C. S. DEMAREST AND J. DAVIDSON, JR.

SIGNALING SYSTEM.

APPLICATION FILED MAY 12, 1919.

1,400,732.

Patented Dec. 20, 1921.

3 SHEETS—SHEET 1.

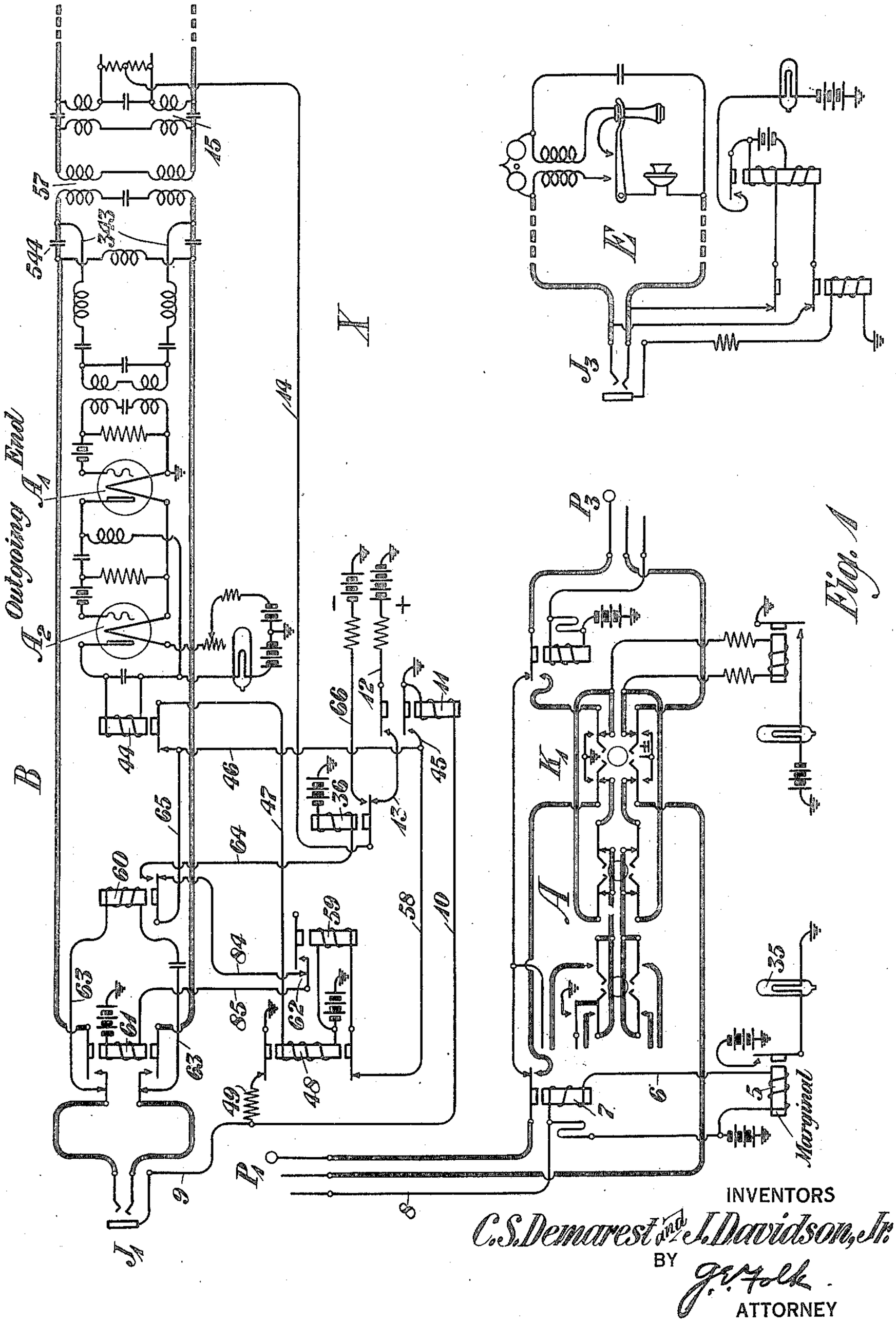

Fig. 1

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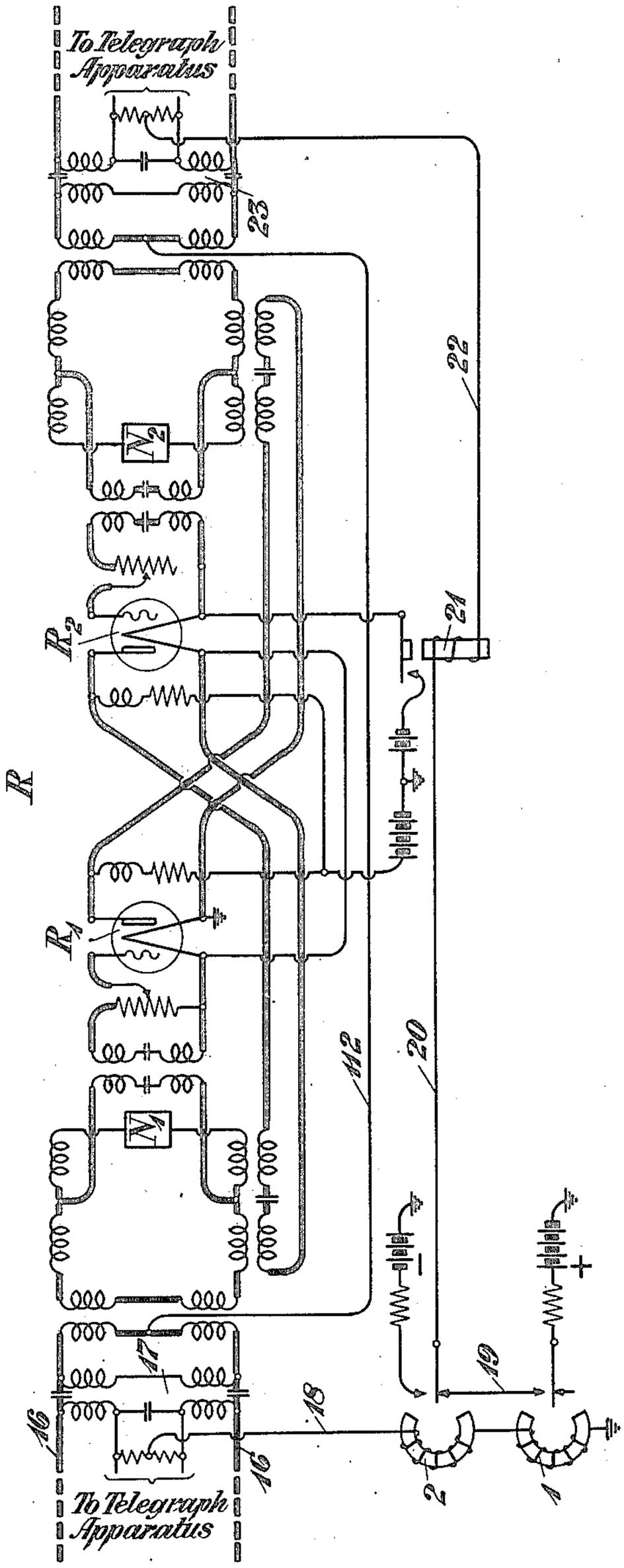

Fig. 2.

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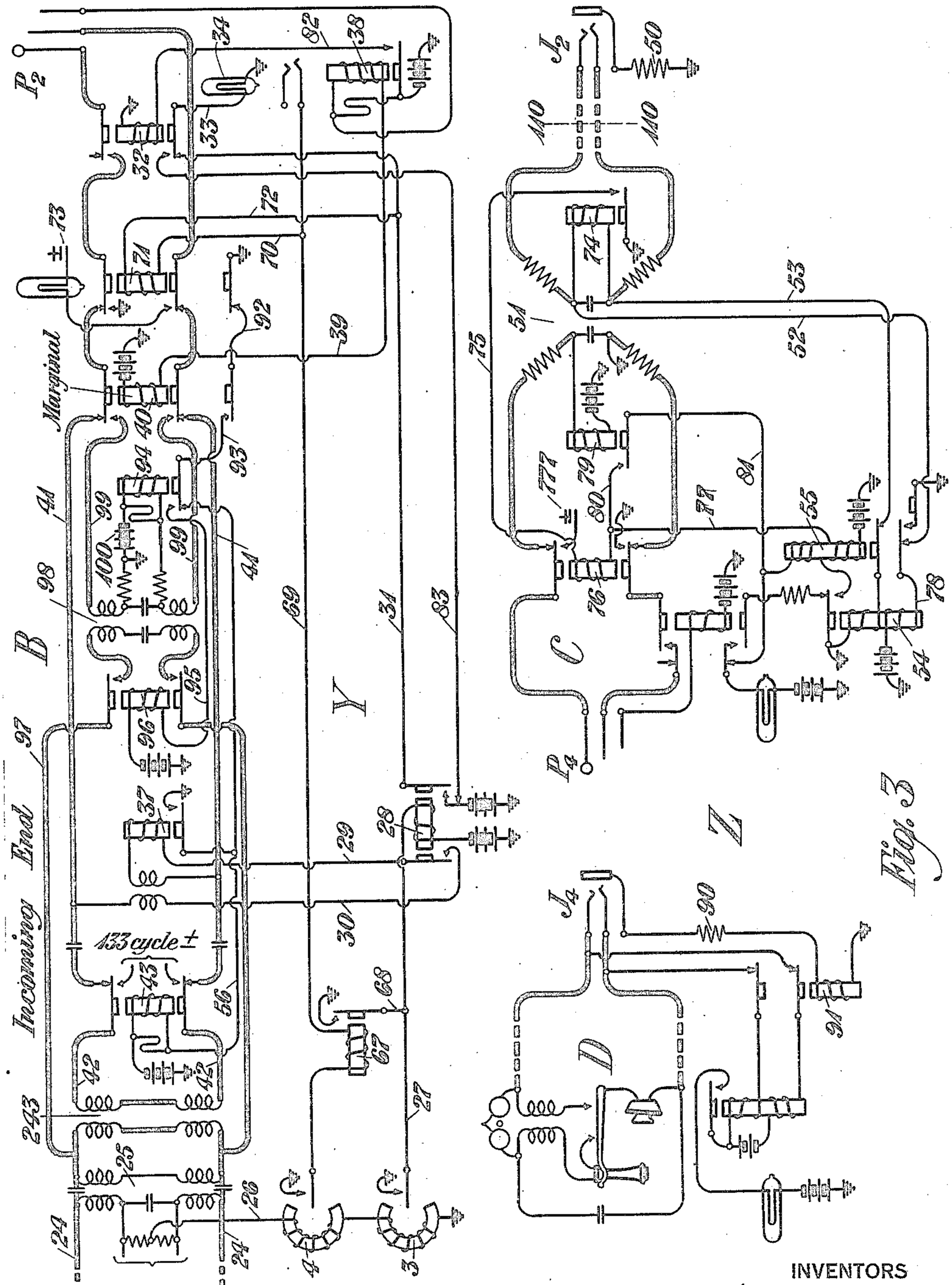

Fig. 3

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UNITED STATES PATENT OFFICE.

CHARLES S. DEMAREST, OF BROOKLYN, NEW YORK, AND JOHN DAVIDSON, JR., OF MONTCLAIR, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SIGNALING SYSTEM.

1,400,732. Specification of Letters Patent. Patented Dec. 20, 1921.

Application filed May 12, 1919. Serial No. 296,498.

To all whom it may concern:

Be it known that we, CHARLES S. DEMAREST and JOHN DAVIDSON, Jr., residing at Brooklyn and Montclair, in the counties of Kings and Essex and States of New York and New Jersey, respectively, have invented certain Improvements in Signaling Systems, of which the following is a specification.

This invention relates to telephone exchange systems and more particularly to such systems in which trunk circuits are employed for completing connections between telephone lines terminating at different central offices or switchboards.

In general the object of this invention is to effect improvement in the practice of signaling in systems of this character.

A prominent feature of the invention consists in the provision of signaling arrangements suitable for a long distance trunk line which is composited for use as a telegraph circuit as well as a telephone circuit, such signaling means being adapted to operate without interference with the telegraph apparatus particularly when a low current metallic telegraph circuit is employed.

Other objects and features of the invention will be clear from the detailed description which follows:

In the arrangements of the invention the outgoing signals over the trunk line are transmitted over a simplex circuit by means of direct current impulses of two polarities, the receiving means for these signals being controlled at the incoming end of the trunk by two polarized relays. Upon the connection of a link circuit with the outgoing end of the trunk, current of a positive polarity is applied over the simplex circuit and operates a polarized relay and signaling means at the incoming end. Upon a connection being established between the incoming end of the trunk and a called for line, alternating signaling current is transmitted back over the trunk to amplifying and rectifying means at the outgoing end and operates relay and signaling means thereat. Upon the operation of ringing means in the link circuit at the outgoing end, current of a negative polarity is transmitted over the simplex circuit and operates a polarized relay and signaling means at the incoming end and furthermore operates relay means to apply ringing current to the line of the called for subscriber. Arrangements are furthermore provided for indicating the response and disconnection of the called for subscriber to the operator at the outgoing end, thereby giving to such an operator complete supervision over the call. By use of the above mentioned amplying means at the outgoing end of the trunk the alternating signaling currents used for incoming signaling purposes may be small enough to cause no appreciable interference with the metallic telegraph system. The use of these weak signaling currents also permits the arrangement to be employed on toll lines equipped with telephone repeaters without the use of relays for transmitting such signaling currents around the repeaters. Furthermore the simplex circuit employed for the outgoing direct current signals is so associated with the metallic telegraph circuit as to cause no interference therewith.

The invention may be more fully understood from the following description taken in connection with the accompanying drawing, wherein Figures 1, 2 and 3 of which, when placed end to end in numerical order, illustrate a preferred arrangement of the invention.

In the drawing a trunk circuit B is shown extending from a central office X to a central office Y. A cord circuit A located at the first central office may form part of the connection between a calling line E and the outgoing end of trunk circuit B. The incoming end of the trunk circuit B may connect with the outgoing end of a toll switching trunk C extending from the central office Y to a switchboard located at another central office, such as Z. The toll switching trunk C may connect with the line of a called for subscriber, such as at substation D. The incoming end of trunk B is also adapted to connect directly with a local telephone line at the central office Y. All apparatus shown in Fig. 1 is located at a first central office, such as X; the arrangements in the upper portion of Fig. 3 are located at a second central office, such as Y; the arrangements in the lower portion of Fig. 3 and to the left of the dotted line 110—110 are located at a third central office such as Z. The trunk circuit B may include a repeater station, such as shown at R in Fig. 2. The repeater station R is of a well known type and in-

cludes the vacuum bulb amplifiers R_1 and R_2, although other repeaters such as of the mechanical type might be employed. An auxiliary path 112 is provided about the repeater set and is employed when the trunk B forms a portion of a phantom circuit. The two sides of trunk B are simplexed for the transmission of telegraph messages between the central offices X and Y. The telegraph apparatus is the low current metallic circuit type and is associated with the trunk B at the composite sets 15, 17, 23, and 25, which serve to prevent the telegraph currents from interfering with the telephone apparatus and the telephone currents from interfering with the telegraph apparatus. This system of telegraphic communication may be employed by the operators for transmitting the proper instructions regarding the setting up of the connection between subscribers.

Other features and purposes of the invention will be clear from the following description of the operation, which is as follows; if the operator at the station X finds, upon connecting her cord circuit A with a subscriber's line, such as at substation E, that the subscriber desires a call which must be completed through a distant station, such as the station Y, she will communicate over a call wire circuit (not shown) or over the telegraph circuit with the operator at the distant station and the latter operator will designate a suitable trunk line for the connection, such as the trunk B. The operator at X will then insert the plug P_1 of cord circuit A in the jack J_1 of trunk B. This will close the following circuit; from ground and battery, winding of relay 5, conductor 6, winding of relay 7, conductor 8, sleeve contacts of plug P_1 and jack J_1, over conductor 9 and thence through resistance 49, contact and armature of relay 48 to ground; also from conductor 9, over conductor 10, winding of relay 11 to ground. The closing of this circuit will operate relay 11 which will pull up its armature and close the following circuit; from ground, armature and contact of relay 11, conductors 45 and 46, contact and armature of relay 44, conductor 47, winding of relay 48 to battery and ground. The closing of this circuit will operate the relay 48 which will pull up its upper armature and disconnect ground from the resistance 49, thereby preventing the resistance 49 from being connected in parallel with the high resistance winding of relay 11. The resistance of the winding of relay 11 is sufficiently high to prevent the operation of the relay 5 upon the completion of the formerly traced circuit. However, the closing of this circuit will operate relay 7 which will remove the busy test conductor from the tip strand of the cord A and will complete the talking circuit of the cord. Upon the operation of relay 11 positive battery will be applied over the following circuit; from ground and battery, conductor 12, armature and contact of relay 11, conductor 13, contact and armature of relay 36, conductor 14, composite apparatus 15, over the sides 16 of trunk B, composite apparatus 17, conductor 18, windings of polarized relays 2 and 1 to ground. The polarized relay 1 is adapted to respond to current of a positive polarity and accordingly will be operated upon the closing of this circuit. The operation of polarized relay 1 will apply positive battery to the following circuit; from ground and battery, armature and contact of relay 1, conductor 19, contact and armature of relay 2, conductor 20, winding of relay 21, conductor 22, composite apparatus 23, over sides 24 of trunk B, composite apparatus 25, conductor 26, windings of polarized relays 4 and 3, to ground. The closing of this circuit will operate relay 21 which will close the filament circuits of amplifiers R_1 and R_2 and condition the repeater apparatus for operation. As the polarized relay 3 is adapted to respond to current of a positive polarity, the closing of this circuit will operate relay 3, the operation of which will complete the following circuit; from ground, contact and armature of relay 3, conductor 27, winding of relay 28, to battery and ground. This will operate relay 28 which will complete a bridge across the talking conductors of trunk B which includes conductors 29 and 30 and winding of relay 37 for purposes which will be pointed out later. The operation of relay 28 also closes the following circuit; from ground and battery, make contact and armature of relay 28, conductor 31, normal contact and armature of relay 32, conductor 33, filament of signal lamp 34, to ground. This will operate signal lamp 34 which will inform the operator at station Y that the operator at station X has connected with the designated trunk B.

If the line of the called for subscriber, such as substation D, terminates at a station other than station Y, such as station Z, the operator at Y will communicate with the operator at Z who will designate a suitable toll switching trunk for the connection, such as the toll switching trunk C. The operator at Z will then connect trunk C with the line of substation D. When the signal lamp 34 has operated to inform the operator at Y that the operator at X has connected with the trunk B, the operator at Y will now connect plug P_2 of trunk B with jack J_2 of the designated toll switching trunk C. This will close the following circuit; from ground, resistance 50, sleeve conductor of jack J_2, sleeve contacts of jack J_2 and plug P_2, sleeve conductor of plug P_2, winding of marginal relay 38, conductor 39, winding of

marginal relay 40, to battery and ground. The resistance 50 included in this circuit is sufficiently high to prevent the operation of marginal relay 40. Relay 38, however, will operate and close the following circuit; from ground and battery, armature and contact of relay 38, conductor 82, winding of relay 32, to ground. This will operate relay 32 which will close a normally open contact in the tip conductor of trunk 13 and will open the circuit for signal lamp 34 and extinguish the lamp. The insertion of plug P_2 in jack J_2 will apply battery from the toll switching trunk C over the talking strands of trunk B and operate relay 37 bridged across said strands over the following circuit; from ground and battery, lower winding of relay 54, conductor 52, upper right hand winding of transformer 51, tip conductor of trunk C, tip contacts of jack J_2 and plug P_2, tip conductor of trunk B, conductor 30, contact and armature of relay 28, conductor 29, winding of relay 37, ring conductor of trunk B, ring contacts of plug P_2 and jack J_2, ring conductor of trunk C, lower right hand winding of transformer 51, conductor 53, contact and armature of relay 55, upper winding of relay 54, to ground. The closing of this circuit will operate relays 54 and 37. The operation of relay 37 closes the following circuit; from ground, contact and armature of relay 37, conductor 56, winding of relay 43 to battery and ground. This will operate relay 43 which will pull up its armatures and connect a source of ringing current of a suitable frequency, such as 133 cycles, to the conductors 42. This ringing current will then be transmitted over the following circuit; from conductors 42, transformer 243, composite apparatus 25, over conductors 24, composite apparatus 23, through the repeater apparatus R (or relayed around the repeater apparatus R if desired), composite apparatus 17, over conductors 16, composite apparatus 15, transformer 57, thence over conductors 343 (as the ringing current is prevented from being transmitted further over the talking strands of trunk B due to the filter apparatus 544 which attenuates and practically extinguishes currents of ringing frequencies), through the amplifier A_1 and the rectifier A_2, and about the winding of relay 44. The alternating ringing current transmitted over this circuit is prevented from interfering with the telegraph apparatus associated with the line by the composite apparatus 15, 17, 23, and 25, and furthermore is sufficiently weak in strength so that any of such current which reaches the telegraph apparatus will cause no interference therewith. The weak ringing current is sufficiently amplified and then translated into direct current by the vacuum bulbs A_1 and A_2 to operate the relay 44. The operation of relay 44 will pull up its armature and open the formerly traced circuit about the relay 48 thereby deënergizing the relay 48. Upon the deënergization of relay 48 the following circuit will be closed; from ground, armature and contact of relay 11, conductors 45 and 58, contact and armature of relay 48, winding of relay 59 to battery and ground. The closing of this circuit will operate the relay 59 which will pull up its armature and hold open at contact point 62 a circuit about the relay 61 thereby preventing the relay 61 from operating. The deënergization of relay 48 will also allow the resistance 49 to be connected in parallel with the high resistance winding of relay 11 to the formerly traced circuit about the relay 5. The addition in parallel of the resistance 49 with the resistance of winding of relay 11 will sufficiently reduce the total resistance of this circuit to cause the operation of the marginal relay 5. The operation of relay 5 will close a circuit from ground and battery, contact and armature of relay 5, filament of signal lamp 35 to ground, thereby operating the signal lamp 35. The flashing of signal lamp 35 will inform the operator at station X that the call has been built up completely to the substation D.

The operator at X will now ring the subscriber at substation D in the following manner: the operator will throw the ringing key K_1 of the cord circuit A and will transmit ringing current over the talking strands of the cord A and the trunk B, over normal contacts of relay 61, over conductors 63 and through the winding of relay 60. As the relay 60 is tuned to respond to ringing current it will be operated and will pull up its armature and close the following circuit; from ground and battery, winding of relay 36, conductor 64, make contact and armature of relay 60, conductors 65, 46 and 45, contact and armature of relay 11 to ground. The closing of this circuit will energize relay 36 which will pull up its armature and apply negative battery over the following simplex circuit; from ground and battery, conductors 66, contact and armature of relay 36, conductor 14, composite apparatus 15, over conductors 16 of trunk B, composite apparatus 17, conductor 18, winding of polarized relays 2 and 1 to ground. As the polarizer relay 2 is adapted to respond to current of a negative polarity, the closing of this circuit will operate the relay 2, which will pull up its armature and apply negative battery over the following simplex circuit; from ground and battery, make contact and armature of relay 2, conductor 20, winding of relay 21, conductor 22, composite apparatus 23, over the conductors 24 of trunk B, composite apparatus 25, conductor 26, windings of polarized re-

lays 4 and 3 to ground. As the polarized relay 4 is adapted to respond to current of a negative polarity, the closing of this circuit will operate relay 4, thereby closing the following circuit; from ground, contact and armature of relay 4, winding of relay 67, conductors 69 and 70, winding of relay 71, conductors 72 and 31, armature and contact of relay 28 to battery and ground. The closing of this circuit will operate the relays 67 and 71. The operation of relay 67 will close a locking circuit over conductor 68 for the relay 28 and serve to maintain the relay 28, which was energized upon the aforementioned operation of relay 3, in an energized condition. The operation of relay 71 will connect to the talking conductors associated with plug P_2 of the trunk B a source 73 of ringing current. Ringing current will now be applied from source 73 over the following circuit; from the source 73, talking conductors of trunk B, contacts of plug P_2 and jack J_2, talking conductors of trunk C, right hand windings of transformer 51 and through the winding of relay 74. As the relay 74 is tuned to respond to ringing current of this frequency, it will operate and close the following circuit; from ground, armature and contact of relay 74, conductor 75, winding of relay 76, conductor 77, winding of relay 55 to battery and ground. The closing of this circuit will operate the relay 76. The operation of relay 76 will apply ringing current from a source 777 to the talking conductors of trunk C. Ringing current will then be applied over the contacts of plug P_4 and jack J_4 to the signaling apparatus at the substation D.

When the subscriber at substation D removes the receiver from the hook the relay 79 will be operated over the following circuit; from ground, lower left hand winding of transformer 51, ring conductor of trunk C, ring contacts of plug P_4 and jack J_4, over the ring conductor of the subscriber's line, through the telephone apparatus at substation D, over the tip conductor of the subscriber's line, tip contacts of jack J_4 and plug P_4, tip conductor of trunk C, upper left hand winding of transformer 51, winding of relay 79 to battery and ground. The operation of relay 79 will close the following circuit; from ground and battery, lower winding of relay 55, conductors 77 and 80, contact and armature of relay 79, conductor 81, upper winding of relay 55, contact and armature of relay 54 to ground. The closing of this circuit will operate the relay 55, which will pull up its armatures and disconnect battery from the talking conductors of trunk C and trunk B, thereby causing the deënergization of relay 37 which was bridged across the talking conductors of trunk B as formerly pointed out. The deënergization of relay 37 will in turn cause the deënergization of relay 43 which will disconnect the source of 133 cycle ringing current from the conductors 42. This in turn will cause the deënergization of relay 44 which will cause its armature to retract and allow the formerly traced circuit about relay 48 to be completed again. This will operate relay 48 and will disconnect ground from the resistance 49. Accordingly this will increase the total resistance of the formerly traced circuit about the relay 5 sufficiently to cause relay 5 to be deënergized, whereupon the signal lamp 35 will be extinguished. The extinguishment of signal lamp 35 will inform the operator at station X that the subscriber at station D has removed the receiver from the hook. In response to the ringing signal upon the aforementioned deënergization of relay 44 and the subsequent energization of relay 48, the following circuit will be completed; from ground, armature and contact of relay 11, conductors 45, 46 and 65, armature and contact of relay 60, conductor 84, contact point 62, conductor 85, winding of relay 61 to battery and ground. The closing of this circuit will energize relay 61 and will complete the normally opened connection between the talking conductors at the outgoing end of trunk B. Accordingly, conversation may now be carried on between the substation E and the substation D.

When the call has been terminated and the subscriber at substation D restores the receiver to the hook, relay 79 will be deënergized. This in turn will open the formerly traced circuit through the winding of relay 55 and will cause the deënergization of relay 55. The deënergization of relay 55 will connect battery to the talking conductors of the trunk C and the trunk B and will thereby cause the relay 37 to be energized again. The energization of relay 37 will in the same manner as previously pointed out operate relay 43 and cause 133 cycle ringing current to be transmitted back over the trunk B to operate the relay 44. The relay 44 will open the circuit of relay 48 which in the same manner as previously pointed out will allow the resistance 49 to be connected to the circuit for relay 5 and will cause the energization of relay 5 and the flashing of signal lamp 35. Upon the flashing of signal lamp 35 the operator at X will be informed that the call has terminated. The operator at X will then remove the plug P_1 from the jack J_1, which will cause the deënergization of relay 11. This in turn will cause the deenergization of the polarized relays 1 and 3 and the relay 28 and will cause the operation of signal lamp 34. The operation of signal lamp 34 will inform the operator at Y that the call has terminated and that the operator at X has disconnected her cord circuit from

the trunk B. As the disconnect signals associated with the toll switching trunk C are of the usual well known type, no further description of the process of disconnecting the trunk C from substation D will be given.

If the line of the subscriber at substation D should terminate at the station Y instead of at another station, such as Z, the connection would be completed without the use of the toll switching trunk C. Accordingly upon the operation of signal lamp 34, signifying that the operator at X had connected with the designated trunk B, the operator at Y would insert the plug P_2 into the jack J_4 of the called subscriber's line. This would close the following circuit; from ground, winding of relay 91, resistance 90, sleeve conductor of jack J_4, sleeve contacts of jack J_4 and plug P_2, sleeve conductor of plug P_2, winding of relay 38, conductor 39, winding of marginal relay 40 to battery and ground. The resistance element 90 is small in value as compared with the aforementioned resistance element 50 associated with the sleeve of jack J_2. Accordingly, the closing of this circuit will operate the relay 38 and the marginal relay 40. The operation of relay 38, will, as formerly pointed out, operate relay 32 which will extinguish signal lamp 34 and will close a normally opened contact in the talking conductors of trunk B. The operation of the marginal relay 40 will disconnect the talking conductors of trunk B from conductors 41 and connect them to conductors 99. The operation of relay 40 will also close the following circuit: from ground, lower armature and contact of relay 71, conductor 92, lower armature and contact of relay 40, conductor 93, armature and normal contact of relay 94, conductor 56, winding of relay 43 to battery and ground. This will operate the relay 43 which will connect a source of 133 cycle current to the conductors 42 in the same manner as previously pointed out. 133 cycle current will now be transmitted back over the trunk B and will cause the operation of relay 44 which in turn will cause the deënergization of relay 48 and the operation of the marginal relay 5, as formerly pointed out. This will cause the signal lamp 35 to flash informing the operator at X that the connection has been completely built up to the substation D.

The operator at X will now ring the subscriber at substation D by throwing the ringing key K_1 in the same manner as previously pointed out. The throwing of the ringing key K_1 will apply negative battery over the simplex circuits associated with trunk B and will operate the polarized relays 2 and 4 which in turn will cause the operation of relay 71. The relay 71 will connect to the talking conductors associated with plug P_2 a source 73 of ringing current. Ringing current will now be applied from the source 73 to the substation D and will operate the signal apparatus thereat. It is pointed out that the operation of relay 71 will hold open at its lower armature and contact the formerly traced circuit about the relay 43, so that while the operator is ringing the subscriber at substation D 133 cycle ringing current will not be transmitted back over the trunk B.

When the subscriber at substation D, in response to the ringing signal, removes the receiver from the hook the following circuit will be closed; from battery 100, winding of relay 94, lower right hand winding of transformer 98, conductor 99, make contact and armature of relay 40, ring conductor of trunk B, ring contacts of plug P_2 and jack J_4, ring conductor of the subscriber's line to the telephone apparatus at substation D, tip conductor of subscriber's line, tip contacts of jack J_4 and plug P_2, tip conductor of the trunk B, armature and make contact of relay 40, conductor 99. upper right hand winding of transformer 98 to battery. The battery 100 serves to furnish the talking current when the connection is made in this manner with the substation D. The closing of this circuit by the removal of the receiver from the hook at substation D will operate relay 94. The operation of relay 94 will open at its normal contact the formerly traced circuit about the relay 43 thereby deenergizing relay 43 and disconnecting the source of 133 cycle ringing current from conductors 42. Accordingly, ringing current will cease to be transmitted back over trunk B and the relay 44 will be deënergized. In the same manner as previously pointed out the deënergization of relay 44 will cause the deënergization of marginal relay 5 and will cause the signal lamp 35 to go out, thereby informing the operator at X that the subscriber at substation D has removed the receiver from the hook. The aforementioned operation of relay 94 will also close the following circuit; from ground, lower armature and contact of relay 71, conductor 92, lower armature and contact of relay 40, conductor 93, make contact of relay 94, conductor 95, winding of relay 96 to battery and ground. This will connect conductors 97 to the left hand winding of transformer 98 and will complete a talking circuit over trunk B for the connection.

When the subscriber at substation D, upon the completion of the call, restores the receiver to the switchhook the formerly traced circuit about relay 94 will be opened and the relay 94 will be deënergized. The deënergization of relay 94 will allow a circuit to be completed for the relay 43. This in turn will apply 133 cycle ringing current to the conductors 42 and ringing current will be transmitted back over the trunk B and will operate relay 44. In the same manner as

previously pointed out the operation of relay 44 will cause the deënergization of relay 48 and the energization of the marginal relay 5. This in turn will cause the signal lamp 35 to flash and it will inform the operator at X that the call has terminated. The operator at X will now remove the plug P_1 from the jack J_1. This in turn will cause the deënergization of relay 28 and will allow the following circuit to be completed, for the signal lamp 34; from ground, filament of signal lamp 34, conductor 33, armature and make contact of relay 32, conductor 83, normal contact of relay 28 to battery and ground. This will cause the signal lamp 34 to flash and will inform the operator at Y that the operator at X has disconnected her cord circuit from the trunk B and that the call has been completed.

While the invention has been disclosed in certain specific arrangements which have been deemed desirable it is understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended calims.

What we claim is:

1. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a link circuit at the first switchboard, a simplex circuit associated with said trunk, a polarized relay included in said simplex circuit and located at said second switchboard, signaling means controlled by said relay, and means in said trunk at said first switchboard responsive upon the connection of said link circuit to said trunk for applying to said simplex circuit direct current of a polarity suitable for operating said relay.

2. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a link circuit at the first switchboard, a simplex circuit associated with said trunk, two polarized relays included in said simplex circuit and located at said second switchboard and responsive to currents of opposite polarities, signaling arrangements controlled by said relays, a source of current of positive polarity, a source of current of negative polarity, means in said trunk at said first switchboard responsive upon the connection of said link circuit to said trunk for connecting said source of current of positive polarity to said simplex circuit, and means in said trunk at said first switchboard and controlled by switching means in said link circuit for connecting said source of current of negative polarity to said simplex circuit.

3. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, an extension circuit at the second switchboard, a simplex circuit associated with said trunk, two relays in said simplex circuit located at said second switchboard and adapted to respond to currents of different polarities, means at said first switchboard for operating either of said relays, a signaling device, means controlled by one of said relays for operating said signaling device, and means controlled by the other of said relays for applying signaling current to said extension circuit.

4. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, an extension circuit at said second switchboard, a source of alternating current, means in said trunk at said second switchboard responsive to the connection of said trunk with said extension circuit for applying current from said source over said trunk to said first switchboard, means at said first switchboard for amplifying said current, means at said first switchboard for rectifying said current, signaling means at said first switchboard and means responsive to said current when rectified for operating said signaling means at said first switchboard.

5. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a signaling device at the first switchboard, a relay in the trunk circuit at the second switchboard, an extension circuit at the second switchboard connected with the trunk circuit, means in the extension circuit for operating the relay of the trunk circuit, a source of alternating current, means responsive to the operation of the trunk relay for connecting the source of alternating current with the trunk circuit, and electromagnetic means energized in response to the connection of the source of alternating current with the trunk circuit for operating the signaling device.

6. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signaling device for the link circuit, a relay in the link circuit controlling the signaling device, a relay at the second switchboard in the trunk circuit, an extension circuit at the second switchboard connected with the trunk circuit, means in the extension circuit for operating the relay of the trunk circuit, a source of alternating current, means responsive to the operation of the trunk relay for connecting the source of alternating current with the trunk circuit, and a ringing responsive relay energized upon the connection of the source of alternating current with the trunk circuit for operating said first mentioned relay and said signaling device.

7. A telephone exchange system comprising a trunk circuit extending from a first

to a second switchboard, a subscriber's line at said second switchboard, means in said trunk at said second switchboard responsive to the connection of said trunk with said subscriber's line for applying signaling current over said trunk to said first switchboard, signaling means at said first switchboard, means at said first switchboard for rectifying said signaling current, and means at said first switchboard responsive to said signaling current when rectified for operating said signaling means at said first switchboard.

8. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a link circuit including a signaling device and connected to said trunk at the first switchboard, a subscriber's line at the second switchboard, a source of alternating current, means in said trunk at said second switchboard responsive to the connection of said trunk with said subscriber's line for applying current from said source over said trunk to said first switchboard, means at said first switchboard for amplifying said current, means at said first switchboard for rectifying said current, and means responsive to said current when rectified for operating the signaling device in said link circuit.

9. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, a signaling device associated with said trunk at said first switchboard, a subscriber's line at the second switchboard, an extension circuit at the second switchboard, a source of alternating current, means in said trunk at said second switchboard responsive to the connection of said trunk with said subscriber's line for applying current from said source over said trunk to said first switchboard, means at said first switchboard for amplifying said current, means at said first switchboard for rectifying said current, and means responsive to said current when rectified for operating said signaling device.

10. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, signaling arrangements at said second switchboard, a repeater station included in said trunk, a low current metallic telegraph circuit associated with said trunk between said first switchboard and said repeater station, a simplex circuit associated with said trunk between said first switchboard and said repeater station, two polarized relays included in said simplex circuit and responding to currents of opposite polarity, means at said first switchboard to apply current of either polarity to said simplex circuit to operate either of said relays, a low current metallic telegraph circuit associated with said trunk between said repeater station and said second switchboard, a second simplex circuit associated with said trunk between said repeater station and said second switchboard, two polarized relays included in said second simplex circuit at said second switchboard and responding to currents of opposite polarity, means controlled by said two first mentioned polarized relays for applying current of either polarity to said second simplex circuit to operate either of said two second mentioned polarized relays, and means controlled by said two second mentioned polarized relays for controlling said signaling arrangements.

In testimony whereof, we have signed our names to this specification this 7th day of May, 1919.

CHARLES S. DEMAREST.
JOHN DAVIDSON, Jr.