

Nov. 5, 1929.

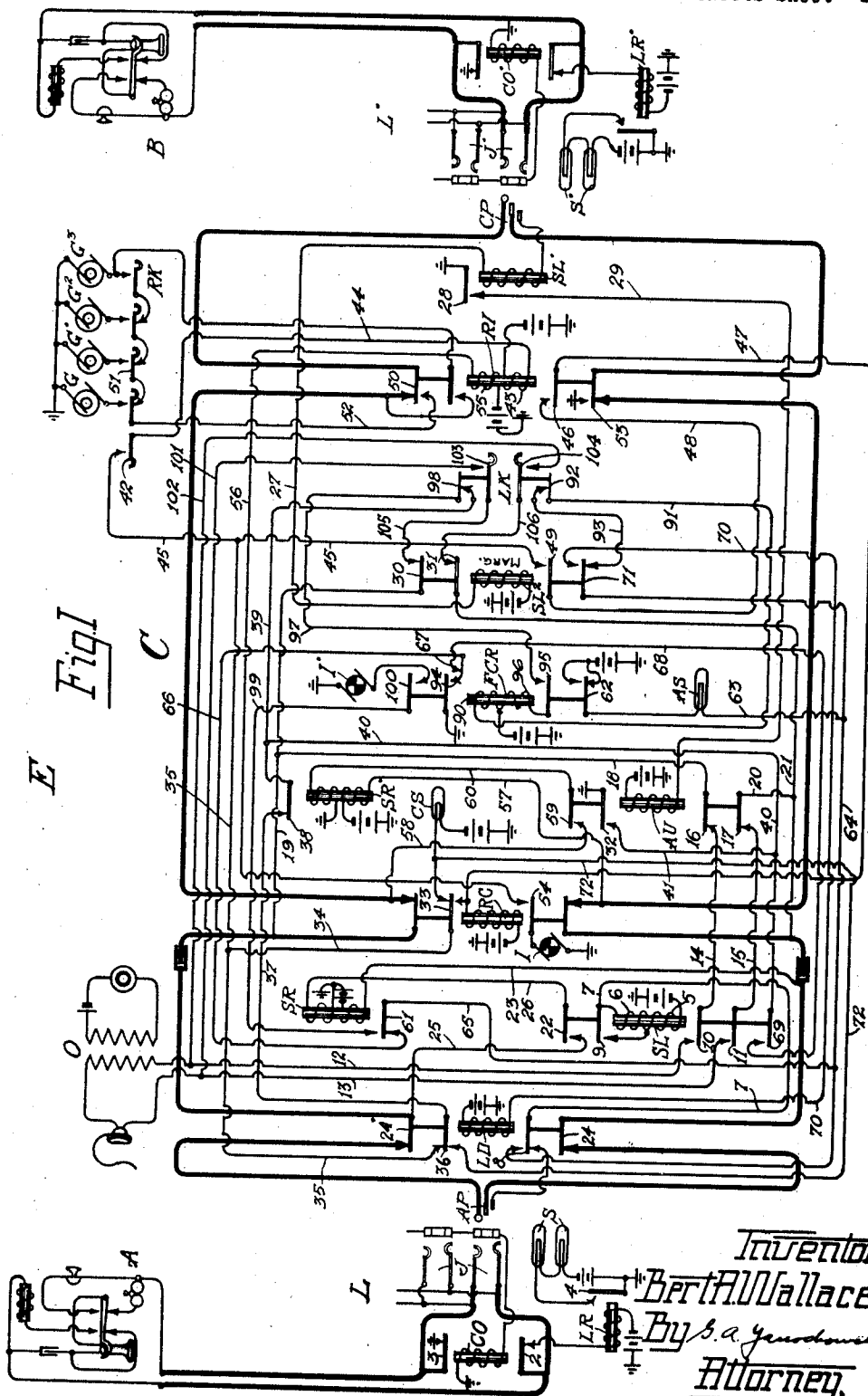
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1,734,355

TELEPHONE SYSTEM.

Filed Dec. 20, 1926

2 Sheets-Sheet 1



Nov. 5, 1929.

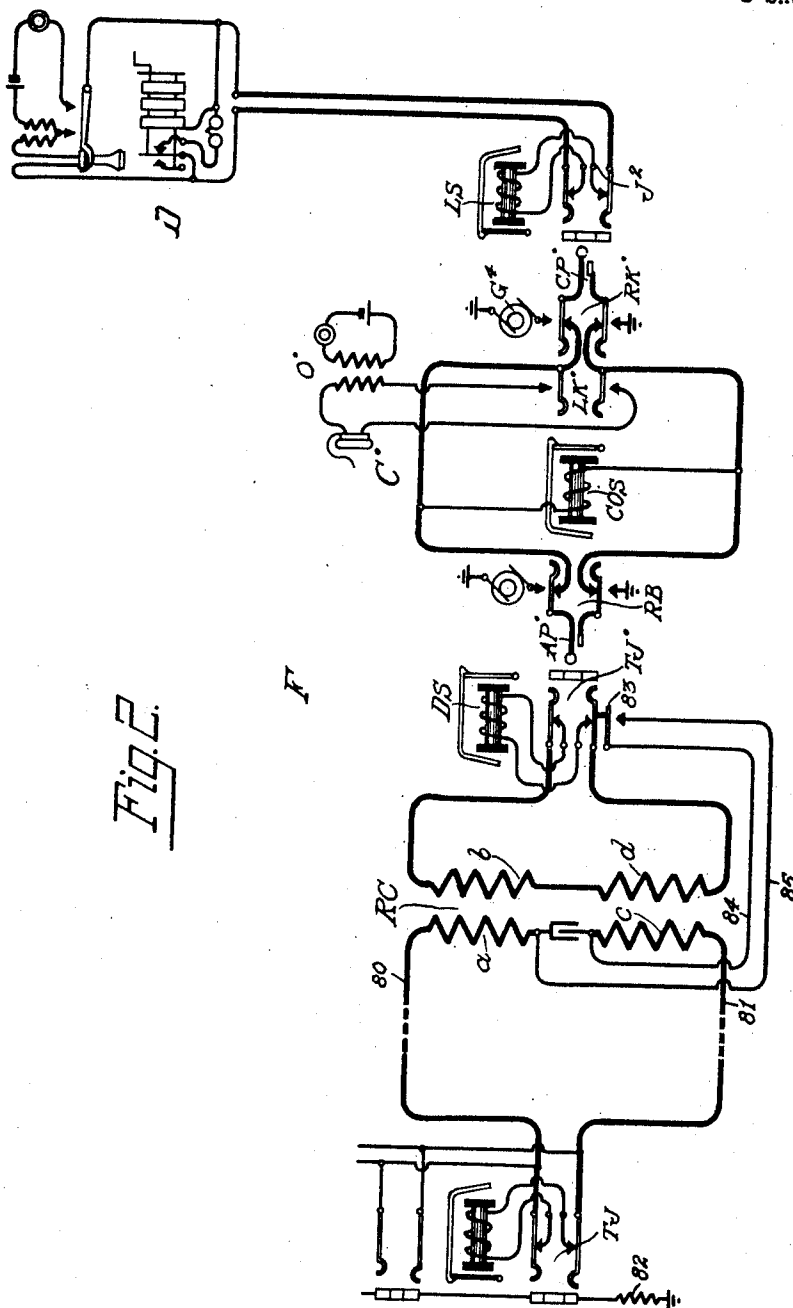
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TELEPHONE SYSTEM

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2 Sheets-Sheet 2



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TELEPHONE SYSTEM

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My invention relates to telephone systems and has to do more particularly with systems for interconnecting lines terminating at different exchanges and has for its object, a novel and improved circuit arrangement.

In systems of the above character a call originating at a common battery exchange will be answered in the usual manner and through the medium of a cord circuit, provided with the well known instantaneous disconnect and line lamp recall means, may be extended to another substation located in the same exchange or may also be used to complete connections direct to toll lines for connections between a local subscriber at one exchange and a subscriber at a distant exchange. Means are provided in the said cord circuit which function when a calling subscriber recalls on a local to toll connection to switch from instantaneous disconnect with line lamp recall to a flashing recall appearing only before the original operator so that she may properly time and supervise the connection or take care of the wants of the recalling subscriber.

Another feature of my invention is the provision of a listening key in association with the keyless listening of the cord which provides means for permitting the operator to cut in only on local to toll connections for supervision purposes and when answering a recall on a connection of this kind.

For a more complete understanding of my invention reference may be had to the accompanying drawings which comprise Figs. 1 and 2. Fig. 2 when placed to the right of Fig. 1 illustrates a complete circuit arrangement for extending a connection from a subscriber at a common battery exchange to a subscriber in a distant exchange. Referring now particularly to Fig. 1, I illustrate at the left of the drawing a calling common battery substation A terminating at the local exchange E in a line circuit L, comprising a line relay LR, cut off relay CO and multiple answering jacks J, associated with the multiple line lamps S. The jacks J and lamps S appear before a plurality of operators and a call initiated at the substation A will appear before a plurality of operators as is well understood.

The cord circuit C for interconnecting a pair of local lines at the exchange E or for extending a connection to a distant exchange comprises an answering plug AP and a calling plug CP connected by the heavily marked conductors. The answering end of the cord C comprises a sleeve relay SL which is energized when the answering plug AP is inserted into the jack J of the calling line to connect the operator's set O to the cord conductors. An answering supervisory relay SR and an answering supervisory lamp AS are provided for the usual supervisory purposes. The calling end of the cord circuit C comprises sleeve relays SL' and SL², the said sleeve relay SL' energizing when connection is made with either a local line or with a trunk leading to a distant exchange. The sleeve relay SL² also energizes when connection is made with a local called line but does not energize when a connection is made with a trunk leading to a distant exchange for purposes as will be more fully hereinafter described.

An auxiliary sleeve relay AU is provided which energizes upon the energization of the relay SL' to disconnect the operator's set O from the cord conductors. A ringing interrupter relay RI, a ringing control relay RC and a party line ringing key RK associated with the ringing generators G, G', G² and G³ provide means for signalling the called for subscriber on a local connection as is well understood and also used for signalling an operator at a distant exchange as will be more fully hereinafter described. A calling supervisory relay SR' and a calling supervisory lamp CS are provided for the usual supervisory purposes. A flashing supervisory signal control relay FCR is provided which controls the flashing of the supervisory signal AS to indicate a recall to the operator of a calling subscriber on a local to toll connection and a listening key LK is also provided which permits the operator at the local exchange to connect her set to the cord conductor on such a connection so she may properly time and supervise a local to toll connection and to permit her to answer a recall in response to the flashing recall signal on such a con-

nection. To the right of Fig. 1, I illustrate a called local substation B terminating at the exchange in a line circuit L' comprising a line relay LR', a cut off relay CO', multiple answering jacks J' and line signals S'.

Referring now to Fig. 2 I illustrate a trunk jack TJ located at the exchange E which extends over the trunk conductors and terminates at the distant exchange in windings *a* and *c* of the repeating coil RC. The windings *b* and *d* of the repeating coil RC terminate in an incoming trunk jack TJ' associated with a drop signal DS, which is operated by ringing current from the exchange E to signal the operator at the exchange F. The cord circuit C' for connecting the called line D which terminates in a jack J² and line signal LS at the exchange F with the trunk jack TJ' comprises an answering plug AP' and calling plug CP' which are connected by the heavily marked conductors. The cord C' is provided with the usual ring back key RB, listening key LK', ringing key RK' and clearing out signal COS.

Having described in general the apparatus comprising the circuit arrangement of my invention I will now describe in detail the operation of the same.

Assuming now that the subscriber at the substation A initiates a call, the removal of the receiver from the switchhook closes an energizing circuit for the line relay LR of the line circuit L traced from battery through the winding of line relay LR, normal contact 2 of the cut off relay CO, through the closed contacts of the substation switchhook, to ground at normal contact 3 of the relay CO. The relay LR energizing, closes its alternate contact 4 thus establishing a circuit for the line signals S traced from battery through the lamps S, to ground at alternate contact 4 of relay LR. The lamps S which appear before a plurality of operators are lighted over this circuit just described and any one of the plurality of operators may seize the call to the exclusion of the others. Assuming that the operator associated with the cord circuit C seizes the call, the insertion of the answering plug AP of the cord circuit C into the answering jack J of the calling line establishes an energizing circuit for the sleeve relay SL of the cord C and the cut off relay CO of the line circuit L, traced from battery through windings 5 and 6 of the relay SL, conductor 7, normal contact 8 of the link disconnect relay LD, sleeve contacts of the connected plug AP and jack J, to ground through the winding of the cut off relay CO. The sleeve relay SL energizing closes its alternate contact 9 thus establishing a circuit for itself and the relay CO traced from battery through the low resistance winding 5 of relay SL, its alternate contact 9, conductor 7 to ground through the winding of relay CO over the previously described path. The relay CO

upon energization opens its normal contacts 2 and 3 which interrupts the circuit of line relay LR and the relay LR upon restoration effaces the line signals S. The relay SL energizing closes its alternate contacts 10 and 11 to connect the operator's set O to the cord conductors over conductors 12 and 13, alternate contacts 10 and 11 of relay SL, conductors 14 and 15, normal contacts 16 and 17 of the auxiliary sleeve relay AU, conductors 18, 19, 20, 21 respectively to the tip and ring conductors of the cord circuit C. The relay SL energizing closes its alternate contact 22 to close a circuit for the supervisory relay SR traced from battery through the lower winding of relay SR, conductor 23, normal contact 24 of relay LD, ring contacts of the connected plug AP and jack J, through the substation A, back through the tip contacts of the jack J and plug AP, normal contact 24' of relay LD, conductor 25, alternate contact 22 of relay SL, conductor 26, to ground through the upper winding of relay SR, and the relay SR operates over this circuit for the usual supervisory purposes. Should another operator attempt to seize the call subsequent to the operator of the cord C, the insertion of the second plug in the multiple answering jack of the calling line will have no effect upon the sleeve relay SL of the second cord as the relay SL of the second cord is shunted due to the low resistance path through the winding 5 of the relay SL of the cord C connected to the calling line. The relay SL of the second cord failing to energize, the operator's set associated with the second cord is of course not connected and the operator failing to receive a response withdraws her plug from the jack.

The operator of the cord C having been connected to the cord conductors as before described now inquires the wants of the calling subscriber and assuming that it is the subscriber at the substation B that is wanted the operator inserts the calling plug CP into the jack J' of the called line. The insertion of the plug CP into the jack J' closes an energizing circuit for the sleeve relays SL' and SL² traced from battery through the winding of relay SL², conductor 27, through the winding of relay SL', sleeve contacts of the connected plug CP and jack J' to ground through the winding of the cut off relay CO' of the line circuit L'. The relay SL' energizing closes its alternate contact 28 to establish an energizing circuit for the auxiliary sleeve relay AU traced from battery through the winding of relay AU, conductor 29 to ground at alternate contact 28 of relay SL'. The relay AU upon energization opens its normal contacts 16 and 17 to disconnect the operator's set O from the cord conductors, and the relay SL² upon energization opens its normal contacts 30 and 31 to prevent the operator from connecting her set O to the cord conductor

should she actuate her listening key LK. The closing of alternate contact 32 of relay AU closes a circuit for the calling supervisory lamp CS traced from battery through the lamp CS, normal contact 33 of ringing control relay RC, conductors 34 and 35, normal contact 36 of link disconnect relay LD, conductor 37, normal contact 38 of supervisory relay SR', conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU. The lamp CS is lighted over this circuit and remains lighted until the operator depresses the ringing key to signal the called for subscriber at substation B.

The operator now signals the subscriber at substation B by depressing one of the ringing key plungers of the party line ringing key RK to connect ringing current of the proper frequency to operate the call signal at the called substation B. Assuming that the generator G' is of the selected frequency the key plunger associated with this generator is moved to its fully depressed position, in which position the end spring contacts 42 of the ringing key RK are also closed. The closure of contact 42 of the end spring contacts establishes an energizing circuit for the ringing interrupter relay RI traced from battery through the winding 43 of relay RI, conductor 44, alternate contact 42 of the end spring contacts, conductors 45 and 35, normal contact 36 of relay LD, conductor 37, normal contact 38, conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU. The relay RI energizes and closes its alternate contact 46 thus establishing an energizing circuit for the ringing control relay RC traced from battery through the relay RC, conductor 47, alternate contact 46 of relay RI, conductor 48, alternate contact 49 of relay SL², conductors 45 and 35, normal contact 36 of relay LD, conductor 37, normal contact 38, conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU. The relay RC energizes and opens its normal contact 33 to efface the signal CS and the closing of its alternate contact 33 establishes a locking circuit for itself traced from battery through the winding of relay RC, its alternate contact 33, conductors 34 and 35, normal contact 36, to ground at alternate contact 32 of relay AU over the previously described path. The relay RI upon energization, as just described, closes its alternate contact 50 to connect ringing current from the selected generator G' which may be traced from the ungrounded pole of the generator G' through the closed contact 51 of the depressed key plunger, conductor 52, alternate contact 50 of relay RI, tip contacts of the plug CP and jack J' through the call bell and condenser at the called substation B, back through the ring contacts of the jack J' and plug CP to ground at alternate contact 53 of relay RI. The instant that the ringing key plunger is depressed and the end springs 42

are closed the relay RI is energized to connect ringing current to the called line giving the subscriber thereat an instantaneous first ring. When pressure is released from the actuated key plunger it assumes its indicating position and the end spring contact 42 is also opened but as the relay RC is now locked in an energized condition independent of alternate contact 46 of relay RI the closure of alternate contact 54 of relay RC connects the constantly rotating interrupter I in circuit with the interrupter relay RI traced from battery through the upper winding 55 of relay RI, conductor 56, alternate contact 54 of relay RI to ground through the constantly rotating interrupter I. The relay RI is alternately energized and deenergized over this circuit to connect ringing current to the called line to intermittently signal the called subscriber at the substation B, and the path for the ringing current from the generator G' to the substation B is the same as previously described.

The subscriber at the substation B in response to his call signal removes his receiver from the switchhook and when the relay RI is in a deenergized condition which is during a silent period of a ringing cycle and energizing circuit is established for the supervisory relay SR', traced from battery through the lower winding of relay SR', conductor 57, ring conductor of the cord C, normal contact 53 of relay RI, ring conductors of the plug CP and jack J' through the now closed contacts at the substation switchhook, back through the tip contacts of the jack J' and plug CP, normal contact 50 of relay RI, tip conductor of the cord C, conductor 58, alternate contact 59 of relay AU, conductor 60, to ground through the upper winding of relay SR'. The relay SR' energizes and opens its normal contact 38 which opens the locking circuit of the relay RC and the relay RC upon deenergization opens its alternate contact 54 and the opening of the contact 54 disconnects the interrupter I from the winding 55 of the relay RI and the relay RI now remains at normal and prevents further application of ringing current to the called line. The calling subscriber at the substation A and the called subscriber at the substation B are now in conversational circuit which may be traced over the heavily marked conductors.

Upon the termination of conversation the subscribers at the stations A and B replace their receivers upon their respective switchhooks. The replacing of the receiver at the substation A opens the energizing circuit of the supervisory relay SR at the switchhook contacts and the relay SR upon deenergization closes its normal contact 61 establishing a circuit for the answering supervisory lamp AS traced from battery at normal contact 62 of relay FCR, through the lamp AS, con-

ductors 63, 64 and 65, normal contact 61 of relay AS, conductor 66, normal contact 67 of relay FCR, conductor 68, alternate contact 69 of relay SL, conductors 40 and 41 to ground at alternate contact 32 of relay AU and the answering supervisory lamp AS is lighted over this circuit. The replacing of the receiver at the called substation B opens the energizing circuit of the calling supervisory relay SR' at the switchhook contacts and the closing of its normal contact 38 establishes a circuit for the calling supervisory lamp CS traced from battery through the lamp CS, normal contact 33 of relay RC, conductors 34 and 35, normal contact 36 of relay LD, conductor 37, normal contact 38 of relay SR', conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU, and the lamp CS is lighted over this circuit. The lighted answering and calling supervisory lamps AS and CS indicate to the operator of the cord C that the subscribers at the calling and called substations A and B have finished conversation and have replaced their receivers upon their respective switchhooks.

The relay SR upon deenergization closes an energizing circuit for the link disconnect relay LD traced from battery through the winding of relay LD, conductor 70, alternate contact 71 of relay SL², conductors 64 and 65, normal contact 61 of relay SR, conductor 66, normal contact 67 of relay FCR, conductor 68, alternate contact 69 of relay SL, conductors 40 and 41 to ground at alternate contact 32 of AU. The relay LD energizes and opens its normal contact 8 interrupting the initial energizing circuit of the sleeve relay SL but the contact 8 of relay LD assuming its alternate position establishes a substitute energizing circuit for the relay SL independent of the cut off relay CO traced from battery through winding 5 of relay SL its alternate contact 9, conductor 7, alternate contact 8, conductors 64 and 65, normal contact 61 of relay SR, conductor 66, normal contact 67 of relay FCR, conductor 68, its alternate contact 69, conductors 40 and 41 to ground at alternate contact 32 of relay AU. The relay SL remaining energized also maintains the relay LD energized over the circuit as previously described. The relay LD energizes and opens its normal contact 36 which interrupts the initial circuit of the calling supervisory lamp CS but a substitute circuit is closed for the lamp CS traced from battery through the lamp CS, conductor 72, alternate contact 36 of relay LD, conductor 37, normal contact 38 of relay SR', conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU.

The link disconnect relay LD upon energizing opens its normal contacts 24 and 24' to disconnect the cord conductors from the calling line, and as the cut off relay CO is now at normal the calling subscriber may initiate

a recall by removing his receiver which again brings about the energization of the line relay LR to light the line signals S and the same operator who answered the original call may seize the recall or any one of a plurality of operators may seize it as is well understood from the previous description.

The operator noting the two lighted signals AS and CS now removes the plugs AP and CP from the respective jacks J and J' and the removal of the answering plug AP from the jack J disconnects the answering end of the cord C from the calling line. The removal of the calling plug CP from jack J' opens the energizing circuit of the cut off relay CO', and sleeve relays SL' and SL². The relay SL' upon deenergizing opens its alternate contact 28 which allows the relay AU to restore and the opening of alternate contact 32 of relay AU allows relays LD and SL to restore and also effaces the signals AS and CS. The apparatus used in establishing the connection above described is now at normal and available for establishing other connections.

Having described in detail the operation of Fig. 1 in which a calling local substation as A is connected to a called local substation B, I will now describe the operation of the circuit arrangement illustrated in Fig. 1 in connection with the circuit arrangement illustrated in Fig. 2. Fig. 2 when placed to the right of Fig. 1 illustrates a circuit connection between the calling subscriber at the substation A terminating at the exchange E and a called subscriber at the substation D terminating at the distant exchange F.

Assuming now that the subscriber at the substation A initiates a call the operation of the circuit arrangement of Fig. 1 is the same as previously described up to and including the connection of the operator's set O to the cord conductors of the cord circuit C. The operator now inquires the wants of the calling subscriber at the substation A and assuming that it is the subscriber at the substation D terminating at the distant exchange F that is wanted, the operator of the cord circuit C inserts the calling plug CP into the trunk jack TJ terminating at her position and which leads to the distant exchange F and depresses one of the key plungers of the ringing key RK to impress ringing current over the trunk conductors 80 and 81 to actuate the drop signal DS at the distant exchange F. The insertion of the calling plug CP into the trunk jack TJ closes an energizing circuit for the sleeve relay SL' traced from ground through the resistance 82, sleeve contacts of the connected jack TJ and plug CP, through the winding of relay SL', conductor 27 to battery through the winding of relay SL². The relay SL' operates over this circuit but the relay SL² does not due to the high resistance 82 in circuit with the relays SL' and SL².

The relay SL' upon energizing closes its alternate contact 28 to operate the relay AU, current flowing from battery through relay AU, conductor 29 to ground at alternate contact 28 of relay SL'. The relay AU energizes and closes its alternate contact 32 closing a circuit for the calling supervisory lamp CS over a path as previously described and the lamp CS is lighted over this circuit and remains lighted until the operator at the distant exchange F inserts the answering plug AP' of the cord circuit C' in the incoming trunk jack TJ' in response to the actuated drop signal DS at the distant exchange as will now be described. The operator of the cord C at the exchange E having depressed a key plunger of the ringing key RK also closes the end spring 42 to energize the relay RI over a circuit as previously described and the closing of alternate contact 50 of relay RI connects ringing current from the connected generator G over conductor 52, alternate contact 50 of relay RI, tip contacts of the connected plug CP and trunk jack TJ, conductor 80, windings *a* and *c* of the repeating coil RC, conductor 81, ring contacts of the connected jack TJ and plug CP to ground at alternate contact 53 of relay RI. Ringing current is induced into the secondary windings *b* and *d* of the repeating coil RC and through the winding of the drop signal DS whereby the signal DS is operated. The operator at the distant exchange F in response to the actuated drop signal DS inserts the answering plug AP' of the cord circuit C' into the incoming trunk jack TJ' and actuates her listening key LK' to connect her operator's set O' to the cord conductors. The insertion of the plug AP' into the jack TJ' closes the normally open auxiliary contact 83 of the jack TJ' which closes an energizing circuit for the calling supervisory relay SR', traced from battery through the lower winding of relay SR', conductor 57, normal contact 53 of relay RI, ring contacts of the connected plug CP and trunk jack TJ, conductor 81, winding *c* of the repeating coil RC, conductor 84, closed contact 83 of the jack TJ', conductor 85, winding *a* of the repeating coil RC, conductor 80, tip contacts of the connected jack TJ and plug CP, normal contact 50 of relay RI, conductor 58, alternate contact 59 of relay AU, conductor 60 to ground through the upper winding of relay SR'. The relay SR' upon energizing opens its normal contact 38 which opens the circuit of the supervisory signal CS which is now effaced and notifies the operator of the cord C at the exchange E that the operator at the distant exchange F has answered the call. The operator of the cord C' at the exchange F now actuates her listening key LK' to connect her operator's set O' and inquires the wants of the calling subscriber A at the exchange E and assuming that it is the sub-

scriber at the substation D that is wanted she inserts the calling plug CP' into the jack J² of the called line and depresses the ringing key RK' to impress ringing current upon the called line from the connected generator G⁴ and the subscriber at D in response to his call signal removes his receiver. The subscriber at the substation A at the exchange E and the subscriber at the substation D at the exchange F are now in conversational circuit which may be traced over the heavily marked conductors.

Upon the termination of conversation the subscribers replace their receivers upon their respective switchhooks and the replacing of the receiver at the called substation D at the distant exchange and the actuation of the hand generator thereat causes the current from the hand generator to actuate the clearing out signal COS of the cord circuit C' at the exchange F'. The operator noting the actuated clearing out signal removes the answering plug AP' of the cord C' from the jack TJ' and the removal of the said plug again opens the contact 83 associated with the jack TJ'. The opening of this contact 83 again opens the circuit of the calling supervisory relay SR' and the relay SR' upon de-energizing again closes its normal contact 38 to close a circuit for the calling supervisory signal CS. The signal CS is again lighted and gives the operator of the cord circuit C at the exchange E an indication that the subscriber at substation D at the distant exchange F has replaced his receiver and that the operator at the distant exchange has removed the plug AP' from the jack TJ'.

The replacing of the receiver at the calling substation A at the exchange E opens the energizing circuit of the answering supervisory relay SR at the switchhook contacts and the closing of its normal contact 61 closes an energizing circuit for the flashing supervisory signal control relay FCR traced from battery through the upper winding 90 of relay FCR, conductor 91, normal contact 92 of the listening key LK, conductor 93, normal contact 71 of relay SL², conductors 64 and 65, normal contact 61 of relay SR, conductor 66, normal contact 67 of relay FCR, conductor 68, alternate contact 69 of relay SL, conductors 40 and 41 to ground at alternate contact 32 of relay AU. The relay FCR energizes over this circuit and the closure of its make before break contact 94 maintains the relay FCR energized the energizing circuit being traced from ground at the make before break contact 94, conductor 66, normal contact 61 of relay SR, conductors 65 and 64, normal contact 71 of relay SL², conductor 93, normal contact 92 of the key LK, conductor 91 to battery through the winding 90 of relay FCR. The closing of alternate contact 95 of relay FCR also closes a circuit through its lower winding 96, traced from battery through the

winding 96 of relay FCR, alternate contact 95 of relay FCR, conductor 97, normal contact 98 of listening key LK, conductors 39, 40 and 41 to ground at alternate contact 32 of relay AU. The closing of alternate contact 62 of relay FCR closes a circuit through the lamp AS traced from battery through alternate contact 62, the lamp AS, conductors 63, 64 and 65, normal contact 61 of relay SR, conductor 66, to ground at the make before break contact 94 of relay FCR. The relay FCR energizes immediately upon the restoration of relay SR to normal and thus prevents the lamp AS from operating over a circuit through normal contact 62 of relay FCR as is the case in a connection between two local substations. The lamp AS is lighted over this circuit and the lighted signal lamps AS and CS indicate to the operator that conversation has terminated.

Assuming now that the calling subscriber wishes information relative to the trunk connection as to the charges, wrong number or inquiry of a similar nature, the removal of the receiver at the substation A again energizes the answering supervisory lamp AS. The relay SR energizes and opens its normal contact 61 thereby opening the circuit through the upper winding 90 of relay FCR, but the relay FCR remains energized over a circuit which extends through its lower winding 96 as before described. The closing of alternate contact 61 of relay SR now closes a circuit through the answering supervisory lamp AS traced from battery, through alternate contact 62 of relay FCR, through the lamp signal AS, conductors 63, 64 and 65, alternate contact 61 of relay SR, conductor 99, alternate contact 100 of relay FCR, to ground through the constantly rotating interrupter I'. The answering supervisory lamp AS is flashed due to the interrupter I' and gives the operator of the cord C at the exchange E a distinctive indication that the subscriber at A is seeking information. The operator of the cord C now actuates her listening key LK to connect her operator's set O to the cord conductors over conductors 12, 13 and 101, 102, alternate contacts 103 and 104 of the listening key LK, conductors 105, 106, normal contacts 30 and 31 of relay SL², and conductors 19 and 21 to the respective tip and ring conductors of the cord C. The opening of normal contact 98 of the listening key LK opens the circuit through the winding 96 of relay FCR and the relay deenergizes to open its alternate contacts 62 and 100 which interrupts the flashing circuit of the lamp signal AS. The operator may now converse with the calling subscriber at A and take care of his wants.

From the previous description of a connection between two subscribers located in the exchange E it will be remembered that when the calling subscriber recalled the recall appeared before a plurality of operators.

When a calling subscriber at E is connected with a subscriber at the distant exchange F the relay SL² of the cord C at the exchange E fails to energize, as before pointed out, and as this relay controls the operation of the link disconnect relay no energizing circuit is established for the relay LD when the calling subscriber at E replaces his receiver so that when a calling subscriber wishes to recall on a local to toll connection as just described, the recall will appear only before the operator who supervised the connection. The operator may supervise the connection at all times through the use of her listening key LK which connects her set O to the cord conductors during the setting up period or while conversation is going on as the relay SL² remains deenergized as before described. The operator's set O is connected to the cord conductors through normal contacts 30 and 31 of relay SL² and in the event that the calling subscriber at A wishes to recall the original operator who received the recall may take care of the wants of the recalling subscriber and also properly supervise a local to toll connection as just described. When the operator notes the two lighted supervisory signals AS and CS she removes the plugs AP and CP from the respective jacks J and TJ. The removal of the plug CP from the jack TJ allows relay SL² to restore to open the circuit of relay AU. The relay AU restoring opens the circuit of relay FCR and effaces the lamp signals AS and CS. The removal of the plug AP from the jack J opens the circuit for the relays SL and CO and the apparatus used in establishing the connection between the subscriber at A and the subscriber at D in the distant exchange F is now at normal and available for establishing other connections.

While I have described my invention in connection with a certain circuit arrangement, I do not wish to be limited to the same, as modifications and changes may suggest themselves to those skilled in the art, therefore I desire 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 comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connection terminals for interconnecting said calling local and called local or toll lines, means in said link circuit controlled by said calling local line on a local to local connection for operatively disassociating itself from a connection terminal of said link circuit, said means being rendered ineffective when said local line is connected to a toll line.

2. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of

connection terminals for interconnecting said calling local and called local and toll lines, means in said link circuit controlled by said calling local line on a local to local connection for operatively disassociating itself from said link circuit, a supervisory signal in said link circuit lighted upon the operation of said means, and means in said link for rendering ineffective the said first means when said local line is connected to a toll line.

3. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connection terminals for interconnecting said calling local and called local or toll lines, means in said link circuit controlled by said calling local line on a local to local connection for operatively disassociating said calling line from the said link circuit, a supervisory signal in said link circuit lighted upon the operation of said means, means in said link circuit for rendering ineffective the said first means on a local to toll connection and for closing another circuit for said supervisory signal to cause said signal to be intermittently operated.

4. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling local and called local or toll lines, a relay in said link responsive to the connection of a connecting terminal of said link to a called local line, means in said link controlled by said calling line on a local to local connection and said relay for disassociating said calling line from a connection terminal of said line, said relay being ineffective when a connecting terminal of said link is connected with a toll line to render ineffective the calling line's control of said means.

5. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling local and said called local and toll lines, a supervisory signal, a relay in said link responsive to the connection of a connecting terminal of said link to a called local line, means in said link controlled by said calling line on a local to local connection through contacts of said relay for disassociating said calling line from the connecting terminal of said line, and lighting said supervisory signal, said relay being inoperative when a connecting terminal of said link is connected with a toll line whereby the calling line's control of said means is rendered ineffective.

6. A telephone system comprising local calling and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling local and said called local and toll lines, a supervisory signal, a relay in said link responsive to the connection of a connecting

terminal of said link to a called local line, means in said link controlled by said calling line on a local to local connection through contacts of said relay for disassociating said calling line from the connecting terminal of said line and lighting said supervisory signal, said relay being inoperative when a connecting terminal of said link is connected with a toll line to render ineffective the calling line's control of said means and means operating through said relay on a local to toll connection to cause said supervisory signal to be intermittently operated.

7. A telephone system including a calling subscriber's line, called lines of different character, a signal individual to said calling line, a link circuit for connecting said calling line to said called lines, a signal individual to said link circuit, and subscriber controlled means for operating said first signal if said link circuit is used to connect said calling line to a called line of one character and for intermittently operating the second of said signals if said link circuit is connected to a called line of a different character.

8. A telephone system including a calling subscriber's line, called lines of different character, a signal individual to said calling line, a link circuit for connecting said calling line to said called lines, a signal individual to said link circuit, and subscriber controlled means for operating said first signal if said link circuit is used to connect said calling line to a called line of one character and for operating the second of said signals if said link circuit is connected to a called line of a different character to denote a recall.

9. A telephone system including a calling subscriber's line, called lines of different character, an operator's link circuit having a pair of connecting terminals for interconnecting said calling and called lines, an operator's telephone set, relay means in said link circuit for connecting said operator's telephone set to said link circuit, other relay means for disconnecting said telephone set from said link circuit, an operator's listening key for connecting said telephone set and said link circuit, relay means in said link circuit responsive to the connection of a connecting terminal of said link circuit to a called line of one character to render said listening key ineffective to connect said operator's telephone set and said link circuit.

10. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling and called lines, an operator's telephone set, relay means in said link circuit for automatically connecting said operator's telephone set to said link circuit, said means responsive to the connection of a connecting terminal of said link circuit to said calling line, relay means in said link circuit responsive to

the connection of a connecting terminal of said link circuit to a called line for automatically disassociating said operator's telephone set from said link circuit, means in said link circuit for connecting said operator's telephone set to said link circuit subsequently to the operation of said second relay means, said means being rendered ineffective when said connecting terminal is connected to a called local line.

11. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling local and called local or toll lines, an operator's telephone set, relay means in said link circuit for automatically connecting said operator's telephone set to said link circuit, relay means in said link circuit for automatically disassociating said operator's telephone set from said link circuit, an operator's listening key for connecting said operator's set and said link circuit subsequently to the operation of said second relay means, means in said link circuit responsive to the connection of a connecting terminal to a called local line whereby the said listening key is rendered ineffective to connect said operator's telephone set and said link circuit.

12. A telephone system comprising local calling lines and called local and toll lines, an operator's link circuit having a pair of connecting terminals for interconnecting said calling local and called local or toll lines, an operator's telephone set, relay means in said link circuit for connecting said operator's telephone set and said link circuit, other relay means for disconnecting said telephone set and said link circuit, an operator's listening key for connecting said operator's set to said link circuit when one of said connecting terminals is connected to a called toll line, means in said link circuit responsive to the connection of a connecting terminal to a called local line for rendering ineffective said listening key.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 18th day of December, 1926.

BERT A. WALLACE.