

June 24, 1924.

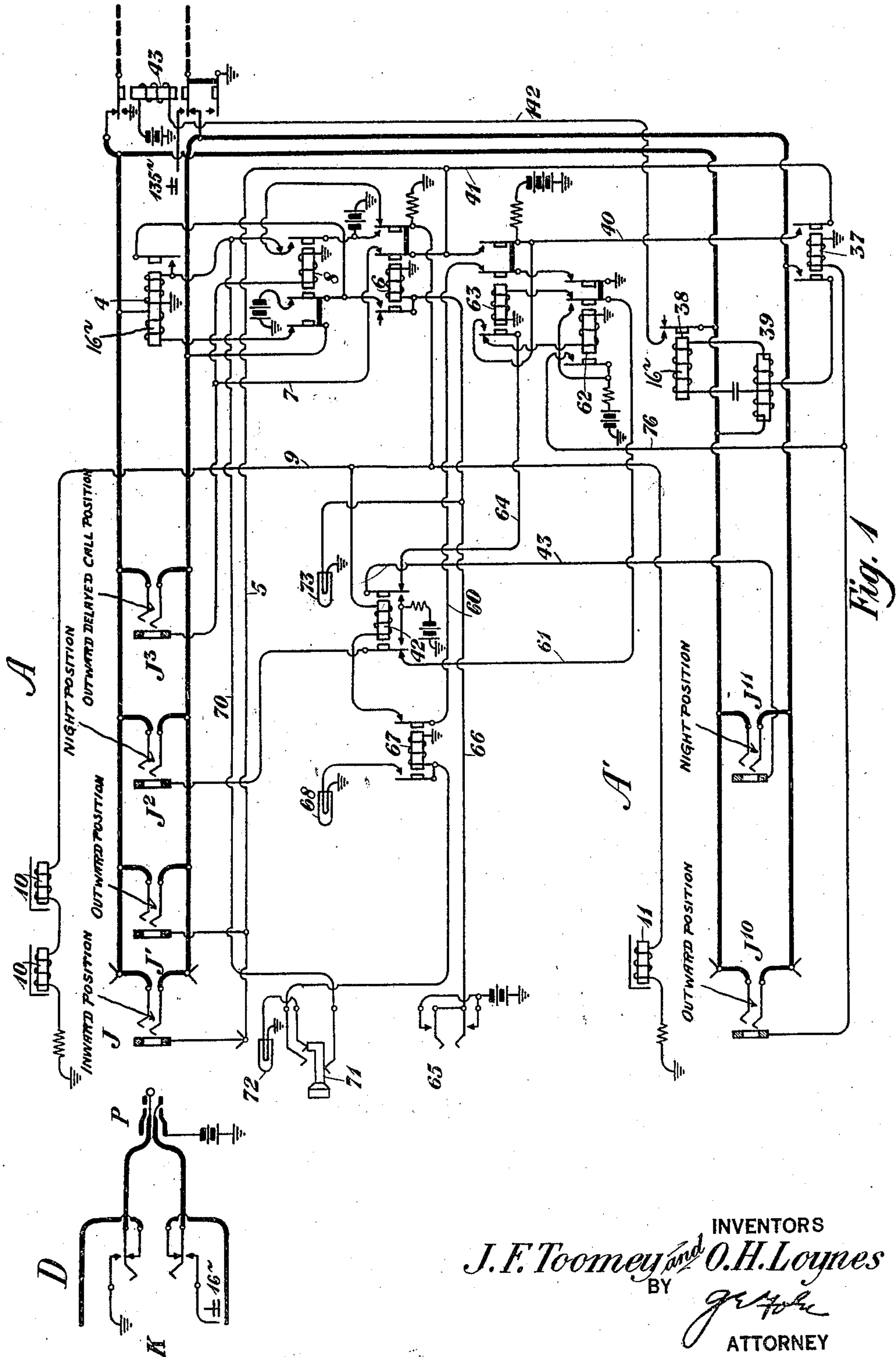
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J. F. TOOMEY ET AL

TELEPHONE SYSTEM

Filed Dec. 23, 1921

3 Sheets-Sheet 1



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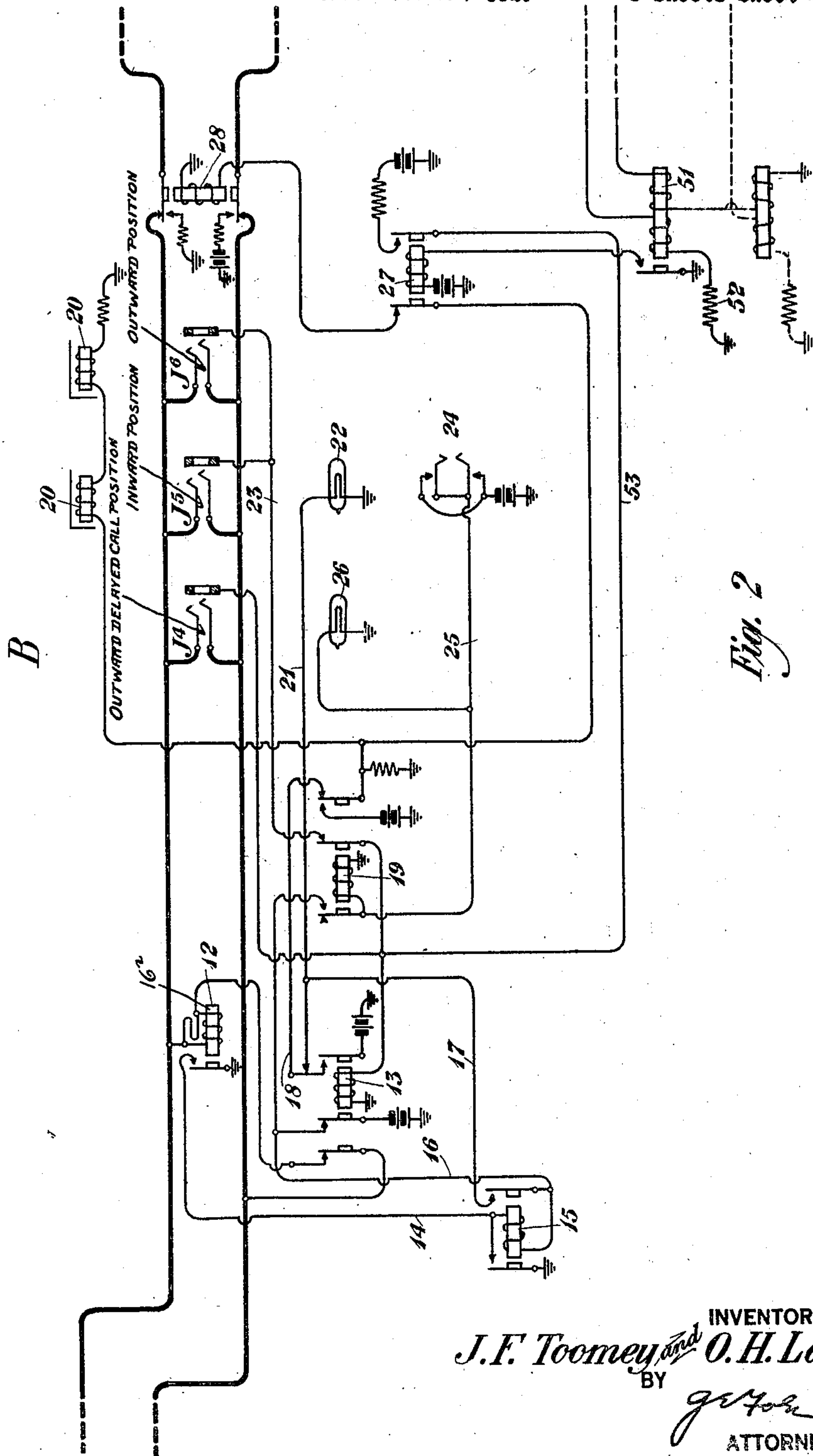
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3 Sheets-Sheet 2



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TELEPHONE SYSTEM

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3 Sheets-Sheet 3

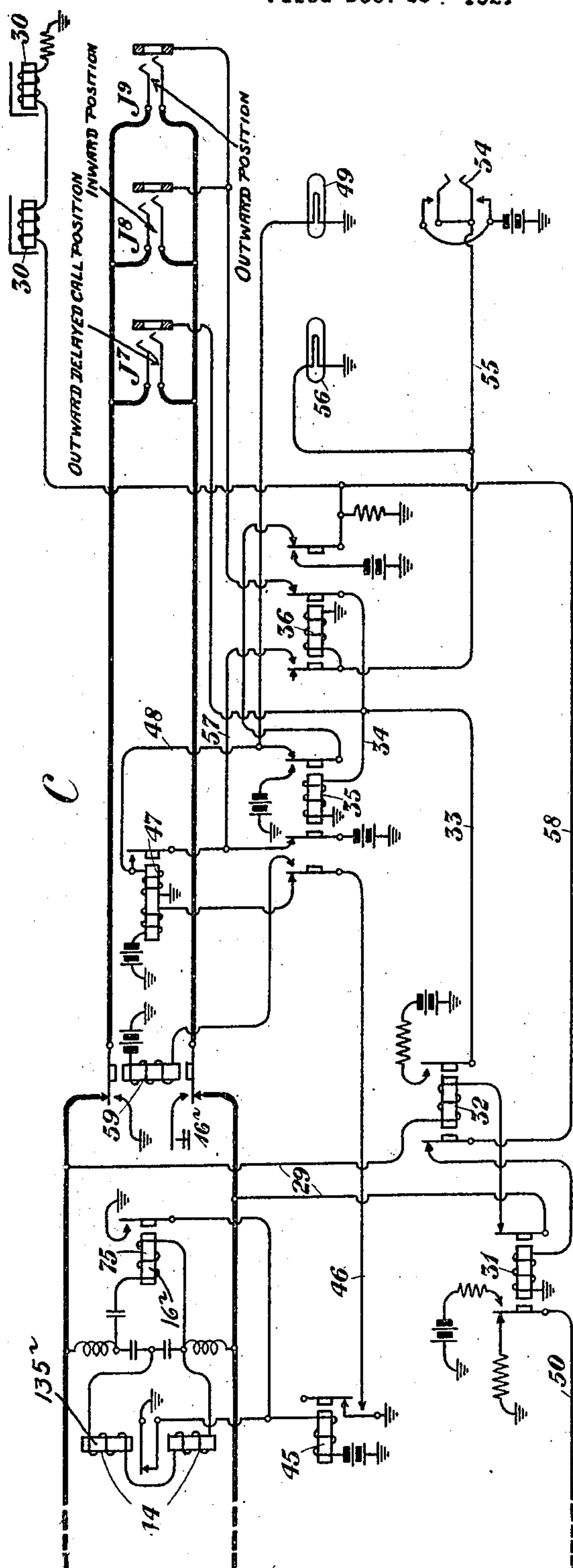


Fig. 3

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UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., AND OWEN H. LOYNES, OF WOODRIDGE, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed December 23, 1921. Serial No. 524,482.

To all whom it may concern:

Be it known that we, JOHN F. TOOMEY and OWEN H. LOYNES, residing at New York and Woodridge, in the counties of New York and Bergen and States of New York and New Jersey, respectively, have invented certain Improvements in Telephone Systems, of which the following is a specification.

10 This invention relates to telephone systems, and more particularly to signaling arrangements between telephone exchanges.

One of the objects of the invention consists in providing means for selectively signaling interconnected telephone exchanges over the same trunk line.

Another object provides for the operation of busy signals at each of the interconnected exchanges during the period the trunk line is in use.

Another object consists in providing one of the interconnected exchanges with means for compensating differences in earth potential between that exchange and other of said exchanges.

Other and further objects of the invention will be apparent from the following description, when read in connection with the accompanying drawings, in which Figure 1 illustrates positions A and A¹ at a central office; Fig. 2 represents a second central office B, and Fig. 3 shows a third central office C. These central offices are interconnected by a trunk line with which is associated the usual multiple jacks at each office. There are shown at each office only such multiple jacks as are necessary for a proper understanding of the invention, these comprising, respectively, a jack at an inward position, where incoming calls are received, a jack at a transferred call position and a jack for the night positions. Associated with each inward position is shown a key for transferring the connections. At D is indicated diagrammatically such parts of a toll cord circuit, including the usual key K, as are pertinent to this invention. A cord circuit similar to that outlined at D, and connected with a source of 16 cycle ringing current, may be used with any of the jacks at the various offices associated with the trunk line. At offices A and A¹ are illustrated, respectively, busy signals 10, 10 and 11, while at offices B and C such signals are represented

at 20, 20 and 30, 30 respectively. A differential relay 51, with a resistance 52, associated therewith, is provided at office B for the purpose of equalizing earth potential between offices B and C, and said resistance is so adjusted that the currents due to earth potential shall be equal through the two windings of relay 51.

The operation of the circuit will be more clearly understood from the following detailed description of its operation.

Assuming that an operator at office A desires to establish a connection with a distant office, for instance, office B, plug P of the cord circuit D is inserted in one of the outward multiple jacks at A, for instance, J¹, and the following circuit is closed: From battery, sleeve contacts of plug P and jack J¹, conductor 5, right-hand inner contact of relay 6, conductor 7, winding of relay 8 to ground. The closing of this circuit causes the operation of relay 8, which disconnects relay 4 from across the tip and ring conductors of the trunk, and also closes a circuit from battery, right-hand make contact of relay 8, right-hand outer contact of relay 6, conductor 9, windings of busy signals 10, 10 to ground, at office A, and a circuit from conductor 9, through winding of busy signal 11 to ground at position A¹, causing these signals to operate. After the plug has been inserted, key K of cord circuit D will be operated and 16 cycle ringing current is transmitted over the following circuit: From ground and source of current supply, closed contacts of key K, tip and ring conductors of plug P and jack J¹, tip and ring conductors of the trunk leading to office B, through the winding of relay 12 and outer left-hand normal contact of relay 13. The closing of this circuit operates relay 12, but relay 44 at office C will not operate at this time because it is not responsive to currents of this frequency. The operation of relay 12 closes a circuit through its make contact from ground, conductor 14, winding of relay 15, conductor 16, inner normal contact of relay 13, to battery. The closing of this circuit causes the operation of relay 15, which closes a locking circuit from ground through its left-hand make contact and winding, conductor 16, inner normal contact of relay 13, to battery. The operation of relay 15 also closes a circuit

from battery, inner normal contact of relay 13, conductor 16, right-hand make contact of relay 15, conductor 17, right-hand normal contact of relay 13, conductor 18, 5 outer right-hand normal contact of relay 19, through windings of busy signals 20, 20 at office B, to ground, thereby operating said busy signals. The operation of relay 15 also closes a circuit from battery, inner normal contact of relay 13, conductor 16, right-hand make contact of relay 15, conductors 17 and 21, filament of line lamp 22, to ground, thereby lighting said lamp. Relay 28 will also be operated at this time, as will 15 be described later.

In response to the lighting of lamp 22, the operator at office B will associate her cord circuit (not shown) with one of the multiple jacks at an inward position, for instance, 20 jack J⁵, thereby closing a circuit from battery on the sleeve of the connected cord circuit, sleeve conductor 23, inner normal contact of relay 19, winding of relay 13, to ground, causing the operation of the latter 25 relay. The operation of relay 13 opens the circuit previously referred to in connection with relay 12. The operation of relay 13 also causes line lamp 22 to be extinguished and relay 15 to be deenergized. The operator at office A will now restore key K to 30 normal, and a talking connection is established between office A and office B. If the number transmitted from the operator at office A to the operator at office B is for a 35 called station connected with the inward position at the latter office, such as position indicated by jack J⁵, the operator at that position may complete the connection in a well understood manner. When the connection has been established the operators at 40 offices A and B may signal each other by means of 16 cycle ringing current. At the termination of the connection, the operator will withdraw the cord circuit from jack J⁵, causing the circuit to return to normal. 45 Should the call be for a station connected with a position at office B not controlled by the operator at the inward position, said operator, by means of a key such as indicated at 24, will transfer the call to the position from which it may be completed and in this instance, for the purpose of illustration, it will be assumed that such position terminates in jack J⁴. Under this condition, 55 key 24 is operated, and a circuit closed from battery, contacts of said key, conductor 25, filament of lamp 26, to ground, and winding of relay 19, to ground. The closing of this circuit causes lamp 26 to light and relay 19 60 to operate. The operation of relay 19 causes relay 13 to release and close a locking circuit for relay 19, from battery, inner left-hand contact of relay 13, left-hand make contact and winding of relay 19, to ground. The 65 closing of this circuit maintains lamp 26

lighted. The operator at the transferred call position may complete the connection with the called station in a well understood manner. The operation of relay 19 also closes circuits through its outer right-hand 70 make contact from battery, winding of busy signals 20, 20 to ground, maintaining these signals operated, and from battery through said contact, winding of relay 28 to ground, operating relay 28. The operation of relay 75 28 connects ground and battery, over the tip and ring conductors, respectively, of the line, conductors 29, right-hand normal contact of relay 31, through the winding of relay 32. The closing of this circuit operates 80 relay 32, which establishes a circuit through its right-hand make contact, from battery, conductor 33, winding of relay 35 to ground, thereby energizing relay 35. The operation of relay 35 closes a circuit through its 85 right-hand make contact, from battery, outer right-hand contact of relay 36, through windings of busy signals 30, 30 to ground, causing said signals to operate. The signals 30, 30 remain operated during the period of 90 connection between offices A and B and at the termination of said connection, when the operator at the latter office removes the cord circuit from its associated jack, the circuits and signals return to normal. 95

Should the operator at office A¹ desire to be connected with the office C, the plug of a cord circuit similar to that indicated at D will be inserted in jack J¹⁰, thereby closing a circuit from battery, connected to the sleeve 100 of said cord, sleeve contacts of the connected plug and jack J¹⁰, including the sleeve conductors associated with said jack, winding of relay 37 to ground, causing the operation of this relay. The operation of relay 37, 105 through its left-hand make contact, closes a bridge across the tip and ring conductors of the trunk, through the windings of relay 38 and retardation coil 39. The operation of relay 37 closes, through its right-hand con- 110 tact, a circuit from battery, conductors 40, 41, inner right-hand normal contact of relay 6, conductor 7, winding of relay 8 to ground, causing the operation of the latter relay. This relay in turn closes a circuit from bat- 115 tery, through its right-hand make contact, which causes the operation of the busy signals 10, 10 at A and 11 at A¹, in a manner similar to that previously described, and also closes a circuit through relay 42, back con- 120 tact of relay 67, conductor 60, inner normal contact of relay 63, and outer normal contact of relay 62, to ground, causing relay 42 to operate. The operation of relay 42 closes a circuit through its right-hand make con- 125 tact from battery, conductor 43, to the sleeve of jack J¹¹ and from battery, through its left-hand contact to the sleeve of jack J², placing a busy test on said jacks. The operator, after inserting the plug of the cord 130

circuit in jack J¹⁰, operates a key similar to key K which causes ringing current to be transmitted over the following circuit: From ground and source of current supply, closed contacts of said key, tip and ring conductors of the connected plug and jack J¹⁰, tip and ring conductors of the line over the bridge closed by the operation of relay 37, including the windings of relay 38 and retardation coil 39, thereby operating relay 38. The operation of relay 38 closes a circuit through its make contact from ground, upper contact of said key, tip contacts of the connected plug and jack J¹⁰, conductor 142, winding of relay 43, to battery. The closing of this circuit energizes relay 43, which upon operating, connects 135 cycle ringing current to the tip and ring conductors of the trunk line. The connection of ringing current to the tip and ring conductors of the trunk line will not operate relay 12 at office B because this relay is not responsive to current of this frequency, but will operate relay 44 at office C. The operation of relay 44 breaks the ground connection which normally maintains relay 45 operated, causing this relay to release, which in turn closes a circuit from ground, conductor 46, outer left-hand normal contact of relay 35, left-hand winding of relay 47, to battery. The closure of this circuit causes the energization of relay 47, which upon operating closes a locking circuit through its right-hand winding and make contact, from ground and inner normal contact of relay 35, to battery. The closing of this circuit operates the busy signals 30, 30 over the following circuit. From battery, inner normal contact of relay 35, make contact of relay 47, conductor 48, right-hand normal contact of relays 35 and 36, windings of said signals, to ground. The operation of relay 47 also completes a circuit from battery, inner normal contact of relay 35, make contact of relay 47, conductor 48, filament of line lamp 49, to ground, causing lamp 49 to light. The operation of relay 47 also closes a circuit over the conductor 48, right-hand normal contacts of relays 35 and 36, conductor 58, left-hand contact of relay 32, winding of relay 31, to ground, causing the operation of relay 31. The operation of this relay disconnects relay 32 from the tip and ring conductors of the trunk, and also closes a circuit from battery, left-hand make contact of relay 31, signaling lead 50, which extends to office B, left-hand winding of differential relay 51, resistance 52 to ground, causing relay 51 to operate. The resistance 52 may be adjusted so that the currents due to earth potential, shall be equal through the two windings of relay 51. The operation of relay 51 closes a circuit through its left-hand make contact, from ground, winding of relay 27 to battery, causing relay 27 to operate. The operation of relay 27 connects a

busy test to the sleeves of jacks J⁴, J⁵ and J⁶, and also closes a circuit from battery, through its right-hand make contact, conductor 53, winding of relay 13 to ground, thereby causing the operation of relay 13. The operation of relay 13 closes a circuit through its right-hand make contact, from battery, conductor 18, outer right-hand make contact of relay 19, through the windings of busy signals 20, 20, to ground, thereby operating said signals. The operation of these signals serves as an indication at the various positions at office B that the line is in use.

In response to the lighting of line lamp 49, the operator at the inward position, for instance, designated by jack J⁸, will associate a cord circuit with said jack and complete the connection, or transfer the call to another position where it may be completed, as the case may be. In case the call is transferred to a position indicated by jack J⁷, for instance, key 54 will be operated at the inward position. The operation of this key closes a circuit through its make contact, from battery, conductor 55, filament of lamp 56 to ground and through winding of relay 36 to ground, thereby lighting lamp 55 and operating relay 36. The operation of relay 36 closes a locking circuit through its winding and left-hand make contact from ground, conductor 57, left-hand inner normal contact of relay 35 to battery. While relay 36 is operated, the busy signals 30, 30 are maintained operated over a circuit from battery, right-hand front contact of relay 36, through the winding of said signals to ground; while relay 31 is maintained operated by a circuit from battery, right-hand front contact of relay 36, conductor 58, left-hand normal contact of relay 32, winding of relay 31 to ground. When the call is answered by the operator inserting the plug of a cord circuit in jack J⁷ at the transferred call position, relay 35 operates over a circuit from battery on the sleeve of the connected cord circuit, conductor 34, winding of relay 35 to ground. The operation of relay 35 causes the release of relay 47. The busy signals 30, 30 and relay 31, as well as the busy signals 20, 20 at office B, are now maintained operated through the right-hand make contact of relay 35 and outer right-hand contact of relay 36.

After the connection has been established the operator at office A¹ can signal the operator at office C by ringing on the circuit. In this case, 135 cycle ringing current is sent out from the office at A¹, as previously described, and operates the relay 44 at office C. The operation of this relay releases relay 45, which in turn causes relay 59 to operate over a circuit from ground, contact of relay 45, conductor 46, left-hand make contact of relay 35, winding of relay 59 to battery. The operation of relay 59 connects ground

and 16 cycle ringing current to the tip and ring conductors of the line respectively, and said current is transmitted over any operator's toll cord which may be inserted in any of the jacks at office C. The operator at office C can signal the operator at office A¹ by ringing on the circuit above described, and thereby transmitting 16 cycle ringing current over the toll line into the toll cord inserted in the jack J¹⁰ at office A¹. At the termination of the call the operators at offices A¹ and C, respectively, will withdraw the plugs of the connected cords and the circuits will return to normal.

15 When an operator at office B wishes to establish a connection with office A, a plug of a toll cord at office B is inserted in the jack of an outgoing position, for instance, jack J⁶, thereby closing the following circuit:
20 From battery, over the sleeve of said connected toll cord and sleeve of jack J⁶, conductor 23, right-hand inner back contact of relay 19, winding of relay 13 to ground. The closing of this circuit operates relay 13,
25 which disconnects relay 12 from the ring conductor of the line, and also closes circuits through its right-hand make contact from battery, conductor 18, outer right-hand back contact of relay 19, through the windings of busy signals 20, 20 and relay 28,
30 thereby operating said busy signals and said relay, in a manner previously described. The operation of relay 28 places battery and ground on the tip and ring conductors connected with office C and causes the operation of relay 32 which is bridged across said conductors. The operation of relay 32 in turn causes the energization of relay 35 which causes the busy signals 30, 30 to be
40 operated at that office, as an indication that the line is in use, as previously described. The ringing key associated with the cord circuit connected with jack J⁶ will be now operated and cause 16 cycle ringing current to be
45 sent out over the tip and ring conductors of toll line, thereby operating relay 4, which is bridged across said line at office A. This relay upon operating closes a locking circuit from battery, left-hand inner normal contact of relay 8, right-hand make contact and winding of relay 4 to ground. The operation of relay 4 closes a circuit from battery and contact of relay 8, as just described, through the closed contact of relay 4, conductor 70,
55 through contacts of key 71, filament of lamp 72 to ground. The closure of this circuit lights lamp 72 at the inward position at office A. In response to the lighting of lamp 72 the operator at the inward position will
60 insert plug P of the cord D in jack J, and cause relay 8 to operate over the circuit previously outlined. The operation of relay 8 causes the deenergization of relay 4, which in turn causes line lamp 72 to be extinguished.
65 When relay 4 operated, the busy signals 10,

10 at A and 11 at A¹ were operated by a circuit from battery, inner left-hand contact of relay 8, make contact of relay 4, right-hand normal contacts of relays 8 and 6, conductor 9, through the windings of said busy signals to ground, and when relay 8 is operated, the busy signals continue to be operated by a circuit from battery, right-hand make contact of relay 8, outer right-hand normal contact of relay 6, conductor 9, through the windings of said signals to ground. Relay 42 operates with the busy signals over the circuit just described, to conductor 9, from which said circuit continues through the winding of relay 42, back contact of relay 67, conductor 60, normal contacts of relays 63 and 62 to ground. The operation of relay 42 connects battery to jacks J² and J¹¹ for a busy test.

The operator at the inward position J at office A will complete the connection at that position in the ordinary manner, or transfer the call to another position where it may be completed. In the latter instance it will be assumed that the position to which the call is transferred terminates at jack J³. To transfer the call, the plug P is withdrawn from jack J, thereby releasing relay 8, and key 65 at the inward position J is operated and closes a circuit through its make contacts, from battery, conductor 66, through filament of lamp 73 to ground and through winding of relay 6 to ground, causing the illumination of lamp 73 and operation of relay 6. The operation of relay 6 closes a locking circuit from battery, inner left-hand normal contact of relay 8, left-hand make contact and winding of relay 6 to ground. The operation of relay 6 maintains the busy signals 10, 10 and 11 operated over a circuit through its outer right-hand contact, from battery, over conductor 9, through the windings of said signals to ground. When the call is answered at the position terminating in jack J³, relay 8 operates over a circuit from battery on the sleeve of the connected cord circuit, sleeve conductor of jack J³, winding of relay 8 to ground. The operation of relay 8 causes the release of relay 6, but the busy signals 10, 10 and 11 are kept operated over the circuit previously outlined. The operator at J³, after learning the number of the desired station, will complete the connection in the usual manner, and at the termination of the call will withdraw the associated cord circuit from the called line and jack J³, whereupon the circuit at office A will return to normal.

When the operator at office C desires to reach the operator at office A, a toll cord is inserted in an outgoing jack, for instance, jack J⁹, which closes a circuit over the sleeve conductor connected with said jack, inner right-hand contact of relay 36, winding of relay 35, to ground, thereby operating relay

35. The operation of relay 35 causes the operation of busy signals 30, 30 and relay 31, through the outer right-hand contact of relay 36. The operation of relay 31 causes the operation of relay 51 at office B, as previously described. The operation of relay 51 causes the operation of relay 27 and this latter relay closes a circuit through its right-hand make contact, from battery, conductor 53, winding of relay 13, to ground. The closing of this circuit causes the energization of relay 13, which provides for the operation of busy signals 20, 20 at office B and also opens the bridge which normally connects relay 12 across the trunk line. When the operator at office C rings on the circuit 16 cycle ringing current is transmitted from the connected cord circuit over the tip and ring contacts of jack J^9 and tip and ring conductors of the trunk line, which terminates at office A. The transmission of 16 cycle ringing current over the trunk line from the connected cord toll at jack J^9 causes the operation of relay 75 at office C and the operation of relay 4 at office A. Relay 44 at office C and relay 12 at office B will not operate at this time because the former does not respond to ringing current of this frequency, and the latter relay has been disconnected from across the line as just described. The operation of relay 75 closes a circuit through its make contact, from ground, through the winding of relay 45 to battery, thereby maintaining relay 45 operated, thus preventing the operation of relay 59 at this time. The operation of relay 4 at office A closes a locking circuit through its winding, from battery, connected with the left-hand inner contact of relay 8, which causes busy signals 10, 10 at position A and 11 at position A^1 , as well as relay 42 and lamp 72 at the inward position, to operate. In response to the lighting of lamp 72 the operator at the inward position at A will connect a toll cord similar to that indicated at D with jack J, causing the energization of relay 8 and the functioning of the circuit in a manner similar to that outlined in the connection between offices B and A. After the connection has been established between offices C and A, the operators at these offices may signal each other by means of 16 cycle ringing current in an obvious manner.

At night, when a decrease in traffic warrants a decrease in the force of operators at various exchanges, the following procedure is carried out:

When it is desired to establish a call from office A to office B, plug P of toll cord D is inserted in jack J^2 at office A, thereby closing the following circuit: From battery, sleeve contacts of plug P and jack J^2 , left-hand back contact of relay 42, conductor 61, inner back contact of relay 62, winding of relay 63 to ground. The closure of this

circuit causes the operation of relay 63, which connects battery to the sleeve of jack J^{11} at position A^1 , and busy test over the following circuit: From battery, left-hand front contact of relay 63, conductor 64, right-hand normal contact of relay 42, conductor 43, and sleeve of jack J^{11} . The operation of relay 63 also causes the energization of relay 8 over the following circuit: From battery, right-hand front contact of relay 63, inner back contact of relay 6, conductor 7, winding of relay 8 to ground. The operation of relay 8 will cause the circuit to function in the manner similar to that previously outlined in the connection between positions A and B when toll cord D was inserted in jack J^1 .

When the operator at position A^1 wishes to connect with position C, shown in Fig. 3, the plug of a toll cord such as plug P of toll cord D is inserted in jack J^{11} , thereby closing a circuit over the sleeve of the connected toll cord and jack, from battery, conductor 43, right-hand back contact of relay 42, conductor 64, right-hand back contact of relay 63, winding of relay 62, to ground. The closing of this circuit causes the operation of relay 62, which in turn closes a circuit through its right-hand make contact, from battery, conductor 61, left-hand back contact of relay 42, and sleeve of jack J^2 at position A, thereby placing a busy test on said jack. The operation of relay 62 also closes a circuit through its left-hand make contact, from battery, conductor 76, sleeve of jack J^{10} and winding of relay 37, to ground, thus placing a busy test on jack J^{10} and causing the operation of relay 37. The operation of relay 37 closes a bridge across the trunk consisting of relay 38 and retardation coil 39 which provides for the application of 135 cycle ringing current to the trunk line and the same sequence of operations as previously mentioned in the connection between positions A and C when the toll cord was inserted in jack J^{10} .

At night, at the exchange designated by position A, incoming calls from the distant exchanges shown by positions B and C respectively, are cared for in the following manner: The transmission of ringing current from either of said exchanges will cause the operation of relay 4 and close a circuit from battery, inner contact of relay 8, make contact of relay 4, conductor 70, through key 71, winding of relay 67, to ground. The closure of this circuit operates relay 67, which lights lamp 68. The operation of relay 67 prevents the operation of relay 42. The operator at the night position indicated by jack J^2 , in response to the lighting of lamp 68, will insert a toll cord in said jack and close a circuit from battery of the connected toll cord, sleeve contacts of said jack, left-hand contact of relay 42, conductor 61,

inner contact of relay 62, winding of relay 63, to ground, causing the operation of the latter relay. The operation of relay 63 connects battery as a busy test to the sleeve of the jack J¹¹ through the right-hand contact of relay 42, in a manner similar to that previously referred to. The operators at A and B and A and C may now signal each other by means of 16 cycle ringing current.

While the arrangements of this invention have been illustrated as embodied in a certain specific form which has been deemed desirable, it will be understood that they are capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A telephone system comprising a plurality of exchanges, a trunk line for interconnecting two terminal exchanges and an intermediate exchange, busy signals associated with the intermediate exchange, signaling means at each exchange, means at one terminal exchange for controlling the selective operation of the signaling means at the opposite terminal exchange and intermediate exchange, and means at the intermediate exchange for compensating for differences in earth potential between the last mentioned exchange and one of the terminal exchanges whereby busy signals at said intermediate exchange are operated when the signaling means at that terminal exchange is operated.

2. In a telephone system comprising a plurality of interconnected telephone exchanges, operators' positions associated with each exchange, signaling means and busy signals at each position, means responsive to the initiation of a connection at one exchange for operating the signaling means at a called exchange and busy signals at an associated exchange, and means at the called exchange for transferring the connection from one position to an associated position and maintaining said busy signals operated at that exchange and an associated uncalled exchange during the period of connection.

3. In a telephone system comprising a plurality of telephone exchanges, operators' positions associated with each exchange, signaling means and busy signals at each position, a trunk line for interconnecting said exchanges, means at one of said exchanges for impressing currents of different frequencies on said trunk line for selectively signaling associated exchanges, means at a second exchange responsive to current of one frequency for operating the signaling means thereat, means at a third exchange responsive to current of another frequency for operating the signaling means thereat to the exclusion of the signaling means at said second exchange, means at said second ex-

change and said third exchange for transferring a connection from one position to another position thereat, and means at said second exchange and said third exchange for providing for the operation of the busy signals at both exchanges during the period of connection of either exchange with said first exchange.

4. In a telephone system comprising a plurality of telephone exchanges, signaling means at each exchange, a trunk line for interconnecting said exchanges, means at one of said exchanges for impressing currents of different frequencies on said trunk line, a second exchange, means at said second exchange responsive to current of one frequency for operating said signaling means thereat, a third exchange, means at said third exchange responsive to current of a different frequency from that of said second exchange for operating the signaling means at said third exchange, and means at said second exchange and said third exchange for operating the signaling means at said first exchange to the exclusion of each other.

5. In a telephone system comprising a plurality of telephone exchanges, signaling means and busy signals at each exchange, a trunk line for interconnecting said exchanges, means at one exchange for impressing currents of different frequencies on said trunk line, means at a second exchange responsive to current of one frequency for operating the signaling means thereat, means at a third exchange responsive to current of another frequency for operating its associated signaling means, means at said second and third exchanges for operating the busy signals at both exchanges during the period of operation of the signaling means, and means at said second exchange responsive to the operation of said last mentioned means at said third exchange for compensating differences in earth potential between said second and third exchanges whereby the busy signals at said second exchange are operated.

6. A trunk line interconnecting a first exchange with a second exchange and through said second exchange with a third exchange, said first exchange comprising two sets of jacks and busy signals associated with each of said jacks, busy signals at said second and said third exchanges, a cord circuit including ringing equipment adapted to be associated with each set of jacks, means associated with one set of said jacks responsive to the connection of a cord circuit and the operation of its ringing equipment for applying ringing current of one frequency to said trunk, means associated with the other set of said jacks and responsive to the connection of a cord circuit and the operation of its ringing equipment for applying ring-

ing current of another frequency to said trunk, means responsive to the operation of either of said two last mentioned means for operating all of said busy signals, means at 5 said second exchange exclusively responsive to ringing current of said first mentioned frequency for operating signaling means at said second exchange, and means controlled by said last mentioned means for operating 10 busy signals at said third exchange.

7. In a telephone system, a trunk line interconnecting a first exchange with a second exchange and through said second exchange with a third exchange, signaling means and 15 busy signals at each exchange, means controlled by said first exchange for selectively operating the signaling means at said second and said third exchange and the busy signals at all exchanges, and means at said second 20 and said third exchanges for operating the signaling means at said first exchange and the busy signals at all exchanges.

8. A trunk line interconnecting a first exchange with a second exchange and through 25 said second exchange with a third exchange, said first exchange comprising two sets of jacks, busy signals at each of said exchanges, signaling means at each exchange, means associated with one set of jacks for apply- 30 ing current of one frequency to said trunk to selectively operate the signaling means at said second exchange, means associated with the other set of jacks for applying current of another frequency to said trunk to selec- 35 tively operate the signaling means at said third exchange, and means responsive to the operation of said two last mentioned means for operating the busy signals at each exchange.

40 9. A trunk line interconnecting a first exchange with a second exchange and through said second exchange with a third exchange, each of said exchanges having a plurality of operators' positions, signaling means and 45 busy signals at each exchange, said first exchange comprising two sets of jacks, means associated with one set of jacks for applying current of one frequency to said trunk, means associated with the other of 50 said jacks for applying current of another frequency to said trunk, means responsive to the operation of said two last mentioned means for operating all of said busy signals, a relay bridged across said trunk line at 55 said third exchange exclusively responsive to current of said second mentioned frequency for operating said signaling means at an operator's position at said third exchange, means at the signalled position for 60 operating the signaling means at an associated position, means for maintaining said busy signals at said second exchange oper-

ated during the period of operation of said signaling means at said associated position, and means at said second and said third 65 exchange for operating the signaling means at the first exchange.

10. A trunk line interconnecting a first exchange with a second exchange and through said second exchange with a third 70 exchange, each of said exchanges having a plurality of operators' positions, signaling means and busy signals at each position, said first exchange comprising two sets of jacks, means associated with one set of said 75 jacks for applying current of one frequency to said trunk, means associated with the other set of said jacks for applying current of another frequency to said trunk, means responsive to the operation of said two last 80 mentioned means for operating all of said busy signals, means at said second exchange exclusively responsive to current of said first mentioned frequency for operating sig- 85 naling means at an operator's position at said second exchange, means controlled by said relay for operating busy signals at said third exchange, means for transferring said signaling means from said signalled 90 operator's position to an associated position, and means for maintaining said busy signals at said third exchange operated during the period of connection with said asso- 95 ciated position.

11. In a telephone system, a trunk line 95 interconnecting a first exchange with a second exchange and through said second exchange with a third exchange, said first exchange comprising two sets of jacks, busy 100 signals at each of said jacks, means associated with one set of jacks for applying ringing current of one frequency to said trunk, means associated with the other set of said jacks for applying ringing current 105 of another frequency to said trunk, means responsive to the operation of either of said two last mentioned means for operating all of said busy signals, a relay bridged across said trunk line at said third exchange ex- 110 clusively responsive to current of said second mentioned frequency for operating said signaling means at said third exchange, and means at said second exchange responsive to the operation of said relay for compensat- 115 ing for differences in earth potential between said second and third exchanges whereby busy signals at said second exchange are operated.

In testimony whereof, we have signed our names to this specification this 21st day of 120 December 1921.

JOHN F. TOOMEY.
OWEN H. LOYNES.