, and 118, conductor 119, the right hand armature and front contact of relay 110, conductor 120, conductor 121 and thence to ground through the motor 122 of the rotary time relay 114. A branch of the circuit above traced extends from conductor 121 over conductor 123, brush 124, collecting ring 125, the winding of clutch magnet 126 and thence to ground. In response to the energization of the motor 122 and energization of clutch magnet 126, the motor 122 drives the brush arm of the time relay 114 in a counter clockwise direction for advancing the brushes 127 over the terminal bank 128. This switch may be of the type disclosed in my co-pending application Serial No. 329,801 filed October 10, 1919 and therefore need not be described in detail herein.

Upon the energization of relay 110 and the establishment of the circuit for starting rotary time relay 114, a circuit is also established in parallel with a portion of the circuit previously traced extending from conductor 120 to ground through the winding of relay 129. Relay 129 upon energizing connects grounded battery and ground respectively to the ring conductor 130 and tip conductor 131 of the recording toll trunk extending to the recording toll operators' positions whereupon a circuit is established for the line relay 200 at the incoming end of the toll trunk. This circuit may be traced from grounded battery through the left hand armature and front contact of relay 129 the lower armature and back contact of relay 132, trunk conductor 130, the lower left hand winding of repeating coil 250, both windings of relay 200, the upper left hand winding of repeating coil 250, trunk conductor 131, the upper armature and back contact of relay 132 and thence to ground through the right hand armature and front contact of relay 129. Relay 200 energizes in this circuit and at its armature and front contact closes a circuit for relay 201. At its left hand armature and front contact relay 201 establishes a circuit extending in parallel branches through the trunk lamp 202 and through the winding of tone relay 203. The circuit of lamp 202 may be traced from grounded battery through the left hand armature and front contact of relay 201, conductor 204, the outer left hand armature and back contact of relay 205, conductor 206 and thence to ground through the lamp 202. The illumination of lamp 202 signals the toll operator that a call is awaiting attention on the toll trunk with which the lamp is associated. Relay 203, which is energized in a branch of the circuit just traced extending from conductor 206 to ground

through the winding of relay 203, connects a source of tone current 207 to the tip and ring conductors 208 and 209 of the incoming end of the toll trunk for inductively transmitting a tone signal to the calling subscriber's line through the windings of repeating coil 250, over the conductors 130 and 131 of the toll trunk, and through the "A" operator's cord circuit which tone signal remains upon the toll trunk until after the recording toll operator has answered the call incoming to her position over the trunk. This signal informs the calling subscriber that the recording operator is being signalled.

Relay 201 also closes at its right hand armature and front contact a circuit for starting the rotary time relay 210. This circuit may be traced from grounded battery through the inner right hand armatures and back contacts of relays 211, 212, 213 and 214, conductor 215, inner right hand armatures and back contacts of relays 216, 217, 218 and 219, conductor 220, right hand armature and front contact of relay 201, conductor 221 and thence in parallel circuits through the motor 222 and the clutch magnet 223 of the rotary time relay 210. The energization of the driving motor 222 and of the clutch magnet 223 causes the movement of the brush arm of the relay in a counter clockwise direction to advance the brushes 224 over the terminals of the terminal bank 225.

From the preceding description it will be noted that the rotary time relays 114 and 210 at the opposite ends of the toll trunk are started into operation at substantially the same time, and since these relays can be so adjusted as to operate at the same speed and since the lag in the starting of time relay 210 at the incoming end of the toll trunk due to the time elapsing after the starting of time relay 114 because of the necessary energization of relays 129, 200, and 201 can readily be compensated for, the two time relays therefore move their respective brushes 127 and 224 over their corresponding terminal banks in synchronism.

Rotary time relay 114 will continue to advance brushes 127 over the terminals of the terminal bank 128 until the brushes engage terminals 150 corresponding to the jack J² which has been employed for the establishment of the connection, when a circuit will be established for relay 116 which may be traced from grounded battery through the winding of relay 116, the normally closed break contacts of the left hand armature of this relay, conductor 133, brushes 127, conductor 134, conductor 135 and thence to ground at the left hand armature and front contact of relay 110. Relay 116 energizes in this circuit, closing at the make contacts of its left hand armature a holding circuit for itself independent of

the bank terminals 150 of the rotary time relay 114. This holding circuit may be traced from grounded battery through the winding of relay 116, the make contacts of its left hand armature, conductor 136 and thence to ground over the circuit previously traced at the left hand armature and front contact of relay 110. Relay 116 at its right hand armature and back contact also opens the circuit previously traced extending through motor 122 and clutch magnet 126 of the rotary time relay 114 and the rotary time relay is thereby arrested in its forward rotary movement, and, due to the deenergization of the clutch magnet 126, the brush arm of the relay returns to its normal position as shown in Fig. 1.

Immediately upon the energization of relay 116 and the opening of the driving circuit of rotary time relay 114, the circuit of relay 129 is also opened and this relay being quick to release opens the circuit of line relay 200 at the incoming end of the toll trunk before relay 132, which is slow to energize and for which a circuit is established upon the energization of relay 116, has time to energize. The circuit of relay 132 may be traced from grounded battery through the right hand armature and back contact of relay 115, the right hand armature and front contact of relay 116, conductor 137 and thence to ground through the winding of relay 132. To diagrammatically indicate on the drawing that relay 132 is slow to energize and that relay 143 is show to release arrows pointing in the direction in which armatures slowly move, are shown.

The momentary deenergization of line relay 200 following the deenergization of relay 129 opens the circuit of relay 201 which, at its right hand armature and front contact, opens the driving circuit of the rotary time relay 210. Thus the forward movement of the brush arm of rotary relay 210 is arrested immediately following the energization of relay 116 upon the advance of the brush arm of the rotary time relay 114 to a position corresponding to the jack J^2 which has been employed in the establishment of the connection. The brushes 224 of the time relay 210 will therefore be positioned upon the second set 227 of active terminals in its terminal bank 225. During the momentary deenergization of relay 200 and while the brush 224 is in engagement with terminal 227 a circuit is established for the relay 217, which, may be traced from grounded battery through the break contacts of the left hand armature of this relay, conductor 226, the second set of active terminals 227 of the terminal bank 225, brushes 224, conductor 228 and thence to ground at the armature and back contact of line relay 200. Relay 217 upon energizing establishes a locking circuit for itself in-

dependent of the terminals 227 and brushes 224 of the time relay 210, and of the line relay 200, which may be traced from grounded battery through the winding and the make contacts of the left hand armature of relay 217, conductor 229 and thence to ground at the break contacts of the inner right hand armature of relay 205. At its inner right hand armature and back contact relay 217 opens the driving circuit previously traced for the rotary time relay 210 to prevent a second operation of the rotary time relay upon a subsequent energization of relay 201. At its outer right hand armature and front contact relay 217 prepares a circuit for relay 212 which circuit becomes effective following the response of the recording toll operator. By the opening of the circuits of the driving motor 222 and of the clutch magnet 223 of the rotary time relay 210, the brush arm of the time relay returns to its normal position as illustrated in Fig. 2.

Following the energization of slow-to-energize relay 132, the circuit of line relay 200 is reestablished and relay 200 again closes the circuit of relay 201. Relay 200 is now energized over a circuit which may be traced from grounded battery at the cord circuit of position O, through the lower right hand winding of repeating coil 138, the winding of calling supervisory relay 139, the ring contacts of plug P' and jack J^2 , conductor 140, the lower armature and front contact of relay 132, conductor 130, the lower left hand winding of repeating coil 250, the windings of relay 200, the upper left hand winding of repeating coil 250, conductor 131, the upper armature and front contact of relay 132, trunk conductor 141, the winding of relay 142, tip contacts of jack J^2 and plug P' and thence to ground through upper right hand winding of repeating coil 138. The current flowing in this circuit while sufficient to energize the line relay 200 is not sufficient to energize either relay 142 or supervisory relay 139.

The recording toll operator at position O' in which the toll trunk line terminates, upon noting the illumination of the trunk lamp 202 takes up the answering plug P^5 of an idle cord circuit and inserts it in the jack J^5 of the toll trunk corresponding to the illuminated trunk lamp 202. A circuit is thereupon established which may be traced from grounded battery through the winding of marginal sleeve relay 300, conductor 301, the winding of sleeve relay 302, sleeve conductor 303, sleeve contacts of plug P^5 and jack J^5 , conductor 230, and thence to ground through the winding of the sleeve relay 231. Sleeve relay 300 being marginally wound does not receive sufficient current when connection is made with a toll trunk line for causing its energization, but relays 302 and 231 become energized in the circuit

traced. Relay 300 is provided with a marginal action for a purpose which will be hereinafter set forth.

Relay 231 upon energizing establishes a shunt around the left hand high resistance winding of line relay 200, which shunt extends over conductor 232, the left hand armature and front contact of relay 231, and conductor 233. Due to the shunting out of the high resistance winding of relay 200, the current flowing over the circuit previously traced, extending through the winding of relay 142 and the winding of supervisory relay 139 is now increased to such an extent that these relays become energized in series with relay 200. The energization of supervisory relay 139 establishes a shunt around the calling supervisory lamp 106 whereupon this lamp ceases to be illuminated. The energization of relay 142 establishes a circuit for relay 143 which may be traced from grounded battery through the winding of relay 143, conductor 144 and thence to ground through the armature and front contact of relay 142. Relay 143 upon energization closes a circuit extending through the high resistance right hand winding of relay 112 which circuit may be traced from grounded battery through the armature and front contact of supervisory relay 139 sleeve contact 107 of plug P', sleeve contact of jack J², conductor 109, winding of relay 110, conductor 111, the left hand armature and back contact of relay 112, the right hand winding of relay 112, conductor 145 and thence to ground at the armature and make contact of relay 143. Relay 112 energizes in this circuit opening at its left hand armature and back contact, the circuit just traced though its high resistance right hand winding and removes a shunt existing up to this time around its left hand low resistance winding. Relay 112 is therefore maintained energized over the circuit previously traced extending from conductor 111 through the left hand low resistance winding of relay 112, conductor 145 and thence to ground at the make contacts of the armature of relay 143. Relay 112 at its right hand armature and front contact prepares a circuit for the peremptory disconnect relay 146 which circuit will be described hereinafter.

At the incoming end of the toll trunk upon the energization of relay 231 a circuit is established for relay 205 which may be traced from grounded battery through the right hand armature and front contact of relay 231, conductor 234 and thence to ground through the winding of relay 205. Relay 205 at its outer left hand armature and back contact opens the circuit previously traced extending in parallel branches through lamp 202 and through the winding of relay 203. The lamp 202 thereupon becomes extinguished and relay 203 deener-

gizes disconnecting the source of tone current 207 from the conductors 208 and 209 of the toll trunk.

Relay 205 at the break contacts of its inner right hand armature, opens the locking circuit previously traced extending through the winding of relay 217, but relay 217 is held locked over a new holding circuit extending from conductor 229, through the outer right hand armature and front contact of relay 205, conductor 235 and thence to ground through the outer left hand armatures and back contacts of relays 214, 213, 212, and 211, thus removing the control of the locking circuit of relay 217 from the contacts of relay 205 to the contacts of relay 212, which relay is now energized over a circuit extending from grounded battery, winding and break contacts of the inner left hand armature of relay 212, conductor 236, the outer right hand armature and front contact of relay 217, conductor 237 and thence to ground at the inner right hand armature and front contact of relay 205. Relay 212 upon energizing establishes a locking circuit for itself extending through its winding, the make contact of its inner left hand armature and thence to ground over conductor 237 and the inner right hand armature and front contact of relay 205. Relay 212 at its outer left hand armature and back contact now opens the substitute locking circuit of relay 217, and relay 217 becomes deenergized. Relay 212 at its inner right hand armature and back contact opens the circuit previously traced over conductor 215 to prevent the reestablishment of the driving circuit of time relay 210 when relay 217 becomes deenergized, and at its outer right hand armature and front contact prepares a circuit for selectively operating class of service lamps associated with the recording toll operator's cord circuit in a manner to be hereinafter described.

At the recording toll operator's position relay 302 becomes energized in the circuit previously traced and at its outer right hand armature prepares a circuit for the supervisory relay 304 for a purpose to be hereinafter described. At its inner right hand armature, relay 302 establishes a circuit for relay 305 which circuit may be traced from grounded battery through the winding of relay 305, the right hand armature and back contact of relay 306, conductor 307, inner right hand armature and front contact of relay 302, conductor 308 and thence to ground through the contacts 309 of the operator's talking key 310 provided the talking key 310 is in its normal position in which the operator's telephone set indicated at O. T. is connected to the talking strands of the cord circuit. Relay 305 upon energizing establishes a simplex operating circuit for controlling the selective operation of one of

the class of service lamps associated with and common to the cord circuits of the operator's position O'.

It having been assumed that the responsive device or relay 212 associated with the incoming end of the toll trunk has been selectively operated through the functioning of the rotary time relay 210, the control circuit for operating the class of service signals may be traced as follows: from the positive grounded pole of battery 238 through resistance element 239, the outer right hand armature and front contact of relay 212, conductor 240, the mid point between the right hand windings of repeating coil 250, thence by parallel paths over trunk conductors 208 and 209, the armatures and back contacts of relay 241, trunk conductors 242 and 243, the tip and ring contacts of jack J⁵ and plug P⁵, the tip and ring strands 311 and 312 of the toll operator's cord circuit, normally closed contacts of the talking key 310, conductors 313 and 314, the armatures and front contacts of relay 305, conductors 315 and 316, thence to the mid point of coil 317, conductor 318 and to ground through the winding of marginal relay 319, the winding of polarized relay 320 and the winding of sensitive relay 321. Since the current flowing in this circuit is impressed from the positive pole of battery 238 and through only a portion 239 of the resistance associated with the circuit of battery 238, the marginal relay 319 at the operator's position receives sufficient current to energize in series with relay 321. Polarized relay 320, however, does not energize since it attracts its armature only when current of negative polarity is impressed upon its winding. With relays 319 and 321 energized, a circuit for class of service pilot lamp 322 is established, which may be traced from grounded battery through lamp 322, the outer right hand armature and front contact of relay 319, the armature and back contact of relay 320 and to ground through the armature and front contact of relay 321.

Class of service lamps 322, 323, 324, and 325 are provided in the well-known manner with distinctive lamp caps corresponding to similar lamp caps which are placed upon the line lamps corresponding to lamp 102 of subscribers' lines, and the toll operator upon noting the illumination of a pilot lamp such as 322 is advised concerning the class of service to which the calling subscriber is entitled.

It is to be noted in this connection that if responsive device 211 had been operated due to the seizure of jack J' at the outgoing end of the trunk, then resistance element 244 would have been included in the circuit previously traced from battery 238 through the windings of relays 319, 320, 321 and in this event marginal relay 319 would not have received sufficient current to energize and

consequently a circuit for lamp 323 would have been established from grounded battery through lamp 323, the outer armature and back contact of relay 319, the armature and back contact of relay 320 and to ground at the armature and front contact of relay 321. Had responsive device 213 been energized, then negative current from battery 245 through resistance element 246 would have been impressed upon the control circuit and relays 319, 320 and 321 would all have been energized, since now the polarized relay 320 responds to the negative current, and lamp 325 would have been illuminated. In a similar manner had responsive device 214 been energized, current from battery 245 would have been impressed upon the control circuit through resistance elements 246 and 247 and relays 320 and 321 would have responded and the circuit of lamp 324 would have been established.

The recording toll operator upon noting the illumination of class of service lamp 322, and upon receiving instructions from the calling subscriber as to the further extension of the connection, proceeds to record the information on a ticket in the routine manner. Upon the completion of the recording, the recording operator dismisses the calling subscriber.

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 310 to its holding position. The contact 309 of the key is now opened and the circuit previously traced through the winding of relay 305 is opened, thereby disestablishing the signal control circuit previously traced for controlling the operation of the class of service lamps. Relays 319 and 321 now become deenergized and lamp 322 is extinguished. If at any time the operator desires to relight the lamp 322 to check up the class of service to which the calling subscriber is entitled, she may do so by throwing the key 310 to the talking position in which position contacts 309 are closed, and the control circuits previously traced are reestablished. She may do this only when the plug P⁵ is in the jack J⁵, since the circuit of relay 305 not only depends upon the closure of contacts 309, but also upon the energization of sleeve relay 302.

Following the completion of recording, the recording operator releases the recording trunk by withdrawing plug P⁵ from jack J⁵ and the circuit previously traced through the windings of relays 300, 302 and 231, is opened thereby opening the initial energizing circuit of relay 205 at the right hand armature and front contact of relay 231. Relay 205, however, does not deenergize at this time, since relays 200 and 201 are still

maintained energized over the toll trunk. Relay 231 upon deenergizing also removes the shunt from around the high resistance winding of relay 200, whereby the current
 5 flowing over the trunk through the windings of relays 200, 142 and 139 is decreased to such an extent that supervisory relay 139 in the originating operator's cord circuit and relay 142 in the trunk circuit become de-
 10 energized. Relay 142 upon deenergizing opens the circuit of slow-to-release relay 143, which after a predetermined interval releases and closes a circuit extending from grounded battery, through interrupter 147,
 15 the winding of relay 146, conductor 148, the right hand armature and front contact of relay 112 and thence to ground at the back contact of relay 143. Relay 112 is now maintained energized over the sleeve con-
 20 ductor 109, through both of its windings and resistance element 113. Relay 146 is intermittently energized in the circuit traced and at its armature and front contact closes a shunt circuit intermittently around the
 25 high resistance winding of relay 112, this circuit extending from ground, through the resistance element 113, the right hand winding of relay 112, conductor 145 and thence to ground at the armature and front con-
 30 tact of relay 146. The resistance of relay 112 being thus intermittently decreased, the current flowing over the sleeve conductor 109 is thus intermittently increased and since at this time relay 139 is deenergized and the
 35 shunt around supervisory lamp 106 is, therefore, removed, the lamp 106 flashes to give the originating operator the peremptory disconnect signal. The operator noting this peremptory signal, takes down the connec-
 40 tion regardless of whether the answering supervisory lamp 103 signifies that the calling subscriber has hung up his receiver or not.

The originating operator upon withdraw-
 45 ing the plug P^1 from the jack J^2 , opens the circuit extending through the windings of relays 139, 142 and 200. These relays deenergize, the relay 200 opening the circuit of relay 201 which in turn opens the lock-
 50 ing circuit of relay 205. Relay 205 upon deenergizing opens the locking circuit previously traced through the winding of relay 212, whereby all of the apparatus at the incoming end of the toll trunk is restored to
 55 normal condition. At the outgoing end of the toll trunk, the withdrawal of plug P' from the jack J^2 also opens the circuit previously traced through the windings of relays 110 and 112 and the apparatus at the out-
 60 going end of the trunk is thereby restored to its normal position.

The recording toll operator now proceeds to secure a connection in the usual manner with the calling subscriber's line over a toll
 65 switching trunk (not shown), and having

obtained such connection, holds it by insert-
 ing the plug of a holding cord circuit (not shown) in the incoming jack of the switch-
 ing trunk and records the number of the
 switching trunk employed on the ticket 70
 which she previously made out. She then transmits the ticket to the toll line operator, who has access to multiples of the switching
 trunks and to toll lines. The toll operator
 after receiving the ticket proceeds to obtain 75
 the desired toll connection, and after obtaining the connection connects the calling sub-
 scriber to the toll line over a multiple of
 the toll switching trunk. As soon as the
 connection is established, the recording op- 80
 erator receives a disconnect signal at her holding cord circuit and thereupon takes
 down the cord circuit. Inasmuch as this
 invention does not involve the consideration
 of the establishment of the connection be- 85
 yond the recording operator's position, the other circuits employed to completely estab-
 lish the toll connection have not been shown
 or described in detail herein.

Should the originating operator at posi- 90
 tion O desire to recall the operator at the recording toll position O' while the connection
 is established over the toll trunk with the
 recording operator's cord circuit, she may
 do so by applying ringing current from her 95
 cord circuit to the conductors of the toll trunk. This ringing current flowing over
 the toll trunk flows through the left hand
 winding of supervisory relay 304, operating
 this relay as a ring-down relay. Relay 304 100
 upon energizing locks up through the con-
 tacts 332 of key 310 and through the aux-
 iliary lamp 333, and establishes a circuit for
 recall lamp 334. The toll recording operator
 noting the illumination of lamp 334 then 105
 throws the key 310 to the talking position
 for connecting her head set to the strands
 of the cord circuit, whereupon she may con-
 verse over the established connection with
 the originating operator. 110

The operator at position O may also re-
 call the operator at position O' by with-
 drawing the plug P' from the jack J^2 and
 reinserting it therein, whereupon relays 142
 and 200 become momentarily deenergized. 115
 The deenergization of relay 142 is without
 effect, since it does not open the circuit of
 slow-to-release relay 143 for a sufficient time
 to cause its deenergization. The deenergiza-
 tion of relay 200 opens the circuit of relay 120
 201, which at its left hand armature and
 back contact closes a circuit for relay 241
 extending from grounded battery through
 the left hand armature and back contact of
 relay 201, conductor 249, inner left hand 125
 armature and front contact of relay 205 and
 thence to ground through the winding of re-
 lay 241. Relay 241 upon energizing mo-
 mentarily establishes a circuit for relay 304,
 which may be traced from grounded battery, 130

through the lower armature and front contact of relay 241, trunk conductor 243, the ring contacts of jack J^5 and plug P^5 , the innermost lower armature and back contact of relay 300, the outer right hand armature and front contact of relay 302, conductor 330, the left hand winding of relay 304, conductor 331, the innermost upper armature and front contact of relay 300, the tip contacts of plug P^5 and jack J^5 , conductor 242 and thence to ground through the upper armature and front contact of relay 241. Relay 304 upon energizing locks up as previously described and establishes the previously traced circuit for lamp 334.

Should the recording toll operator O' desire to recall the originating operator at position O , she may do so by intermittently withdrawing the plug P^5 from the jack J^5 . Since at this time relay 200 is energized over the toll trunk, thereby maintaining relay 201 energized, which relay in turn maintains a locking circuit for relay 205, the withdrawal of plug P^5 and the consequent deenergization of relay 231 does not permit relay 205 to deenergize to restore the signaling apparatus including relay 212. The intermittent deenergization of relay 231 however, opens and closes the shunt around the high resistance winding of relay 200 and thereby causes the intermittent operation of relay 142 and supervisory relay 139.

Upon each deenergization of relay 142 the circuit of relay 143 is opened, but as relay 143 is slow-to-release, this relay does not deenergize between the intermittent deenergizations of relay 142. The intermittent operation of supervisory relay 139 intermittently removes the shunt from around supervisory lamp 106 so that the lamp 106 flashes in unison with the withdrawal and insertion of plug P^5 at the toll position. The operator noting the flashing of the lamp throws her listening key 105 for connecting her head set with the strands of her cord circuit. She may now converse with the operator at the position O' as soon as the operator at the latter position restores the plug P^5 to the jack J^5 and throws her key 310 to its talking position.

It may be desirable to permit the recording toll operator to have access directly to the calling subscriber's line, this traffic feature being of special importance in financial districts where telephone lines from brokers' offices are terminated directly before toll operators for the purpose of giving such lines quick toll service. To enable the toll operator to supervise such connection and to supply such calling lines with talking current, it then becomes necessary to equip the answering end of the toll cord circuits with apparatus especially designed for the purpose.

When the toll operator answers a call in-

itiated upon such a subscriber's line she inserts the plug P^5 in the jack of the calling line whereupon a circuit is established through the cut-off relay of the calling line, the sleeve contacts of the subscriber's jack and plug P^5 , conductor 303, winding of sleeve relay 302, conductor 301 and to grounded battery through the winding of marginal relay 300. Sleeve relays 300 and 302 now both energize since the winding of the cut-off relay of the subscriber's line is of such low resistance that marginal sleeve relay 300 receives sufficient current to cause its energization. Relay 300 upon energizing disconnects at its innermost armatures and back contacts, the winding of bridged supervisory relay 304 from the strands of the cord circuit, and at these armatures and their front contacts bridges the windings of supervisory relay 337 across the strands 311 and 312 of the cord circuit. At its uppermost armature and back contact relay 300 opens the circuit for lamp 334 extending to the contact of relay 304, and at its lowermost armature and front contact establishes a circuit for relay 306. Relay 306 upon energizing opens the circuit of relay 305 to prevent a false operation of the class of service signaling apparatus which apparatus is not now needed, since the operator can obtain the class of service to which the calling subscriber is entitled directly from the lamp cap of the calling subscriber's line lamp. At its left hand armature and front contact, relay 306 establishes a circuit for lamp 334 which may be traced from grounded battery through the lamp, the left hand armature and front contact of relay 306, conductor 338 and thence to ground at the armature and back contact of supervisory relay 337. Lamp 334, however, is not illuminated at this time since supervisory relay 337 which was bridged across the strands of the cord circuit upon the energization of sleeve relay 300 is energized at this time over the calling subscriber's line loop.

The recording toll operator receives instruction from the calling subscriber and proceeds in the manner previously described to make out a ticket and to transmit the ticket to the toll operator who attends to the establishment of the desired toll connection.

The recording toll operator also has access to tie lines extending to the information desk, the rate charging desk and other traffic desks of the office and may, when requested by the calling subscriber, complete connections to such desks by inserting the plug P^6 in the jack J^6 of such a line. Upon the insertion of the plug P^6 in the pack J^6 , a circuit is established for sleeve relay 323, which may be traced from grounded battery, through the winding of relay 323 and thence to ground through the sleeve contacts of

plug P⁶ and jack J⁶. Relay 323 upon energizing establishes a circuit for relay 324 extending from grounded battery through the armature and front contact of relay 323 and
 5 thence to ground through the winding of relay 324. Relay 324 upon energizing opens the circuit extending from the tip of plug P⁶ to the test lead 325 extending to the operator's set and connects the tip of the plug
 10 to the tip strand of the cord circuit, and at its lower armature and front contact closes a circuit for bridging the supervisory relay 326 across the strands of the cord circuit. The supervisory relay 326 is controlled over
 15 the tie lines to which the cord circuit is connected and controls the circuit of supervisory lamp 328 in the usual manner.

If the calling subscriber abandons the call after becoming connected to the recording
 20 operator's position O', the originating operator noting the illumination of supervisory lamp 103 proceeds to take down the connection. Upon the withdrawal of plug P' from jack J², the circuit previously traced extending through the winding of relay 139,
 25 the winding of relay 142 and the winding of relay 200 is opened and these relays deenergize. The deenergization of relay 200 opens a circuit of relay 201 which in turn
 30 opens the locking circuit of relay 205, which locking circuit extends from grounded battery through the left hand armature and front contact of relay 201, over conductor 204 and the outer left hand armature and
 35 front contact and winding of relay 205. Relay 205, however, does not deenergize at this time as the recording toll operator still maintains the connection with the toll trunk over her cord circuit and the initial energizing circuit of relay 205 is still maintained
 40 at the armature contacts of relay 231.

Relay 201 at its left hand armature and back contact now establishes a circuit for relay 241 which may be traced from
 45 grounded battery, through the left hand armature and back contact of relay 201, conductor 249, the inner left hand armature and front contact of relay 205 and thence to ground through the winding of relay 241. Relay 241 upon energizing establishes the
 50 previously traced circuit for relay 304 which upon energizing closes a locking circuit for itself extending from grounded battery through its right hand winding, its armature and front contact, contacts 332 of key
 55 310, it being assumed that key 310 is in its holding position; since the operator throws it to the holding position following the establishment of the connection, and thence to ground through the auxiliary signal 333. Relay 304 also establishes a circuit for the recall lamp signal 334. The circuit of lamp
 60 334 may be traced from grounded battery, through the lamp, conductor 335, the uppermost armature and back contact of relay

300, conductor 336 and thence to ground through the armature contacts of relay 304 and auxiliary signal lamp 333.

The toll operator noting the illumination of lamp 334 proceeds to take down the connection by withdrawing the plug P⁵ from the jack J⁵, whereupon the circuit previously traced through the windings of relays 300, 302 and 231 is opened and these relays deenergize. The circuits at the toll
 70 operator's cord circuit are now in normal position with the exception of the circuit previously traced through the supervisory lamp 334 and through the auxiliary signal lamp 333. These circuits remain closed
 75 until the operator restores the key 310 to its normal position, in which position her head set is again connected with the strands of the cord circuit.

Relay 231 upon deenergizing opens the
 85 circuit of relay 205 and since at this time relay 201 is deenergized, relay 205 becomes deenergized opening the circuits of relays 241 and 212. The circuits at the incoming end of the toll trunk are now in normal
 90 condition.

At the originating operator's position upon the withdrawal of the calling plug P' from the jack J², the circuit previously traced through the winding of relay 110
 95 and the winding of relay 112 is opened and these relays become deenergized. The circuits at the originating or outgoing end of the toll trunk are now restored to their normal condition.

While the invention has been disclosed in connection with circuits operating upon a manual basis, it is obvious that the multiple terminals of the toll trunk at the originating
 100 operator's position might terminate in the terminal banks of selector switches, as shown in applicant's copending application Serial No. 431,425, filed December 17, 1921, and be selected automatically by the functioning of the switches in accordance with digits
 105 dialed either by a calling subscriber or by a semi-mechanical operator. Further, it is obvious that the number of class of service lamps to be operated at the toll operator's position need not be limited to four as herein
 110 disclosed, as the system may readily be extended to provide for the operation of any desired number of lamps.

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 plurality of responsive devices associated with the incoming end of
 120 said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation
 125 130

of one of said responsive devices, means for connecting with the incoming end of said trunk circuit, and signaling means associated with said connecting means and adapted to be selectively operated by said operated responsive device.

2. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, means for connecting with the incoming end of said trunk circuit, a plurality of signaling devices associated with said connecting means corresponding in number to said responsive devices and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

3. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a cord circuit for connection with the incoming end of said trunk circuit, a plurality of signaling devices associated with said cord circuit corresponding in number to said responsive devices, and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

4. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a cord circuit for connection with the incoming end of said trunk circuit, a plurality of signaling devices associated with said cord circuit corresponding in number to said responsive devices and means operated over a simplex circuit comprising a portion of the talking conductors of said trunk circuit and of said

cord circuit and under control of said operated responsive device for causing the operation of the corresponding signaling device.

5. A telephone exchange system comprising a trunk circuit, terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a cord circuit for connection with the incoming end of said trunk circuit, a plurality of signaling devices associated with said cord circuit corresponding in number to said responsive devices, and means comprising a sensitive relay, a marginal relay, and a polarized relay under the control of said operated responsive device for causing the operation of the corresponding signaling device.

6. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon the connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a cord circuit for connection with the incoming end of said trunk circuit, a talking key for said cord circuit, a plurality of signaling devices associated with said cord circuit corresponding in number to said responsive devices, and means under the control of said key and of said operated responsive device for causing the operation of the corresponding signaling device.

7. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating upon connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a plurality of cord circuits for connection with the incoming end of said trunk circuit, a plurality of signaling devices common to said cord circuits said signaling devices corresponding in number to said responsive devices, and means under the

control of said operated responsive device for causing the operation of the corresponding signaling device.

8. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of jacks, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said jacks, a cord circuit, switching apparatus associated with the trunk circuit operating upon the connection of the cord circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, means for connecting with the incoming end of said trunk circuit and signaling means associated with said connecting means and adapted to be selectively operated by said operated responsive device.

9. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of jacks, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said jacks, a cord circuit, switching apparatus associated with the trunk circuit operating upon connection of the cord circuit with the trunk circuit for selecting and causing the operation of one of said responsive devices, a plurality of cord circuits for connection with the incoming end of said trunk circuit, a plurality of signaling devices common to said cord circuits said signaling devices corresponding in number to said responsive devices, and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

10. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, and a second selective switch at the incoming end of said trunk circuit operating in accordance with the setting of said first switch for selecting and causing the operation of one of the said responsive devices.

11. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating

upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, and a second selective switch associated with the incoming end of said trunk circuit operating synchronously with said first switch for selecting and causing the operation of one of said responsive devices.

12. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a rotary time relay at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, and a second rotary time relay associated with the incoming end of said trunk circuit operating synchronously with said first relay for selecting and causing the operation of one of said responsive devices.

13. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, a second selective switch at the incoming end of said trunk circuit operating in accordance with the setting of said first switch for selecting and causing the operation of one of said responsive devices, means for connecting with the incoming end of said trunk circuit, a plurality of signaling devices associated with said connecting means corresponding in number to said responsive devices, and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

14. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating upon the connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, a second selective switch associated with the incoming end of said trunk circuit operating synchronously with said first switch for selecting and causing the operation of one of said respon-

sive devices, means for connecting with the incoming end of said trunk circuit, a plurality of signaling devices associated with said connecting means corresponding in number to said responsive devices, and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

15. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of responsive devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a rotary time relay at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, a second rotary time relay associated with the incoming end of said trunk circuit operating synchronously with said first relay for selecting and causing the operation of one of said responsive devices, means for connecting with the incoming end of said trunk circuit, a plurality of signaling devices associated with said connecting means corresponding in number to said responsive devices, and means under the control of said operated responsive device for causing the operation of the corresponding signaling device.

16. A telephone system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of electromagnetic devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, switching apparatus associated with the trunk circuit operating in response to the connection of the connecting circuit with the trunk circuit for selecting and causing the operation of one of said electromagnetic devices, and signaling means selectively operated by said operated electromagnetic device.

17. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of electromagnetic devices associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, and a second selective switch at the incoming end of said trunk circuit operating in accordance with the setting of said first switch for selecting and causing the operation of one of the said electromagnetic devices.

18. A telephone exchange system comprising a trunk circuit terminating at its outgoing end in a plurality of sets of switching terminals, a plurality of signals associated with the incoming end of said trunk circuit corresponding in number to said switching terminals, a connecting circuit, a selective switch at the outgoing end of said trunk circuit operating upon connection of the connecting circuit with the trunk circuit in accordance with the switching terminal employed, and means including a second selective switch at the incoming end of said trunk circuit operating in accordance with the setting of said first switch for selecting and causing the operation of one of the said signals.

19. A plurality of classes of telephone lines, means for similarly supplying said lines with operating current, a trunk circuit therefor, means for connecting any one of said lines to said trunk circuit, visual signaling means for each of said classes of lines, and means responsive to the seizure of the incoming end of said trunk for operating said signaling means to indicate the class of telephone line associated therewith.

20. In a telephone exchange system, a plurality of classes of telephone lines, a trunk circuit having a terminal corresponding to each of said classes of lines, an electromagnetic device individual to each of said classes of lines, and synchronously operable means common to all of said lines for selectively actuating one of said electromagnetic devices in response to the seizure of said trunk by way of a corresponding terminal.

21. In a telephone system, a plurality of classes of lines, a trunk circuit terminating at one end in a switching terminal for each of said lines, a cord circuit for interconnecting said lines and said trunk circuit by way of said switching terminals, a second cord circuit adapted to be associated with said trunk in the establishment of a connection, a rotary switch at the outgoing end of said trunk, a rotary switch at the incoming end of said trunk, a signaling device for each of said classes of lines, means responsive to the connection of said first cord circuit with one of the terminals of said trunk for effecting the synchronous operation of said rotary switches, and means responsive to the operation of said switches subsequent to the association of said second cord circuit with said trunk for selectively actuating a signal corresponding to the switching terminal employed in completing the connection.

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

JOHN F. TOOMEY.