Nov. 5, 1935. W. E. DARROW ET AL 2,019,561

TELEPHONE SYSTEM

Filed Nov. 2, 1933 4 Sheets-Sheet 1

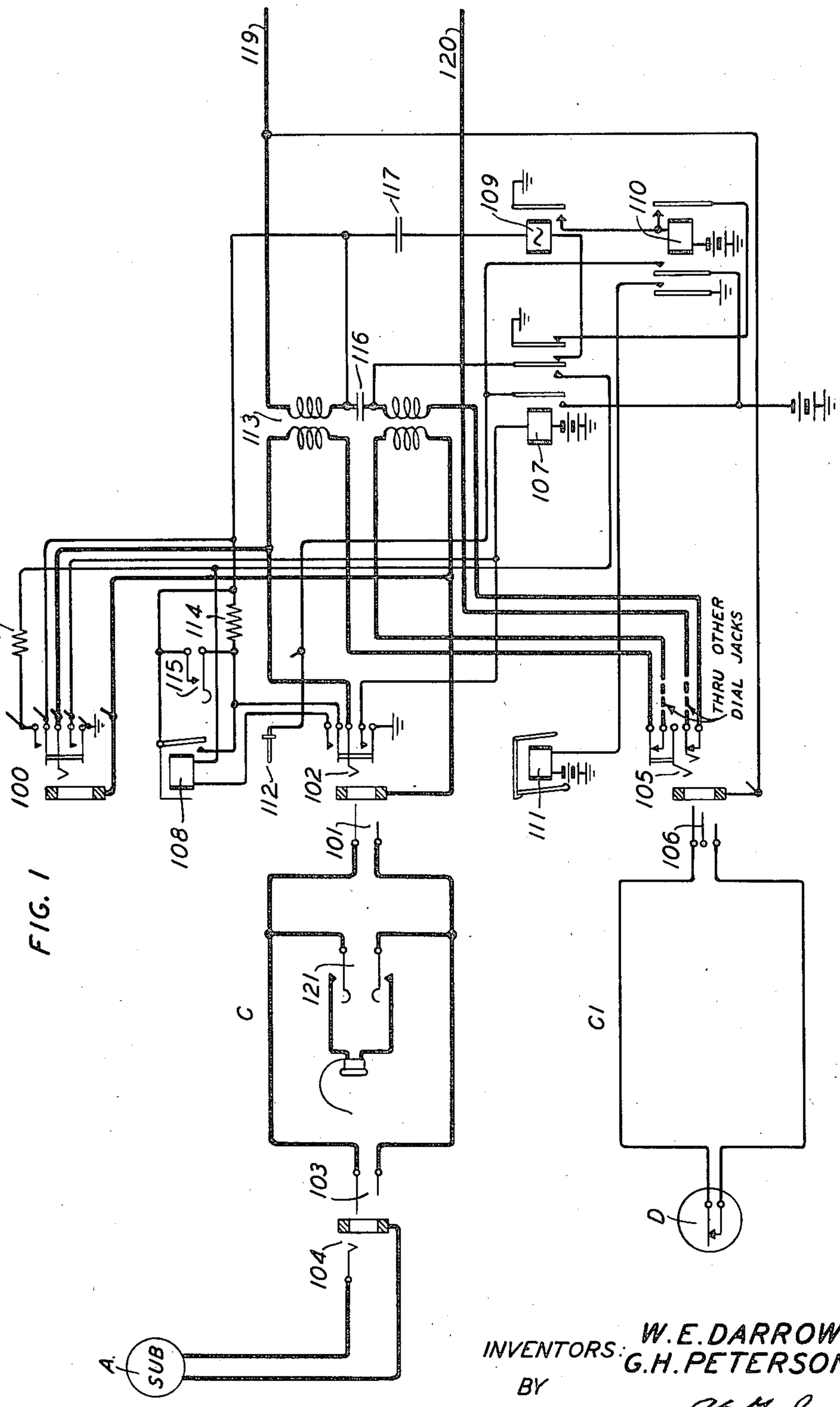

FIG. 1

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TELEPHONE SYSTEM

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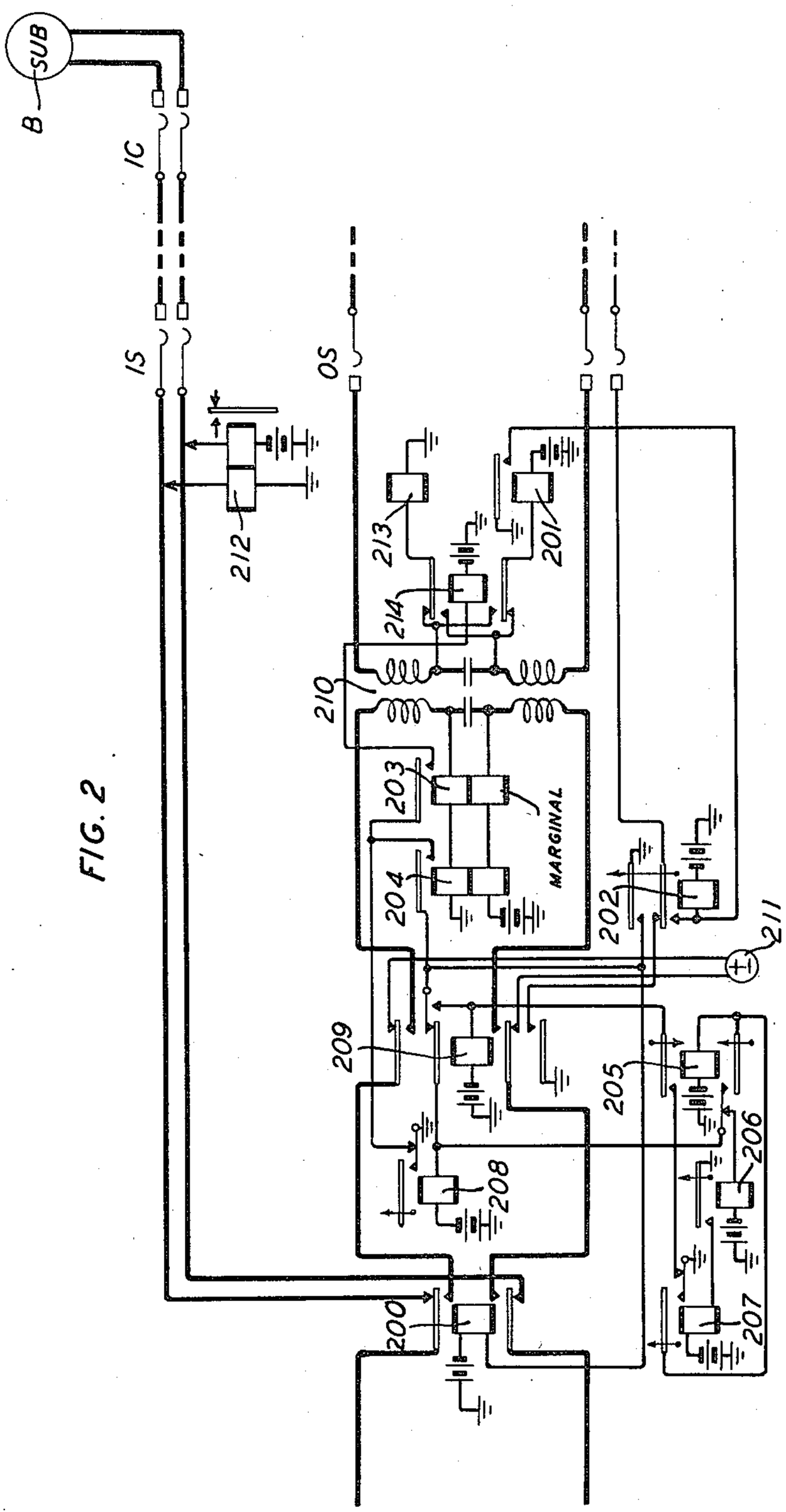

FIG. 2

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TELEPHONE SYSTEM

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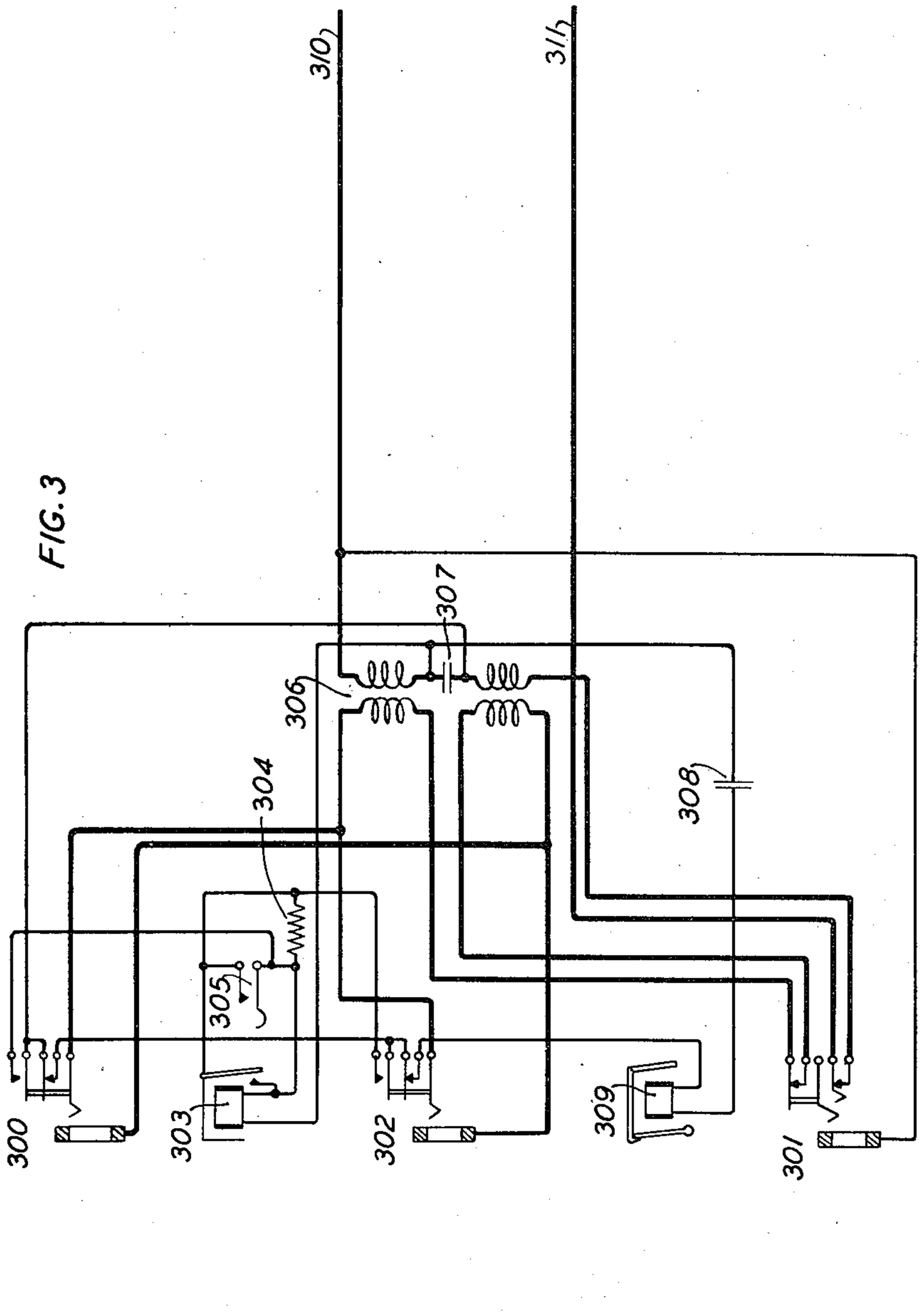

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TELEPHONE SYSTEM

Filed Nov. 2, 1933 4 Sheets-Sheet 4

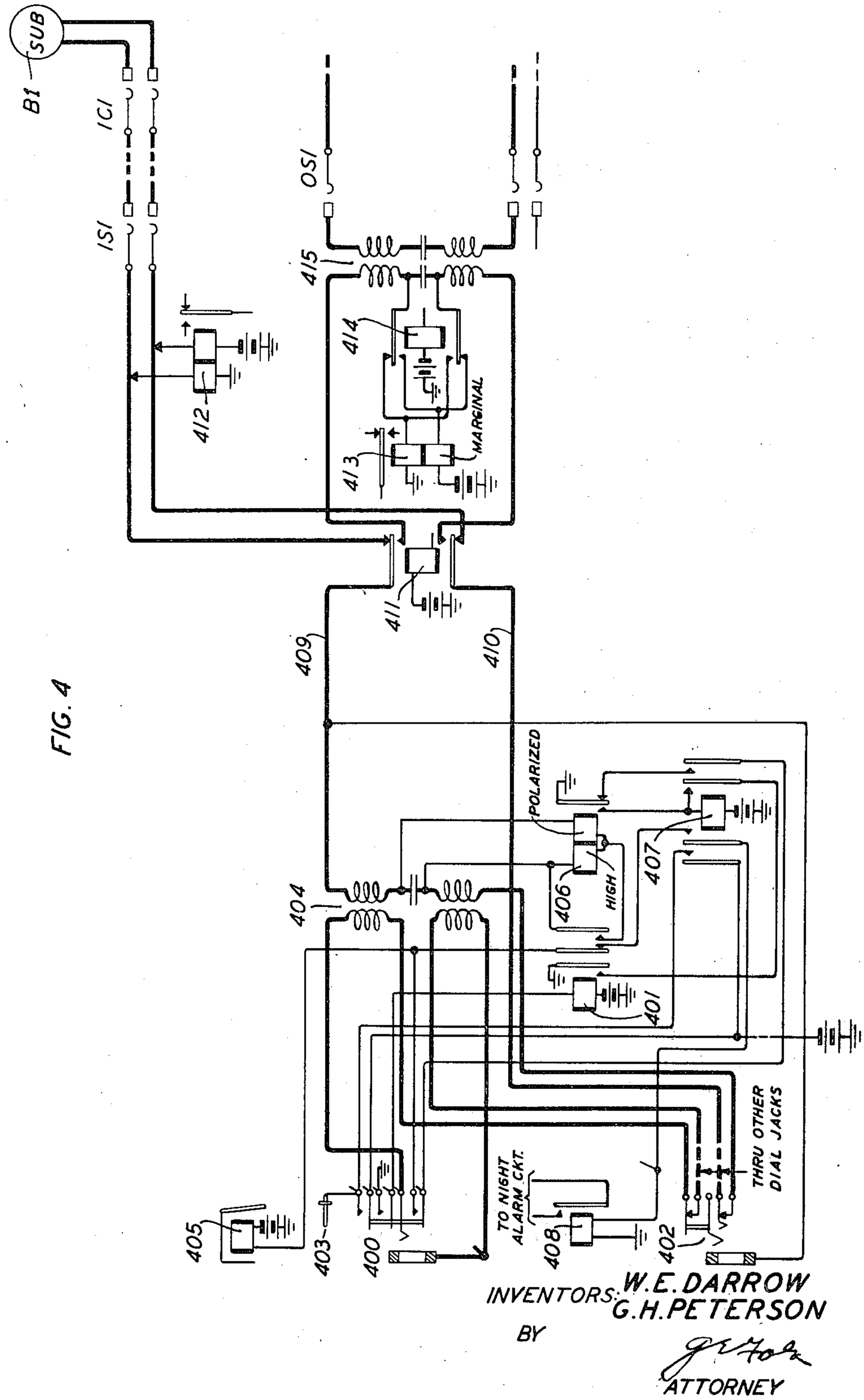

FIG. 4

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UNITED STATES PATENT OFFICE

2,019,561

TELEPHONE SYSTEM

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Application November 2, 1933, Serial No. 696,414

11 Claims. (Cl. 179—27)

This invention relates to telephone systems and more particularly to those in which impedance devices, such as repeating coils, are used in the trunks or other connecting circuits over which conversational connections are established.

The object of the invention is to protect the subscribers or operators, who may be engaged in setting up a connection, from disagreeable noises in their telephones due to changes of current which it is necessary to effect in the circuits involving repeating coils or other impedance devices.

Systems have been devised heretofore in which relays are used for controlling the circuits in such a way as to avoid a sudden change in the flow of current through one side of a repeating coil, such as would be caused by the closing or opening of the circuit, while the other side of said coil is in telephonic connection with a subscriber's or an operator's telephone. In certain systems, however, as for example those in which trunk lines extend between a small magneto office and a dial office it is desirable to minimize the use of relays in the magneto office as much as possible or in some cases to eliminate them entirely, thus avoiding the use of a separate source of power to operate them which otherwise would be unnecessary. At the same time it is necessary for the operator in the magneto exchange to connect and disconnect her dial to and from these trunks, thus opening and closing a circuit through the repeating coil.

According to the present invention these conditions are met by means of a circuit arrangement in which the plug and jack used for connecting the operator's dial cord to the trunk effect a definite sequence of circuit changes whereby current may be changed in one side of the repeating coil without inducing disturbing currents in the other side of said coil. More specifically stated, the windings of the repeating coil are so connected to the spring contacts of the dial jack that, when the operator inserts the plug to connect the dial to the trunk, the tip of the plug engages the ring spring of the jack and opens the subscriber's side of the coil slightly before it engages the tip spring to break the circuit over which current is flowing through the trunk side of said coil. Conversely, when she removes the plug at the completion of dialing, the tip of said plug disengages the tip spring of the jack to reestablish the circuit for the flow of current through the trunk side of the coil slightly before it disengages the ring spring to reclose the subscriber's side of said coil. This enables the current changes to be effected at a time when the subscriber's and the operator's telephones are disconnected telephonically from the repeating coil, thus safeguarding them against the objectionable noises to which they would otherwise be subjected.

Other features of this invention will appear more fully from the following detailed description and also from the appended claims.

The invention has been illustrated in the accompanying drawings in which

Fig. 1 shows a manual subscriber's station A, a portion of a cord circuit C, dialing cord circuit C1 and the manual exchange equipment of a two-way multiple trunk circuit terminating at its distant end in a mechanical exchange.

Fig. 2 shows the mechanical exchange equipment of the two-way trunk of Fig. 1 together with the switches necessary for completing an incoming or outgoing call. Since the switches at the mechanical office form no part of the present invention they have been only diagrammatically represented.

Fig. 3 is a non-multiple adaptation of that part of the trunk circuit shown in Fig. 1.

Fig. 4 is a modification of the system of Figs. 1 and 2 combined.

Referring now to the drawings, description will be made: First, of the operation of the circuits shown when a connection is established between the manual exchange station A and the mechanical exchange station B through the cord circuit C and two-way trunk of Figs. 1 and 2; second, of the operation taking place when a connection is established between the manual exchange station A and the mechanical exchange station B through the cord circuit C of Fig. 1 and two-way trunk of Figs. 3 and 2; and third, of the operation taking place when a connection is established between the manual exchange station A and the mechanical exchange station B1 through the cord circuit C of Fig. 1 and the two-way trunk of Fig. 4.

It is assumed then that subscriber A in the manual exchange desires to communicate with subscriber B in the mechanical exchange. The manual operator responds to the line signal (not shown) by inserting plug 103 of cord circuit C into jack 104, and with talking key 121 operated obtains the desired station number. The connection is extended to the trunk circuit by inserting plug 101 of cord circuit C into outgoing trunk jack 100, whereupon relay 107 will be energized

over an obvious path to connect battery to test pin 112, over a path from battery through inner armature and front contact of said relay to the test pin, the function of which is to indicate a busy condition of the trunk at its multiple appearances. Subscriber's station A, which is of the magneto type, will be telephonically connected to the trunk over a path from the sleeve of jack 100, lower left winding of repeating coil 113, top normally made contacts of jack 105, upper left winding of repeating coil 113, tip of jack 100, tip of plug 101, tip of plug 103, tip of jack 104, subscriber's station A, sleeve of jack 104, sleeve of plug 103, sleeve of plug 101 to sleeve of jack 100. Relay 107 operated also disconnects the ringing relay 109 from the trunk side of repeating coil 113, and closes a circuit for operating incoming selector relay 212 over a path from battery through right winding of said relay, lower armature and back contact of relay 200, trunk conductor 120, lower normally made contacts of dialing jack 105, lower right winding of repeating coil 113, middle armature and front contact of relay 107, resistance 118, upper closed contacts of jack 100, upper right winding of repeating coil 113, trunk conductor 119, upper armature and back contact of relay 200, thence to ground through left winding of relay 212.

In order to set the incoming selector and connector switches IS and IC, respectively, on the desired subscriber's station terminals, a dialing means, comprising dial D, to which is attached dialing cord C1 and plug 106, is used. Said dialing means is associated with the trunk circuit through the medium of dialing jack 105. When the plug 106 of dialing cord C1 is inserted into dialing jack 105 the following sequence of three circuit operations takes place: First, the left windings of repeating coil 113, which are included in the circuit for subscriber's station A, are opened by the top opened contacts of dialing jack 105. Second, the contacts of dial D are connected to trunk conductors 119 and 120 over a circuit traced from trunk conductor 119, sleeve of dialing jack 105, sleeve of dialing cord plug 106, contacts of dial D, tip of dialing cord plug 106, tip of dialing jack 105 to the trunk conductor 120. Third, the bridge circuit, comprising right windings of repeating coil 113 and resistance 118, extending to trunk conductors 119 and 120, previously traced, is opened by the lower opened contacts of dialing jack 105. The switches IS and IC, at the mechanical exchange, respond to the dial to locate the desired station terminals, in the well-known manner, after which the dialing cord circuit C1 is removed from the dialing jack 105, restoring the circuit to the condition as described prior to dialing.

With current flowing in the trunk side of repeating coil 113, any change of current through said side of the coil, such as is effected when the dialing cord is associated with the trunk circuit, produces, by transformer action to the line side of said coil, objectionable acoustic disturbances, to both the operator and subscriber. In order to eliminate this undesirable condition the windings of the repeating coil 113 are connected to the contacts of the dialing jack 105 so that a definite sequence of circuit operations is obtained when the dialing cord C1 is associated with the trunk circuit. The dialing jack 105 is so constructed that when the tip of the dialing plug 106 engages the ring contact of dialing jack 105 the line side of repeating coil 113 is disconnected telephonically slightly before the tip of said plug engages the tip contact of said jack to break the circuit over which current is flowing through the trunk side of said coil. Conversely, when the dialing cord is removed from the dialing jack 105 the tip of dialing plug 106 disengages the tip spring of jack 105 to reestablish the circuit for the flow of current through the trunk side of repeating coil 113 slightly before the tip of said plug disengages the ring spring of said jack to reestablish telephonically the circuit for the operator and subscriber, through the line side of said coil. In this manner both the subscriber's and operator's telephones are disconnected from the repeating coil 113 at a time when the current flow in the trunk side of said coil is of a transient nature and productive of said objectionable acoustic disturbances. When the dialing cord circuit C1 is removed from the dialing jack 105 subscriber A will converse with subscriber B, upon the removal of the latter's switchhook. After completion of the conversation the operator at the manual exchange will remove plugs 101 and 103 of cord circuit C from jacks 100 and 104 respectively, thereby restoring all relays at the manual end of the trunk circuit to normal and opening the bridge across the trunk side of repeating coil 113. The release of the switches IS and IC at the mechanical exchange is effected in the well-known manner.

It will now be assumed that a subscriber B at the mechanical exchange, desiring a connection with subscriber A at the manual exchange, has dialed, and has obtained connection to the trunk by means of the selector switch OS in the well-known manner. Relay 201 operates over a path traced from battery through winding of said relay, lower armature and back contact of relay 214, lower right winding of repeating coil 210, middle brush of selector switch OS, subscriber's loop (not shown) upper brush of selector switch OS, upper right winding of repeating coil 210, upper armature and back contact of relay 214 thence through winding of relay 213 to ground. Relay 201 closes an obvious circuit for operating relay 202 which extends its operating ground to the lower brush (sleeve) of the selector OS to maintain said selector busy. Relay 202 closes an obvious circuit for operating relay 200 and also closes a circuit for operating relays 206 and 208 over a path extending from ground on upper outer armature and front contact of relay 202, upper inner armature and make-before-break contacts of relay 209, one path extending through winding of relay 208 to battery, and the other through lower make-before-break contacts of relay 205 through winding of relay 206 to battery. Relay 200 disconnects the incoming selector IS from the trunk conductors 119 and 120 and connects said conductors to a source of ringing current 211 over a path traced from right side of said ringing source, upper outer armature and back contact of relay 209, upper armature and front contact of relay 200, trunk conductor 119, upper right winding of repeating coil 113, and thence in parallel, one path extending through condenser 116, and the other through condenser 117, winding of ringing relay 109, middle armature and back contact of relay 107, to lower right winding of repeating coil 113, lower normally made contacts of dialing jack 105, trunk conductor 120, lower armature and front contact of relay 200, lower inner armature and back contact of relay 209 to left side of ringing source 211. Ringing current is transmitted to the trunk over the path just described, for a sufficient length of

time to operate ringing relay 109 at the manual exchange end of the trunk, thereby operating relay 110 and locking said relay over a path traced from battery through winding and right armature and front contact of said relay to ground through outer armature and back contact of relay 107. Relay 206 operated, operates relay 207 and the latter relay operates relay 205. Relay 205 locks through its lower make-before-break contacts to ground on the upper outer armature and front contact of relay 202, over a path previously traced, and releases relay 206. Relay 206 releases relay 207 and thereby closes an energizing circuit for relay 209 over a path traced from ground through make-before-break contacts of relay 207, upper armature and front contact of relay 205 to battery through winding of relay 209. Relay 209 locks through its upper inner make-before-break contacts to ground on upper armature and front contact of relay 202. Relay 209 operated releases relays 205 and 208, removes the ringing source 211 from the trunk conductors 119 and 120, and closes said conductors to the upper and lower left windings of repeating coil 210 respectively. Relays 205, 206 and 207 are slow acting in order to insure that ringing current will be applied to the trunk for a sufficient interval of time.

Returning to the manual exchange end of the trunk we find that relay 110 operated closes an energizing circuit for the drop 111 over a path traced from ground on left outer armature and front contact of relay 110, through winding of said drop to battery. Relay 110 also connects battery to busy test pin 112, in order that the trunk will test busy for outgoing traffic, over a circuit traced from battery left inner armature and front contact of relay 110 to test pin 112. The manual exchange operator responds to the operated drop by inserting the plug 101 of cord circuit C into answering jack 102.

Relay 107 operates and, in addition to its previously described functions, it opens the locking circuit for relay 110. Relay 110 released opens the operating circuit for the drop 111 and removes means for applying battery to the busy test pin 112, but since cord circuit C is now connected to the trunk this test potential is maintained on said test pin by relay 107 as previously described. Relay 107 also closes a supervisory circuit, including resistance 114 and signal 108 at the manual exchange and relays 203 and 204 at the mechanical exchange, over a path traced from battery and lower winding of relay 204, lower winding of marginal relay 203, lower left winding of repeating coil 210, lower inner armature and front contact of relay 209, lower armature and front contact of relay 200, trunk conductor 120, lower normally made contacts of dialing jack 105, lower right winding of repeating coil 113, middle armature and front contact of relay 107, winding of signal 108, upper closed contacts of answering jack 102, resistance 114, upper right winding of repeating coil 113, trunk conductor 119, upper armature and front contact of relay 209, upper outer armature and front contact of relay 209, upper left winding of repeating coil 210, upper winding of marginal relay 203, to ground through upper winding of relay 204. Relay 204 operates over the path just described, but since relay 203 and signal 108 are both marginal said relay and signal will not operate in series with high resistance 114. The operation of relay 204 provides an independent means for energizing relay 209 in order to maintain a busy condition on the lower brush (sleeve) of selector switch OS in the event that the calling subscriber B should disconnect first and thereby release relays 201 and 202. This circuit is traced from ground on make-before-break contacts of relay 208, armature and front contact of relay 204 thence through the upper inner make-before-break contacts and winding of relay 209 to battery. The call is completed with cord circuit C to subscriber A in the usual manner and when the subscriber at A responds, the operator will be apprised of this condition by means of talking key 121 of cord circuit C, with which she monitors on the connection. In order to set up a charge condition at the mechanical exchange end of the trunk the operator will depress non-locking charge key 115, which short circuits high resistance 114, thereby allowing sufficient current to flow through the signal 108 and marginal relay 203 to cause the operation of said signal and relay. The signal 108 operated provides an obvious path for maintaining the short circuit around resistance 114 and at the same time provides means for indicating that a charge condition has been applied. Relay 203, at the mechanical exchange, operated, closes a circuit for operating relay 214 over a path traced from battery and winding of said relay, armature and front contact of relay 203 thence to ground through make-before-break contacts of relay 208. Relay 214 operated reverses battery and ground toward the originating subscriber to set up a charge condition for the call in the well-known manner. Conversation between subscriber A and B takes place and when the mechanical subscriber hangs up and the manual operator disconnects the cord circuit C from the trunk all apparatus is restored to normal.

If a connection is desired from the manual exchange subscriber A to a mechanical exchange subscriber B over the two-way non-multiple trunk shown in Figs. 3 and 2, the operations of the trunk circuit of Fig. 3 are practically identical with those as described for the trunk circuit of Fig. 2, except that when the cord circuit plug 101 of cord circuit C is inserted into outgoing trunk jack 300 a circuit is closed to operate incoming selector relay 212 over a circuit traced from battery through right winding of said relay, lower armature and back contact of relay 200, trunk conductor 311, lower normally made contacts of dialing jack 301, lower right winding of repeating coil 306, upper closed contacts of outgoing trunk jack 300, winding of signal 303, upper right winding of repeating coil 306, trunk conductor 310, upper armature and back contact of relay 200, to ground thru left winding of relay 212. The dialing cord circuit C1 is then associated with the trunk circuit and the incoming selector and connector switches IS and IC, respectively, are set in the usual manner, after which the dialing cord circuit C1 is removed from the trunk circuit. All of the subsequent operations, for an outgoing call, are substantially the same as described for the trunk circuit of Fig. 1.

For a call from mechanical exchange station B to manual exchange station A the selector switch OS is set on the terminals of the trunk, and ringing current is transmitted to the trunk conductors 310 and 311 as previously described for the trunk circuit of Figs. 1 and 2. The circuit for operating ringdown drop 309 is traced from trunk conductor 310, upper right winding of repeating coil 306, thence in parallel, one path extending thru condensers 307, and the other through condenser 308, ringdown drop 309, normally made contacts of answering jack 302, normally made

contacts of outgoing trunk jack 300, to lower right winding of repeating coil 306, thence through lower normally made contacts of dialing jack 301 to trunk conductor 311. The manual operator, being apprised of an incoming call by the operation of the ringdown drop, responds by associating cord circuit C with the trunk circuit by inserting plug 101 of said cord circuit into answering jack 302, an action, which opens the circuit of ringdown drop 309 at lower opened contacts of said jack, and closes a supervisory bridge, comprising signal 303, resistance 304 and right windings of repeating coil 307 across trunk conductors 310 and 311 by means of upper closed contacts of said jack. The circuit of this bridge is traced from trunk conductor 311, lower normally made contacts of dialing jack 301, lower right winding of repeating coil 306, lower normally made contacts of outgoing trunk jack 300, upper closed contacts of answering jack 302, resistance 304, winding of signal 303 thence to trunk conductor 310 through upper right winding of repeating coil 306. From trunk conductors 310 and 311 the bridge circuit is extended to the mechanical exchange end of the trunk as previously traced. Subsequent operations of the circuit such as the charging operation and disconnect features are the same as described for the trunk circuit of Fig. 1.

The two-way trunk circuits, just described, are of the ringdown type, that is, ringing current is applied at the mechanical exchange portion of the trunk circuit to signal the manual exchange operator. A description will now be made for the interconnection of manual exchange subscriber A with mechanical exchange subscriber C by means of cord circuit C, dialing cord circuit C1 and the two-way multiple trunk of Fig. 4 which employs the well-known reversed battery and ground type of supervision. Since the method of interconnecting subscriber A with subscriber C is identical with that previously described for the ringdown type of trunk circuit, only those features of difference such as supervision, etc., will be discussed in detail.

Assume that a connection is desired between manual exchange subscriber A and mechanical exchange subscriber B1. Subscriber A is associated with the trunk circuit through the medium of cord circuit C, cord circuit plug 101, and trunk jack 400. Relay 401 is operated and battery potential is applied to test pin 403 through closed contacts of trunk jack 400 over obvious circuits. Relay 401, through its outer armature and front contact, short circuits the left high resistance winding of polarized relay 406 allowing sufficient current to flow to operate incoming selector relay 412 over a path traced from battery and right winding of said relay, lower armature and back contact of relay 411, trunk conductor 410, lower normally made contacts of dialing jack 402, lower right winding of repeating coil 404, outer armature and front contact of relay 401, right winding of polarized relay 406, upper right winding of repeating coil 404, trunk conductor 409, upper armature and back contact of relay 411 thence to ground thru left winding of relay 412. Polarized relay 406 due to the direction of current flow will not operate at this time. The manual exchange operator associates the dialing cord C1 with the trunk circuit through the medium of dialing jack 402, performs the dialing operation, and removes the dialing cord C1 from the trunk circuit as previously described. When mechanical exchange subscriber B1 removes the receiver from the switchhook the connector switch IC1 reverses battery and ground to trunk conductors 409 and 410 (apparatus not shown) to operate polarized relay 406 over a path which previously included incoming selector relay 412 but now includes the connector relay (not shown) with battery and ground reversed. The operation of polarized relay 406 operates relay 407. Relay 407 locks over a circuit traced from battery through winding, and inner right armature and front contact of said relay to ground through inner armature and front contact of relay 401. Relay 407 also closes a parallel path for maintaining a test potential on test pin 403 over a circuit traced from battery outer left armature and front contact of relay 407, to test pin 403. This path is necessary to maintain a busy condition on the test pin until the mechanical exchange subscriber disconnects. Conversation takes place and when mechanical exchange subscriber B1 disconnects, battery and ground from the connector switch IC1 are again reversed causing the release of polarized relay 406. This relay closes a circuit for operating signal 405 over a circuit traced from ground on armature and back contact of polarized relay 406, outer right armature and front contact of relay 407, lower closed contacts of trunk jack 400, through winding of signal 405 to battery. The signal 405 indicates a disconnect condition to the manual exchange operator who breaks down the connection in the usual manner restoring all apparatus to normal.

The operation of the circuit will now be described for a call originated by subscriber B1 at the mechanical exchange for the manual exchange subscriber A. Assume that mechanical exchange subscriber B1 has dialed the proper code for extending a connection to the manual exchange, in which subscriber A is located, and that selector switch OS1 is set on the terminals associated with a trunk to said manual exchange. Relays 411 and 414 will operate (circuits not shown) from the selector OS1 under control of mechanical exchange subscriber B1. The operation of relay 411 disconnects the trunk conductors 409 and 410 from the incoming selector IS1 and connects these conductors to the upper and lower right windings of repeating coil 415 respectively. The operation of relay 414 reverses battery and ground to the trunk conductors 409 and 410 over a circuit from battery, lower winding of marginal relay 413, upper armature and front contact of relay 414, upper left winding of repeating coil 415, upper armature and front contact of relay 411, trunk conductor 409, upper right winding of repeating coil 404, right and left windings of polarized relay 406, lower right winding of repeating coil 404, lower normally made contacts of dialing jack 402, trunk conductor 410, lower armature and front contact of relay 411, lower left winding of repeating coil 415, lower armature and front contact of relay 414 thence to ground through upper winding of marginal relay 413. Polarized relay 406 operates over the circuit just traced, but, due to the high resistance of the left winding of said relay the marginal relay 413 does not operate. The operation of polarized relay 406 operates relay 407, and the latter relay closes a circuit for the signal 405 and night alarm relay 408 over a path traced from ground, through winding of night alarm relay 408, left inner armature and front contact of relay 407, middle armature and back contact of relay 401 to battery through winding of signal 405. The manual ex-

change operator is apprised of an incoming call by the signal 405 and associates the cord circuit C with the trunk circuit as described for an outgoing call. Relay 401 operates, and, in addition to the features described for an outgoing call, opens the circuit for night alarm relay 408 and signal 405. Marginal relay 413 receives sufficient current at this time to operate, due to the short circuit connected to the left high resistance winding of polarized relay 406 by the outer armature and front contact of relay 401, as previously described. Relay 413 causes the trunk circuit at the mechanical exchange to assume a condition for communication (apparatus not shown). Conversation and disconnection take place and the apparatus is restored to normal as heretofore described.

It will be understood that the invention is not limited to the specific embodiments herein shown and described. It should not be limited to use in any particular kind of telephone system nor to any specific type of operator's position. The kind of switching or other connection establishing equipment is obviously immaterial to this invention, nor is it limited to means for eliminating noises produced by repeating coils. Moreover this invention is not limited to the use of plugs and jacks for securing the desired sequence of operations but may be embodied in other forms of connecting devices.

What is claimed is:

1. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a controlling device, and a switch comprising a movable element and a stationary element for connecting said controlling device to said outgoing circuit, said stationary element including contact members so arranged that when said movable element is brought into engagement with said stationary element it actuates first one of said contact members to open said incoming circuit to disable said telephone and then another of said contact members to open said outgoing circuit.

2. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a controlling device, a stationary switch element having a contact member for closing said outgoing circuit and a second contact member for closing said incoming circuit, and a movable switch element for connecting said controlling device to said stationary element, said contact members being so arranged that when said movable element is disengaged from said stationary element it first controls the movement of said first mentioned contact member and then the movement of said second mentioned contact member to close the circuit from said telephone to said impedance device.

3. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a jack having one contact member for opening said incoming circuit and another contact member for opening said outgoing circuit, a controlling device, and a plug for connecting said controlling device to said jack, said contact members being so arranged that first one and then the other of them is actuated by said plug.

4. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a jack having one contact for controlling said incoming circuit and a second contact for controlling said outgoing circuit, a controlling device, and a plug for connecting said controlling device to said jack, said jack contacts being so arranged that the insertion of said plug first operates the first mentioned contact to open the incoming circuit and then the second mentioned contact to open the outgoing circuit.

5. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a jack having one contact for controlling said incoming circuit and a second contact for controlling said outgoing circuit, a controlling device, and a plug for connecting said controlling device to said jack, said jack contacts being so controlled by the insertion and withdrawal of said plug that the incoming circuit is always opened before and closed after the outgoing circuit.

6. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a jack having tip and ring springs for controlling said circuits, a controlling device, and a plug for connecting said controlling device to said jack, said springs being so arranged that the plug first engages the ring spring to open the incoming circuit and then the tip spring to open the outgoing circuit.

7. The combination in a telephone system of a telephone, an impedance device, an incoming circuit extending from said telephone to said impedance device, a second circuit outgoing from said impedance device, a jack having tip, ring and sleeve terminals connected to said incoming and outgoing circuits, a controlling device, and a plug for connecting said controlling device to said jack, said tip and ring terminals being so arranged that the tip of the plug first engages the ring terminal to open the incoming circuit and then the tip terminal to open the outgoing circuit.

8. The combination in a telephone system of a repeating coil having two windings, an incoming circuit including one of said windings, an outgoing circuit including the other of said windings, a jack having one contact member for opening and closing said incoming circuit and another contact member for opening and closing said outgoing circuit, a circuit controlling mechanism, and a plug for connecting said mechanism to said jack, said contact members being so arranged that first one and then the other of them is actuated by said plug.

9. In combination, a telephone, a repeating coil having a plurality of windings, an incoming circuit including one of said windings, means for associating said telephone with said circuit, an outgoing circuit including another of said windings, a source of current in said outgoing circuit, a jack having one terminal for opening and closing said incoming circuit and another terminal for opening and closing said outgoing circuit, an impulse device for sending impulses over said outgoing circuit, and a plug for connecting said impulse device to said jack, said terminals being so arranged that first one and then the other is engaged by said plug.

10. The combination with an operator's position of a trunk terminating in a jack thereat, a repeating coil in said trunk, a cord circuit at said position having a plug for extending a connection by way of said jack through one of the windings of said coil, means responsive to the insertion of said plug in the jack for completing a circuit through another winding of said coil, a second jack for said trunk having one set of contact springs for controlling the circuit through said first mentioned winding and another set of springs for controlling the circuit through said second mentioned winding, a dial for sending impulses over said trunk, and a plug for connecting said dial to the last mentioned jack, said springs being so arranged that one set is opened before the other on insertion of the plug and closed after the other on removal of the plug.

11. The combination in a telephone system of an operator's position, an automatic switch, a trunk terminating at one end in a jack at said position and in said switch at the other end, a repeating coil in said trunk, means at the operator's position for completing a circuit by way of said jack through a winding of said coil, means for completing a circuit through a second winding of said coil, a second jack for said trunk having one contact spring for opening and closing the circuit through said first mentioned winding and another contact spring for opening and closing the circuit through said second winding, a dial for sending impulses over said trunk to set said automatic switch, and a plug for connecting said dial to the trunk by way of said last mentioned jack, said springs arranged for engagement and disengagement by the plug in such an order that the circuit of said first winding is opened before and closed after the circuit of the second winding.

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