

March 24, 1931.

B. WALLACE

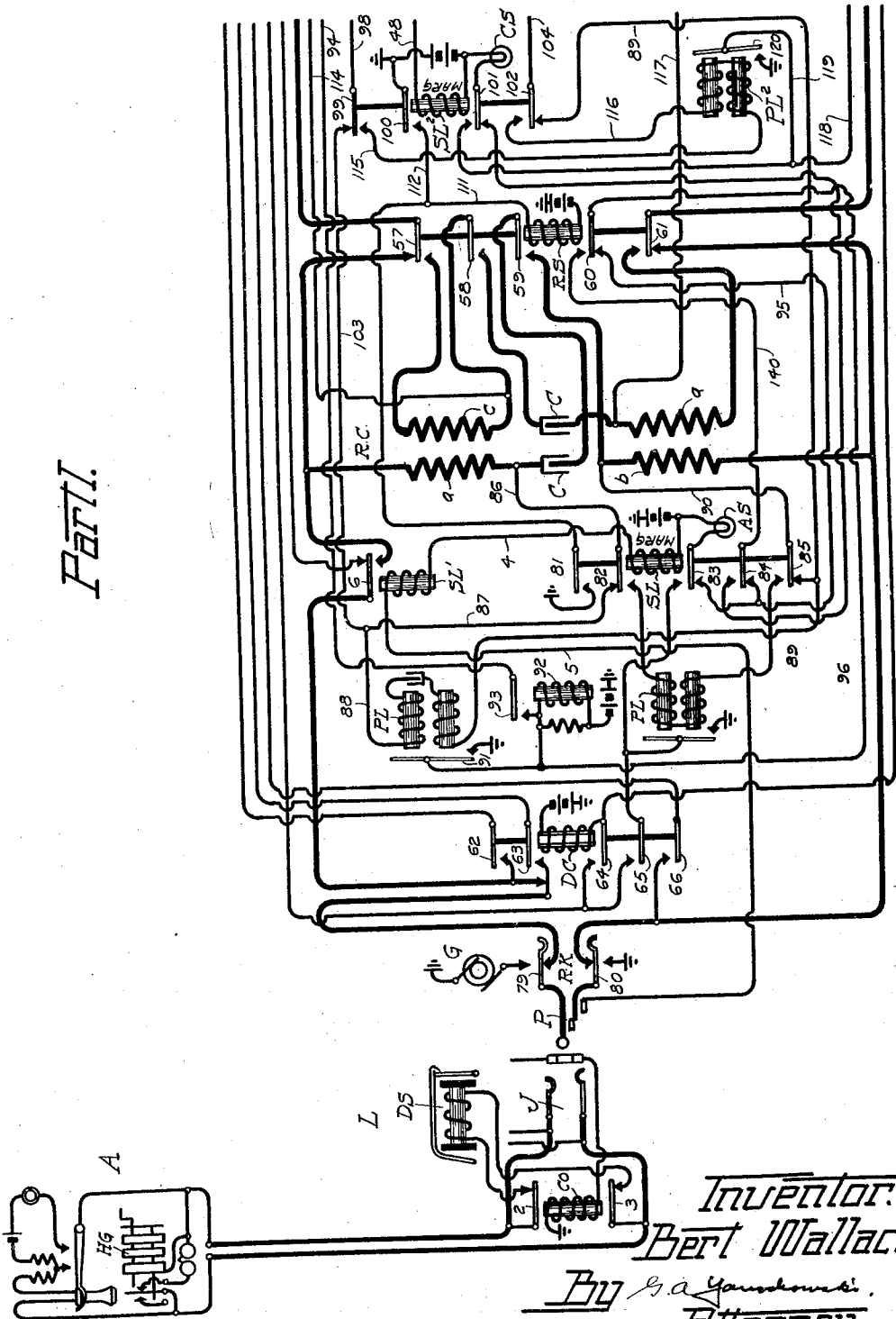
1,797,935

TELEPHONE SYSTEM

Filed June 17, 1929

2 Sheets-Sheet 1

Part I.



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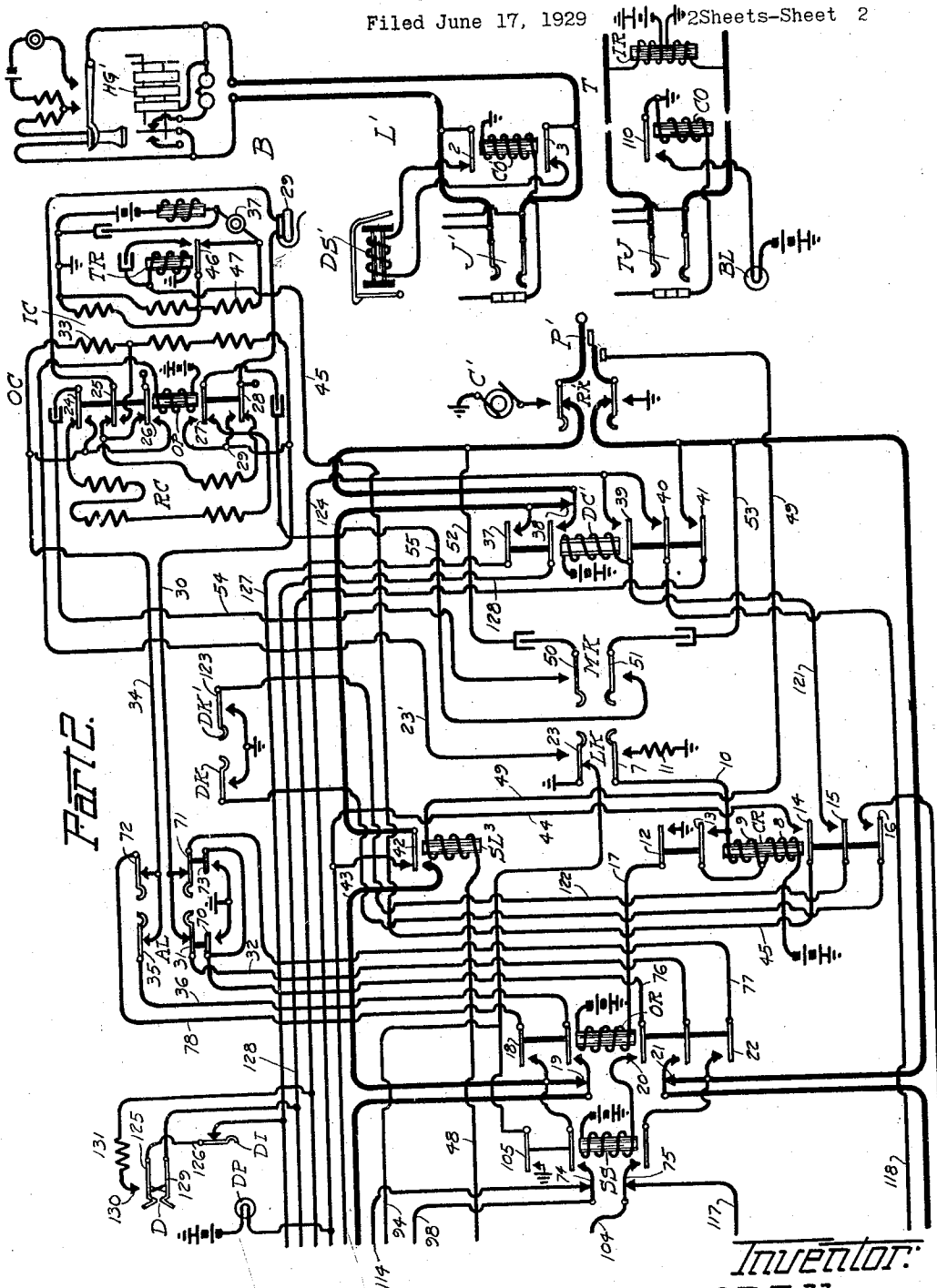
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2Sheets-Sheet 2



104
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TELEPHONE SYSTEM

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My invention relates to telephone systems and has to do more particularly with cord circuits of branch exchange systems such as are used for interconnecting local or toll subscribers' lines terminating at a branch exchange switchboard and for also connecting the local or toll subscribers' lines terminating at the branch exchange with subscribers' lines terminating at a main exchange.

10 An object of my invention is the provision of an improved circuit arrangement which has desirable features of operation in interconnecting subscribers' lines as calling and called lines, all in a simple, efficient and economical manner.

15 In a branch exchange system it is desirable in addition to the usual toll to toll connections, to connect a toll subscriber's line terminating at a branch exchange switchboard with a subscriber's line terminating at a main exchange and a feature of my invention is the provision of a universal toll cord circuit which is adapted to interconnect toll or local substations as calling and called lines or toll or local substations with subscribers' lines terminating at a main exchange.

20 Another feature of my invention is the arrangement of the universal cord circuit of my invention whereby both cord plugs of a cord pair have associated therewith apparatus to permit either plug of the cord pair to be connected with a calling line or to extend a connection by way of a trunk connection to a called line terminating at a main exchange system.

25 Another feature of my invention is the provision of a calling or impulse sending device which, through the medium of a pair of common dialing keys, may be connected to either plug of a cord pair to permit dialing on either end of a cord pair to establish a connection with a subscriber's line terminating at a main automatic exchange.

30 Another feature of my invention is the provision of means in the cord circuit whereby an operator, attempting to answer a second call before completing a preceding connection is prevented from being connected with the second calling line until the other connection is completed.

Still another feature of my invention is the provision of a key, common to an operator's position, which may be actuated when the listening key of a cord is in its talking position, to connect the operator's set with either the calling or the called end of an established connection to permit the operator to converse with either of the substations connected to the respective ends of the cord.

The above features, as well as others not particularly pointed out and through the provision of which the above mentioned and other advantageous results are attained, will be described by reference to the accompanying drawing in which—

Part 1 and part 2 taken together with the lines terminating at the right in part 1 joined to the respective lines terminating at the left in part 2, form a circuit diagram of the universal toll cord circuit of the present invention.

Referring now to the accompanying drawings, at the left of part 1, I show a calling toll or magneto substation A terminating at the branch or toll switchboard in a line circuit L comprising a drop signal DS, a cut-off relay CO and multiple jacks J. The cord C illustrated in parts 1 and 2 is provided with connecting plugs P and P' which may be interchangeably used as answering and calling plugs. A listening key LK is provided which, when actuated in response to a call, controls the operation of a listening control relay CR, which relay in turn controls the operation of the operator's listening relay OR. The actuation of the listening key LK also controls the operation of the operator's connecting relay OP associated with the operator's circuit OC shown in part 2. The operator's set is connected to the cord C through the medium of relays OR and OP. Sleeve relay SL and an auxiliary sleeve relay SL', associated with the plug P, are affected differently depending upon the type of line to which the plug P is connected. Sleeve relay SL² and an auxiliary sleeve relay SL³ are associated with plug P' and are also affected differently depending upon the type of line to which the plug P' is connected. An auxiliary listening key AL of

the double cut off type, common to a position having a plurality of cord circuits such as the one here shown, may be actuated in association with an actuated listening key of a connected cord to permit the operator to converse with either the calling or called line of an established connection.

A repeating coil connecting relay RS, the energization of which is under the control of either relay SL or SL', controls the connection of the repeating coil RC with the tip and ring conductors of the cord C. This connection of the repeating coil RC in circuit with the tip and ring conductors depends upon the type of line to which the plug P or P' of the cord C is connected. A polarized relay PL', which serves as a supervisory relay, receives current from the calling or called substation in a toll to toll connection, when either substation gives the disconnect signal upon the termination of conversation, to bring about the lighting of the supervisory signal AS. The dialing control relays DC and DC' are associated respectively with the plugs P and P' and through the medium of the dialing keys DK and DK', the calling device D, which is common to the position may be connected with either of the plugs P or P' when the same are connected to a trunk extending to a main automatic exchange. The polarized relays PL' and PL² are associated respectively with the plugs P and P' and control the lighting of the supervisory signals AS and CS when either plug P or P' is connected with a trunk extending to a main automatic exchange. The ringing keys RK and RK', associated respectively with the plugs P and P', are for the usual purposes. To the right in part 2 I show a called toll or magneto substation B terminating at the branch exchange in a line circuit L' comprising a drop signal DS', a cut-off relay CO' and a multiple jack J'. I also show a trunk circuit T which terminates at its one end at the branch exchange switchboard in a trunk jack TJ and its other end in an automatic exchange and to which either plug P or P' may be connected. A relay CO², associated with the trunk jack TJ, controls the lighting of the busy signal lamps BL.

Having described in general the apparatus comprising the universal toll cord circuit C of my invention I will now describe in detail the operation of the same.

Assuming now that the subscriber at the toll or magneto substation A initiates a call, current from the actuated hand generator HG at the substation A causes the operation of the drop signal DS. The circuit being traced through normally closed contacts 2 and 3 of the cut-off relay CO of the line circuit L which terminates at the branch exchange. The operator associated with the toll cord circuit C noting the actuated drop sig-

nal DS, inserts the plug P of the toll cord circuit C into the answering jack J of the calling line which restores the actuated drop signal DS and also establishes an energizing circuit for the cut off relay CO of the line circuit L and the sleeve relay SL' of the toll cord circuit C. This circuit may be traced from battery through the winding of relay SL, conductor 4, the winding of the auxiliary sleeve relay SL', conductor 5, the sleeve contacts of the connected plug P and jack J to ground through the cut-off relay CO of the line circuit L. The cut-off relay CO and the auxiliary sleeve relay SL' are energized over this circuit but, due to the high resistance of the cut-off relay CO, the sleeve relay SL remains unenergized. Upon the energization of the cut-off relay CO its normal contacts 2 and 3 are opened to disconnect the drop signal DS from the line conductors and the secondary sleeve relay SL' energizes and closes its alternate contact 6 for purposes which will presently be described.

The operator now actuates the listening key LK, closing alternate contact 7, to establish an energizing circuit for the listening control relay CR traced from battery through low and high resistance windings 8 and 9 of the relay CR, conductor 10, alternate contact 7 of the listening key LK, to ground through the resistance 11. The relay CR, upon energizing, closes its alternate contacts 12, 13, 14, 15 and 16. The closing of alternate contact 13 establishes a substitute circuit through the relay CR traced from battery, through the low resistance winding 8, alternate contact 13, and alternate contact 7, to ground through the resistance 11. The closing of alternate contact 12 of the relay CR establishes an energizing circuit for the operator's listening relay OR traced from battery, through the winding of relay OR, conductor 17 to ground through alternate contact 12 of the relay CR. Relay OR closes its alternate contacts 18, 19, 20, 21 and 22. The energization of relays CR and OR is for purposes which will presently be described.

The closing of alternate contact 23 of the listening key LK establishes an energizing circuit for the operator's connecting relay OP, associated with the operator's circuit OC, traced from battery, through the winding of the relay OP, conductor 23' to ground at alternate contact 23 of the listening key LK. Relay OP operates to close its alternate contacts 24, 25, 26, 27 and 28. The closing of alternate contacts 25 and 28 of the relay OP connects the operator's receiver 29 to the tip and ring conductors of the cord C over a circuit through alternate contact 28 of relay OP, conductors 29' and 30, normal contact 31 of the auxiliary listening key AL, which is common to an operator's position, conductor 32 and through alternate contact 21 of the relay

OR to the ring conductor of the cord C. The connection to the tip conductor of the cord C is traced through alternate contact 25 of the relay OP, the winding 33 of the induction coil IC, conductor 34, normal contact 35 of the key AL, conductor 36 and through alternate contact 19 of the relay OR to the tip conductor of the cord C. The operator's transmitter 37 is connected inductively to the tip and ring conductors of the cord C over conductors 30 and 34 and the path just described, through the windings of the induction coil IC. The operator having been connected to the cord C as just described now inquires the wants of the calling subscriber at the substation A, and, assuming the subscriber at the toll or magneto substation B is wanted, she tests the jack of the wanted line as to its idle or busy condition by placing the tip conductor of the plug P' against the sleeve conductor of the jack J'.

If the wanted line is busy the sleeve of the jack of the wanted line will be at battery potential and this battery potential will extend from the tip of the plug P' of the cord C through normal contact 38 of the dialing control relay DC', normal contact 42 of the relay SL³, conductors 43 and 44, alternate contact 14 of relay CR, conductor 45 to ground through the winding of the test relay TR of the operator's circuit OC. The relay TR energizes over this circuit and the opening of its normal contact 46 will remove the shunt from the winding 47 of the induction coil IC to give the operator the usual busy indication.

If the operator upon testing it, finds the wanted line idle she inserts the plug P' into the jack J' of the called line and actuates the ringing key RK' to impress ringing current from the ringing generator G' on the called line. The insertion of the plug P' into the jack J' establishes a circuit traced from battery through the winding of the relay SL², conductor 48, winding of auxiliary sleeve relay SL³, conductor 49, the sleeve contacts of the connected plug P' and jack J' to ground through the winding of the cut-off relay CO' of the line circuit L'. The cut-off relay CO' energizes over this circuit to open its normally closed contacts 2' and 3' to remove the drop signal DS' from the control of the called subscriber. The sleeve contacts of the multiple jacks of the line are thus joined to battery so the line will test busy. The auxiliary sleeve relay SL³ is also energized over this circuit to close its alternate contact 42 but the sleeve relay SL² does not energize due to the high resistance of the cut off relay CO'.

The operator, having tested the line and actuated the ringing key RK' to signal called substation B, now restores her listening key LK. The opening of alternate contact 7 of the restored listening key opens the energizing circuit of the relay CR which now re-

stores and by opening its alternate contact 12 interrupts the energizing circuit of the relay OR which restores to normal and again closes its normal contacts 19 and 21 to again close the continuity of the tip and ring cord conductors. The called subscriber at the substation B, in response to the call signal at the substation, removes his receiver from the switchhook and this act places the calling and called subscribers at the respective substations A and B in conversational circuit. This talking circuit may be traced over the heavily marked tip and ring conductors which include the alternate contacts 6 and 42 of the sleeve relays SL' and SL² and the normal contacts 63, 57, 19 and 38 of the respective relays DC, RS, OR and DC' in the tip conductor and normally closed contacts 61 and 21 of the relays RS and OR in the ring conductor. For reasons previously described, the sleeve relays SL and SL² do not energize when the respective plugs P and P' are inserted in the jacks J and J' of the calling and called magneto lines A and B. As the energization of the repeating coil switching relay RS is controlled by either relay SL or SL² no energizing circuit is established for the same, and in the connection just described, the repeating coil RC is not included in the talking circuit.

The operator may supervise the connection by actuating the monitoring key MK to close the alternate contacts 50 and 51 to connect the operator's receiver circuit across the tip and ring conductors of the cord C, the connection extending over conductors 52 and 53, through alternate contacts 50 and 51 of the monitoring key MK, conductors 54 and 55 to normal contacts 24 and 27 of the relay OP of the operator's circuit OC and through the repeating coil RC' associated with the operator's circuit OC. The operator's receiver 29 is inductively associated with the coil RC' in a manner well understood.

Should the operator associated with the cord C attempt to answer another call before she has completed the connection now being described, the actuation of a listening key LK of another cord at this operator's position will connect the high resistance 11, which is common to the operator's position, through the alternate contact 7 of the actuated listening key in the second cord in circuit with the relay CR of the second cord. This second relay CR will not operate, however, due to the shunting effect of the low resistance winding 8 of the relay CR of the first cord C which is in parallel with both windings of the second relay CR. Relay OR of the second cord also remains unenergized, thus preventing the operator's set from being connected to the second cord conductors.

In the connection above described conditions may arise whereby it becomes necessary for the operator to converse with either the

calling or called subscriber before the conversational circuit is established between the respective substations. To this end I provide an auxiliary listening key AL of the double cut-off type which is common to the operator's position. Assuming that the operator wishes to converse with the called subscriber at substation B before connecting the subscribers in conversational circuit, the auxiliary listening key AL is actuated to open the normally closed contacts 31 and 35 and close the normally open contact 70 associated with the left hand set of contact springs. The listening key LK, associated with the cord C is also actuated to bring about the operation of the relays CR and OR of the cord C and the relay OP of the operator's circuit OC as previously described. The closing of the normally open contact 70 of the left hand set of contact springs establishes an energizing circuit for the supervisory switching relay SS, traced from battery, through the winding of relay SS, alternate contact 20 of relay OR and conductor 76 to ground at alternate contact 70 of the key AL. The operation of relay SS is for purposes which will presently be described. Due to the operation of relay OP, the operator's set is now connected over conductors 30 and 34, through normal contacts 71 and 72 of right hand set of contact springs of the key AL, over conductors 77 and 78, through alternate contacts 22 and 18 of the relay OR, to the ring and tip conductors of the calling end of the cord C. The tip and ring conductors of the cord C are open at the contacts 19 and 21 of the relay OR thus disconnecting the operator from the answering end of the cord C. The operator may now converse with the called subscriber at substation B.

To converse with the calling subscriber at substation A to the exclusion of the subscriber at substation B the operator actuates the key AL to open the normally closed contacts 71 and 72 and close the normally open contact 73 of the right hand set of springs of the key AL. The operator's set is now connected over conductors 30 and 34, through normal contacts 31 and 35 of the key AL over conductors 32 and 36 and through alternate contacts 21 and 19 of the relay OR to the ring and tip conductors of the answering end of the cord C. The operator may now converse with the subscriber at the substation A to the exclusion of the substation B. The restoration of the key LK will bring about the deenergization of relays SS, OR and CR of the cord C and the deenergization of the relay OP of the operator's circuit OC. The restoration of relay OR of the cord C permits contacts 19 and 21 to close the continuity of the tip and ring conductors of the cord C.

We will now assume that the conversation between the subscribers at substations A and

B has terminated and the subscribers replace their receivers upon their respective switch-hooks. The actuation of the hand generator at the calling substation A will send an impulse of current from the generator through the tip contacts of the connected jack J and plug P, the normal contact 79 of the ringing key RK, normal contact 63 of the relay DC, alternate contact 6 of relay SL', the winding "a" of the repeating coil RC, conductor 86, normal contact 82 of relay SL, conductors 87 and 88, the windings of the polarized relay PL, conductor 89, normal contact 85 of relay SL, conductor 90, winding "b" of the repeating coil RC, normal contact 80 of the key RK, the ring contacts of the connected plug P and jack J back to the generator HG, at the substation A. The polarized relay PR is operated by this flow of current and closes its alternate contact 91, establishing an energizing circuit for the relay 92, traced from battery through the winding of relay 92, to ground at alternate contact 91 of the polarized relay PR. The relay 92 is energized and closes a locking circuit for itself traced from battery through its winding, its alternate contact 93, conductor 94, to ground at normal contact 23 of the listening key LK. The closing of alternate contact 93 of relay 92 also closes a circuit for the supervisory signal AS, traced from battery through the lamp AS, normal contact 83 of relay SL, conductor 95, normal contact 60 of relay RS, conductor 96, alternate contact 93 of relay 92, and conductor 94 to ground at normal contact 23 of the listening key LK. The supervisory signal AS is lighted over this circuit and indicates to the operator that the conversation has terminated. Should the called subscriber at the substation B be the one to operate his hand generator to give the disconnect signal, current from the hand generator HG' at the called substation B will operate the polarized relay PL over the tip conductor of the cord C, through the winding "a" of the repeating coil RC, the windings of the relay PL, the winding "b" of the repeating coil RC to the ring conductor of the cord C and back to the hand generator HG'. The relay PL now operates as before described to operate the relay 92 which in turn closes a circuit for the supervisory signal AS. The operator noting the lighted lamp signal AS, now withdraws the plugs P and P' from their respective jacks J and J' and also actuates her listening key LK. The key LK, when actuated, opens its normal contact 23, which interrupts the locking circuit of relay 92, which restores to normal, and also opens the energizing circuit of the supervisory signal AS. The removal of the plugs P and P' from the respective jacks J and J' permits the sleeve relays SL' and SL^a of the cord C and the cut-off relays CO and CO' 120

of the respective line circuits L and L' to restore and the apparatus used in establishing a connection between the substations A and B is now at normal and available for establishing other connections.

Referring again to the operation of the auxiliary listening key AL, the actuation of this key brings about the operation of the supervision switching relay SS as previously described. Should the called subscriber at substation B operate the hand generator HG' to give the disconnect signal while the operator of the cord C is conversing with the calling subscriber at the substation A, the current from the hand generator HG' extends over the tip conductor of the cord C, through alternate contact 74 of the relay SS, conductor 98, normal contact 99 of the relay SL², conductors 103 and 88, the windings of the polarized relay PL, conductor 89, normal contact 102 of relay SL², conductor 104, alternate contact 75 of the relay SS to the ring conductor of the cord C and back to the hand generator HG' at the substation B. The relay PL is operated by current over this circuit and closes a circuit for the relay 92 as previously described. The relay 92 is locked up over a circuit to ground at alternate contact 105 of the relay SS, instead of the locking ground at normal contact 23 of the listening key LK, as in this instance the listening key LK is also actuated to open its normal contact 23 when the auxiliary listening key AL is actuated. The circuit of the supervisory signal AS is also closed to ground through alternate contact 105 of the relay SS. The lighted signal AS indicates to the operator that the called subscriber at substation B has given a disconnect signal. The operator now removes the plugs P and P' from the respective jacks J and J' and restores the keys AL and LK and the apparatus used in establishing the connection is restored as previously described.

Assuming now that the toll subscriber at the magneto substation A initiates a call and wishes to converse with a subscriber whose line terminates at an automatic exchange, the operation of the circuit is the same as previously described up to and including the inquiry of the operator in response to the actuated drop signal DS. The operator, upon receiving the number of the main exchange subscriber, inserts the plug P' into an idle trunk jack TJ, establishing an energizing circuit for the cut-off relay CO² associated with the trunk jack TJ and the sleeve relays SL² and SL³ of the cord C, traced from battery through the winding of the sleeve relay SL², conductor 48, winding of the sleeve relay SL³, conductor 49, the sleeve contacts of the connected plug P' and trunk jack TJ to ground through the winding of the trunk cut-off relay CO². The sleeve relays SL² and SL³ and cut-off relay CO² en-

energize over this circuit, the sleeve relay SL³ closing its alternate contact 42 and the sleeve relay SL² closing its alternate contacts 99, 100, 101 and 102. The cut-off relay CO² energizes to close its alternate contact 110 to light the busy lamps BL associated with the multiple trunk jacks TJ which indicates the busy condition of the trunk with which the plug P' is associated. The closing of alternate contact 100 of the relay SL² establishes an energizing circuit for the repeating coil switching relay RS, traced from battery, through the winding of relay RS, conductors 111 and 112 to ground at alternate contact 100 of relay SL². The relay RS energizes and closes its alternate contacts 57, 58, 59, 60 and 61 which connect the windings "a," "b," "c" and "d" of the repeating coil across the tip and ring conductors of the cord C. The closing of alternate contacts 99 and 102 of the relay SL² closes an energizing circuit for the polarized relay PL² which receives battery current over a circuit traced from battery through the winding of the impulse relay IR at the main exchange, the tip contacts of the connected trunk jack TJ and plug P', normal contact of the ringing key RK', normal contact 38 of the relay DC', alternate contact 42 of relay SL³, normal contact 19 of the relay OR, alternate contact 57 of relay RS, the winding "c" of the repeating coil RC, conductor 114, normal contact 74 of relay SS, conductor 98, alternate contact 99 of relay SL², conductor 115, through the windings of the polarized relay PL², conductor 116, alternate contact 102 of the relay SL², conductor 104, normal contact 75 of the relay SS, conductor 117, the winding "d" of the repeating coil RC, alternate contact 61 of the relay RS, normal contact 21 of the relay OR, normal contact of the ringing key RK', the ring contacts of the connected plug P' and jack TJ to ground through the winding of the impulse relay IR at the automatic main exchange. The polarized relay PL² is energized over this circuit and its alternate contact 120 establishes a circuit for the calling supervisory lamp CS, traced from battery through the lamp CS, alternate contact 101 of relay SL², conductors 118 and 119 to ground at alternate contact 120 of relay PL². The relays CR and OR are energized due to the actuation of the listening key LK as before, the relay CR operating to prevent the operator from connecting to a second cord, in the manner previously described.

The operator, having inserted the plug P' in the trunk jack TJ to cause the operation of certain instrumentalities of the cord C as above described, now actuates the dialing key DK' which is associated with the plug P' and common to an operator's position. This closes an energizing circuit for the dialing control relay DC', traced from battery through the winding of the relay DC', con-

ductor 121, alternate contact 15 of the relay CR, conductor 122, to ground at alternate contact 123 of the dialing key DK'. The closure of alternate contacts 39 and 40 of the relay DC' established a locking circuit for itself, traced from battery through the winding of relay DC', the alternate contacts 39 and 40, conductors 118 and 119 to ground at alternate contact 120 of the relay PL². The closing of alternate contact 40 of the relay DC' also closes a circuit for the dial pilot lamp DP, traced from battery through the lamp DP, conductor 124, alternate contact 40 of relay DC', conductors 118 and 119, to ground at alternate contact 120 of the relay PL² for purposes which will presently be described. The closing of alternate contacts 37, 38 and 41 of the relay DC' bridges the impulse dial D, associated with the cord C and common to the operator's position, across the tip and ring conductors of the cord C and in circuit with the impulse relay IR at the main automatic exchange. The impulse circuit may be traced from battery through the winding of the relay IR at the main exchange, tip contacts of the connected plug P' and jack TJ, normal contact of the ringing key RK', alternate contact 38 of relay DC', conductor 128, closed impulse spring contacts 129 and 125 of the dial D, normal contact 126 of the dialing release key DI, conductor 127, alternate contact 37 of the relay DC', alternate contact 42 of relay SL³, alternate contact 18 of relay OR, conductor 78, normal contacts 72 and 35 of the auxiliary double cut-off listening key AL, conductor 36, alternate contact 19 of relay OR, alternate contact 57 of the relay RS, the winding "c" of the repeating coil RC, conductor 114, normal contact 74 of relay SS, conductor 98, alternate contact 99 of relay SL², conductor 115, the windings of the polarized relay PL², conductor 116, alternate contact 102, conductor 104, normal contact 75 of relay SS, conductor 117, the winding "d" of the repeating coil RC, alternate contact 61 of relay RS, alternate contact 21 of relay OR, conductor 32, normal contacts 31 and 71 of the key AL, conductor 77, alternate contact 22 of relay OR, normal contact of the ring key RK', ring contacts of the plug P' and trunk jack TJ to ground through the other winding of the impulse relay IR at the main automatic exchange. The opening of normal contact 38 of the relay DC' opens the initial energizing and bridged across the tip and ring conductors of the cord C over the circuit just described.

The operator now actuates the calling or impulse device D to send a series of impulses corresponding to the digits of the number of the wanted subscriber. Each time the impulse device is moved from normal the shunt spring 130 is moved into engagement with the impulse spring 125 to bridge the resist-

ance 131 across the tip and ring conductors of the cord through alternate contacts 38 and 41 of the relay DC' and upon the subsequent opening and closing of the impulse springs 125 and 129, each impulse will extend through the resistance 131 and the alternate contact 38 and 41 of the relay DC' instead of the bridged circuit, previously described. After the last digit of the number of the called subscriber has been dialed and, assuming that the line is idle, certain instrumentalities in the circuit at the automatic exchange operate in a manner well understood, to reverse the flow of battery through the windings of the polarized relay PL² over the circuit above described causing its armature to open its alternate contact 120 and efface the supervisory signal CS and dialing pilot signal DP. The effacement of the two signals gives the operator of the cord C an indication that the call has been extended to the called line. The opening of alternate contact 120 of the polarized relay PL² also opens the locking circuit of the relay DC' which restores to normal to disassociate the impulse dial D from the cord C. The operator now actuates the ringing key RK' to connect the generator G' to the line to signal the called subscriber at the main exchange. As the listening key LK is in its off normal position the operator may supervise the connection. When the called subscriber answers, in response to his call signal, the operator restores the listening key LK. The opening of alternate contact 7 of the key LK opens the energizing circuit of the relay CR which now restores and in turn opens the energizing circuit of the relay OR. The calling subscriber at the magneto substation A and the called subscriber at the main automatic exchange are now in a conversational circuit which may be traced over the heavily marked conductors which, in a trunk connection such as just described, include the windings "a" and "b", and "c" and "d" of the repeating coil RC, connected in the talking circuit through alternate contacts 57, 58, 59 and 61 of the relay RS.

The subscribers at the respective substations in the connection just described, having finished their conversation, replace their receivers upon their respective switchhooks. The subscriber at the calling toll or magneto substation A, after replacing his receiver upon the switchhook, actuates the hand generator HG to send an impulse of current through the windings of the polarized relay PL over a circuit previously described. The relay PL closes a circuit for the relay 92 which is locked up to ground at normal contact 23 of the listening key LK. The closing of alternate contact 93 of the relay 92 closes a circuit for the answering supervisory signal AS, traced from battery, through the supervisory signal AS, normal

contacts 83 and 84 of relay SL, conductor 140, alternate contact 60 of the relay RS, conductor 96 to ground at normal contact 23 of the listen key LK over the path previously traced in connection with relay 92. The lighted signal AS gives the operator of the cord a disconnect signal as previously described. The called subscriber at the main automatic exchange, replacing the receiver at the substation, operates instrumentalities at the main exchange which again reverse the flow of battery through the windings of the polarized relay PL² to cause the same to again close its alternate contact 120 to light the calling supervisory signal CS. The operator of the cord C, noting the lighted supervisory signals AS and CS, now removes the plugs P and P' from the respective jacks J and TJ. The removal of the plug P from the jack J opens the series energizing circuit of the cut-off relay CO of the line circuit L and the sleeve relay SL' of the cord C and the said relays restore. The operator now momentarily actuates the listening key LK to open its alternate contact 23 thus interrupting the locking circuit of the relay 92 which restores and interrupts the circuit of the answering supervisory signal AS. The removal of the plug P' of the cord C from the trunk jack TJ opens the series energizing circuit for the cut-off relay CO² associated with the trunk jack TJ and the sleeve relays SL² and SL³ of the cord C. The opening of alternate contact 101 of the relay SL² effaces the calling supervisory signal CS and the opening of alternate contact 100 opens the circuit of the repeating coil switching relay RS which restores to disconnect the repeating coil from the tip and ring conductors of the cord C. The relay CO², restoring, opens its alternate contact 110 to efface the busy lamp signal BL. The apparatus used in establishing the connection just described is now at normal and available for establishing other connections.

Referring again to the dialing operation by the operator associated with the cord C in extending a connection from the toll or local subscriber at substation A to a subscriber terminating at the automatic main exchange, should the operator inadvertently dial the wrong number, she may release the connection by actuating the dial release key DI. When the normal contact 126 of the dialing release key DI is opened it interrupts the dialing circuit to effect the release of the automatic switches at the main exchange. The opening of normal contact 126 also opens the energizing circuit of the polarized relay PL² which circuit extends through the normal contacts of the impulse springs of the calling device D, over a circuit previously described. The relay PL², in restoring, opens its alternate contact 120 to interrupt the locking circuit of the dialing control relay DC'

and also opens the circuit of the dialing pilot signal DP to efface the same. In case the dialing equipment associated with the cord C does not function properly or the operator does not dial the complete number the pilot lamp DP remains lighted until the operator actuates the dialing release key DI to release the apparatus of the cord C and the switches of the trunk connection as just described. The operator may again dial the number of the wanted substation at the main automatic exchange by actuating the dialing key DK' associated with the plug P' to effect the operation of the relay PL² and the dialing control relay DC' as previously described.

The auxiliary double cut-off listening key AL may also be used by the operator to converse with either the calling or called subscriber in a connection between a toll or local substation and a substation terminating at an automatic main exchange such as just described as is readily apparent from the detailed description of this operation relative to the connection between the toll or local substations A and B.

In describing the operation of my invention I have described the connections between two toll or local substations and a toll or local substation and an automatic main exchange substation. In these connections I have used the plug P of the cord C as the answering plug and the plug P' as the calling plug but the cord circuit C of my invention is of the universal type in which the plugs P and P' may be used interchangeably for either answering a call from a calling toll or magneto line or for extending a connection to an automatic main exchange through the medium of the trunk jack TJ. The dialing control relays DC and DC' are associated, respectively, with the plugs P and P' and, through the medium of the dialing keys DK and DK', the impulse or calling device D may be connected with either plug P or P' depending upon which plug is connected to the trunk jack TJ.

A polarized relay PL', associated with the plug P, operates in a manner similar to that described above in connection with the relay PL², should the plug P be connected with the trunk jack TJ. As it is readily apparent, from the previous description, how the cord C will operate should the plug P' be used for answering a call from the toll substation A and the plug P be used for extending a connection to a called toll substation as B or for extending a connection to a main automatic exchange through the medium of the trunk jack TJ, a detailed description of such a connection is not thought necessary.

While I have illustrated and described a specific form of my invention, it is to be understood that my invention may be modified by those skilled in the art without de-

parting from the spirit of my invention and I therefore do not wish to be limited to the exact circuit arrangement as shown but aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

Having described my invention what I claim is new and desire to secure by United States Letters Patent is—

1. A telephone system including telephone lines and cord circuits for use in interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cord circuits, means for interchangeably connecting said terminals with a calling line or with said trunk terminal, an impulse device common to said cord circuits, manual means common to said cords, and means in said cords, respectively, controlled by said key for bridging said impulse device across said connected trunk.

2. A telephone system including telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cord circuits, means for interchangeably connecting said plug terminals with a calling line or with said trunk line, an impulse device common to said cord circuits, a listening key for said connected cord, manual means common to said cords, and means in said cord for operatively connecting said impulse device to said connected trunk controlled by said listening key and said manual means.

3. A telephone system including telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting the terminals of a cord with a calling line or with said trunk line, an impulse device common to said cord circuits, a listening key in said connected cord, manual means common to said cords, means in said cord controlled by said listening key and manual means for bridging said impulse device across said connected trunk, and locking means for holding said impulse dial bridged across said trunk.

4. A telephone system including telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord with a calling line or with said trunk line, an impulse device common to said cord circuits, a listening key, manual means common to said cords, means in said

cord controlled by said key and said manual means for bridging said impulse device across said connected trunk, means for holding said impulse dial bridged across said connected trunk during the sending of impulses to operate said impulse controlled mechanism at the distant end of said trunk.

5. A telephone system including telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord with a calling line or with said trunk line, an impulse device common to said cord circuits, manual means common to said cords, means in said cord controlled by said manual means for bridging said impulse device across said connected trunk, means for holding said impulse dial bridged across said trunk during the sending of impulses to operate said impulse controlled mechanism at the distant end of said trunk and means at the distant end of said trunk for releasing said holding means.

6. A telephone system including telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord with a calling line or with said trunk terminal, an impulse device common to said cords, manual means common to said circuits, a listening key, means in said connected cord controlled by said key and said manual means for bridging said impulse device across said trunk, said means maintaining said bridge during the sending of a series of impulses, means in said cord for restoring said bridging means, and means at the distant end of said trunk for effecting the operation of said restoring means at the completion of the series of impulses.

7. A telephone system including magneto telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord with a calling magneto line or with said trunk line, an impulse device common to said cords, a listening key for the connected cord, a dial connecting key common to said cords, means under the control of said listening key, and means controlled by said connecting key through said means controlled by said listening key for bridging said impulse device across said connected trunk.

8. A telephone system including magneto telephone lines and cord circuits for inter-

connecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord to a calling magneto line or to said trunk line, an impulse device common to said cords for transmitting impulses to said mechanism, a listening key for the connected cord, a dial connecting key, common to said cords, means in said cord under the control of said listening key, a relay initially controlled by said connecting key through said means controlled by said listening key for bridging said impulse device across said connected trunk, and a second relay in said cord, operated when said impulse device is bridged across said trunk, and a circuit for said first mentioned relay controlled by said second relay.

9. A telephone system including magneto telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cord circuits, means for interchangeably connecting either terminal of a cord to a calling line or to said trunk line, relays, one associated with each of the plug terminals of a connected cord, an impulse device common to said cord circuits, an impulse device connecting key controlling the said relay associated with the plug terminal of the cord connected to said trunk to bridge said impulse device across said trunk.

10. A telephone system including magneto telephone lines and cord circuits for interconnecting them as calling and called lines, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cord circuits, means for interchangeably connecting either terminal of a cord circuit to a calling line or to said trunk line, relays, one associated with each of the plug terminals of a connected cord, an impulse device common to said link circuits, a listening key for said connected cord, a dial connecting key, means in said cord circuit under the control of said listening key, said dial key controlling the one of said relays associated with the plug terminal of the cord joined to said trunk through said means under the control of said listening key to bridge said impulse device across said trunk.

11. A telephone system including telephone lines and cord circuits for interconnecting them, a trunk line having directive impulse controlled mechanism at its distant end, a pair of plug terminals for each of said cords, means for interchangeably connecting either terminal of a cord with a calling line or with said trunk, a relay in said cord associated with the plug terminal connected to said trunk, a circuit for said relay, a listen-

ing key for said connected cord, means in said cord controlled by said listening key, manual means common to said cords initially controlling said relay circuit through said first mentioned means, a second relay in said cord energized over said trunk when said first relay operates, to hold said first relay operated to maintain said impulse device in bridge of said trunk during the transmission of impulses.

12. A telephone system including telephone lines and cord circuits for interconnecting them, a trunk line having directive impulse controlled mechanism at its distant end, plug terminals, one for each end of each of said cords, means for interchangeably connecting either terminal of a cord to a calling line or to said trunk, a relay in said cord associated with the plug terminal connected to said trunk, a circuit for said relay, a listening key for the connected cord, means in said cord controlled by said listening key, manual means common to said cords initially controlling said relay circuit through said first mentioned means, a second relay in said cord, energized over said trunk when said first relay is initially operated, to hold said first relay operated to maintain said impulse device in bridge of said trunk during the transmission of impulses and means in said trunk for affecting said second relay at the termination of said impulses to interrupt said bridge.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 12th day of June, 1929.

BERT WALLACE.

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