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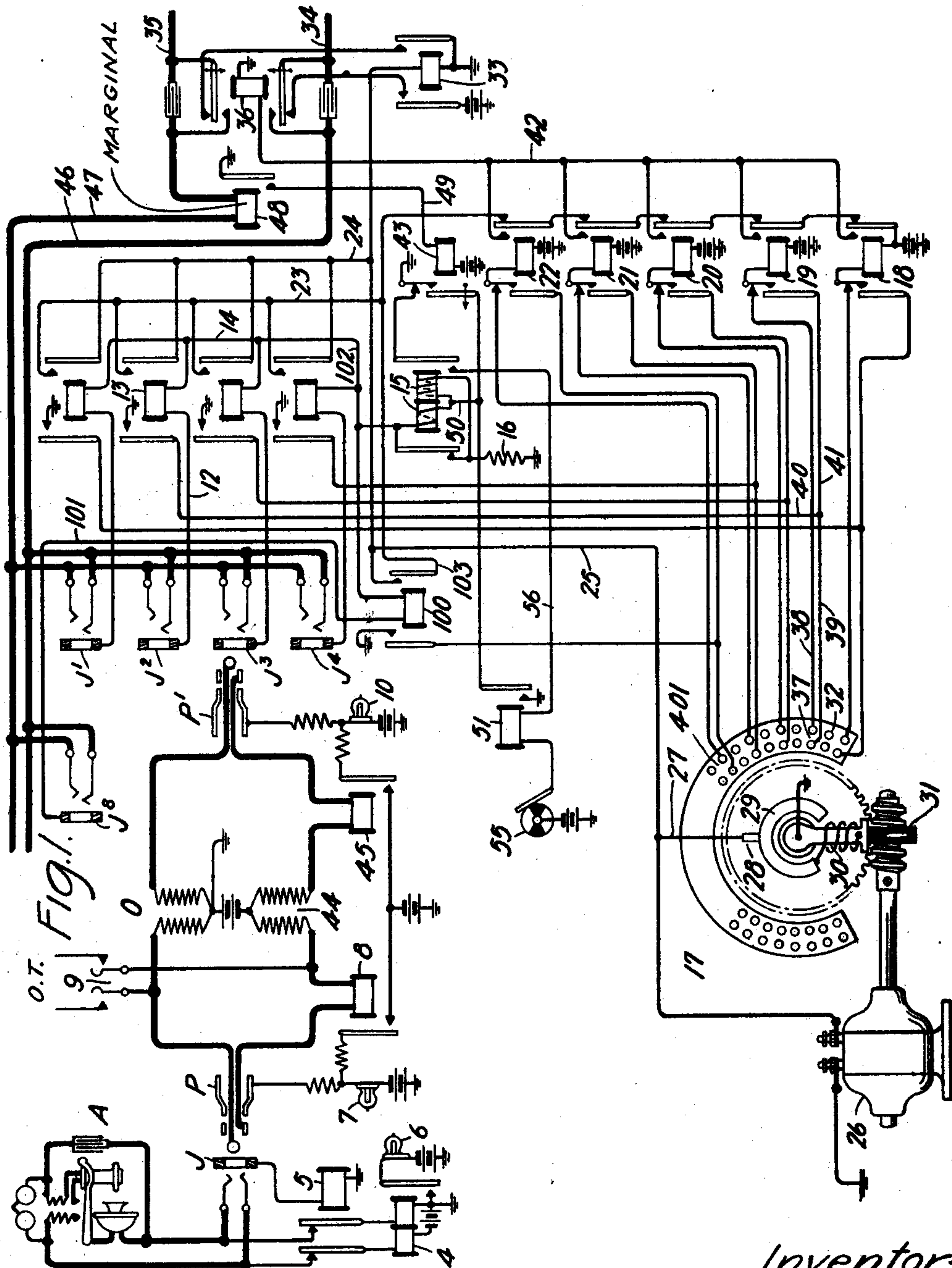
1,531,360

J. F. TOOMEY

TELEPHONE SYSTEM

Filed Oct. 11, 1922

3 Sheets-Sheet 1



Inventor:
John F. Toomey.

by

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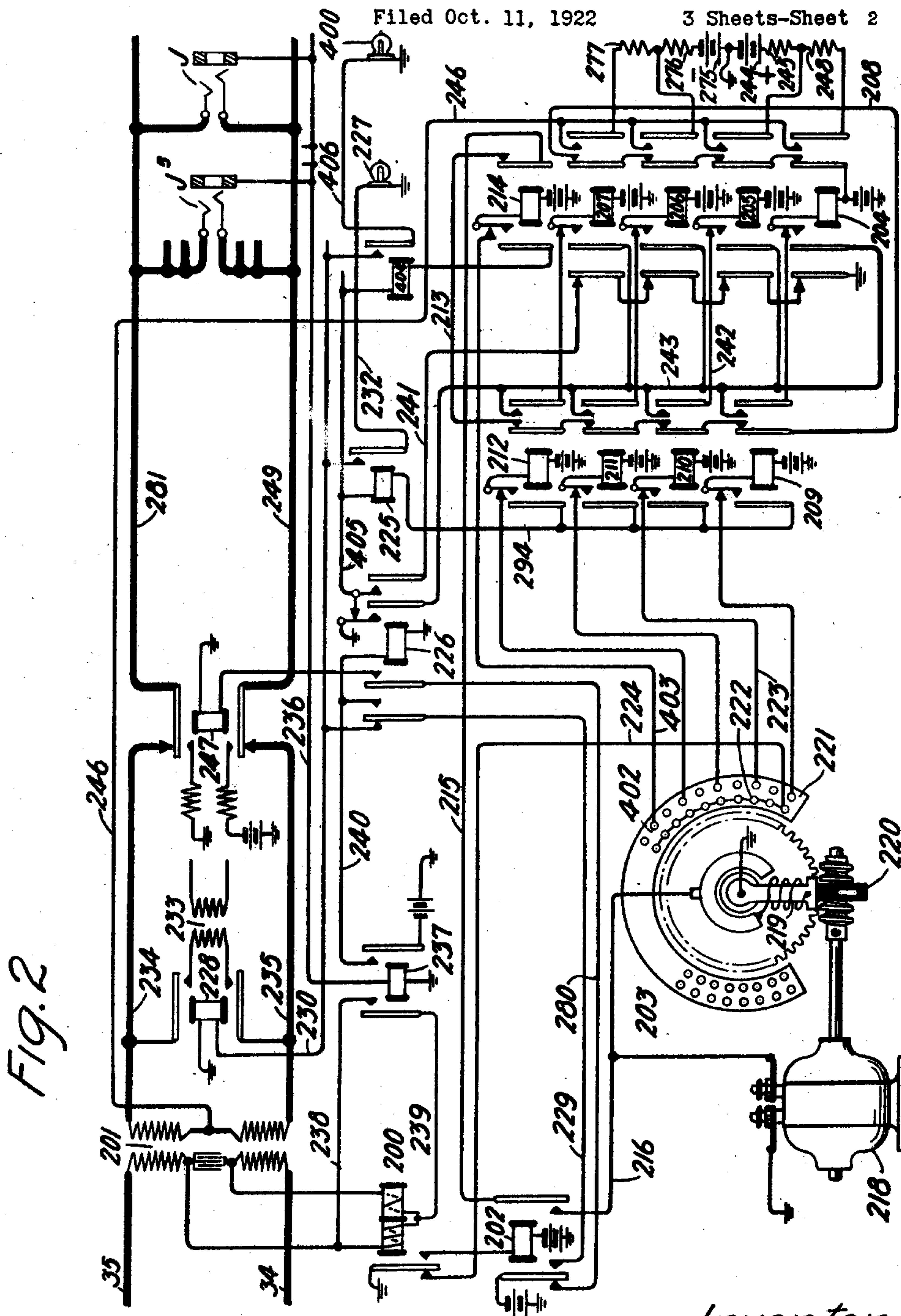
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3 Sheets-Sheet 2



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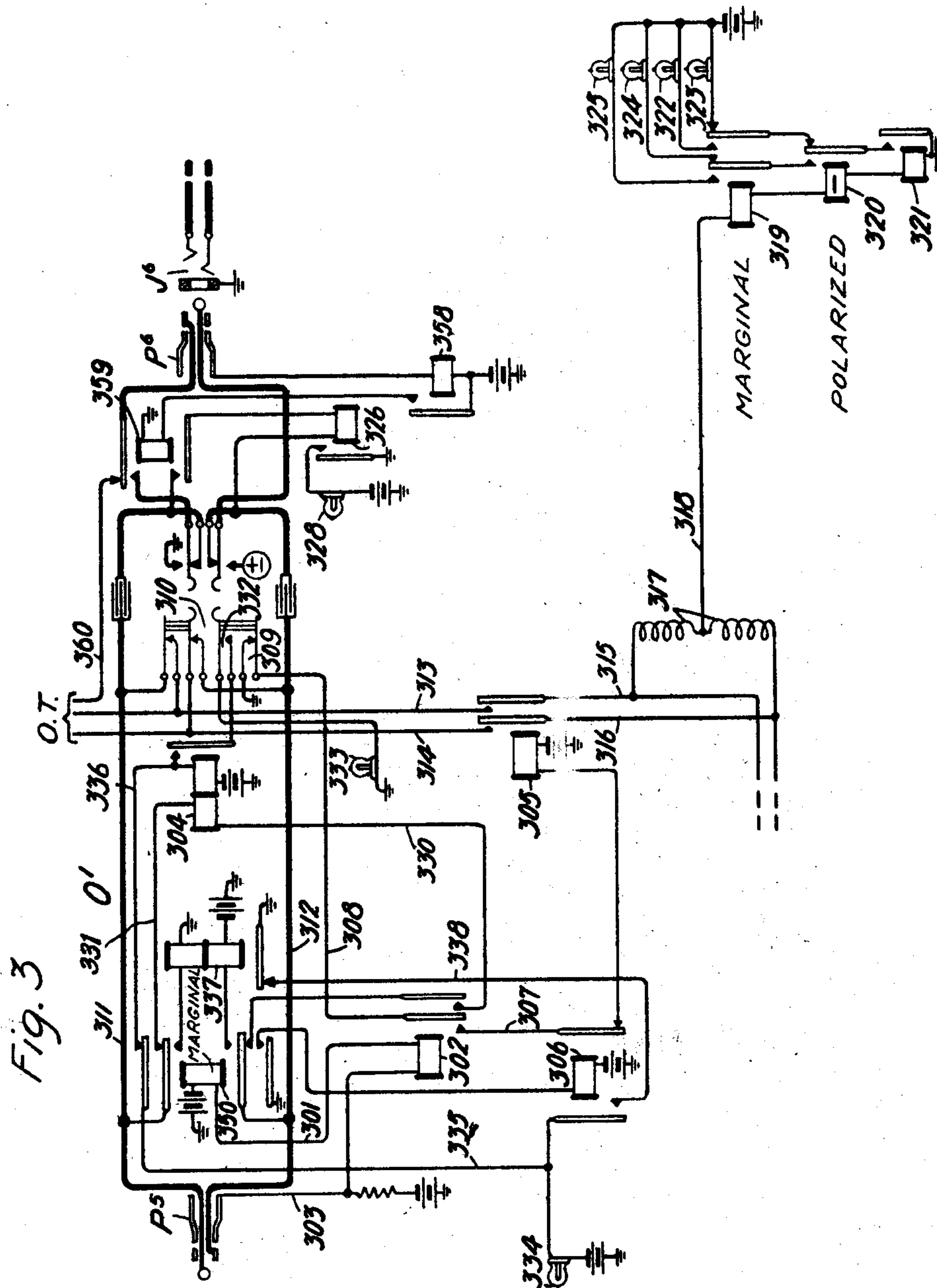
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TELEPHONE SYSTEM

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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 October 11, 1922. Serial No. 593,833.

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.

The usual practice in telephone exchange systems is 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, in answering a call incoming upon a toll trunk records upon a ticket the details of the call, as given by the calling subscriber, and notes, 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 disconnect signal and disconnects from the calling line, 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 may 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 station, 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 the complete data for recording the toll call upon the ticket, it is necessary to transmit to her, information regarding the class of service to which the calling subscriber is entitled. Heretofore, in some exchanges in which subscribers have access to recording toll trunks and to an A operator's position, the A operator 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 notified the toll operator in case the call is from a coin box line or from a line to which 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, groups of recording trunks are provided in certain cases 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 lamp, the recording operator being advised of the class of service of the calling subscriber by means of a distinctive lamp cap associated with the trunk answering jack. 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.

In my Patent No. 1,488,847, issued April 1, 1924, there are described and claimed systems of this sort which obviate the aforesaid difficulty by employing a single group of trunks over which indications of the class of service may be selectively transmitted to the recording operators' positions, as well as means for selectively operating one of a plurality of class denoting signaling devices over the trunk line in accordance with the particular terminal or jack employed for connection with the trunk line.

A feature of the present invention is to make it possible for a subscriber or local operator to have access to different operators' positions at a toll office and to not be limited to connection with a single operator. Such a condition may exist in cases wherein a subscriber or local operator may

desire telephonic communication with the particular person recorder, the two number recorder or to any other special operators or desks in the toll office. Connection is also
 5 provided to an operator who is not required to receive an indication of the class of service to which the calling subscriber is entitled.

Other features of the invention not specifically mentioned, will appear from the following description taken in connection with the accompanying drawings, in which
 10 Figure 1 shows the outgoing end of a toll trunk together with associated signal transmitting apparatus, the cord circuit of an originating or A operator and a line of a calling subscriber. Fig. 2 shows the incoming end of
 15 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 positions.

A clearer understanding may be had from the following description of the method of
 25 extending connections, first from the line of subscriber A to an operator at the recording toll station, who requires knowledge as to the class of service of the calling subscriber, and second from a line of a subscriber A to
 30 an operator at the recording toll station who may or may not require knowledge as to the class of service necessary.

Subscriber A, upon removing his receiver to initiate a call, establishes an energizing
 35 circuit for line relay 4 which may be traced from grounded battery through the left-hand winding of relay 4, outer left-hand armature and back contact of cut-off relay 5, over the substation line loop through the
 40 inner armature and back contact of cut-off relay 5, right-hand winding of relay 4 to ground. Line relay 4 thereupon is actuated and establishes a circuit through its armature and front contact for line lamp 6.

The operator at position O, upon noting the illumination of the subscriber's line lamp 6 inserts the plug P of an idle cord circuit at her position in the jack J of the line with which lamp 6 is associated, whereupon cut-off relay 5 is energized over a circuit extending
 50 from grounded battery through the supervisory lamp 7 over the sleeve contacts of plug P and jack J, winding of cut-off relay 5 to ground. Relay 5 opens the circuit at its contacts for relay 4, whereupon the energizing circuit for line lamp 6 is interrupted and the lamp extinguished. Supervisory lamp 7 does not become illuminated though included in the circuit just traced as
 55 relay 8 becomes energized over the subscriber's line loop in the well-known manner upon the insertion of plug P in jack J and closes at its armature and front contact a circuit in shunt of the lamp 7.

65 The operator then throws her listening

key 9 to connect her set (not shown), indicated by the letters "O. T.", with the strands of her cord circuit and ascertains from the calling subscriber the nature of the connection desired. It is here assumed that the
 70 calling subscriber desires a toll connection and that he is entitled to regular toll service. The lamp cap of line lamp 6 informs the operator of the class of service of the calling subscriber. The operator then inserts plug
 75 P' into jack J², thereupon extinguishing the lamp.

Upon insertion of plug P' in jack J², a circuit is established from grounded battery through the calling supervisory lamp 10, sleeve contacts of plug P' and jack J², conductor 12, winding of relay 13, conductor 14, and left-hand armature and back contact of relay 15 to ground, through the resistance element 16. Lamp 10 is illuminated in
 80 this circuit and relay 13 energized. Relay 13, upon energization, establishes a circuit for the switching apparatus or rotary time relay 17 which may be traced from grounded battery through the armatures and back contacts of relays 18, 19, 20, 21 and 22, conductor 23, right-hand armature and front contact of relay 13, conductor 24, conductor 25
 85 and thence to ground through the motor 26. A branch of the circuit above traced extends from conductor 25, over conductor 27, brush 28, collecting ring 29, winding of clutch magnet 30 and thence to ground. In response to the energization of motor 26 and of clutch magnet 30, the motor 26 drives the
 90 brush arm of time relay 17 in a counter-clockwise direction, advancing the brushes 31 over the terminal bank 32. This switch may be of the type disclosed in a copending application, Serial No. 329,801, filed October
 95 10, 1919, and therefore need not be described in detail herein.

Upon the energization of relay 13 and the establishment of the circuit for starting rotary time relay 17, a circuit is also established in parallel with the circuit previously traced extending from conductor 24 to ground, through the winding of relay 33. Relay 33, upon energizing, connects grounded
 100 battery and ground, respectively, to the ring conductor 34 and tip conductor 35 of the recording toll trunk extending to the recording toll operator's position, whereupon a circuit is established for the line relay 200 at the incoming end of the toll trunk. This
 105 circuit may be traced from grounded battery, through the left-hand armature and front contact of relay 33, the lower armature and back contact of relay 36, trunk conductor 34, lower left-hand winding of repeating coil 201, both windings of relay 200, the upper left-hand winding of repeating coil 201, trunk conductor 35, upper armature and back contact of relay 36, and thence to
 110 ground through the right-hand armature

and front contact of relay 33. Relay 200 energizes in this circuit and at its armature and front contact closes a circuit for relay 202.

5 Relay 202 closes at its right-hand armature and front contact a circuit for starting a rotary time relay 203. This circuit may be traced from grounded battery, through the inner right-hand armatures and back
10 contacts of relays 204, 205, 206 and 207, conductor 208, inner right-hand armatures and back contacts of relays 209, 210, 211 and 212, conductor 213, right-hand armature and back contact of relay 214, conductor 215,
15 right-hand armature and front contact of relay 202, conductor 216, thence in parallel circuits through the motor 218 and the clutch magnet 219 of the rotary time relay 203. The energization of the driving motor
20 218 and of the clutch magnet 219 causes a movement of the brush arm of the relay in a counter-clockwise direction to advance the brushes 220 over the terminals 221.

From the preceding description, it will be
25 noted that the rotary time relays 17 and 203 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
30 since the lag in the starting of the time relay 203 at the incoming end of the toll trunk, due to the time lapsing after the starting of time relay 17 because of the necessary energization of relays 33, 200 and 202, can
35 readily be compensated for, the two time relays, therefore, move their respective brushes 31 and 220 over their corresponding terminal banks in substantial synchronism.

Upon actuation of the rotary time relay
40 203, a circuit for relay 210 is established extending from grounded battery through the break contacts of the left-hand armature of this relay, conductor 223, the second set of active terminals 222, brush 220, conductor
45 224 to ground at the armature and back contact of line relay 200, which is now deenergized as described below. Relay 210, upon energizing, establishes a locking circuit for itself traced from grounded battery, through
50 the winding and the make contacts of the left-hand armature of relay 210, conductor 294, winding of relay 225, and thence to ground at the break contacts of the inner right-hand armature of relay 226. Relay
55 225 energizes in this circuit and establishes the following circuit for lamp 227: from grounded battery through the left-hand armature and front contact of relay 202, (since relay 200 is now energized, as de-
60 scribed below), conductor 229, outer left-hand armature and back contact of relay 226, conductor 230, contact and armature of relay 225, conductor 232 to ground through the filament of supervisory lamp 227. The
65 illumination of lamp 227 signals the toll op-

erator that a call is awaiting attention on the toll trunk with which the lamp is associated. Relay 228, which is energized in a branch of the circuit just traced extending
70 from conductor 230 to ground, through the winding of relay 228, connects a source of tone current 233 to the tip and ring conductors 234 and 235 of the incoming end of the toll trunk for inductively transmitting a
75 tone signal to the calling subscriber's line through the windings of repeating coil 201, over the conductors 34 and 35 of the toll trunk and through the A operator's cord circuit which tone signal remains upon the
80 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 signaled. The rotary
85 time relay 17 will continue to advance brushes 31 over the terminals of terminal bank 32 until the brushes engage terminals 37 corresponding to the jack J^2 which has been employed for the establishment of the
90 connection. A circuit will be established for relay 19 which may be traced from grounded battery through the winding of relay 19, the normally closed break contacts of the left-hand armature of this relay, con-
95 ductor 38, brushes 31, conductor 39, conductor 40 to ground, through the left-hand armature and front contact of relay 19. Relay 19 energizes in this circuit, closing at the make contacts of its left-hand armature a holding circuit for itself independent of
100 the banking terminals 37 of the rotary time relay 17. This holding circuit is traced from grounded battery through the winding of relay 19, through the make contacts of its left-hand armature, conductor 41, and thence
105 to ground over the circuit previously traced at the left-hand armatures and front contacts of relay 19. Relay 19 at its right-hand armature and back contact also opens the circuit extending through the motor 26 and
110 clutch magnet 30 of the rotary time relay 17 which is thereby arrested in its forward rotary movement and due to the deenergization of the clutch magnet 30, the brush arm of the relay returns to its normal position,
115 as shown in Fig. 1.

Upon the energization of relay 19 the circuit of relay 33 is also opened and this relay being quick to release, opens the circuit of
120 the line relay 200 at the incoming end of the toll trunk before the slow-to-energize relay 36 operates, a circuit for which is established through the right armature and front contact of relay 19. The circuit of relay 36 may be traced from grounded battery through
125 the right-hand armature and back contact of relay 18, right-hand armature and front contact of relay 19, conductor 42 to ground, through the winding of relay 36. The slow operating characteristics of relays 36 and
130

43 are designated on the drawing by arrows pointing in the direction in which the armatures slowly move.

The momentary deenergization of line relay 200, following the deenergization of relay 33, opens the circuit of relay 202 which at its right-hand armature and front contact opens the driving circuit of rotary time relay 203, thus the forward rotary movement of the brush arm of rotary relay 203 is checked immediately following the energization of relay 19. Upon the advance of the brush arm of rotary time relay 17 to a position corresponding to the jack J^2 which has been employed in the establishment of the connection, the brushes 220 of the time relay 203 will, therefore, be positioned upon the second set of active terminals 222 in this terminal bank 221. During the momentary deenergization of relay 200, and while brush 220 is in engagement with terminals 222, a circuit is established for relay 210 which is traced from grounded battery through the break contacts of the left-hand armature of this relay, conductor 223, the second set of active terminals 222, brushes 220, conductor 224 to ground at the armature and back contact of line relay 200. Relay 210, upon energizing, establishes a locking circuit for itself independent of the terminals 222 and brushes 220 and of the line relay 200, which may be traced from grounded battery through the winding of the make contacts of the left-hand armature of relay 210, conductor 294, winding of relay 225 and thence to ground at the break contacts of the inner right-hand armature of relay 226. At its right armature and back contact, relay 210 opens the driving circuit for rotary time relay 203 to prevent a second operation of this relay upon a subsequent energization of relay 202. At its outer right-hand armature and back contact, relay 210 prepares a circuit for relay 205 which circuit becomes effective following the response of the recording toll operator. By the opening of the circuits of the driving motor 218 and of the clutch magnet 219, the brush arm of the time relay returns to its normal position.

Following the energization of slow-to-energize relay 36, the circuit of line relay 200 is reestablished and relay 200 again closes the circuit of relay 202. Relay 200 is now energized over a circuit which is traced from grounded battery at the cord circuit of position O, through the lower right-hand winding of repeating coil 44, the winding of calling supervisory relay 45, the ring contacts of plug P' and jack J^2 , conductor 46, the lower armature and front contact of relay 36, conductor 34, the lower left-hand winding of repeating coil 201, windings of relay 200, upper left-hand winding of repeating coil 201, conductor 35, upper armature and front contact of relay 36, winding of relay

48, trunk conductor 47, tip contacts of jack J^2 and plug P' and thence to ground through the upper right-hand winding of repeating coil 44. The current flowing in this circuit while sufficient to energize the line relay 200 is not sufficient to energize either relay 48 or supervisory relay 45.

The recording toll operator at position O' in which the toll trunk line terminates upon noting the illumination of the trunk line lamp 227 takes up 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 227. A circuit is thereupon established which may be traced from grounded battery through the winding of marginal sleeve relay 350, conductor 301, winding of sleeve relay 302, sleeve conductor 303, sleeve contacts of plug P^5 and jack J^5 conductor 236, and thence to ground through the winding of sleeve relay 237. Sleeve relay 350, 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 237 become energized in the circuit just traced. Relay 350 is provided with a marginal action for a purpose which will be hereinafter set forth.

Relay 237, upon energizing, establishes a shunt around the left-hand high resistance winding of line relay 200, which shunt extends over conductor 238, left-hand armature and front contact of relay 237 and conductor 239. Due to the shunting of the high resistance winding of relay 200, current flowing over the circuit previously traced extending through the winding of relay 48 and the winding of supervisory relay 45 is now increased to such an extent that these relays become energized in series with relay 200. The energization of supervisory relay 45 establishes a shunt around the calling supervisory lamp 10 whereupon this lamp ceases to be illuminated. The energization of relay 48 establishes a circuit for relay 43 which may be traced from grounded battery through the winding of relay 43, conductor 49 to ground, through the armature and front contact of relay 48. Relay 43, upon energization, closes a circuit extending through the high resistance right-hand winding of relay 15, which circuit may be traced from grounded battery through the armature and front contact of supervisory relay 45, sleeve contacts of plug P' and jack J^2 , conductor 12, winding of relay 13, conductor 14, the left-hand armature and back contact of relay 15, right-hand winding of relay 15, conductor 50, and thence to ground at the armature and make contact of relay 43. Relay 15 energizes in this circuit opening at its left-hand armature and back contact the circuit just traced through its high resistance right-hand winding and removes a shunt ex-

isting up to this time around its left-hand low resistance winding. Relay 15 is therefore maintained energized over the circuit previously traced extending from conductor 14 through the left-hand low resistance winding of relay 15, conductor 50 and to ground at the make contacts of the armature of relay 43. Relay 15 at its right-hand armature and front contact prepares a circuit for the peremptory disconnection relay 51, which circuit will be traced hereinafter.

At the incoming end of the toll trunk upon energization of relay 237, a circuit is established for relay 226 which may be traced from grounded battery through the right-hand armature and front contact of relay 237, conductor 240 to ground through the winding of relay 226. Relay 226 at its outer left-hand armature and back contact opens the circuit previously traced extending in parallel branches through lamp 227 and through windings of relay 228. Lamp 227 thereupon becomes extinguished and relay 228 becomes deenergized and disconnects the source of tone current 223 upon the conductors 234 and 235 of the toll trunk.

Relay 226 at the break contacts of its inner right-hand armature opens the locking circuit previously traced extending through the winding of relay 210. Relay 210 is held locked over a new holding circuit extending from conductor 294, through the outer-right hand armature and front contact of relay 226, conductor 241 and thence to ground through the outer left-hand armatures and back contacts of relays 207, 206, 205 and 204, thus removing the control of the locking circuit of relay 210 from the contacts of relay 226 to the contacts of relay 205, which relay is now energized over a circuit extending from grounded battery, the winding and break contacts and inner left-hand armatures of relay 205, conductor 242, outer right-hand armature and front contact of relay 210, conductor 243 to ground at the inner right-hand armature and front contact of relay 226. Relay 205 at its outer left-hand armature and back contact now opens the substitute locking circuit of relay 210 which becomes deenergized. Relay 205 at its inner right-hand armature and back contact opens the circuit previously traced over conductor 208 to prevent the re-establishment of the driving circuit of time relay 203. When relay 210 becomes deenergized, at its outer right-hand armature and front contact it prepares a circuit for selectively operating class of service lamps associated with the recording toll operator's cord circuit in a manner 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 extending from grounded battery through the windings of relay 305, right-hand armature and back contact of relay 306, conductor 307, inner right-hand armature and front contact of relay 302, conductor 308 to ground through the contacts 309 of the operator's talking key 310, provided the key 310 is in its normal position in which the operator's telephone set, indicated by O. T., is connected to the talking strands of the cord circuit. Relay 305, upon energization, 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 205, associated with the incoming end of the toll trunk, has been selectively operated through the functioning of the rotary time relay 203, the control circuit for operating the class of service signals may be traced as follows: from the grounded pole of positive battery 244, through resistance element 245, the outer-right-hand armature and front contact of relay 205, conductor 246, the midpoint between the right-hand windings of repeating coil 201, thence by parallel paths over trunk conductors 234 and 235, the armatures and back contacts of relay 247, trunk conductors 281 and 249, 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 midpoint of coil 317, conductor 318 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 a positive pole of battery 244 and through only a portion 245 of the resistance element associated with battery 244, 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 a negative polarity is impressed upon its windings. 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, outer right-hand armature and front contact of relay 319, armature and back contact of relay 320 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 6 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 204 had been operated, due to the seizure of jack J' at the outgoing end of the trunk, then resistance element 248 would have been included in the circuit previously traced from battery 244 through the windings of relays 319, 320 and 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 206 been energized, a negative current from battery 275 through resistance 276 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 207 been energized, current from battery 275 would have been impressed upon the control circuit through resistance element 276 and 277 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, records the information on a ticket in the usual manner. Upon the completion of the recording, the 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 employed, by throwing the key 310 to its holding position. Contact 309 of the key is now open and the circuit previously traced through the winding of relay 305 is opened thereby interrupting 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 the operator desires to relight the lamp 322, in order 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. This, however, may be done only when plug P⁵ is in jack

J⁵ since the circuit of relay 305 not only depends upon the closure of contacts 309 but also upon the energization of relay 302.

Following the completion of the call, 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 237 is opened thereby opening the initial energizing circuit of relay 226 at the right-hand armature and front contact of relay 237. Relay 226, however, does not de-energize at this time since relays 200 and 202 are still maintained energized over the toll trunk. Relay 237, upon de-energizing, removes the shunt from around the high resistance winding of relay 200, whereby the current flowing over the trunk, through the winding of relays 200, 48 and 45, is decreased to such an extent that supervisory relay 45 in the A operator's cord circuit and relay 48 in the trunk circuit become deenergized. Relay 48, upon deenergizing, opens the circuit of slow-to-release relay 43 which, after a pre-determined interval, releases and closes a circuit extending from grounded battery through the interrupter 55, the winding of relay 51, conductor 56, the right-hand armature and front contact of relay 15, and thence to ground at the back contact of relay 43. Relay 15 is now energized over the sleeve conductor 12, through both of its windings and the resistance element 16. Relay 51 is intermittently energized in the circuit traced and at its armature and front contact closes a shunt circuit intermittently around the high resistance winding of relay 15, this circuit extending through the resistance element 16, right-hand winding of relay 15, conductor 50, and thence to ground at the armature and front contact of relay 51. The resistance of relay 15 being thus intermittently decreased, the current flowing over the sleeve conductor 12 is thus intermittently increased, and since at this time relay 45 is deenergized and the shunt around supervisory lamp 10 is, therefore, removed, the lamp 10 flashes to give the A operator the peremptory disconnect signal. The operator, noting this signal, takes down the connection, regardless of whether the answering supervisory lamp 7 signifies that the calling subscriber has hung up his receiver or not.

The originating operator, upon withdrawing the plug P' from the jack J² opens the circuit extending through the winding of relays 45, 48 and 200. These relays deenergize, the relay 200 opening the circuit for relay 202, which in turn opens the locking circuit of relay 226. Relay 226 upon deenergizing opens the locking circuit previously traced, through the winding of relay 210, whereby all of the apparatus at the

incoming end of the toll trunk is restored to normal condition. At the outgoing end of the toll trunk, the withdrawal of the plug P' from the jack J² also opens the circuit previously traced through the windings of relays 13 and 15 and the apparatus at the outgoing end of the trunk is thereby restored to its normal condition.

The recording toll operator now proceeds to secure a connection in the usual manner to the calling subscriber's line over a toll switching trunk (not shown), and having obtained such connection, holds it by inserting the plug of a holding cord circuit (not shown) in the incoming jack of the switching trunk and records the number of the switching trunk employed on the ticket 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 the desired toll connection, and after obtaining the connection, connects the calling subscriber to the toll line over a multiple of the toll switching trunk. As soon as the toll operator takes up the toll switching trunk, the recording operator 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 beyond the recording operator's position, the other circuits employed to complete the toll connection have not been shown or described in detail herein.

The operator at position O may recall the operator at position O' by withdrawing the plug P' from the jack J² and reinserting it therein whereupon relays 48 and 200 become momentarily deenergized. The deenergization of relay 48 has no effect since it does not open the circuit of slow release relay 43 for a sufficient time to cause its deenergization. The deenergization of relay 200 opens the circuit of relay 202, which at its left-hand armature and back contact, closes a circuit for relay 247 extending from grounded battery, through the left-hand armature and back contact of relay 202, conductor 280, inner left-hand armature and front contact of relay 226, and thence to ground through the winding of relay 247. Relay 247, upon energizing, momentarily establishes a circuit for relay 304 which may be traced from grounded battery through the lower armature and front contact of relay 247, trunk conductor 249, the ring contacts of jack J⁵ and plug P⁵, the innermost lower armature and back contact of relay 350, 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 back contact of relay 350, the tip contacts of plug P⁵ and

jack J⁵, conductor 281, and thence to ground through the upper armature and front contact of relay 247. Relay 304, upon energizing, locks up, as previously described, and establishes the circuit for lamp 334.

Should the recording toll operator at O' desire to recall the originating operator at position O, she may do so by intermittently withdrawing the plug P⁵ from the jack J⁵. Since at this time, relay 200 is energized over the toll trunk thereby maintaining relay 202 energized, which relay in turn maintains a locking circuit for relay 226, the withdrawal of plug P⁵ and the consequent deenergization of relay 237 does not permit relay 226 to deenergize to restore the signaling apparatus including relay 205. The intermittent deenergization of relay 237, however, opens and closes the shunt around the high resistance winding of relay 200, thereby causing the intermittent operation of relay 48 and supervisory relay 45.

Upon each deenergization of relay 48, the circuit of relay 43 is open but as relay 43 is slow to release, it does not deenergize between the intermittent deenergizations of relay 48. The intermittent operation of supervisory relay 45 intermittently removes the shunt around supervisory lamp 10 so that this lamp flashes in unison with the withdrawal and insertion of plug P⁵ at the toll position. The operator, noting the flashing of this lamp, throws her listening key 9 for connecting her head set with the strands of her cord circuit. She may now converse with the operator at position O' as soon as the operator at the latter position restores the plug P⁵ to the jack J⁵ 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. The telephone lines from broker's offices are terminated directly before toll operators for the purpose of giving such lines quick toll circuits. 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 this purpose.

When a toll operator answers a call initiated upon such a subscriber's line, she inserts the plug P⁵ 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 P⁵, conductor 303, winding of sleeve relay 302, conductor 301 and to grounded battery through the winding of marginal relay 350. Relays 350 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 350 receives sufficient current to cause its energization. Relay 350, upon energizing, disconnects at its innermost armatures and back contacts the winding of bridged
 5 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 upper-
 10 most armature and back contact, relay 350 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 energiz-
 15 ing, opens the circuit of relay 305 to prevent false operation of the class of service signaling apparatus which is not now needed since the operator can obtain the class of service to which the calling subscriber is
 20 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
 25 the lamp 334, 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
 30 this time since supervisory relay 337, which was bridged across the strands of the cord circuit upon the energization of sleeve relay 350, is energized at this time over the calling subscriber's line loop.

35 The recording toll operator receives instructions 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
 40 the establishment of the desired toll connection.

The recording toll operator also has access to tie lines extending to the information desk, the rate quoting desk and other traffic
 45 desks of the office, and may, when requested by the calling subscriber, complete connections to such desks by inserting the plug P⁶ in the jack J⁶ of such a line. Upon the insertion of the plug P⁶ in the jack J⁶, a
 50 circuit is established from relay 358 which may be traced from grounded battery through the winding of relay 358, and thence to ground, through the sleeve contacts of plug P⁶ and jack J⁶. Relay 358, upon en-
 55 ergizing, establishes a circuit for relay 359 extending from grounded battery through the armature and front contact of relay 358 to ground through the winding of relay 359. Relay 359, upon energizing, opens the cir-
 60 cuit extending from the tip of plug J⁶ to the test lead 360 extending to the operator's set and connects the tip of the plug to the tip strand of the cord circuit, and at its lower armature and front contact closes a
 65 circuit for bridging the supervisory relay

326 across the strands of the cord circuit. Supervisory relay 326 is controlled over the tie lines to which the cord circuit is connected and controls the circuit of supervisory lamp
 70 328 in the usual manner.

If the calling subscriber abandons the call after becoming connected to the recording operator's position O', the originating oper-
 75 ator, noting the illumination of supervisory lamp 7, proceeds to take down the connection. Upon the withdrawal of plug P' from jack J², the circuit previously traced ex-
 80 tending through the winding of relay 45, the winding of relay 48 and the winding of relay 200 is opened, and these relays de-
 85 energize. The deenergization of relay 200 opens a circuit of relay 202 which in turn opens the locking circuit of relay 226, which locking circuit extends from ground-
 90 ed battery through the left-hand armature and front contact of relay 202, conductor 229 and the outer left-hand armature and front contact and winding of relay 226. Relay 226, however, does not deenergize at
 95 this time as the recording toll operator still maintains the connection with the toll trunk over her cord circuit and the initial energiz-
 100 ing circuit of relay 226 is still maintained at the armature contacts of relay 237.

Relay 202 at its left-hand armature and
 105 back contact now establishes a circuit for relay 247, which may be traced from ground-
 110 ed battery, through the left-hand armature and back contact of relay 202, conductor 280, the inner left-hand armature and front
 115 contact of relay 226, and thence to ground through the winding of relay 247. Relay 247, upon energizing, establishes the pre-
 120 viously traced circuit for relay 304 which, upon energizing, closes a locking circuit for
 125 itself extending from grounded battery, through its right-hand winding, its arma-
 130 ture and front contact, contacts 332 of key 310, it being assumed that the key 310 is in its holding position, since the operator
 135 throws it to this position following the establishment of the connection, and thence to ground through the auxiliary signal 333. Relay 304 also establishes a circuit for the
 140 recall lamp signal 334. The circuit of lamp 334 may be traced from grounded battery
 145 through the lamp, conductor 335, the uppermost armature and back contact of relay 350, conductor 336, and thence to ground
 150 through the armature and contacts of relay 304 and auxiliary signal lamp 333.

The toll operator, noting the illumination of lamp 334, proceeds to take down the con-
 155 nection by withdrawing plug P⁶ from jack J⁶, whereupon the circuit previously traced
 160 through the windings of relays 350, 302 and 237 is open and these relays deenergize. The circuits at the toll operator's cord circuit are now in normal position with the excep-
 165 tion of the circuit previously traced, through

the supervisory lamp 334 and through the auxiliary lamp signal 333. These circuits remain closed 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 237, upon deenergizing, opens the circuit of relay 226, and since at this time relay 202 is deenergized, relay 226 becomes deenergized opening the circuits of relays 247 and 205. The circuits at the incoming end of the toll trunk are now in normal position.

At the originating operator's position, upon the withdrawal of calling plug P' from the jack J², the circuit previously traced through the winding of relay 13 and the winding of relay 15 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 position.

Assuming now that the subscriber at line A or the operator at position O desires to signal an operator at a position other than the one designated by the illumination of lamp 227 as described in the foregoing description, the A operator inserts plug P' into jack J^s, which jack corresponds to the position of the operator whose attention is desired, which position is shown on the drawing terminating in jack J⁷. The jack J⁷ may designate various positions, such as that of the particular person recorder, the two number recorder or any other special operators or desks in the toll office to which a subscriber or local operator may wish to be connected.

Upon insertion of plug P' into jack J^s, a circuit is established for relay 100 which functions in the same manner as relay 13, previously described in connection with a call being extended through jack J². It is thought unnecessary to trace out all the steps necessary to effect the illumination of lamp 400 associated with the position of the desired operator since the procedure in this case is very similar to that followed out in connection with the illumination of lamp 227 but wherein these steps differentiate and where new apparatus is employed the separation will be readily obtainable from the following description.

Subsequent to the insertion of plug P' into jack J^s and the energization of relay 202, the time rotary relays 17 and 203 are synchronously operated, as hereinbefore described. In this instance, the brushes 31 and 220 will travel over their respective terminal banks until the terminals 401 and 402, respectively, are reached. Brushes 31, upon making contact with terminals 401, establish circuits similar to those previously described in connection with terminals 37 and need not be traced out at this time.

Brushes 220, upon making contact with

the terminals 402, establish a circuit for energizing relay 214 which may be traced from grounded battery through the winding and the break contacts of relay 214, conductor 403, the set of active terminals 402, conductor 224 and to ground through the normal contact and armature of relay 200. Relay 214 energizes in this circuit and closes a locking circuit for itself extending from grounded battery through the winding of relay 214, the armature and make contact of relay 214, winding of relay 404, conductor 405 to ground through the right-hand contacts of relay 226. Relay 404 energizes in this circuit and establishes a circuit extending from grounded battery through the left-hand armature and front contact of relay 202, (due to energization of relay 22, relay 36 having now energized and operated relays 200 and 202) conductor 229, outer left-hand armature and back contact of relay 226, conductor 230, contact and armature of relay 404, conductor 406, thence to ground through the filament of lamp 400. Lamp 400 thereupon is illuminated to signal the desired operator at the position with which the lamp is associated that her attention is desired.

In systems of the nature just described, it is not always necessary that each operator be notified as to the class of service to which the calling subscriber is entitled and it is, therefore, a matter of requirements whether or not the circuit arrangements including class of service lamps, such as 322, 323, 324 and 325, be provided, but it is obvious from the foregoing descriptions that any one of a plurality of operators may be selectively signalled and may or may not be informed by class of service lamp signals as to the class of service to which the calling subscriber is entitled.

The number of operators that can be selectively signalled is limited by the capacity of the rotary time relays since for each operator's position, there need be a duplication of the apparatus mentioned in connection with the illumination of lamp 400.

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 operator's position might terminate in the terminal banks of selector switches, as shown in applicant's Patent No. 1,492,868, issued May 6, 1924, and be selected automatically by the functioning of the switches in accordance with digits dialed either by a calling subscriber or by a semi-mechanical operator.

What is claimed is:

1. A telephone system, comprising a trunk circuit terminating at one end in a plurality of sets of switching terminals, a plurality of operators' positions at another end of

said trunk, a cord circuit, a signaling device at each of said positions, means for selectively actuating one of said signaling devices upon connection of said cord circuit with said trunk circuit, class of service indicating means associated with one of said positions and means responsive to the seizure of said trunk at said second mentioned end for operating said class of service indicating means.

2. A telephone system, comprising a trunk circuit, a group of signaling devices for said trunk circuit, cord circuits, a group of class of service signaling devices for one of said cord circuits, and means for actuating a signaling device in each of said groups upon connection of said cord circuits with said trunk circuit.

3. A telephone system, comprising a trunk circuit terminating at one end in a plurality of groups of switching terminals, a plurality of signaling devices corresponding in number to the switching terminals of one of said groups, a plurality of positions at the other end of said trunk, a signaling device at each of said positions, cord circuits, and means for selectively operating a signaling device at one of said positions and one of said first signaling devices, upon the connection of said cord circuits with said trunk circuit.

4. In a telephone system having a plurality of classes of telephone lines, signaling means for each of said classes of lines, a trunk circuit, a plurality of operators' positions at one end of said trunk, a signaling device at each of said operators' positions, cord circuits, means responsive to the connection of said cord circuits with said trunk circuit for selectively operating a signaling device at one of said positions and one of said signaling means to indicate the class of telephone line associated therewith.

5. In a telephone system, a trunk circuit terminating at one end at a plurality of operators' positions and at another end in a plurality of sets of switching terminals adapted to function with a plurality of classes of telephone lines, and means responsive to the employment of one of said sets of switching terminals for selectively signaling an operator at one of said positions and for indicating the class of telephone line associated with said trunk.

6. In a telephone system, a trunk circuit terminating at one end in a plurality of jacks, a signaling device for each of said jacks, a cord circuit, means responsive to the connection of said cord circuit with said trunk circuit by way of one of said jacks for preparing an operating circuit for the sig-

naling device corresponding to the jack employed, a second cord circuit, and means responsive to the connection of said second cord circuit with said trunk circuit for completing said operating circuit and effecting the operation of the selected signaling device.

7. In a telephone system, a plurality of classes of telephone lines, a trunk circuit terminating at one end in a switching terminal for each class of line, a signaling device for each class of line, a cord circuit, means responsive to the connection of said cord circuit with said trunk circuit by way of one of said switching terminals for preparing an operating circuit for selectively operating the signaling device corresponding to the switching terminal employed, a second cord circuit, and means responsive to the connection of said second cord circuit with said trunk circuit for completing said operating circuit and effecting the operation of the selected signaling device to indicate the class of line associated with the trunk.

8. In a telephone system having a plurality of classes of telephone lines, a signaling device for each of said classes of lines, a trunk circuit, cord circuits, means controlling said signaling devices, and substantially synchronously operated means operated upon the connection of one of said cord circuits with said trunk circuit for actuating said signal controlling means to prepare a circuit for selectively actuating said signaling devices, said circuit being completed upon the connection of another of said cord circuits with said trunk circuit.

9. In a telephone system having a plurality of classes of telephone lines, a signaling device for each of said classes of lines, a trunk circuit terminating at one end in switching terminals corresponding in number to said classes of lines, a cord circuit, means controlling said signaling devices, substantially synchronously operated means operated in response to the seizure of said trunk by way of one of said switching terminals for actuating said signal controlling means to prepare a circuit for certain of said signaling devices, a second cord circuit, and means controlled by the connection of said second cord circuit with said trunk for completing said circuit and actuating the signaling device to indicate the class of telephone line associated with the trunk.

In testimony whereof, I have signed my name to this specification this 10th day of October, 1922.

JOHN F. TOOMEY.