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J. F. TOOMEY ET AL

TELEPHONE SYSTEM

Original Filed Dec. 17, 1920

2 Sheets-Sheet 1

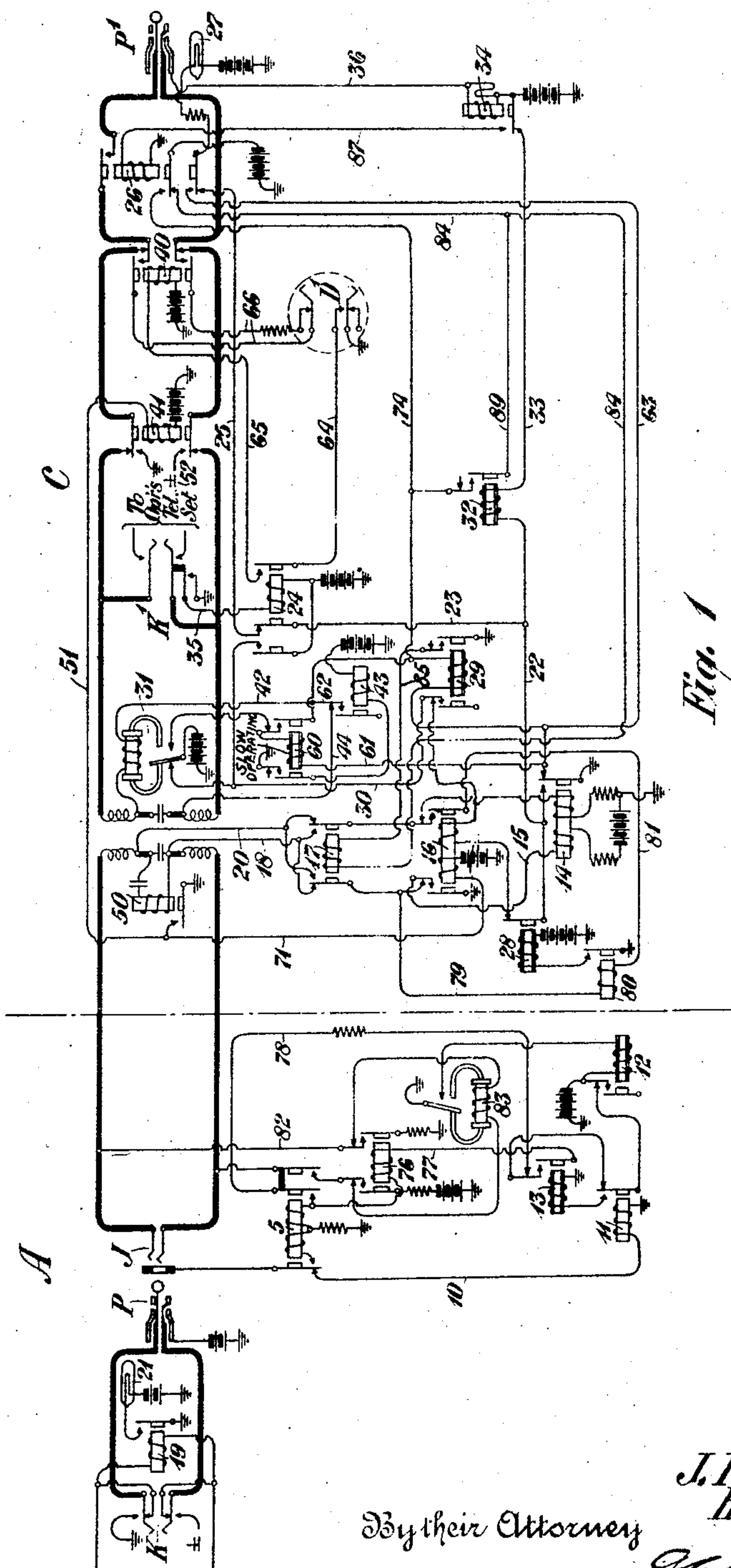


Fig. 1

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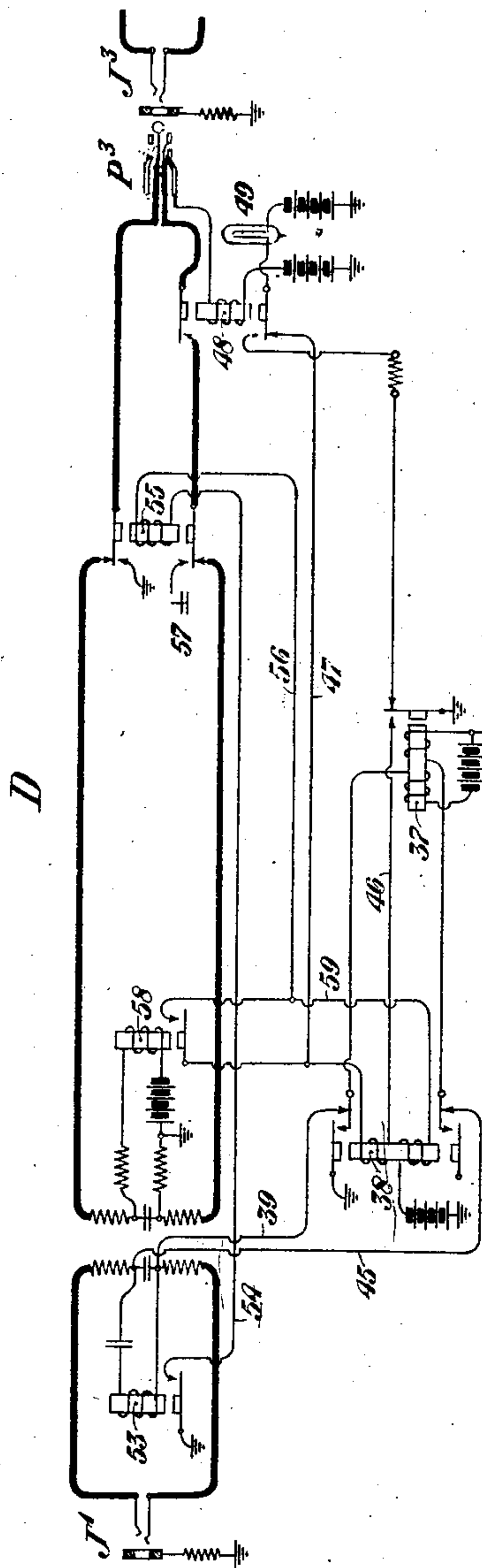


Fig. 2

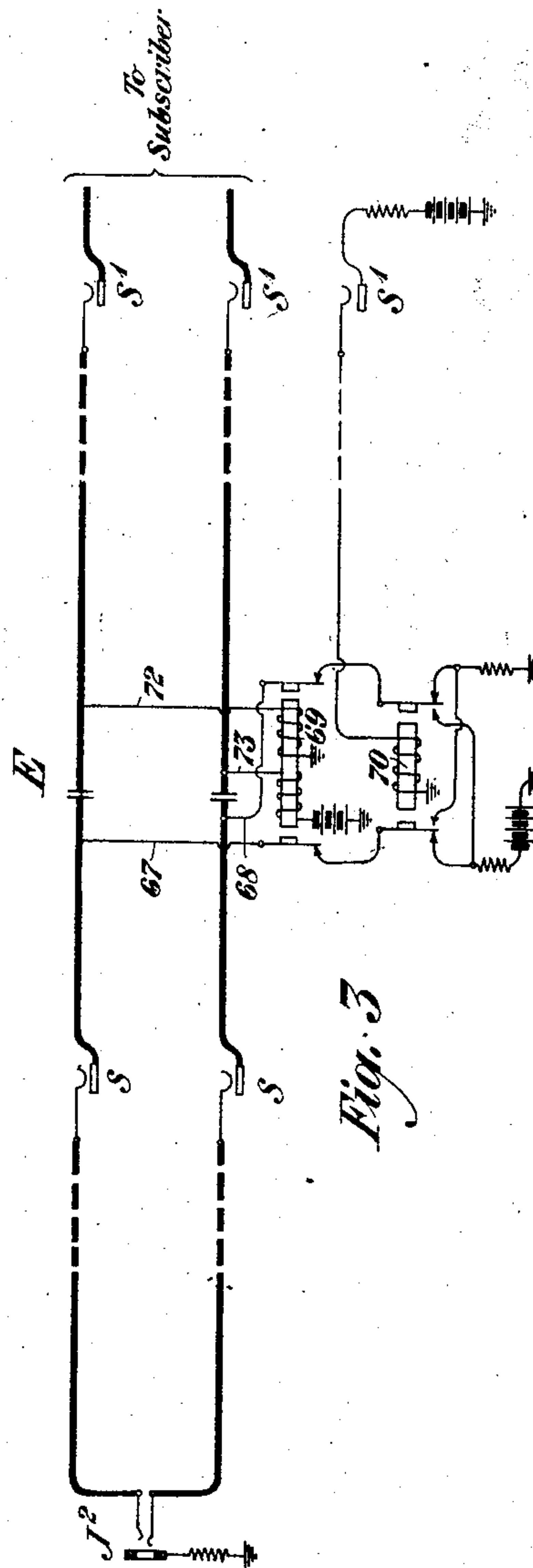


Fig. 3

By their Attorney

Inventors
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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 SYSTEM.

Application filed December 17, 1920, Serial No. 431,426. Renewed March 18, 1925.

To all whom it may concern:

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

This invention relates to telephone exchange systems, and more particularly to such systems in which connections are established between telephone lines terminating at different switchboards.

One of the objects of the invention is to provide a trunk circuit for such systems which is adapted to connect an office of the manual type with an office of either manual or automatic type.

Another object of the invention is to provide such system with apparatus at the originating end which, in case the operator thereat disconnects, will maintain it in busy condition until the remainder of the circuit is restored to normal.

A further object of the invention is to provide signaling arrangements whereby the operator at the interconnecting office is signaled upon the disconnection of the originating end irrespective of the condition of the circuit at the opposite end.

These objects, as well as other objects of the invention, may be attained by means of the apparatus set forth in the following description and illustrated in the accompanying drawings in which Figures 1, 2 and 3 illustrate a circuit diagram of one embodiment of the invention.

Referring to the drawing, A represents a portion of an operator's toll cord which terminates in plug P. The plug P is adapted to co-operate with jack J which is connected to a trunk C at an interconnecting or tandem office. The trunk C terminates in plug P¹ which is adapted to co-operate with the jack J¹ of trunk D in an office where connections are established manually, or jack J² of trunk E in an office where connections are established by means of automatic machinery. Both of the latter trunks are adapted to be connected to extension lines, such as subscribers' stations.

Ringling key K is associated with the plug P of cord A for operating electromechanism in the trunk C upon the connection of said plug with jack J, and said trunk is provided with a key K¹ for connecting an oper-

ator's set therewith. The trunk C is equipped with a dial D¹ in order that the operator may establish a connection with a subscriber by means of the switching machinery which is shown diagrammatically at E.

The details of this circuit may now be sufficiently understood from the following description of its operation.

Assuming that an operator at a toll office desires to establish a connection with a subscriber, as, for example, a subscriber whose line terminates in a manual office at a jack J³, or with a subscriber whose line terminates in an office where switching machinery is employed such as shown at E, the toll operator will insert plug P of cord A in jack J and close the following circuit: from battery, sleeve contacts of plug P and jack J, back contact of relay 5, conductor 10, winding of relay 11, to ground. This circuit energizes relay 11, which upon operating closes a circuit through its front contact from battery, normal contact of relay 12, winding of slow releasing relay 13 to ground. Relay 13 is operated by the closing of this circuit, but performs no useful function at this time.

The insertion of plug P in jack J also establishes a bridge across the tip and ring conductors of the cord A by the following current path: from battery, left-hand winding of relay 14, conductor 15, left-hand normal contact of relay 16, left-hand back contact of relay 17, conductor 18, ring contacts of jack J and plug P, winding of supervisory relay 19 of cord A, including normal contacts of key K, tip contacts of plug P and jack J, conductor 20, right-hand back contacts of relay 17, right hand normal contact of relay 16, right-hand winding of relay 14 to ground. The closing of this circuit energizes relay 14 and supervisory relay 19, but the latter relay releases immediately upon the operation of relay 16, as will be described later, and the supervisory lamp 21 does not light at this time. The operation of relay 14 closes a circuit through its front contact from ground, conductors 22 and 23, left middle contact of relay 24, conductor 25, lower back contact of relay 26, filament of lamp 27 to battery. The closing of this circuit causes the illumination of guard lamp 27. The operation of relay 14 also causes the energization of relays 16 and 32, the former by a current path from ground, make contact of relay 14, normal contact of relay

28, right-hand winding of relay 16, normal contact of relay 29, conductor 30, back contact of polar relay 31 to battery. Relay 32 is energized by the following circuit: from
 5 ground, front contact of relay 14, conductor 22, winding of slow release relay 32, conductor 33, back contact of relay 34, to battery, but performs no useful function at this time. The operation of relay 16 breaks
 10 its back contacts and opens the bridge circuit previously outlined across the tip and ring conductors of the trunk C. Relay 14, however, is maintained in operated condition by a holding circuit from battery, left-
 15 hand winding of said relay, conductor 15, left front contact of relay 16 to ground. When the operator at C notes the lighting of guard lamp 27, she operates talking key K^1 to answer the call, and receives the number of the desired party in the usual manner. The operation of key K^1 closes a circuit from ground, through the lower contact of said key, winding of relay 24, to battery, thus energizing relay 24, which breaks its
 25 left-hand middle contact, and opens the circuit previously traced in connection with the lighting of lamp 27, thereby extinguishing said lamp temporarily. The energization of relay 24 maintains relay 16 in operated condition by a holding circuit from battery, outer left-hand contact of relay 24, conductor 30, normal contact of relay 29, right-
 30 hand winding of relay 16, normal contact of relay 28, front contact of relay 14 to ground.

The operator at C after manipulating key K^1 , and ascertaining that the call is for a party whose line terminates at a manual office, as, for instance, in jack J^3 , goes in on a
 40 call circuit in the customary manner, and receives a trunk assignment such as the trunk D, which terminates in jack J^1 . The operator then restores key K^1 to normal thereby deenergizing relay 24 and causing guard
 45 lamp 27 to again glow. She then inserts plug P^1 in jack J^1 which closes a circuit from battery, winding of relay 34, conductor 36, sleeve contacts of plug P^1 and jack J^1 to ground. This circuit energizes relay
 50 34 and closes a circuit from battery, front contact of relay 34, conductor 87, winding of relay 26 to ground, thereby operating the latter relay. The operation of relay 34 opens its back contact and thereby deenergizes relay 32, and the operation of relay
 55 26 causes the guard lamp 27 to be extinguished by opening the circuit previously traced through the lower back contact of said relay. The insertion of plug P^1 in jack J^1
 60 also closes a circuit from battery, left-hand winding of relay 37 of trunk D, upper normal contact of relay 38, conductor 39, ring contacts of jack J^1 and plug P^1 , lower normal contacts of relays 40 and 41, ring conductor of trunk C, conductor 44, normal contact

62 of relay 43, conductor 42, winding of polar relay 31, tip conductor of trunk C, upper normal contacts of relays 41 and 40, upper closed contacts of relay 26, tip contacts of
 70 plug P^1 and jack J^1 , conductor 45, lower normal contact of relay 38, right hand winding of relay 37 to ground. The closing of this circuit operates relay 37 of trunk D. The polar relay 31 does not operate at this time
 75 because relay 38 operates immediately, as will presently be described, and opens the above traced circuit. The operation of relay 37 closes a circuit through its front contact from ground, conductor 46, upper winding of relay 38, conductor 47, lower back
 80 contact of relay 48, filament of lamp 49 to battery. This circuit operates relay 38 and also causes the illumination of guard lamp 49. Relay 38 at its back contacts opens the circuit just described through the winding
 85 of polar relay 31, and at its upper make contact closes a holding circuit for relay 37 from ground, make contact of relay 38 left-hand winding of relay 37 to battery. The operator at the local office after assign-
 90 ing the trunk, inserts plug P^3 in jack J^3 of the subscriber's line, thereby closing a circuit from battery, winding of relay 48, sleeve contacts of plug P^3 and jack J^3 to ground. This circuit operates relay 48 which breaks
 95 its lower back contact and extinguishes lamp 49. At the same time it opens the previously traced circuit through the upper winding of relay 38, which releases said relay and thereby re-establishes the previously traced cir-
 100 cuit through the polar relay 31, which now operates, and opens the circuit through right-hand winding of relay 16. This releases relay 16 and re-establishes the circuit traced above through supervisory relay 19
 105 in the cord circuit A, and relay 19 operates and lights supervisory lamp 21 in an obvious manner. This provides a ringing signal for the toll operator A, who now operates the ringing key K of cord A which causes
 110 ringing current to be transmitted over the tip and ring conductors of the cord A, operating relay 50 in the trunk C. The operation of relay 50 closes a circuit through its contact from ground, conductor 51, winding of relay 41, to battery. This circuit operates relay 41, which connects ringing current from source 52 over the front contacts of relay 41, tip and ring conductors of plug
 120 P^1 and jack J^1 in a well understood manner, thereby operating relay 53 of trunk D. The operation of relay 50 also closes a circuit through its contact from ground, conductor 71, left-hand winding of relay 16 to battery and operates relay 16 and closes the holding
 125 circuit for relay 14, as traced above, and maintains relay 14 in operated condition. The operation of relay 53 closes a circuit through its contact, conductor 54, winding of relay 55, conductor 56, lower winding of
 130

relay 38 to battery. This circuit serves to again operate relay 38, which maintains relay 37 in an operated condition over the holding circuit previously traced and also operates relay 55 which attracts its armatures and transmits ringing current from source 57 over the tip and ring contacts of plug P³ and jack J³ signals the subscriber in the usual manner. The toll operator at A having signaled the subscriber, restores key K to normal thereby releasing relay 50, which will in turn break the energizing circuit for relay 41 causing it to release. The release of relay 41 will disconnect the ringing current from the trunk and deenergize relay 53 and accordingly break the circuit by which relay 55 was operated. The release of relay 50 also releases relay 16 by opening the circuit through the left-hand winding of the latter relay. The release of relay 53 will deenergize relay 38 by opening the circuit through its lower winding.

The subscriber in response to the signal, will remove the receiver from its hook, thereby closing a circuit from battery, winding of relay 58, upper back contact of relay 55, tip contacts of plug P³ and jack J³ through subscriber's station and return by way of the ring contacts of said plug and jack upper contact of relay 48, lower back contact of relay 55 to ground. This circuit will operate relay 58 and close a circuit from battery, lower winding of relay 38, conductor 59, contact of relay 58, upper winding of relay 38, conductor 46, contact of relay 37 to ground. This circuit provides for the energization of relay 38, which in operating will hold relay 37 energized by a circuit from ground, upper front contact of relay 38, left-hand winding of relay 37 to battery. The operation of relay 38 opens the circuit previously traced whereby polar relay 31 of trunk C was operated, causing said relay to release. The release of relay 31 will cause relay 16 to again operate by the completion of the circuit through the normal contact of relay 31, previously described. The operation of relay 16 will break its normal contacts thereby opening the circuit formerly traced whereby the supervisory lamp 21 at cord A was illuminated. If the subscriber whose line terminates at jack J³ moves the switch hook up and down, relay 19 alternately operates and releases thereby causing supervisory lamp 21 to flash.

When the subscriber at the termination of a call hangs up the receiver, the circuit whereby relay 58 was energized will be broken at the subscriber's switchhook, in a manner well understood and relay 58 will become deenergized thereby opening the circuit by which relay 38 was operated, causing said relay to release. The release of relay 38 will again provide for the operation of polar relay 31 over normal contacts of

relay 38 and tip and ring conductors of the trunks D and C, energizing relay 31 as previously out-lined. The operation of polar relay 31 of trunk C opens the circuit just described whereby relay 16 was energized, thus releasing the latter relay which causes the operation of relay 19 in the cord A by a circuit previously traced. The closing of this circuit will cause lamp 21 to glow which gives the operator at A a disconnect signal and she thereupon removes plug P from jack J releasing relay 14. Release of relay 14 closes a circuit through its back contact from ground, conductor 63, lower closed contact of relay 26, filament of lamp 27 to battery. The closing of this circuit lights lamp 27 and thereby furnishes a disconnect signal for the operator at C. The release of relay 14 also causes the operation of slow releasing and slow operating relay 60 by closing a circuit from ground, back contact of relay 14, conductor 61, winding and right-hand normal contact of relay 60, closed contact of polar relay 31 to battery. The operation of relay 60 closes locking circuit from battery, front middle contacts of relay 26, conductor 74, closed contact and winding of relay 60, conductor 61, back contact of relay 14 to ground. The operation of relay 60 through its left-hand front contact also closes a circuit for operating relay 43, from ground, winding of relay 43 to battery. The operation of relay 43 will break at its left-hand contact 62, bridged circuit through polar relay 31 thereby deenergizing the latter relay and opening the circuit previously described whereby relay 37 of trunk D was energized. The deenergization of relay 37 closes a circuit through its back contact from ground, through lower closed contact of relay 48, filament of lamp 49 to battery, thus causing lamp 49 to glow and this serves as a disconnect signal for the operator at D. The operators at C and D upon receiving simultaneous disconnect signals, indicated by the glow of lamps 27 and 49, will remove the plugs of their trunks from their associated jacks and the circuit will be restored to normal.

If the tandem operator at C in response to a call, as indicated by the glowing of guard lamp 27, operates key K and ascertains that the call is for a subscriber whose line terminates at an office such as indicated at E, where switching machinery is used for establishing connections the plug P¹ is inserted in jack J² and the dial D¹ of trunk C is operated in a well-known manner to set up a connection by means of the selector switches S and S¹ at office E. The insertion of plug P¹ in jack J² will close a circuit from battery, winding of relay 34, conductor 36, sleeve contacts of plug P¹ and jack J² to ground. This circuit operates relay 34

which closes a circuit through its front contact from battery, conductor 87, winding of relay 26 to ground, thereby operating relay 26. The operation of relay 26 connects the tip strand of plug P^1 to the tip conductor of the trunk C and also opens at its lower back contact the circuit by which lamp 27 was lighted, it being understood that the relays 14 and 16 are energized as previously described in connection with the call to a manual office. The operation of the key K^1 will close a circuit through its lower contact from ground, conductor 35, winding of relay 24 to battery. The operation of relay 24 closes the circuit previously traced for maintaining relay 16 in operated condition, and also closes a circuit through its right-hand contact from ground, over conductors 64 and 65, winding of relay 40 to battery when the dial D^1 is operated. The closing of this circuit will energize relay 40 and connect the conductors 66 of dial D^1 with the tip and ring conductors of plug P^1 and jack J^2 . The operation of dial D^1 will step the automatic apparatus at trunk E to the proper subscriber's line. As soon as the operator at C has completed dialing, the circuit of relay 40 is opened at the off normal contacts of the dial. The operator at C, having completed the dialing operations, restores key K^1 , thereby deenergizing relay 24. In response to the dialing operations, the sleeve terminal of switch S^1 will be connected with the sleeve contact of the subscriber's line and will close a circuit from battery, through the sleeve contacts of switch S^1 , winding of relay 70 to ground, thereby energizing relay 70. The insertion of plug P^1 in jack J^2 will not cause polar relay 31 of trunk B to operate but when the final selector has seized the subscriber's line and relay 70 is operated as just outlined, there will be a reversal of current which will cause said polar relay 31 to operate upon the closing of the following circuit: from ground and battery at trunk E, front contacts of relay 70, back contacts of relay 69, conductors 67 and 68, tip and ring contacts of jack J^2 and plug P^1 , tip and ring conductors of trunk C, including the closed contact of relay 26 and back contacts of relays 40 and 41, winding of relay 31, conductors 42 and 44, and contact 62 of relay 43. The operation of polar relay 31 causes the deenergization of relay 16, which again completes the bridged connection over its back contacts to the tip and ring conductors of cord A by a circuit from ground and battery at relay 14 as formerly described, thereby energizing relay 19 of cord A and causing lamp 21 to glow, thus providing a ringing signal for the operator at the toll office A. The operator at A, upon receiving the ringing signal as indicated by the glowing of lamp 21, will operate key K of her cord and transmit ring-

ing current over the tip and ring conductors of said cord through the winding of relay 50 thereby operating it. The operation of relay 50 completes a circuit through its contact from ground, conductor 51, winding of relay 41, to battery, thus energizing relay 41. The operation of the ringing relay 50 also operates relay 16 which in turn holds relay 14 operated. The operation of relay 41 causes ringing current to be applied in a well-known manner from source 52, over the tip and ring contacts of plug P^1 and jack J^2 , switches SS and S^1S^1 over the subscriber's line thereby signaling said subscriber. The removal of the receiver from its hook at the subscriber's station in response to signal will complete a circuit from battery, left-hand winding of relay 69, conductor 73, ring contact S^1 through the subscriber's station and return in the usual manner, tip contact of switch S^1 , conductor 72, right-hand winding of relay 69 to ground. This circuit will cause the relay 69 to operate, thereby opening the circuit previously outlined whereby polar relay 31 of trunk C was energized thereby causing relay 31 to release. The deenergization of relay 31 closes a circuit through its back contact from battery, conductor 30, normal contact of relay 29, right-hand winding of relay 16, contact of relay 28, front contact of relay 14 to ground. This circuit operates relay 16 and opens the bridged circuit across the tip and ring conductors of trunk B and cord A whereby the lamp 21 was illuminated upon the energization of relay 19.

When the subscriber whose line terminates at trunk E restores the receiver to its hook, the circuit which was previously described for energizing relay 69 will be broken and said relay will release thereby energizing relay 31 of trunk C, which in turn causes relay 16 to release. The relay 19 in cord A is energized by a circuit previously described in connection with a call to a manual office and the operation of said relay causes lamp 21 to glow, thereby giving a disconnect signal to the toll operator at A. The toll operator upon receiving such disconnect signal will remove plug P from jack J which will deenergize relay 14. Said relay upon releasing will close a circuit by way of its back contact from ground, conductor 63, make contact of relay 26, filament of lamp 27 to battery, thereby giving the operator at C a disconnect signal. The selector switches in the trunk E will be obviously released at this time simultaneously with the operation of lamp 27 as a disconnect signal.

Should the operator at A for any reason disconnect before the subscriber who is connected with either the manual or automatic machinery controlled office hangs up, the removal of plug P from jack J will cause relay

11 to become deenergized. The release of relay 11 will close a circuit from battery normal contact of relay 12, back contact of relay 11, make contact of relay 13, this relay being momentarily held operated as it is slow to release, conductor 77, through the windings of relays 76 and 5 in series to ground. This circuit will cause the operation of relay 76 and differential relay 5. The operation of the latter relay will complete a locking circuit from ground, through its right-hand winding and make contact, conductor 78, normal contact of relay 13, this relay now being released, back contact of relay 11, normal contact of relay 12, to battery. The outgoing end of trunk C terminating in jack J will then automatically lock itself and test busy until said trunk is disconnected at its opposite end. Should the operator at A insert plug P in jack J again at this time, the differential relay 5 would be released and the circuit restored to the same condition as was previously outlined upon the original association of said plug and jack. However, if the operator at A does not come in on the circuit again, the operator at C will receive a disconnect signal in the following manner: The relay 76 being operated as previously indicated will close a circuit through its left-hand front contact from the battery, right-hand outer contact of relay 5, ring conductor of trunk C, conductor 18, left-hand normal contact of relay 17, conductor 79, winding of relay 80, conductor 81, right-hand make contact of relay 16, right-hand back contact of relay 17, conductor 20, tip conductor trunk C, conductor 82, right-hand make contact of relay 76 to ground. This circuit energizes relay 80, which, in turn, closes a circuit from ground, through its contact, winding of relay 28 to battery, energizing relay 28. The operation of relay 28 opens its contact and breaks the holding circuit previously described through the right-hand winding of relay 16, causing this relay to release. The deenergization of relay 16 opens its left-hand front contact and causes relay 14 to be released in an obvious manner. The release of relay 14 completes a circuit through its back contact from ground, conductor 63, lower make contact of relay 26, filament of relay 27, to battery. This circuit causes the lighting of guard lamp 27, which serves as a disconnect signal for the operator at C. The release of relay 14 also closes a circuit through its back contact from ground, winding of relay 29, conductor 74, middle make contact of relay 26 to battery. This circuit energizes relay 29. The operator at C, in response to the disconnect signal, will withdraw plug P¹ from its associated jack, thereby causing the release of relay 26, which closes a circuit through its middle

back contact from battery, conductor 84, winding of relay 17, conductor 85, right-hand closed contact of relay 29 to ground. Relay 29, being slow-to-release, is momentarily held operated. Relay 17 is energized upon the closing of this circuit, and, as relay 76 at A and relays 80 and 28 of trunk C have by this time released, the following circuit will be established: from battery, left winding of relay 14, conductor 15, back contact relay 16, left front contact relay 17, conductor 20, tip conductor of trunk C, conductor 82, right normal contact of relay 76, winding of polar relay 83, left normal contact of relay 76 outer closed contact of relay 5, ring conductor of trunk C, conductor 18, right front contact of relay 17, back contact of relay 16, right-hand winding of relay 14, to ground. This circuit reverses current through polar relay 83 and causes it to operate. The operation of the polar relay 83 completes a circuit through its grounded contact to battery through the winding of relay 12, causing the latter relay to operate which, in turn, breaks its normal contact and opens the locking circuit previously referred to, whereby relay 5 was held energized. It will be understood that after a certain time slow release relay 29 will become deenergized, thereby releasing relay 17 and the latter, in turn, releasing polar relay 83, thus restoring the circuit to normal.

Should the operator at A inadvertently insert plug P in jack J and then remove said plug therefrom, the circuit will function similarly to that described in connection with removal of the plug before the subscriber has returned the receiver to its hook. In this case, however, the slow release relay 32 will be momentarily held up after the release of relay 14 and relay 29 will be energized by a circuit from ground, back contact of relay 14, winding of relay 29, closed contact relay 32, conductors 89 and 84 to battery by way of middle back contact of relay 26. The operation of relay 29 results in the operation of polar relay 83 and the clearing of the circuit in the same manner as just described in the case of a disconnect. Relay 32 will, after a time, release and break the contact whereby the relay 29 was energized and the latter relay will become deenergized and the same circuit conditions will prevail as were described above.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a telephone system comprising a toll office, a tandem office, subscribers' lines,

manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, a trunk circuit at the tandem office for inter-
 5 connecting said toll office with said manually operated trunks and with said automatically operated trunks, means including a polar relay bridged across the trunk circuit and responsive to its connection with
 10 said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, and means associated with said trunk circuit responsive to the application of current thereto for impressing current on said
 15 manually operated trunk and said automatically operated trunk whereby the subscribers on the lines connected with the two latter trunks are signalled.

2. In a telephone system comprising a toll office, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, a
 25 trunk circuit at the tandem office for interconnecting said toll office with said manually operated trunks and with said automatically operated trunks, means including a polar relay bridged across the trunk circuit and responsive to its connection with
 30 said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, means associated with said trunk circuit responsive to the application of current thereto for impressing current on said manually
 35 operated trunk and said automatically operated trunk whereby the subscribers on the lines connected with the two latter trunks are signalled, and means bridged across said trunk circuit and responsive to the disconnection of the toll office therefrom
 40 for operating a disconnect signal associated with said trunk circuit.

3. In a telephone system comprising a toll office having toll cords, signaling means associated therewith, a tandem office, subscribers' stations, manually operated trunks and automatically operated trunks associating said subscribers' stations with said tandem office, trunk circuits at said tandem office for interconnecting said toll cords with
 50 said manually operated trunks and with said automatically operated trunks, signaling means associated with said trunk circuits, means including a polar relay bridged across each trunk circuit and responsive to the connection of said trunk circuits and
 60 said manually operated trunks and with said automatically operated trunks for operating the signaling means in said toll cords, means associated with said toll cords for impressing current on said trunk circuits,

means associated with the trunk circuits responsive to the application of current thereto for impressing current on said manually operated trunks and on said automatically operated trunks whereby the subscribers' stations connected with the two latter trunks are signalled, means associated with said manually operated trunks and with said automatically operated trunks for operating the signaling means associated with said toll
 75 cords as a disconnect signal upon the disconnection of the subscribers' stations, and means bridged across said trunk circuit responsive to the disconnection of the toll cords therefrom for operating the signaling
 80 means of said trunk circuits.

4. A telephone system comprising a toll office, signaling means thereat, a tandem office, signaling means thereat, subscribers' lines, manually operable tandem trunks and automatically operable tandem trunks associating said subscribers' lines with said
 85 tandem office, a trunk circuit interconnecting said toll office and said tandem office, a circuit bridged across said trunk, said circuit controlling said toll office signaling means, a relay controlling said bridged circuit, a polarized relay associated with said trunk controlling said first relay, a third relay included in said bridged circuit and controlling
 90 said tandem office signaling means, and means in said tandem trunks controlled by said subscribers' lines for controlling said polarized relay whereby said toll office signaling means may be controlled.

5. A telephone system comprising a toll office, a toll cord including signaling means located thereat, a tandem office, subscribers' lines, manually operable tandem trunks and automatically operable tandem trunks associating said subscribers' lines with said tandem
 105 office, a trunk circuit interconnecting said toll office and said tandem office, signaling means in said trunk at said tandem office, a circuit bridged across said trunk, said circuit controlling said toll office signaling means, a relay controlling said bridge circuit, a polarized relay associated with said trunk controlling said first relay, a third relay included in said bridged circuit and controlling said
 110 tandem office signaling means, means in said tandem trunks controlled by said subscribers' lines for controlling said polarized relay whereby said toll office signaling means may be controlled, said third relay being locked up over a contact of said first relay and the tandem office signaling means being thus extinguished when a connection is established between said toll cord and a subscribers' lines and means associated with said
 125 trunk and operable when said toll cord is disconnected from said trunk before said connection has been terminated by said subscriber for releasing said first relay and breaking said locking circuit whereby said
 130

third relay causes said tandem office signaling means to function again.

6. A telephone system comprising a toll office, a toll cord including signaling means located thereat, a tandem office, subscribers' lines, manually operable tandem trunks and automatically operable tandem trunks associating said subscribers' lines with said tandem office, a trunk circuit interconnecting said toll office and said tandem office, signaling means in said trunk at said tandem office, a circuit bridged across said trunk, said circuit controlling said toll office signaling means, a relay controlling said bridged circuit, a polarized relay associated with said trunk controlling said first relay, a third relay included in said bridged circuit and controlling said tandem office signaling means, means in said tandem trunk controlled by said subscribers' lines for controlling said polarized relay, whereby said toll office signaling means may be controlled, said third relay being locked up over a contact of said first relay and the tandem office signaling means being thus extinguished when a connection is established between said toll cord and a subscribers' line, means associated with said trunk and operable when said toll cord is disconnected from said trunk before said connection has been terminated by said subscriber for releasing said first relay and breaking said locking circuit whereby said third relay causes said tandem office signaling means to function again, and means associated with said trunk and operable upon the disconnection of said trunk from one of said tandem trunks after said toll cord has been disconnected from said trunk for restoring all of said apparatus to normal.

7. In a telephone system comprising a toll office, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, switches associated with the automatically operated trunks, a trunk circuit at the tandem office for interconnecting said toll office with said manually operated trunks and with said automatically operated trunks, a dial associated with the trunk circuit for operating said switches, means bridged across the trunk circuit and responsive to its connection with said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, and means associated with said trunk circuit responsive to the application of current thereto for impressing said current on said manually operated trunk and said automatically operated trunk, whereby the subscribers on the lines connected with the two latter trunks are signaled.

8. In a telephone system comprising a toll

office, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, a trunk circuit at the tandem office for inter-connecting said toll office with said manually operated trunks and with said automatically operated trunks, means bridged across the trunk circuit and responsive to its connection with said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, means associated with said trunk circuit responsive to the application of current thereto for impressing current on said manually operated trunk and said automatically operated trunk, whereby the subscribers on the lines connected with the two latter trunks are signaled, and means associated with said trunk circuit and responsive to the disconnection of the toll office therefrom and the opening of a subscriber's line for simultaneously operating a disconnect signal in said trunk circuit and in said manually operated trunk.

9. In a telephone system comprising a toll office having toll cords, signaling means associated therewith, a tandem office, subscribers' stations, manually operated trunks and automatically operated trunks for associating said subscribers' stations with said tandem office, trunk circuits at said tandem office for inter-connecting said toll cords with said manually operated trunks and with said automatically operated trunks, signaling means associated with said trunk circuits, means including a polar relay bridged across each trunk circuit and responsive to the connection of said trunk circuits and said manually operated trunks and with said automatically operated trunks for operating the signaling means in said toll cords, means associated with said toll cords for impressing current on said trunk circuits, means associated with the trunk circuits responsive to the application of current thereto for impressing current on said manually operated trunks and said automatically operated trunks, whereby the subscribers' stations connected with the two latter trunks are signaled, means associated with said manually operated trunks and with said automatically operated trunks for operating the signaling means associated with said toll cords as a disconnect signal upon the disconnection of the subscribers' stations, and means bridged across said trunk circuit responsive to the disconnection of the toll cords therefrom and the disconnection of the subscribers' stations for simultaneously operating the signaling means of said trunk circuits and said manually operated trunks.

10. In a telephone system comprising a

toll office having toll cords, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, switches associated with the automatically operated trunks, a trunk circuit at the tandem office for inter-connecting said toll office with said manually operated trunks and with said automatically operated trunks, a dial associated with the trunk circuit for operating said switches, means bridged across the trunk circuit and responsive to its connection with said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, means associated with said trunk circuit responsive to the application of current thereto for impressing said current on said manually operated trunk and said automatically operated trunk, whereby the subscribers on the lines connected with the two latter trunks are signaled, and means associated with said trunk circuit for simultaneously operating a disconnect signal in said trunk circuit and said manually operated trunk upon the opening of the subscribers' lines and the disconnection of the toll cord from the trunk circuit.

11. In a telephone system comprising a toll office having toll cords, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, switching apparatus associated with the automatically operated trunks, a trunk circuit at the tandem office for inter-connecting said toll office with said manually operated trunks and with said automatically operated trunks, a dial associated with the said trunk circuit for operating said switching apparatus, means bridged across the trunk circuit and responsive to its connection with said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on

said trunk circuit, means associated with said trunk circuit responsive to the application of current thereto for impressing said current on said manually operated trunk and said automatically operated trunk whereby the subscribers on the lines connected with the two latter trunks are signaled, and means associated with said trunk circuit for simultaneously operating a disconnect signal in said trunk circuit and releasing said switching apparatus in the automatically operated trunks upon the opening of the subscribers' lines associated with the latter trunks and the disconnection of the toll cords from the trunk circuits.

12. In a telephone system comprising a toll office, a tandem office, subscribers' lines, manually operated trunks and automatically operated trunks for associating said subscribers' lines and said tandem office, a trunk circuit at the tandem office for inter-connecting said toll office with said manually operated trunks and with said automatically operated trunks, means bridged across the trunk circuit and responsive to its connection with said manually operated trunk and with said automatically operated trunk for signaling said toll office, means at said toll office for impressing current on said trunk circuit, means associated with said trunk circuit responsive to the application of current thereto for impressing current on said manually operated trunk and said automatically operated trunk, whereby the subscribers on the lines connected with the two latter trunks are signaled, and means associated with said trunk circuit and responsive to the disconnection of the toll office therefrom for maintaining said trunk circuit in busy condition until its disconnection from said manually operated trunk and said automatically operated trunk.

In testimony whereof, we have signed our names to this specification this 15th day of December 1920.

JOHN F. TOOMEY.
HENRY E. PHELPS.