

Nov. 24, 1925.

1,562,527

J. F. TOOMEY ET AL
TELEPHONE EXCHANGE SYSTEM

Filed Oct. 5, 1923

8 Sheets-Sheet 1

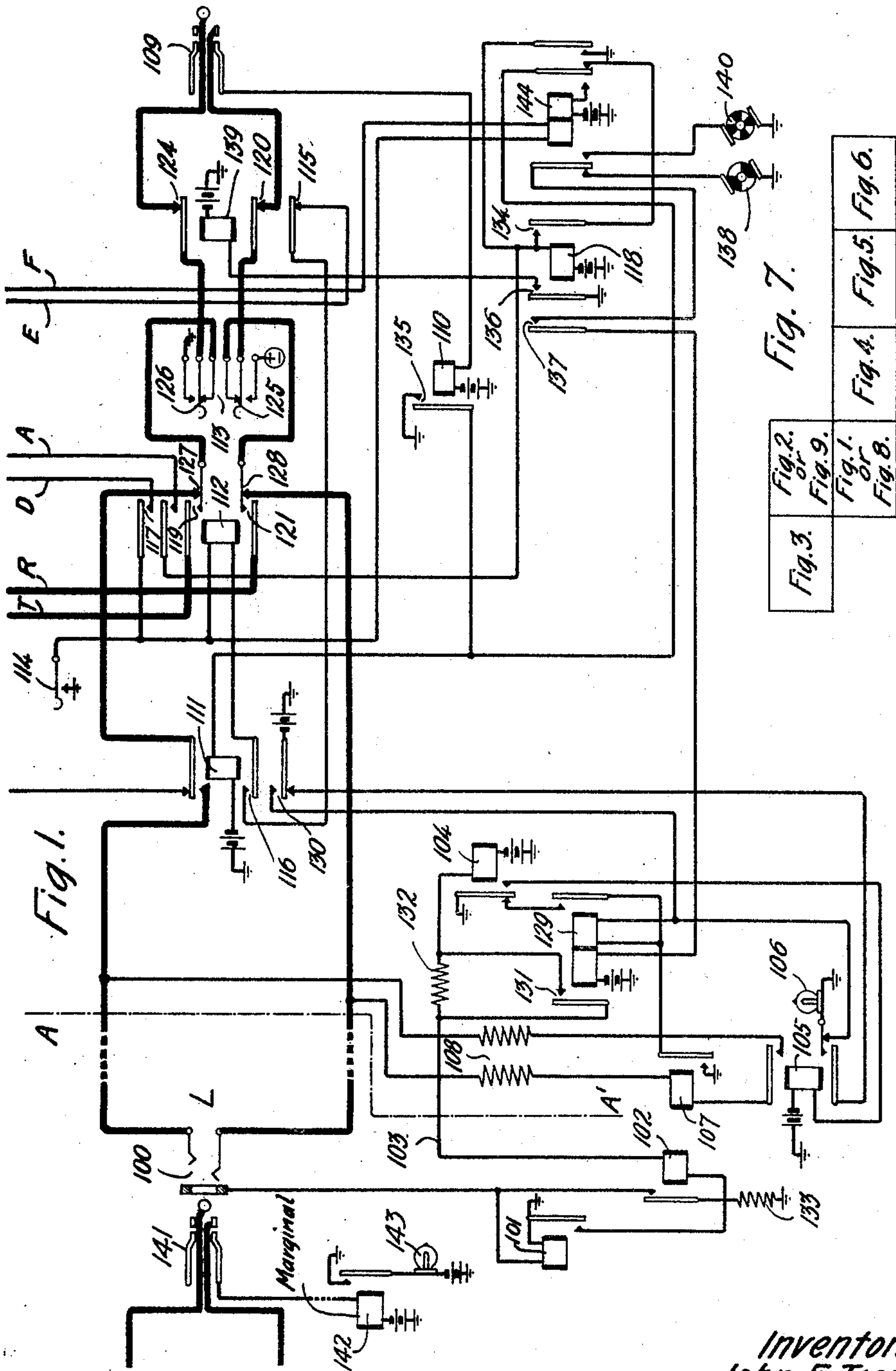


Fig. 3.	Fig. 2. or Fig. 9.	Fig. 4.	Fig. 5.	Fig. 6.
	Fig. 1. or Fig. 8.			

Fig. 7.

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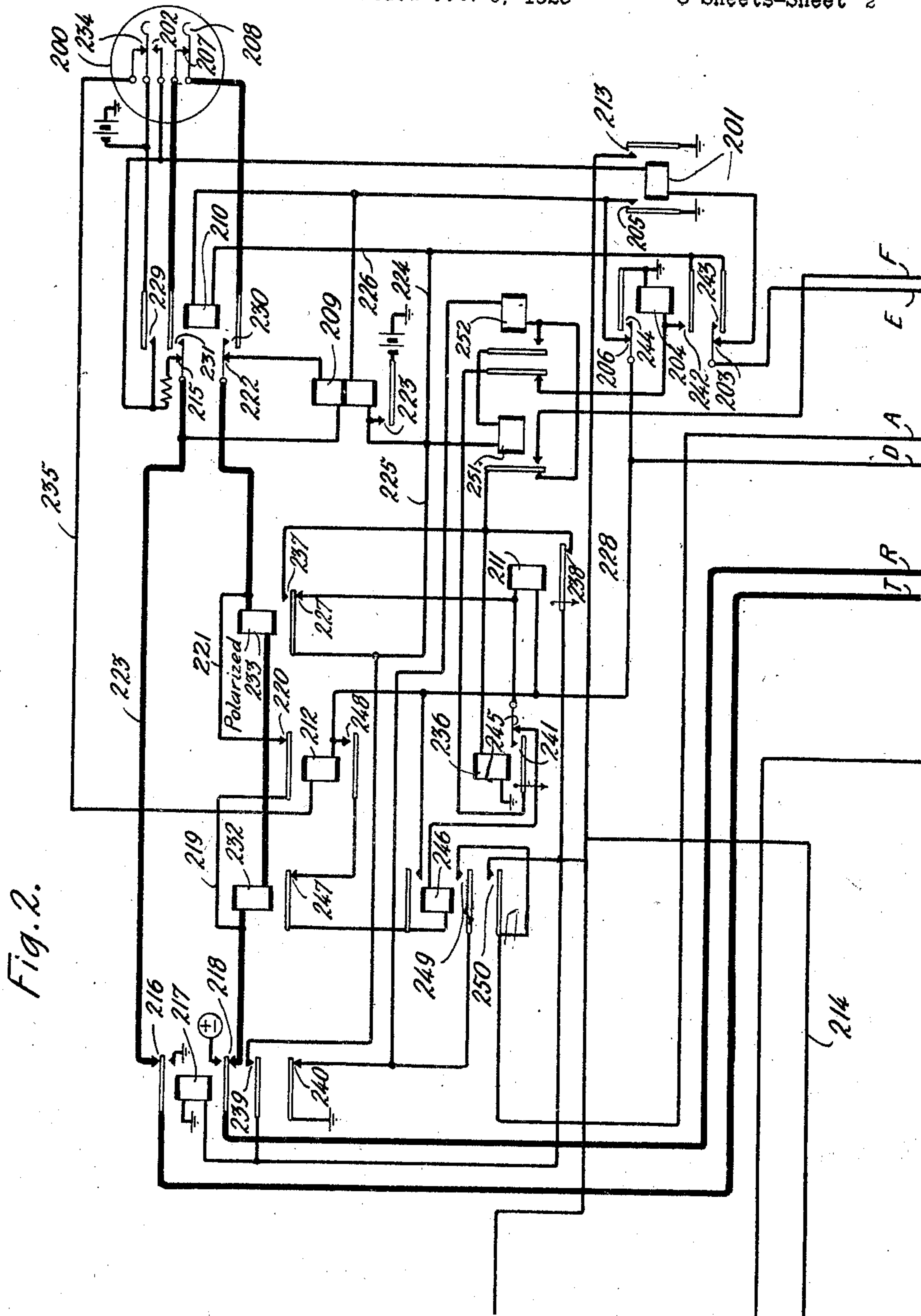
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8 Sheets-Sheet 2



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TELEPHONE EXCHANGE SYSTEM

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8 Sheets-Sheet 3

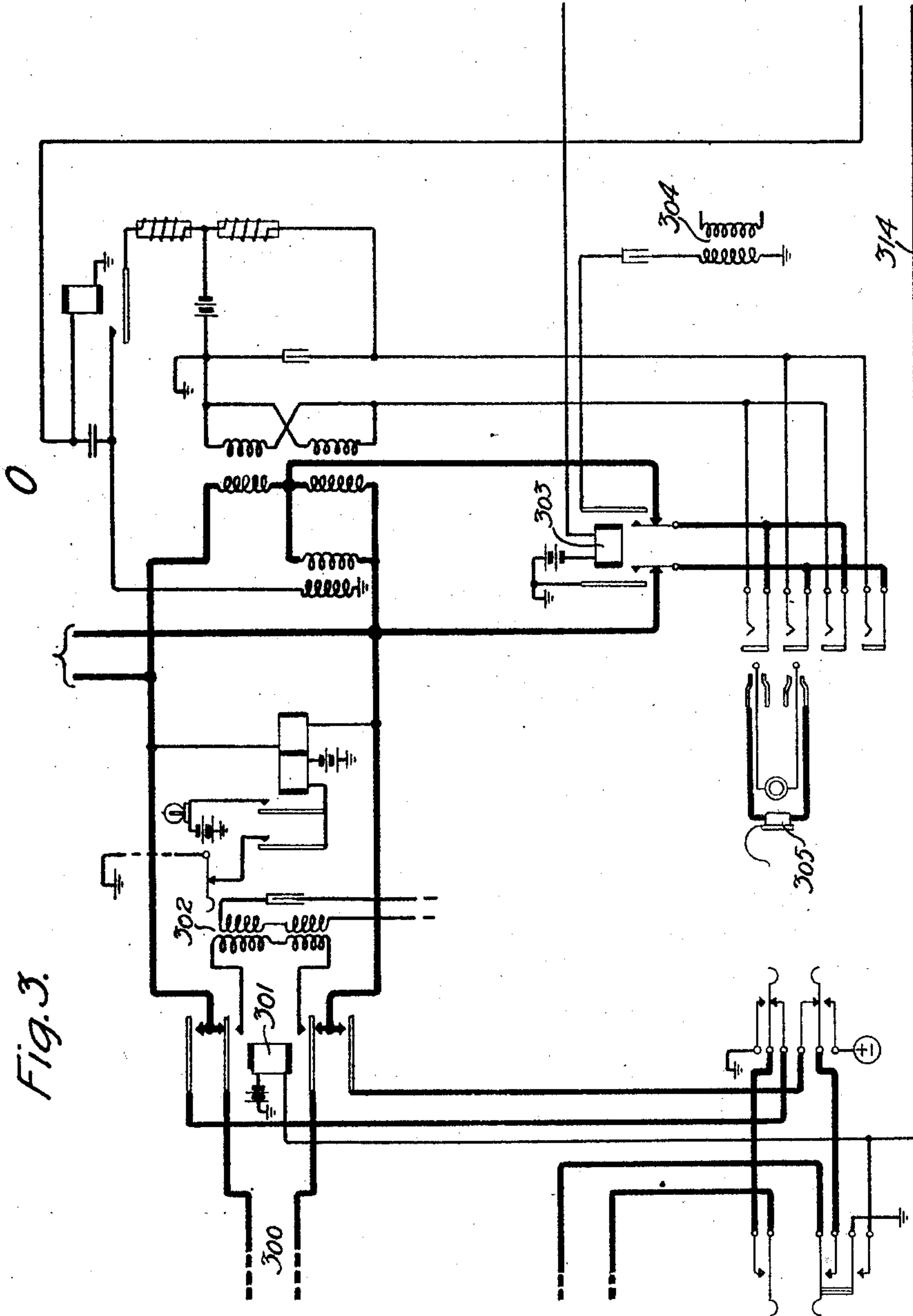


Fig. 3.

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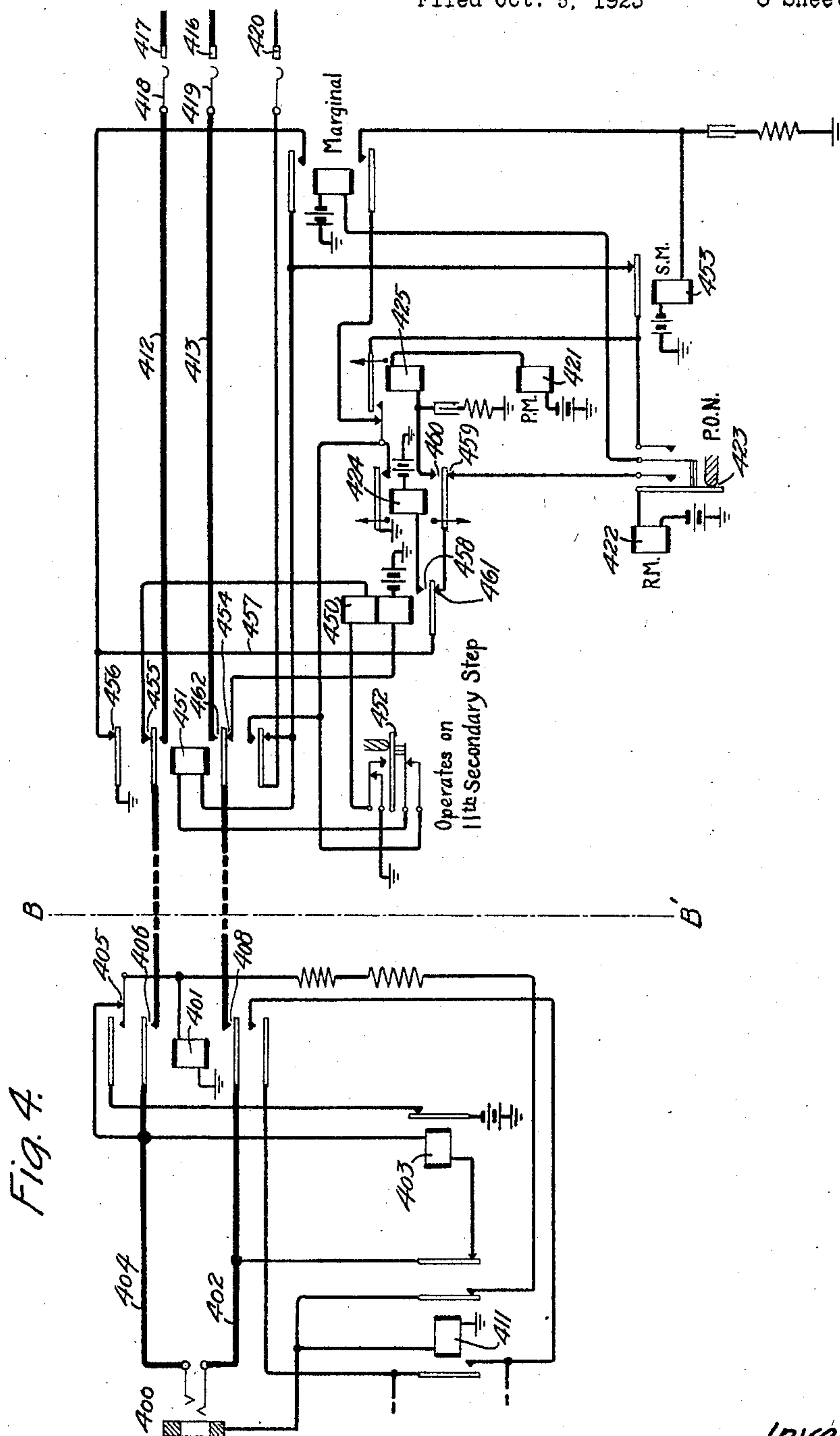
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TELEPHONE EXCHANGE SYSTEM.

Filed Oct. 5, 1923

8 Sheets-Sheet 4



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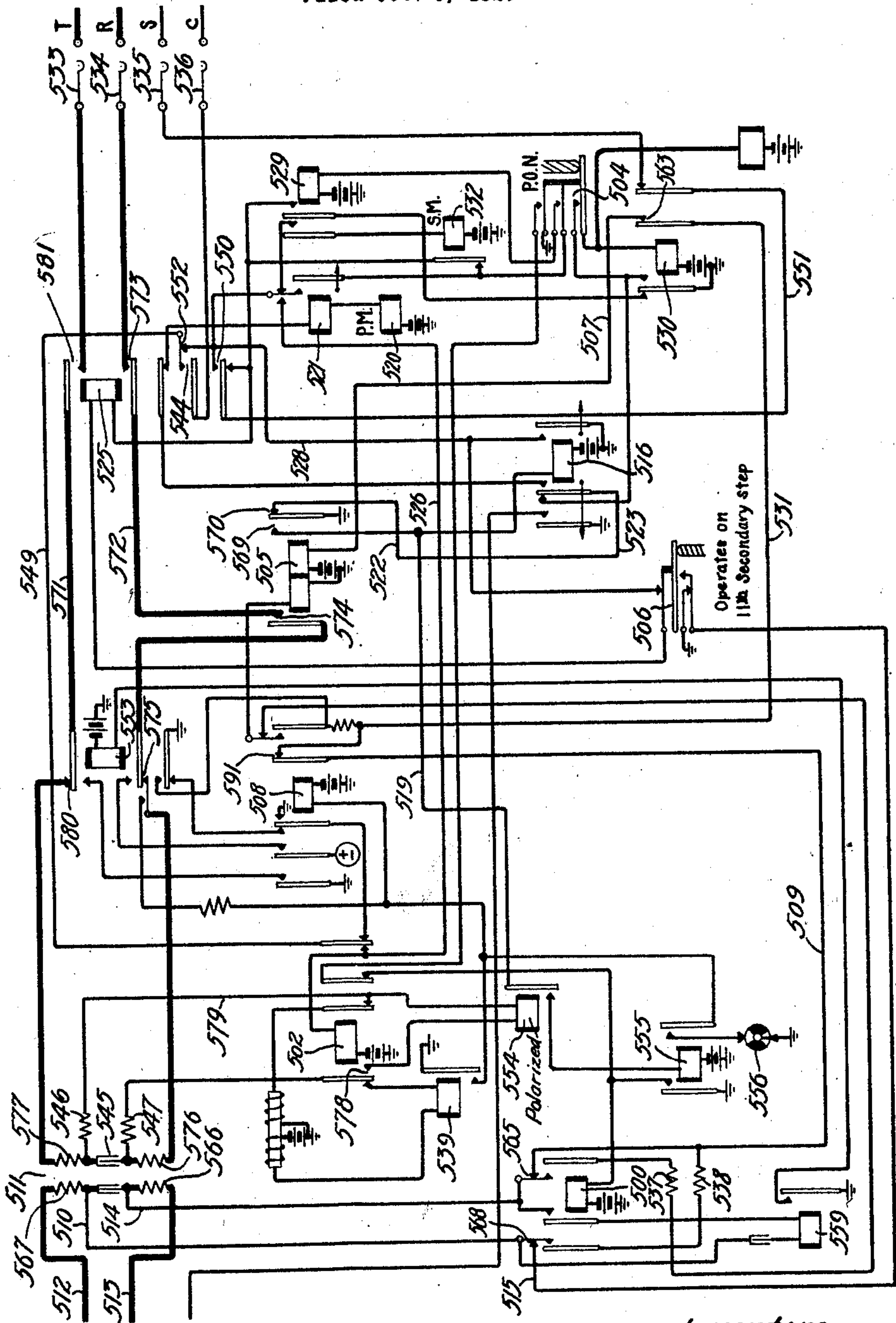
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J. F. TOOMEY ET AL
TELEPHONE EXCHANGE SYSTEM

Filed Oct. 5, 1923

8 Sheets-Sheet 5

Fig. 5.



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1,562,527

J. F. TOOMEY, ET AL
TELEPHONE EXCHANGE SYSTEM

Filed Oct. 5, 1923

8 Sheets-Sheet 6

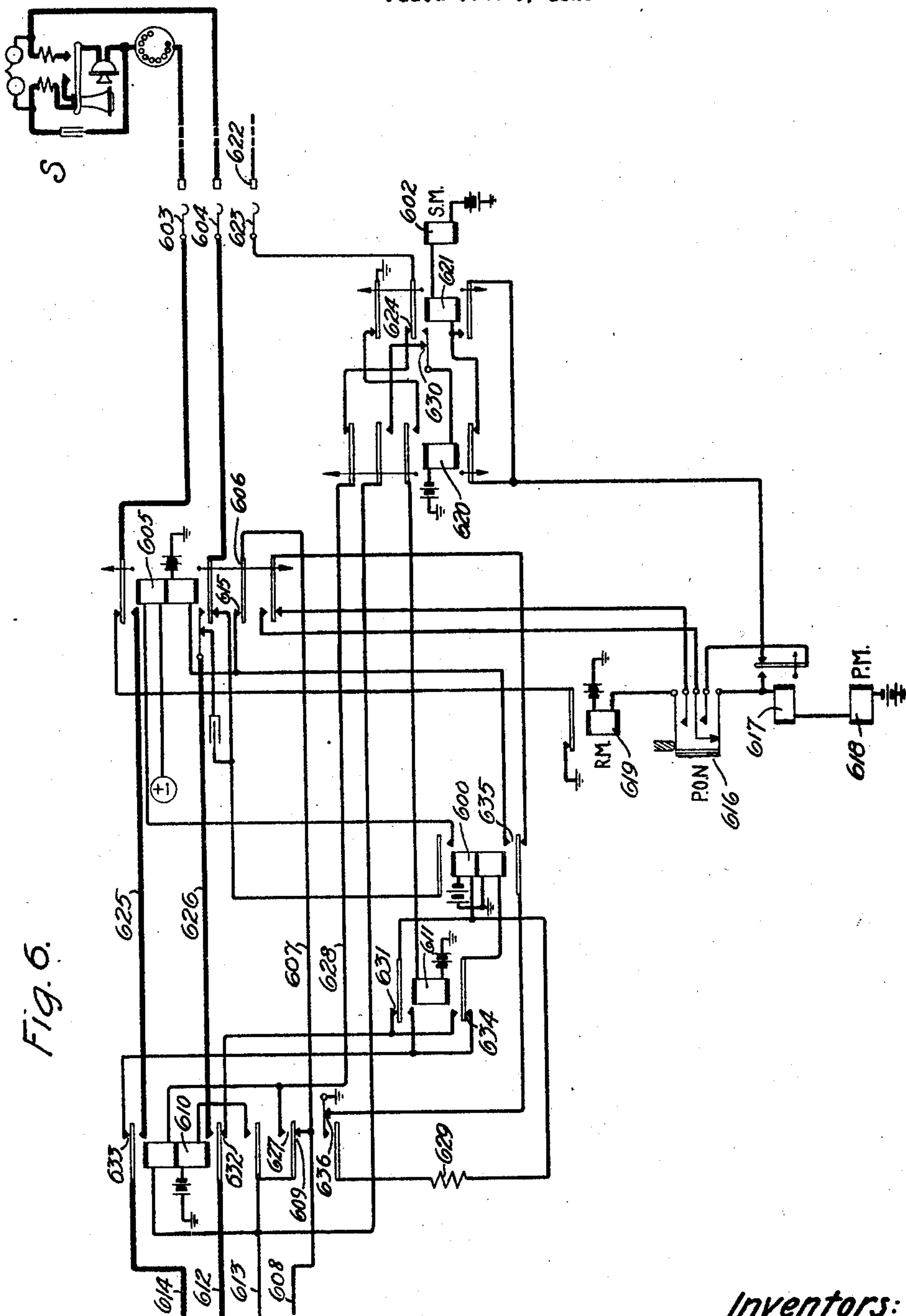


Fig. 6.

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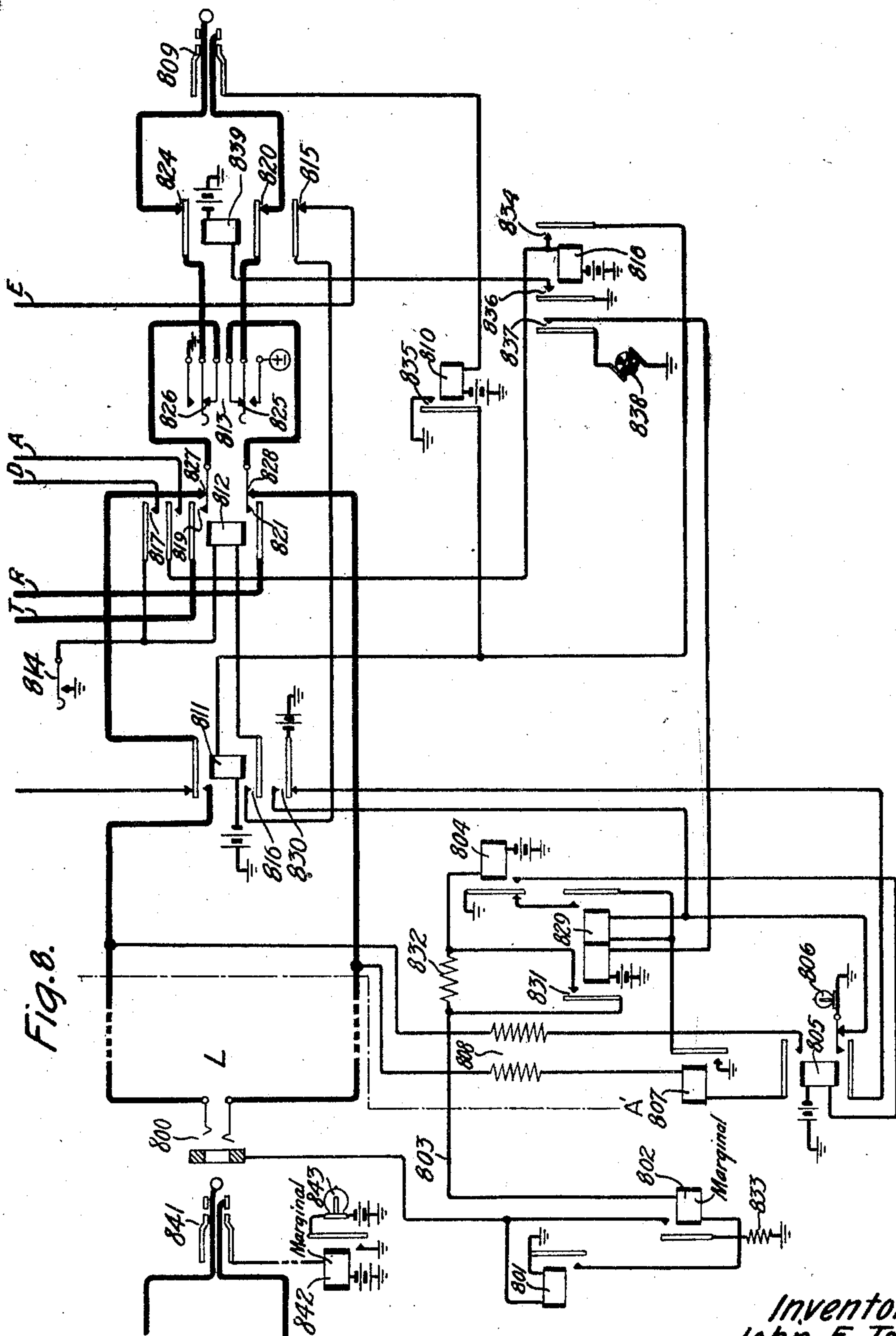
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8 Sheets-Sheet 7



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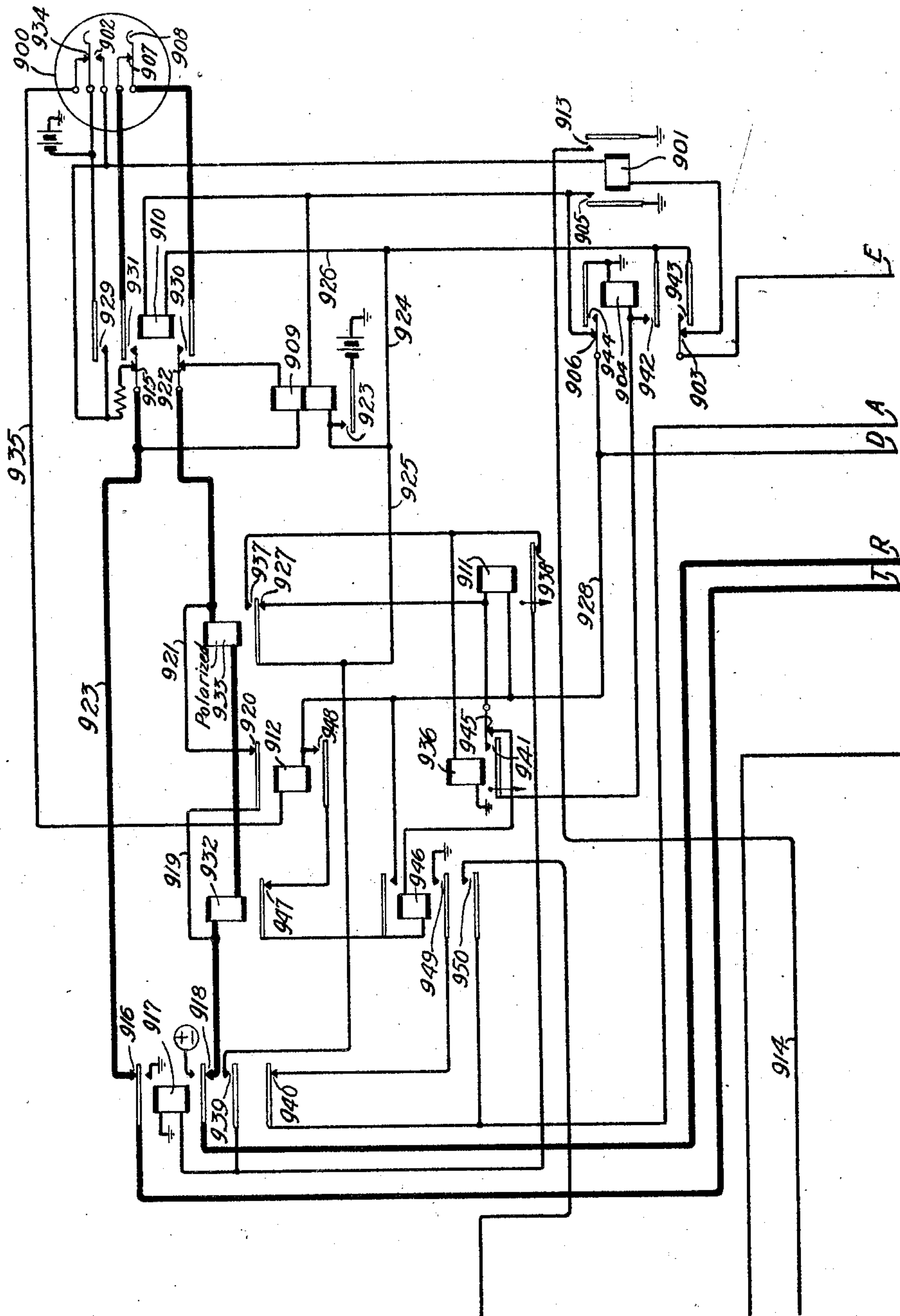
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J. F. TOOMEY ET AL
TELEPHONE EXCHANGE SYSTEM

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8 Sheets-Sheet 8

Fig. 9.



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1,562,527

UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY AND HENRY E. PHELPS, OF NEW YORK, N. Y., ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed October 5, 1923. Serial No. 666,802.

To all whom it may concern:

Be it known that we, JOHN F. TOOMEY and HENRY E. PHELPS, residing at New York and New York, in the counties of New York and Bronx and States of New York and New York, respectively, have invented certain Improvements in Telephone-Exchange Systems, of which the following is a specification.

10 This invention relates to telephone exchange systems, and more particularly to circuit arrangements for enabling toll operators to build up toll connections to automatic subscribers' lines.

15 The object of this invention is to improve the operating efficiency of circuits of this character.

A feature of the invention is the provision of a circuit arrangement for toll cords wherein a dial, common to the toll position, which is placed in operative relation with the cord taken for use by the combined actuation of a key and the movement to dial off-normal, is disconnected upon any one of the selector switches engaged in extending the connection encountering a busy trunk group. This feature is in addition to the well known feature of disconnecting the dial from the cord or trunk when the desired subscriber's line is reached by the connector brushes irrespective of the busy or idle condition of the called line.

Another feature related to the foregoing consists in the provision of a circuit arrangement such that upon the release of the dialing equipment from the cord when a busy trunk group is encountered, a distinctive signal is given the operator to warn her of the futility of dialing further. This signal is automatically disconnected after a short interval.

Another related feature is the provision of a circuit arrangement such that, when an automatic switch finds a busy trunk group, the trunk through which the toll cord is placed in operative relation with the first selector switch is automatically disconnected from the toll cord, thereby initiating the release and return to normal of the automatic switches already involved in building up the connection.

Another feature of the invention is the provision, in a system where the operator is a tandem operator handling the incoming

end of a call circuit toll line, of a circuit arrangement such that, when any one of the automatic switches engaged in extending the connection encounters a busy trunk group, a signal at the outgoing end of the toll line is caused to operate in a distinctive manner by means of apparatus located at the tandem operator's position.

Another feature of the foregoing arrangement for sending a busy trunk group signal over the toll line is, that the signal is operated over a circuit including the sleeve of the outgoing toll operator's cord connected with the toll line.

Another feature of the invention, is the provision, in a system where the operator is a tandem operator handling the incoming end of a call circuit toll line, of a circuit arrangement such that, when a busy subscriber's line is encountered, a signal at the outgoing end of the toll line is caused to operate, by apparatus located at the tandem operator's position, in a manner differing from the operation of the signal when a busy trunk group is encountered.

Another feature related to the foregoing arrangement is that the signal at the outgoing end of the toll line is operated over a circuit including the sleeve of the outgoing toll operative cord connected with the toll line.

A further feature of the foregoing arrangement is the provision of a circuit arrangement such that, when a busy subscriber's line is encountered and the apparatus, located at the tandem operator's position for sending line-busy signals over the toll line, is started, the trunk is automatically disconnected from the tandem operator's cord, thus causing the return of all the automatic switches to normal.

An alternative feature of the invention, related to the foregoing, is the provision, in a system where the operator is a tandem operator handling the incoming end of a call circuit toll line, of a circuit arrangement such that, after the dial circuit has been disconnected from the tandem operator's cord due to the switch finding the desired subscriber's line busy, the line-busy signals sent back over the trunk from the automatic office will be received by apparatus included in the supervisory bridge of the tandem operator's cord and relayed by

it to the outgoing toll office over a circuit including the sleeve of the outgoing toll operator's cord.

Another feature of the invention is the provision of a circuit arrangement such that, in the case of the operator being a tandem operator handling the incoming end of call circuit toll lines, the operator's telephone set is automatically disconnected from the incoming call circuit during the dialing operation and a busy tone connected to the call circuit in its stead to prevent disturbing the operator while she is busy dialing, and also to notify the outgoing operators at the distant end of the toll line that the incoming operator is engaged, in case of an attempt to communicate over the call circuit in question.

Other features will appear hereinafter.

Referring to the drawings:

Figure 1 shows, to the left of the broken line A—A', a portion of the outgoing end of a call circuit toll line, and to the right of the line A—A', the incoming end thereof, the tip and ring conductors of which terminate in a cord and plug;

Fig. 2 shows the dialing equipment;

Fig. 3 shows a tandem operator's telephone equipment;

Fig. 4 shows, at the left of the broken line B—B', an outgoing trunk circuit to a machine switching office, and to the right of the line B—B' an incoming selector at the machine switching office;

Fig. 5 shows a toll transmission selector;

Fig. 6 shows a toll connector; and

Fig. 7 shows how the various sheets of the drawings may be arranged for the reading of the circuits.

Figs. 8 and 9 show alternating arrangements to those of Figs. 1 and 2 respectively.

In general, in the system of this invention the toll operator's position described is a tandem operator's position arranged to handle the incoming end of call circuit toll lines at which the toll lines terminate in plugs, as shown in Fig. 1. The dialing circuit is shown by Figs. 2 or 9 and is common to all the toll lines terminating at the position.

In the preferred embodiment of the invention, when an operator, at the outgoing end of a group of toll lines, desires connection over one of these lines with a subscriber in the local machine switching office, which has been described for convenience as being of the well known step-by-step type, she passes the details of the desired connection over a call circuit to a tandem toll operator "O", Fig. 3, at the incoming end of the group of toll lines. The tandem operator thereupon assigns a toll line. The outward operator (to the left of line A—A' Fig. 1,) now inserts the plug 141 of the toll cord, which is

to be used in the connection, in the assigned

toll line jack 100, whereupon battery in the sleeve circuit of the toll cord operates relay 101, the operation of which connects ground to the signal wire 103, thus permitting battery to operate relay 104 at the incoming end of the toll line. The operation of relay 104 operates relay 105, the operation of which completes a circuit to light guard lamp 106.

The tandem operator now tests for an outgoing switching trunk to the desired machine switching office, and upon finding one, for example, the trunk shown in Fig. 4, she plugs the incoming end of the assigned toll line into the jack 400. Ground in the sleeve of the jack 400 completes a circuit to operate relay 110, which in turn operates relay 111. The operation of relay 111 connects through the tip side of the toll line, connects lead E to the winding of relay 112 and removes the battery from the guard lamp 106, thereby extinguishing it. The tandem operator now operates the dialing key 114 and proceeds to dial the called number.

At the first movement of the dial, battery is furnished to operate relays 201 and 112, both of which when operated are held up by a circuit from said battery to ground furnished by the make contact of relay 201, independently of the ground at key 14. The operation of relay 112 connects the dialing circuit over leads T and R to the toll cord, and also closes lead A to the winding of relay 118. The operation of relay 201 supplies a ground to the windings of relays 209, 210, 211 and 212 in the dialing circuit, and also through another contact supplies ground to conductor 214 to operate relay 301 in the operator's telephone set circuit, the operation of which disconnects the operator's telephone set from the incoming call circuit 300, and at the same time connects a tone to the call circuit, thus preventing orders coming in to the operator while she is dialing.

With the first movement of the dial off-normal, battery was also connected by the off-normal contact of the dial to the tip side of the trunk, thus operating relay 401 in the trunk circuit, the operation of which connects the trunk through to the machine switching office so that current is received back over the tip and ring conductors of the trunk, which operates relay 209 in the dialing circuit, which locks up to relay 201. The operation of relay 209 operates relays 210 and 211. Relay 210 connects the pulsing springs of the dial to the dialing circuit and also connects battery to hold relays 201 and 112 operated, as the battery supplied through the dial is interrupted during dialing. Relays 201 and 112 are made slow to release so that they will not release during the change-over to the battery supply through the contacts 229 in place of through the contacts 202. It will be noted that relays 112,

209, 210, 201 and 211 are operated on ground supplied at relay 201, and therefore the dialing key may be restored at this time without affecting the remainder of the dialing operation.

During the dialing of the called number, relays 232 and 212 operate between digits, relay 232 being operated by the current received back over the trunk from the machine switching office, and relay 212 being operated in an obvious circuit including contact 234 of the dial and contact 205 of relay 201. Polarized relay 233 does not operate on the current received back over the switching trunk between digits.

If a paths busy condition is encountered between digits, no current is received over the trunk and only relay 212 will operate. Under this condition, with relay 212 operated and relay 232 released, a circuit will be completed from the battery at relay 209, through contacts of relays 233 and 236, winding of relay 246 and contacts of relays 232, 212, 204 and 201 to ground, thus operating relay 246, which locks up to ground at relay 201. The operation of relay 246 connects ground to the A lead, thereby operating relay 118, and also closes a circuit for the operation of relay 303 in the operator's telephone set, which connects a paths busy tone to the operator's receiver, whereupon she is instructed to cease dialing. When relay 118 operated, it locked to ground at relay 110. Its operation also connected ground to relay 139, thereby operating it. Relay 118 also connected ground through an interrupter 138 to one winding of relay 129, causing relay 129 to operate and release sixty times per minute. This alternate operation and release of relay 129, causes the marginal relay 142 to alternately operate and release through the shunting of resistance 132, the consequent operation of relay 102 and the establishing thereby of the shunt circuit to ground through resistance 133 for relay 142. These operations of relay 142 cause the lamp 143 to be flashed at the same rate as a paths busy signal to the outward toll operator. The operation of relay 139 removes the dialing circuit from the switching trunk and opens lead E, thereby causing the release of relays 112 and 201, which disconnects the dialing equipment from the cord and restores all relays in the dialing circuit to normal, as well as releasing relay 301 in the operator's telephone set circuit, thereby reconnecting the call circuit to the operator's telephone set. Further, the operation of relay 139 opens the tip and ring of the trunk thereby causing the release of the switches at the machine switching office.

Assuming no paths busy condition is encountered and dialing is completed, the connector will seize the wanted subscriber's line upon completion of the dialing operation

and the current flowing back to the dial is reversed and reduced, thereby operating polarized relay 233 and also relay 232, relay 212 being operated at this time as the dial contacts are in normal position. Relay 233 in operating closes a circuit to energize relay 236, thereby opening the circuit for the slow-to-release relay 211, which after an interval releases. When relay 211 retracts its armature a circuit is closed to operate relay 217, which locks up to battery at relay 209. Relay 217 in operating connects ringing current to the leads T and R, which are now connected through to the switching trunk. Relay 217 also removes ground from lead A, thereby preventing the operation of relay 118 and the consequent connection of the paths busy interrupter, and also prevents the operation of relay 303 in the operator's telephone circuit, which would give the operator a paths busy tone. When relay 233 operated relay 252 was also operated but it performed no useful function as it released when relay 217 operated. Further, relay 217 in operating opens the dialing circuit, thereby releasing relay 232 and 233. Relay 233 in releasing operates relay 204, which locks up to battery at relay 209, thus connecting battery to lead E and ground to lead D to hold operated relays 112 and 212. Relay 204 at the same time opens the locking circuit of relay 201, which now releases and causes the release of relay 301 in the operator's telephone circuit and relays 209 and 210 in the dialing circuit. Relay 209 releases relays 211, 217, 236 and 204. The release of relay 204 releases relays 112 and 212, removing the dialing circuit from the toll line and connecting the supervisory bridge comprising relay 107 across the switching trunk. The current received back over the trunk then operates relay 107, which acts to transmit a signal to the outward operator at the distant end indicating that the connection has been completed to the subscriber's line and that ringing has started. Although the relay 217 has now released, it was energized for a sufficient period to start the machine ringing at the machine switching office, as fully described in the copending application, Serial No. 657,756, filed August 16, 1923. With the release of relays 112 and 212, the dialing equipment is restored to normal and may be used to establish another connection.

When dialing is completed, if the called subscriber's line is found busy, reversed and reduced current, interrupted at the rate of 120 times per minute, is received back over the switching trunk, thus alternately operating and releasing relays 232 and 233.

The first time relay 233 operates, relays 236 and 252 will operate. Relay 252 in operating closes a circuit through relay 251, but this relay does not operate at this time

as it is shunted by relay 233. However, when relay 233 releases, the shunt around 251 is broken and this relay operates and holds up in series with relay 252.

Unlike the case when an idle subscriber's line was seized, relay 204 does not operate when relay 233 releases because its circuit is open at the contacts of relay 252.

The second time relay 233 operates, battery is connected through its contacts to lead F and relay 144. Relay 144 now operates and locks to ground at the sleeve relay 110. Relay 144 in operating closes a circuit for relay 118 which in operating operates relay 139, thus opening the tip and ring conductors of the cord and also lead E as was the case when a paths busy condition was encountered, thus releasing the switches at the automatic office and disconnecting the dial from the cord.

Relay 144 in operating also disconnects the interrupter 138 previously used to transmit "paths busy" flashes and connects, in its stead, the interrupter 140 which transmits line busy flashes at the rate of 120 per minute, back over the toll line to flash lamp 143 in a similar manner to the paths busy flashes previously described.

It will be noted from the above description that the dialing equipment is released and the release of the automatic switches initiated when either a paths busy or a line busy condition is encountered, that the operator's telephone set is automatically disconnected from the incoming call circuit during the dialing operation and a tone is applied to the call circuit in its stead, and that a distinct tone is applied to the tandem operator's receiver when the dialing equipment is released due to the switches encountering a paths busy condition.

In the alternative arrangement shown by Figs. 8 and 9, the operation of the circuit, as regards a line busy condition, is slightly different in that relay 839 is not operated and, therefore, when the dial is released by the release of relay 812, the line busy flashes sent back from the automatic office are connected to the cord and received by the regular supervisory bridge relay 807 which, in turn, transmits these flashes over the toll line to cause the flashing of lamp 843.

In general, the operation of these alternative circuits is as follows:

When dialing is completed and the called line is found busy, the reversed and reduced current, interrupted at the rate of 120 times per minute, received back over the switching trunk, alternately operates and releases relays 932 and 933, as in the case of Figs. 1 and 2.

The first time relay 933 operates, relay 936 will be operated. Relays 936 and 911 are of the slow-to-release type and will hold energized over the flashing interval, relay

911 having been operated following the movement of the dial off normal. Relay 917 is prevented from operating when relay 933 operates due to the fact that relay 911 is operated. In like manner, relay 946 is prevented from operating when relays 932 and 933 release as its circuit is opened by the operation of relay 936. With relay 936 operated, when relay 933 is in its normal position, relay 904 will be operated. Relay 904, in operating, locks up to battery at relay 909 and connects battery to lead E and ground to lead D to hold operated relays 812 and 912. Relay 904 also opens the circuit for relay 901 which releases and causes the disconnection of the dialing circuit from the toll line, as previously described. The interrupted current, flowing back over the switching trunk from the distant automatic office is now connected through to the supervisory bridge across the cord, and relay 807 operates in step therewith, which relay causes the flashing of supervisory lamp 843 at the outward toll operator's position at the distant toll office.

In the case of the alternative arrangement, employing the circuits of Figs. 8 and 9, it will be noted that the dialing equipment is released and the release of the automatic switches initiated when a paths busy condition is encountered, that the line busy signals are received by the regular supervisory bridge across the cord, that the operator's telephone set is automatically disconnected from the incoming call circuit during the dialing operation and a tone is applied to the call circuit in its stead and that a distinctive tone is applied to the tandem operator's receiver when the dialing equipment is released due to the switches encountering a paths busy condition.

It may be that at certain times, the operator will be requested to obtain connections with subscribers in manual offices as well as with subscribers in offices operating on an automatic basis. In such cases, the same cord is used but the dialing key will not be operated, the outgoing trunk with which the cord is associated in this case being of the usual manual type.

Having described in a brief way the operation of the system embodying the present invention, a more detailed description will now be given.

When the outward operator at a distant toll office desires connection over a toll line with a subscriber S in a local machine switching office (Figs. 4, 5 and 6), she passes the details of the desired connection over the call circuit 300 to a tandem operator at the incoming end of the toll line who assigns a toll line, for example, L (Fig. 1). The distant toll operator upon receiving this assignment inserts plug 141 of the toll cord which is to be used into the jack 100.

Battery on the sleeve of the plug operates relay 101 in an obvious circuit. Relay 101, when operated, connects ground to the signal wire 103 of the toll line which extends to the incoming end thereof. This permits current to flow in the following circuit: battery, relay 104, resistance 132, signal wire 103, relay 102 and to ground at relay 101. When relay 104 operates, it closes at its alternate contact an obvious circuit for relay 105 which operates and closes an also obvious circuit for the operation of guard lamp 106 which is lighted to notify the tandem operator that the outgoing operator has seized the assigned toll line.

Operator tests and inserts plug.

The tandem operator now tests for an idle trunk to the desired machine switching office in the well known manner and, finding one, inserts the plug 109 of the incoming end of the assigned toll line into the jack 400, whereupon ground in the jack sleeve circuit completes a circuit to operate relay 110. This circuit can be traced from battery, relay 110, sleeve contacts of the jack and plug and relay 411 to ground. Relay 110 operates and closes an obvious circuit for relay 111 which operates and connects the toll line through to the trunk over the inner normal contacts of relay 112, normal contacts of ringing key 113 and the normal contacts of relay 139. Relay 111 in operating also connects lead E to the winding of relay 112, thus preparing a circuit for the operation of this relay upon the operation of the dialing key 114 and the movement of the dial 200 off normal. Relay 111, in operating, also removes battery from the guard lamp 106 whereby it is extinguished.

Operator dials.

The operator now actuates the dialing key 114 and rotates dial 200 to transmit the first digit of the desired number. At the first movement of the dial off normal, battery is supplied to operate relays 201 and 112 in the following circuit; battery, contacts 202 of the dial, relay 201, contacts 203 of relay 204, lead E, contacts 115 of relay 139, contacts 116 of relay 111 and winding of relay 112 to ground at the dialing key 114. Relays 201 and 112 operate and relay 201, in attracting its left armature, locks itself and relay 112 to ground in the following circuit; ground, contacts 205 of relay 201, contacts 206 of relay 204, lead D, contacts 117 of relay 112, winding of relay 112, contacts 116 of relay 111 and over the previously traced circuit including lead E to battery at the dial 200. Relay 112, in operating, connects the tip and ring of the plug 109 to the T and R leads of the dial circuit and also connects lead A to the winding of relay 118. Relay 201, in operating, connects

ground through its contacts 205 to relays 209, 210, 211 and 212 and at its contacts 213 closes a circuit for the operation of relay 301 in the operator's telephone circuit, which circuit may be traced from ground, contacts 213 of relay 201, conductors 214 and 314 to battery through the winding of relay 301. Relay 301 operates in this circuit and disconnects the operator's telephone set "O" from the incoming call circuit 300 and at the same time connects a tone, supplied through the transformer 302, to the call circuit to prevent orders coming in to the tandem operator while she is busy dialing.

Now returning to the start of the dialing operation, when the dial is first moved off normal, battery is also connected through the make contacts 202 of the dial to the tip of the plug to operate relay 401 of the trunk circuit. This circuit can be traced as follows: battery, contacts 202 of the dial, contacts 215 of relay 210, conductor 223, contacts 216 of relay 217, lead T, contacts 119 of relay 112, contacts 126 of key 113, contacts 124 of relay 139, tip conductor of the cord and plug, tip springs of jack 400, conductor 404, contacts 405 of relay 401 and winding of that relay to ground. Relay 401 operates in this circuit and connects the trunk through to the machine switching office which is shown to the right of the broken line B'—B' (Fig. 4), and by Figs. 5 and 6. Battery is now applied to the trunk from relay 450 and flows back through relay 209 in the following circuit: battery, lower winding of relay 450, contacts 454 of relay 451, contacts 408 of relay 401, conductor 402, ring spring of the jack 400, and the ring contacts of the plug 109, contacts 120 of relay 139, contacts 125 of key 113, contacts 121 of relay 112, lead R, normal contacts 218 of relay 217, conductor 219, contacts 220 of relay 212, conductor 221, contacts 222 of relay 210, upper winding of relay 209, conductor 223, contacts 216, lead T, contacts 119, 126 and 124, tip of the plug 109, tip spring of jack 400, conductor 404, contacts 406 and 455, upper winding of relay 450 to ground at switch 452. Relays 209 and 450 operate in this circuit. Relay 209, in operating, locks up to ground at relay 201 in the following circuit: battery, contacts 223 and lower winding of relay 209 and contacts 205 of relay 201 to ground. Relay 209, in operating, also supplies battery to complete the energizing circuits of relays 210 and 211. The circuit of relay 210 may be traced as follows: battery, contacts 223 of relay 209, conductors 224 and 226, relay 210 and to ground at contacts 205 of relay 201; for relay 211, the circuit is from battery, contacts 223, conductor 225, contacts 227, winding of relay 211, conductor 228 and contacts 206 and 205 to ground. Relay 210, in operat-

ing, connects the dialing circuit with the dial and by closing its contacts 229 supplies battery for the continued energization of relays 201 and 112 the circuit of which would otherwise be interrupted each time the dial returned to normal during the dialing operation.

It should be noted at this time that relays 112, 201, 209, 210 and 211 are held operated by ground furnished through the contacts 205 of relay 201 and therefore the dialing key may be restored at this time without affecting the remainder of the dialing operation.

When relay 450 operated, it closed a circuit for slow relay 424 from ground at the upper normal contacts 456 of relay 451, conductor 457, contacts 458 and winding of relay 424 to battery. Relay 424, in operating, at its contacts 459, interposes a break in the circuit for the release magnet 422, and connects, at its contacts 460, the vertical or primary magnet 421 through the usual slow relay 425 to the back contacts 461 of the impulse relay 450, preparatory to receiving the impulses from the dial 200.

As the dial returns to normal, to transmit the thousands digit of the called number, the primary magnet 421 receives impulses from impulse relay 450 in the well known manner and raises the brushes to the desired level. The selector then hunts for an idle trunk leading to a toll transmission selector (Fig. 5). The operation of the incoming selector in hunting for an idle trunk will not be described in detail, since it is similar to that shown and described in Patent 1,377,225, to A. J. Seymour, issued May 10, 1921.

Upon the seizure of an idle trunk, relay 451 operates, cut off the bridge containing the impulse relay 450, and extends the trunk conductors 402 and 404 through to the toll transmission selector (Fig. 5). Whereupon the impulse relay 505 (Fig. 5), thereof operates in the following circuit: battery, right winding of relay 505, conductor 507, contacts 563, conductor 531, contacts 591 of relay 508, conductor 509, contacts 565 of relay 500, conductor 514, winding 566 of repeating coil 511, conductor 513, terminal 416 and brush 419 (Fig. 4), conductor 413, contacts 462 of relay 451, contacts 403 of relay 401, conductor 402, ring contacts of the jack 400 and plug 109, contacts 120 (Fig. 1) of relay 139, contacts 125 of ringing key 113, contacts 121 of relay 112, lead R, contacts 218 of relay 217, (Fig. 2), conductor 219, contacts 220, conductor 221, contacts 230, springs 203 and 207, contacts 231 of relay 210, conductor 223, contacts 216, lead T, contacts 119, 126 and 124, tip of plug 109, tip spring of jack 400 (Fig. 4), conductor 404, contacts 406 and 455, conductor 412, brush 418, terminal 417, conductor 512 (Fig. 5), winding 567 of coil 511, conductor 510, contacts 568, conductor

515 and to ground at switch 506. Relay 505 is energized in this circuit and in operating, closes its contacts 569 which completes a circuit for the energization of relay 516 which, in attracting its outer left armature places ground on the test multiple terminal 420 to cause this trunk to test busy. As the relay 505 follows the dial pulses of the first digit, its right armature closes contacts 570 at each interruption of the pulsing circuit and causes magnet 520 to step the brushes 533 and 534 to the level in which trunks to the desired connector group terminate.

A more detailed description of the seizure of a trunk to the desired connector group by the toll transmission selector will not be given as the operation of this circuit and that of the connector (Fig. 6) is similar to that of the circuits of the above mentioned copending application, Serial No. 657,756, filed August 16, 1923, it being sufficient to mention that if an idle trunk is found by the toll transmission selector, relay 525 is operated which connects the talking conductors 571 and 572 through to the connector whereupon relay 600 operates in the following circuit: battery, upper winding of relay 600, contacts 631 and 632, conductor 612, brush 534, contacts 573, conductor 572, contacts 574 and 575, winding 576, resistance 547, contacts 578, relay 554, conductor 579, resistance 546, winding 577, contacts 580, conductor 571, contacts 581, brush 533, conductor 614, contacts 633 and 634 and lower winding of relay 600 to ground. When relay 600 operates, it closes a circuit for the operation of relay 605 which may be traced from battery, lower winding of relay 605, contacts 635 of relay 600, and contacts 636 of relay 610 to ground. The return of the dial to normal in transmitting the tens and units digits interrupts the circuit of relay 600 at contacts 574 of relay 505. As relay 600 follows the dial pulses, its lower armature transmits the pulses to the vertical magnet 618 to elevate the brushes to the desired level and then transmits pulses to the rotary magnet 602 to step the brushes around into engagement with the desired line.

Called line seized.

If the called line is idle, full potential is encountered on the test terminal 622 and relay 500 operates to reverse and reduce the current flowing back to the dialing operator's position as described in the before mentioned copending application, Serial No. 657,756. This reversed and reduced current operates relays 232 and 233 to initiate the disconnection of the dial from the cord and the application of a pulse of ringing circuit which acts to start the machine ringing apparatus at the automatic office, whereby the called subscriber is rung until his receiver is removed from the hook. A more detailed

description of the operation of the apparatus at the dialing operator's position will now be given: Between the digits of the called number, assuming that no busy conditions are encountered at any stage, relays 212 and 232 operate, relay 212 operating in a circuit which may be traced from battery, normal contacts 234 of the dial, conductor 235, relay 212, conductor 228, contacts 206 and 205 to ground, and relay 232 operates on the current flowing back from the automatic office due to the removal of the shunt including conductor 219, contacts 220, and conductors 221, around it and relay 233. Relay 233 is polarized and does not operate on the current flowing in the loop between digits since the current flowing in the loop between digits is not of the proper direction.

When the dialing is completed and relay 500 operates to reverse and reduce the current flowing in the loop, relays 232 and 233 both operate as relay 212 is operated at this time due to the dial contacts being in normal position. When relay 233 operates, a circuit is closed for relay 236 which can be traced from battery, contacts 223 of relay 209, conductor 225, contacts 237, and winding of relay 236 to ground. Relay 252 is also momentarily operated by the operator from relay 233 but as this relay performs no useful function, it will not be further discussed at this time. Relay 233, in operating, also opens at its contacts 227 the energizing circuit of slow-to-release relay 211 which, after an interval, releases. When relay 211 releases it closes at its back contact a circuit for the operation of relay 217 which can be traced from battery, contacts 223 of relay 209, conductor 225, contacts 237 and 238, and to ground through the winding of relay 217, which relay now operates and locks to ground over the following circuit: ground, winding of relay 217, contacts 239 and contacts 223 of relay 209 to battery.

Start of ringing and release of dial.

Relay 217, in operating, connects ringing current at its inner make contacts to the leads T and R and thence over the tip and ring conductors of the trunk to the automatic office where it starts the machine ringing apparatus to ring the called subscriber as described in detail in the before mentioned copending application.

Relay 217 also opens the circuit of the dial, thus releasing relays 232 and 233. When relay 233 releases, relay 204 will be operated in the following circuit: battery, contacts 223 of relay 209, conductor 225, contacts 227 and 241 and winding of relay 204 to ground.

Relay 204, in operating, locks up in the following circuit: battery, contacts 223 of relay 209, conductor 224, contacts 242 and

winding of relay 204 to ground. Relay 204 also in operating connects battery at its contacts 243 to the lead E, and ground at its contacts 244 to lead D and conductor 228 to hold relays 112 and 212 operated. It also opens at its contacts 203 the previously traced locking circuit for relay 201. Relay 201 now releases and by breaking its contact 205 opens the energizing circuit of relays 209 and 210 and by breaking its contacts 213 opens the circuit for relay 301 (Fig. 3). When relay 209 releases, relays 211, 217, 236 and 204 release due to the disconnection of battery at contacts 223. The release of relay 217 disconnects the ringing current from the switching trunk but the impulse of ringing current sent out has been sufficient to operate relays at the machine switching office to initiate ringing on the called subscriber's line as already referred to. When relay 204 releases, it opens at its contacts 244, the previously traced holding circuit of relays 112 and 212 which relays now release. Relay 112 in releasing disconnects the dialing circuit from the cord and closes contacts 127 and 128, which connect the incoming end of the toll line through to the trunk, whereupon the supervisory relay 107 operates on the current flowing back over the trunk.

Relay 107 in operating closes a circuit for the operation of relay 129 in the following circuit: battery, contacts 130 of relay 111, right winding of relay 129, and to ground at relay 107. When relay 129 operates it closes at its left contact a shunt around resistance 132, thereby permitting an increased flow of current over the signal line 103, which causes the operation of marginal relay 102, which cannot operate in series with resistance 132. Relay 102 in operating, shunts relay 101 with resistance 133, thus causing the operation of marginal relay 142 in the toll cord to light lamp 143 to indicate that the connection has been completed to the called line and that ringing has started.

With the release of relays 112 and 212, the dialing equipment is restored to normal and may be used to establish another connection.

Paths busy.

If, during dialing, the incoming selector (Fig. 4) or the toll transmission selector (Fig. 5) encounters a busy trunk group, no current is received over the switching trunk due to the operation of switch 452 in the incoming selector or switch 506 in the toll transmission selector, which operate on the eleventh secondary or rotary step of their associated selector, thus opening the dialing circuit at contacts of said switches 452 and 506 as will be readily seen, and only relay 212 will operate. Under this condition, with relay 212 operated and relay 232

released, battery will be connected through contacts 223 of relay 209, contacts 227 of relay 233, contacts 245 of relay 236, winding of relay 246, contacts 247, contacts 248, conductor 228, contacts 206 and 205 to ground, thus operating relay 246 which closes the following circuit for the operation of relay 303 (Fig. 3) ground, contacts 240 of relay 217, contacts 249 of relay 246, contacts 250 of relay 246, winding of relay 303 to battery and ground. Relay 303 in operating connects a tone supplied by transformer 304 to the operator's receiver 305 in an obvious circuit. When the operator hears this tone, she is instructed to cease dialing.

Relay 246 in closing its contacts 249 also completes a circuit for connecting ground to lead A which can be traced as follows: ground, contacts 240 of relay 217, contacts 249 of relay 246 to lead A. This causes relay 118 to operate in an obvious circuit. Relay 118 locks up at its contacts 134 to ground at contacts 135 of relay 110. This circuit can be traced as follows: battery, winding of relay 118, contacts 134 of relay 118, inner right-hand normal contact of relay 144 to ground at contacts 135 of relay 110.

When relay 118 operates, it connects ground at its contacts 136 to operate relay 139. It also closes at its contacts 137 a circuit from ground through interrupter 138 and one winding of relay 129 to battery, which causes this relay to operate and release in step with the interrupter, which in practice may be at the rate of sixty times per minute. This alternate operation and release of relay 129 causes relay 102 to be alternately operated and released due to the shunting of resistance 132, and therefore the supervisory relay 142 in the toll operator's cord at the distant end will be flashed at this same rate.

When relay 139 operates, the dialing circuit is disconnected from the trunk and lead E is opened, thus causing the release of relays 112 and 201. Relay 112 in releasing disconnects the dialing circuit from the cord and relay 201 in releasing restores all relays in the dialing circuit to normal, and also releases relay 301 in the tandem operator's telephone circuit (Fig. 3), thus reconnecting the incoming call wire circuit 300.

The opening of contacts 124 and 120 of relay 139 also opens the circuit for the impulse relay 450 or 505, as the case may be, thereby causing the corresponding release magnets to restore the switches to normal, thus making them available, except the first selector, for other connections.

It will be noted from the foregoing that the dial is released from the cord and the release of the switches at the mechanical office initiated when any of the selectors

engaged in extending the connection encounter a paths busy condition.

Line busy.

In case the dialing is completed and the called subscriber's line is found busy, ground will be present on the test terminal 622 and before slow relay 621 has time to release relay 620 which is also slow-to-release will be energized, thus breaking the pulsing circuit branch through the lower armature contact. When relay 621 finally releases, relay 620 locks up to ground on sleeve conductor 613 in the following circuit: battery, winding of relay 620, contact 630 of relay 621, upper middle contacts of relay 620, conductor 613, sleeve terminal S, brush 535, outer right normal contacts of relay 530, conductor 551, contacts 550 of relay 525, conductor 528 and to ground at the right alternate contact of relay 516. Relay 621, in releasing, also connects ground to operate the reverse relay 611, the circuit of which may be traced as follows: ground, upper contacts of relay 621, upper inner contacts of operated relay 620 and winding of relay 611 to battery. Relay 611 now operates and reverses the current flowing back to the toll transmission selector (Fig. 5) where it operates polar relay 554 bridged at the center of the right winding of repeating coil 511 in series with resistances 546 and 547. Polar relay 554, in operating, closes a circuit for relay 555 which may be traced as follows: battery, winding of relay 555 and contacts of relay 554 to ground over conductor 519 and the right alternate contacts of relay 505. Relay 555, in attracting its left-hand armature closes an obvious energizing circuit for relay 500 which now operates and reverses and reduces the current in the loop circuit leading back to the toll office. Relay 555, in attracting its right-hand armature, connects an interrupter 556 in circuit with relay 508 in an obvious circuit. Relay 508 at its contacts 591 intermittently opens the loop circuit leading back to the toll office. This intermittent opening and closing of the reversed and reduced current flowing in the loop circuit results in the intermittent operation and release of relays 232 and 233. The first time relay 233 operates, it closes at its contacts 237 parallel circuits for relays 236 and 252 which can be traced as follows: for relay 236, from battery, contacts 223 of relay 209, conductor 225, contacts 237 of relay 237 and winding of relay 236 to ground, and for relay 252 from battery, contacts 223 of relay 209, conductor 225, contacts 237 of relay 233, left-hand normal contacts of relay 251, winding of relay 252 and through contacts 240 of relay 217 to ground. Relay 252 in operating closes at its left-hand inner alternate contacts a lock-

ing circuit including relay 251. Relay 251 does not operate at this time, however, as its winding is short-circuited by a circuit closed at contacts 237 of relay 233, the left-hand normal contacts of relay 251 and the inner left-hand alternate contacts of relay 252. Relay 252 in operating also opens its outer left-hand normal contact to prevent the false operation of relay 204. Relay 233, in operating, also breaks at its contacts 227 the circuit for relay 211, but this relay is of the slow-to-release type and holds up over the flashes as its circuit will be again closed when relay 233 releases. In the same manner, relay 236, which is also slow-to-release, will be deenergized when relay 233 is deenergized, but it also will hold operated as its energizing circuit will be again closed when relay 233 operates. Relay 217 is kept from operating when relay 233 operates as the lead to its winding is opened at contacts 238 of relay 211, thereby preventing the sending out of ringing current as was the case when an idle subscriber's line was seized. Relay 246 is prevented from operating when relays 232 and 233 release as the lead to its winding is opened at contacts 245 of relay 236 which is operated on the first actuation of relay 233. The first time relay 233 releases, it opens at its contacts 237 the operating circuit for relay 252 and also the short-circuit around relay 251, thus permitting relay 251 to operate in the aforetraced holding circuit for relay 252. Relay 251 in operating also interposes a break in the aforetraced operating circuit of relay 252 and at its left alternate contact prepares a circuit to operate relay 144, when relay 233 again operates, which can be traced as follows: battery, contacts 233 of relay 209, conductor 225, contacts 237 of relay 233, left alternate contacts of relay 251, lead F, left-hand winding of relay 144, contacts 117 of relay 112, lead D, contacts 206 of relay 204 and through contacts 205 of relay 201 to ground. Relay 144 operates in this circuit and locks up in the following circuit: battery, right winding of relay 144, inner right alternate contact of relay 144 and through contacts 145 of relay 110 to ground. Relay 144 in operating also closes an obvious circuit for the operation of relay 118.

Relay 118 in operating closes at its contacts 137 a circuit for connecting interrupter 140 to operate relay 129. This circuit can be traced from battery, left winding of relay 129, contacts 137 of relay 118, left-hand alternate contacts of relay 144 and to interrupter 140 to ground. Relay 129 follows the interrupter 140 which may, in practice, operate at the rate of 120 interrupters per minute. Relay 129 in alternately operating and releasing, transmits a signal over the signal circuit 103 to the distant toll office, being attracted in the same manner, as pre-

viously described under the heading of "Paths busy". Relay 118 in operating also closes at its contacts an obvious operating circuit for relay 139. When relay 139 operates, an idle circuit is disconnected from the trunk and lead E is open, thus causing the release of relays 112 and 201. Relay 112 in releasing disconnects the dialing circuit from the cord, and relay 201 in releasing restores all relays in the dialing circuit to normal and also releases relay 301 in the tandem operator's telephone circuit (Fig. 3), disconnecting the call wire circuit 300. The opening of contacts 124 and 120 of relay 139 also opens the circuit for the impulse relay 450 or 505, as the case may be, thereby causing the corresponding release magnets to restore the switches to normal.

It will be observed in the foregoing that the dial is disconnected from the cord and the release of the switches at the automatic office is initiated when a busy line is encountered.

In the alternative arrangement shown by Figs. 8 and 9, the operation of the circuit, as regards a line busy condition, is slightly different in that relay 839 is not operated to release the switches at the automatic office, and therefore when the dial is disconnected from the cord by the release of relay 812 the line busy flashes transmitted back over the trunk from interrupter 556 are connected to the cord and received by the bridge supervisory relay 107, which, in turn, transmits the flashes over the signal circuit 103 to cause the flashing of lamp 143.

The operation of these circuits are as follows:

When, as previously described, interrupted, reversed and reduced current is transmitted back over the trunk from the automatic office, due to the switches countering a busy line, relay 933 is operated which closes at its contacts 937 a circuit with relay 936 which can be traced as follows: battery, contacts 933 of relay 909, conductor 925, contacts 937 of relay 933 and winding of relay 936 to ground. Relay 933 in operating also breaks at its contacts 927 the circuit for relay 911 but this relay is of the slow-to-release type and holds up over the flashes as its circuit will be again closed when relay 933 releases. In the same manner, relay 936, which is also slow-to-release, will be deenergized when relay 933 is deenergized but it will also operate as its energizing circuit will be again closed when relay 933 operates. Relay 917 is kept from operating when relay 933 operates as the lead to its winding is opened at contacts 938 of relay 911, thereby preventing the sending out of ringing current, as was the case when an idle subscriber's line was seized. Relay 946 is prevented from operating when relays 932 and 933 release as the lead to each

winding is opened at contacts 945 of relay 936 which is operated on the first actuation of relay 933. With relay 936 operated, when relay 933 is released, relay 904 will be operated in the following circuit: battery, contacts 933 of relay 909, conductor 925, contacts 927, contacts 941 of relay 936 and winding of relay 904 to ground. Relay 904 in operating locks up in the following circuit: ground, winding of relay 904, contacts 942, conductor 924 and contacts 923 of relay 909 to battery. Relay 904 in operating also opens at its contacts 903 the locking circuit of relay 901 and at the same time connects at its contacts 943 battery to the lead E to hold operated relay 812, and at its contacts 944 connects ground to the lead D to hold operated relay 912, which latter relay would otherwise release due to the retraction of the left-hand armature. The release of relay 901 causes the dialing equipment to be disconnected from the cord, as previously described, and the trunk to the machine switching office cut through to the toll line at contacts 827 and 828 of relay 812. The busy signal interruptions, being sent back to the mechanical office, are now received by the supervisory bridge across the toll line which includes relay 107. This relay, in following the interrupter 556, alternately closes and opens a circuit from ground, through the right-hand winding of relay 829 to battery at contacts 830 of relay 811, thus alternately operating and releasing relay 829 and causing the shunt around resistance 832 to be alternately closed and broken.

The outward toll operator's supervisory signal 843 at the distant end of the toll line is accordingly flashed in step with the interrupter 556 at the rate of 120 interrupters per minute instead of at the rate of 60 interruptions per minute as in the case previously described when a paths busy condition was encountered.

What is claimed is:

1. In a telephone system, a sender, automatic switches to be set thereby, a manual connecting circuit, means responsive to the actuation of the sender for connecting it to the connecting circuit, and means for automatically disconnecting the sender from said connecting circuit when one of said switches encounters a busy trunk group.

2. In a telephone system, an operator's position, a trunk extending from said position and terminating in an automatic switch, trunk groups also terminating therein, said trunk groups extending to and terminating in other automatic switches in which other trunk groups also terminate, an impulse sender, means responsive to the actuation of the sender for associating it with said trunk for the setting of said switches, and means for automatically releasing said sender from said trunk when one of said switches encounters a busy trunk group.

3. In a telephone system, an operator's position, a trunk extending from said position and terminating in an automatic switch in which trunk group also terminate, an impulse sender, means responsive to the actuation of the sender for associating it with said trunk for the setting of said switch, other automatic switches, trunk groups terminating therein, and means for automatically disconnecting said sender from said trunk when one of said switches encounters a busy trunk group.

4. In a telephone system, an operator's position, a cord circuit thereat, a trunk extending from said operator's position to automatic switches, trunk groups terminating in said switches, an impulse sender, means responsive to the actuation of the sender for associating it with said cord circuit for the setting of said switches, and means operated automatically to disconnect said sender from said cord when one of said switches encounters a busy trunk group.

5. In a telephone system, an operator's position including cord circuits and an operator's receiver, a trunk extending from said position to automatic switches, trunk groups terminating in said switches, an impulse sender, means responsive to the actuation of the sender for associating it with said cord circuit for the setting of said switches, and means automatically operated to disconnect said sender from said cord and to give a distinctive signal to said operator when one of said switches encounters a busy trunk group.

6. In a telephone system, an operator's position including cord circuits, a trunk circuit extending from said operator's position to an automatic switch, trunk groups terminating in said switch, an impulse sender adapted to be associated with one of said cord circuits for setting said switch, means operated automatically to disconnect said sender from said cord when one of said switches encounters a busy trunk group and other automatically operated means for giving a distinctive signal to said operator responsive to the disconnection of said sender from said cord due to said switch encountering a busy trunk group.

7. In a telephone system, a tandem operator's position, a link circuit, a trunk circuit extending therefrom to an automatic switch, a signal circuit extending thereto from a distant toll office, a subscriber's line terminating in said automatic switch, a sender circuit adapted to be switched into connection with said link circuit to set said switch, means for automatically disconnecting said sender circuit from said link circuit

cuit when said switch finds said line busy, a supervisory signal at said toll office, and means bridged across said link circuit to operate said supervisory signal over said signal circuit responsive to the disconnection of said sender circuit from said link circuit due to said automatic switch finding said subscriber's line busy.

8. In a telephone system, a tandem operator's position, a call circuit toll line including a signal circuit terminating therein from a distant toll office, a supervisory signal at said toll office, a trunk circuit extending from said tandem operator's position to an automatic switch, subscribers' lines terminating in said switch, a cord circuit at said tandem operator's position for connecting with said trunk, an impulse sender adapted to be placed in operative relationship with said switch, a supervisory bridge across said cord circuit which is disconnected from said trunk circuit while said impulse sender is in operative relationship with said switch, means for automatically removing said sender from operative relationship with said switch when said switch finds the called subscriber's line busy, means at the automatic end of said trunk for sending back a line busy signal, and means responsive to the removal of said sender from operative relationship with said switch for connecting said supervisory bridge across said trunk circuit to control said supervisory signal at said toll office over said signal circuit in accordance with said busy signal.

9. In a telephone system, an operator's position, an incoming call circuit terminating thereat in the operator's telephone set, a trunk circuit extending therefrom to an automatic switch, a cord circuit at said operator's position for connecting to said trunk, an impulse sender adapted to be connected to said cord circuit for setting said switch, and means for automatically disconnecting said call circuit from said operator's telephone circuit while said switch is being set said means being responsive to the connection of the impulse sender.

10. In a telephone exchange system, a calling line, called lines, a train of switches for interconnecting said lines, trunk groups terminating in certain of said switches, a sender, means responsive to the actuation of the sender for placing it in operative relationship with said switches, and means for automatically disconnecting said sender from said switches as soon as a busy trunk group is encountered.

11. In a telephone exchange system, a calling line, called lines, a train of switches for interconnecting said lines, trunk groups terminating in certain of said switches, a sender, means responsive to the actuation of the sender for placing it in operative relationship with said switches, and means for

automatically disconnecting said sender from operative relationship with said switches as soon as a busy trunk group or a busy line is encountered.

12. In a telephone system, a tandem operator's position including an operator's telephone set, an incoming call circuit terminating therein, a trunk circuit extending from said position to an automatic switch, subscribers' lines terminating in said switch, a key, an impulse sender adapted to be connected to said trunk for moving said switch into contact with one of said lines, and means responsive to the combined actuation of said key and said impulse sender for connecting said impulse sender to said trunk, for disconnecting said call circuit from said operator's telephone set, and for applying a distinctive tone to said call circuit.

13. In a telephone system, a tandem operator's position including an operator's telephone set, an incoming call circuit terminating therein, a trunk circuit extending from said position to an automatic switch, subscribers' lines terminating in said switch, a sender adapted to be connected to said trunk for moving said switch into contact with one of said lines, a manual switch, and means responsive to the combined operation of said sender and said manual switch for connecting said sender to said trunk, for disconnecting said call circuit from said telephone set, and for connecting a tone circuit to said call circuit in place of said operator's telephone circuit.

14. A telephone exchange system, a tandem operator's position including an operator's telephone set, a call circuit terminating therein, subscribers' lines, a train of automatic switches for interconnecting said operator's position with one of said lines, trunk groups terminating in certain of said switches, an impulse sender, means for placing said sender in operative relationship with said switches, means for automatically disconnecting said sender from said switches as soon as a busy trunk group or a busy subscriber's line is encountered, means for automatically disconnecting said call circuit from said operator's telephone set while said sender is in operative relationship with said switches and means for automatically reconnecting said call circuit to said operator's set when said sender is removed from operative relationship with said switches.

15. In a telephone system, an operator's position, an incoming call circuit terminating thereat in the operator's telephone set, a trunk circuit extending therefrom, an automatic switch, a cord circuit at said operator's position for connecting to said trunk, a sender adapted to be connected to said cord circuit for setting said switch, means for automatically disconnecting said call

circuit from said operator's telephone set while said switch is being set, and means for automatically applying a tone to said call circuit during the period said operator's set is disconnected from said call circuit.

16. In a telephone exchange system, a tandem operator's position including an operator's telephone set, a call circuit terminating therein, subscribers' lines, a train of automatic switches for interconnecting said operator's position with one of said lines, trunk groups terminating in certain of said switches, an impulse sender, means for placing said sender in operative relationship with said switches, means for automatically disconnecting said sender from said switches as soon as a busy trunk group is encountered or the called subscriber's line is reached, means for automatically disconnecting said call circuit from said operator's telephone set while said sender is in operative relationship with said switches, means for connecting a tone circuit to said call circuit in place of said operator's telephone circuit, and means for automatically disconnecting said tone circuit from and reconnecting said call circuit to said operator's telephone set when said sender is removed from operative relationship with said switches.

17. In a telephone system, a toll operator's position, a call circuit toll line extending therefrom to a tandem operator's position comprising a talking and a signaling circuit, a trunk circuit extending from said tandem operator's position and terminating in an automatic switch, subscribers' lines terminating in said automatic switch, a connecting circuit at said tandem operator's position for interconnecting said toll line and said trunk, a sender adapted to be connected to said connecting circuit to move the brushes of said automatic switch into engagement with one of said subscribers' lines, means for automatically disconnecting said sender from said connecting circuit when said automatic switch finds a called subscriber's line busy, and means in bridge of said connecting circuit effective when said sender is disconnected from the connecting circuit, due to a line busy condition, to alter the condition of said signaling circuit.

18. In a telephone operator's position, a call circuit toll line, having a sleeve wire signal circuit extending therefrom to a tandem operator's position, apparatus in the sleeve circuit, a trunk circuit extending from said tandem operator's position and terminating in an automatic switch, subscribers' lines terminating in said automatic switch, a link circuit at said tandem operator's position for connecting said toll line and said trunk, an impulse sender adapted to be connected to said link circuit to move the brushes of said switch into engagement with a desired one of said subscribers' lines,

means to automatically disconnect said sender from said link circuit when the desired subscriber's line is found busy at said automatic switch, and means in bridge to said link circuit for causing the operation, over said signal circuit, of said apparatus when said sender is disconnected from said link circuit due to a line busy condition.

19. In a telephone system, a sender, automatic switches to be set thereby, a manual connecting circuit, means responsive to the actuation of the sender for connecting it to the connecting circuit, and means for automatically disconnecting the sender from said connecting circuit and initiating the release of the switches when said switches encounter any busy condition.

20. In a telephone exchange system, a calling line, called lines, a train of switches for interconnecting said calling and called lines, trunk group terminating in certain of said switches, a sender, means responsive to the actuation of the sender in placing it in operative relationship with said switches, and means for automatically disconnecting said sender from said switches and for initiating their release as soon as they encounter any busy condition.

21. In a telephone exchange system, a calling line, called lines, a train of switches for interconnecting said lines, trunk groups terminating in certain of said switches, a sender, means responsive to the actuation of the sender for placing it in operative relationship with said switches, and means for automatically disconnecting said sender from said switches and for initiating their release as soon as a busy trunk group is encountered.

22. In a telephone system, an operator's position, a trunk extending from said position and terminating in an automatic switch, trunk groups also terminating therein, said trunk groups extending to and terminating in other automatic switches in which other trunk groups also terminate, an impulse sender, means responsive to the actuation of the sender for associating it with said trunk for the setting of said switches, and means for automatically releasing said sender from said trunk and initiating the release of the automatic switches when one of said switches encounters a busy trunk group.

23. In a telephone system, an operator's position, a trunk extending from said position and terminating in an automatic switch in which trunk groups also terminate, an impulse sender, means responsive to the actuation of the sender for associating it with said trunk to set said switch, other automatic switches, trunk groups terminating therein, and means for automatically disconnecting said sender from said trunk and for initiating the release of the auto-

matic switches when one of said switches encounters a busy trunk group.

24. In a telephone system, a tandem operator's position, a link circuit, a trunk circuit extending therefrom to an automatic switch, a subscriber's line terminating in said automatic switch, a sender and a circuit therefor, means responsive to the actuation of the sender for switching the sender and its circuit into connection with said link circuit for the setting of said switch, and means for automatically disconnecting said sender and its circuit from said link circuit and for initiating the release of said switch when said switch finds the subscriber's line busy.

25. In a telephone system, a tandem operator's position, a link circuit, a trunk circuit extending therefrom to an automatic switch, a signal circuit extending thereto from a distant toll office, a subscriber's line

terminating in said automatic switch, a sender and a circuit therefor, means responsive to the actuation of the sender for switching the sender and its circuit into connection with said link circuit for the setting of said switch, means for automatically disconnecting said sender and its circuit from said link circuit and for initiating the release of all switches involved in the connection when said switch finds said line busy, a supervisory signal at said toll office, and interrupter means at said tandem position operatively associated with said signal circuit to flash said supervisory signal upon said switch encountering a busy line.

In testimony whereof, we have signed our names to this specification this 3rd day of October 1923.

JOHN F. TOOMEY.
HENRY E. PHELPS.