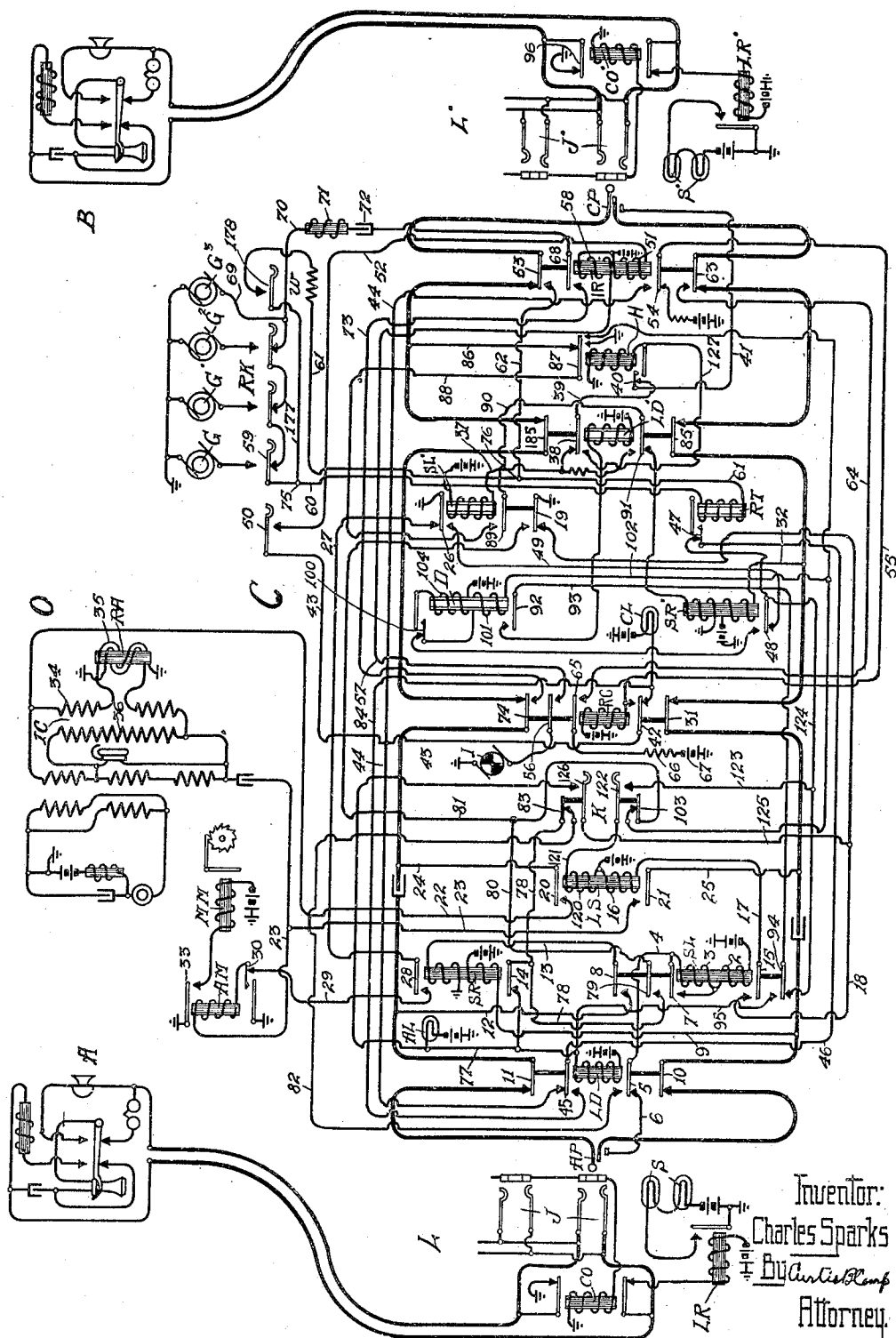


Dec. 26, 1922.

C. SPARKS.  
TELEPHONE SYSTEM.  
FILED JULY 1, 1918.

1,440,112



## UNITED STATES PATENT OFFICE.

CHARLES SPARKS, OF OAK PARK, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## TELEPHONE SYSTEM.

Application filed July 1, 1918. Serial No. 242,711.

*To all whom it may concern:*

Be it known that I, CHARLES SPARKS, a citizen of the United States of America, residing in Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in which manual link or cord circuits are provided for interconnecting telephone lines, and has to do more particularly with the so-called multiple line lamp systems in which instantaneous disconnect and recall are provided.

In cord circuits of the above character, provisions have been made whereby when a calling subscriber replaces his receiver upon the switch hook means is provided in the cord circuit which operates to disassociate its line circuit from the connected cord. Should the calling subscriber wish to recall after the replacement of his receiver, the removal of the receiver from the switch hook causes the multiple line lamps to be lighted so that the recall may be seized by the same operator who handled the original call or by another operator, either one to the exclusion of the other, depending on which one seized the recall first.

A feature of my invention is the provision of means in the cord circuit whereby the line circuit of the called subscriber is disconnected from the connected cord circuit so that upon the removal of the receiver at the called substation from its switch hook the multiple line signals associated with the called line are lighted and the call may be answered by the operator who established the original connection or by any other operator, each one to the exclusion of the other.

Another feature of my invention is the provision of means whereby a called subscriber is prevented from initiating a call until after the calling subscriber has replaced his receiver so that in the event that the called subscriber fumbles his receiver in answering a call the momentary closing and opening of the switch hook contacts will not disassociate the called subscriber's line from the connected link circuit.

A still further feature of my invention is the provision of means for removing the busy potential from the jack of the called

line when the called party signals for disconnection, which means is only operative after the calling subscriber has signaled for disconnection.

And still another feature of my invention is the provision of means in the link circuit whereby when a called subscriber signals for a call while a cord circuit is still connected to his line, the seizure of the call by another operator actuates said means to prevent the operator whose cord circuit is still connected to the line from coming in and disturbing the call being handled by the second operator.

The above features, as well as others, will be more fully hereinafter described in the following specification.

For a better understanding of my invention, reference may be had to the accompanying drawing in which I illustrate my invention operating in connection with a telephone system.

In the drawing, I show a calling substation A and a called substation B, the said calling and called substations A and B terminating, respectively, at the exchange in line circuits L and L'. The line circuits L and L' at the exchange comprise, respectively, the usual line relays LR and LR', cut-off relays CO and CO', multiple jacks J and J', and the multiple line signals S and S'. The jacks of the lines are distributed among different operators' positions, and there is a line signal for each jack at the operators' positions so that when a call is initiated over any line the line signals at the operators' positions are lighted, and one of a plurality of operators may seize the call to the exclusion of the other operators.

The cord circuit C for interconnecting the substations A and B as calling and called lines is provided with an answering plug AP and a calling plug CP, the said answering and calling plugs AP and CP being connected by the heavily marked conductors. The answering end of the cord circuit C is provided with a sleeve relay SL which is energized when an answering plug AP is inserted into the jack J of the calling line. The relay SL is provided with a high resistance winding and a low resistance winding, and upon the actuation of the relay SL the high resistance winding is shunted and this prevents the sleeve relay from being energized in another cord circuit should another

operator attempt to answer the call. An operator at any other cord attempting to seize the call after the first operator has connected to the calling line is prevented from communicating with the subscriber, as the shunt of the low winding of the relay SL of the first cord prevents the relay SL of the second cord from operating. As the second operator is not connected to the calling line, due to the relay SL of the second cord remaining at normal, she does not receive an answer from the calling subscriber and withdraws the answering plug of her cord circuit from the connected jack. A supervisory relay SR is provided which is energized upon the actuation of the relay SL, the said relay SR operating over the line. The relay SR, upon actuation, prevents the premature lighting of the answering supervisory lamp AL. A listening relay LS is provided and is actuated in response to the energization of the relay SL to connect the operator's set O to the cord conductors. A link disconnect relay LD is provided which is energized when the calling subscriber replaces his receiver after finishing conversation to open the link conductors to allow the line circuit of the calling subscriber to restore to normal to permit the calling subscriber to recall. The link disconnect relay LD also operates when the calling subscriber replaces his receiver and before the called subscriber answers to disconnect the ringing current from the called line.

An answering meter relay AM is also associated with the answering end of the cord circuit C and is energized upon the actuation of the listening relay LS, and the relay AM, upon energization, brings about the actuation of the meter magnet MM, which magnet operates the register device. A recall key K is provided, which key may be actuated by the operator to bring about the actuation of the listening relay LS to connect her operator's set O to the cord conductors to answer a recall.

The calling end of the cord circuit C is provided with a sleeve relay SL' actuated when the calling plug CP is inserted into the jack J' of the called line. The said relay SL', upon energizing, opens the circuit of the listening relay LS, which relay de-energizes to disconnect the operators' set O from the cord conductors. The relay SL' also upon its energization opens the circuit of the answering meter relay AM. A party line ringing key RK is provided for connecting one of a plurality of generators G, G', G<sup>2</sup> and G<sup>3</sup> to signal the called for subscriber. An interrupter relay IR is energized upon the actuation of the party line ringing key RK, the said relay remaining energized as long as the party line ringing key RK is held in its fully depressed position to give the called subscriber an instantaneous first ring. The relay IR, upon energization, closes the circuit for the ringing control relay RC, which relay controls the connection of the ringing current to the called line, and also connects the interrupter I to the interrupter relay IR to intermittently energize and de-energize the said relay IR. A ringing trip relay RT is also provided which is actuated upon the response of the subscriber at the called-for substation, should the called subscriber remove his receiver in response to the call signal during a ringing period. The relay RT, upon energization, interrupts the circuit of the ringing control relay RC and the said relay RC in turn disconnects the interrupter I from relay IR to allow the said relay IR to restore to normal. A supervisory relay SR' is also provided which is actuated upon the response of the called subscriber to interrupt the circuit of the relay RC should the subscriber at the called for substation remove his receiver during a silent period. A calling supervisory lamp CL is provided and is used for the usual supervisory purposes. A link disconnect relay LD' is provided which is energized when the called subscriber replaces his receiver upon the switch hook and after the calling subscriber has replaced his receiver upon the switch hook. Relay LD' in energizing opens the cord conductors to allow the line circuit of the called subscriber to restore to normal to permit the subscriber at the called substation to recall. A holding relay H is provided, as is also a double wound relay D, for purposes as will be hereinafter fully described.

Having described in general the arrangement of the circuits and apparatus employed in my invention, I will now describe it more in detail, and assuming that the subscriber at the calling substation A initiates a call, the removal of the receiver thereat brings about the energization of the line relay LR of the line circuit L, and the closing of its alternate contact lights the line lamps S at a plurality of operators' positions. Assuming that it is the operator at cord circuit C that answers the call, the insertion of the answering plug AP into the jack J of the calling line establishes a series energizing circuit for the cut-off relay CO of the line circuit L, and the sleeve relay SL, the circuit being traced from battery through the windings 2 and 3 of relay SL, conductor 4, normal contact 5 of relay LD, conductor 6, sleeve contacts of the connected plug AP and jack J, and through the winding of the cut-off relay CO to ground. The closure of alternate contact 7 of relay SL, upon its energization, closes a lower resistance circuit through its winding 2, shunting winding 3, this circuit being traced from battery through the lower winding 2 of the relay SL,

its alternate contact 7, conductor 4, normal contact 5 of relay LD, conductor 6, sleeve contacts to connect the plug AP and jack J, through the winding of the cut-off relay CO to ground. The high resistance winding 3 of the relay SL is shunted, this arrangement providing for secret service, as a relay SL of a second cord circuit will not operate in series with the relay CO as the shunt of the low winding 2 of the relay SL of the first cord circuit renders the relay SL of the second cord inoperative.

The closing of alternate contact 8 of relay SL establishes an energizing circuit for the supervisory relay SR, traced from battery through the lower winding of relay SR, conductor 9, normal contact 10 of relay LD, ring contacts of the connected plug AP and jack J, through the closed contacts of the substitution switch hook, back through the tip contacts of the connected jack J and plug AP, normal contact 11 of relay LD, conductor 12, alternate contact 8 of relay SL, conductor 13, and through the upper winding of the relay SR to ground. The opening of normal contact 14 of relay SR prevents the premature lighting of the answering supervisory lamp AL. The energization of the relay CO of the line circuit L opens the energizing circuit of the line relay LR which restores to efface the line signals S. The closing of alternate contact 15 of sleeve relay SL establishes an energizing circuit for the listening relay LS, traced from battery through the lower winding 16 of relay LS, conductor 17, alternate contact 15 of relay SL and conductor 18 to ground at normal contact 19 of the sleeve relay SL'.

The relay LS, upon energizing, closes its alternate contacts 20 and 21 to connect the operator's set O to the cord conductors. Should another operator attempt to seize the call after the operator associated with the cord circuit C is connected thereto, the low resistance path through winding 2 of the relay SL prevents the relay SL of the second cord circuit from operating, and the relay LS of the second cord failing to operate does not connect the operator's set O of the second cord across the cord conductors. The second operator failing to receive a response when she answers, knows that the call has been answered by another operator and withdraws the plug of her cord circuit from the multiple jack of the calling line.

The closing of alternate contact 21 of the listening relay LS establishes an energizing circuit for the answering meter relay AM, traced from ground at normal contact 26 of relay SL', over conductor 27, through alternate contact 28 of relay SR, conductor 29, normal contact 30 of relay AM, through the winding of the said relay, conductor 23, alternate contact 21 of relay LS, conductor 25, normal contact 31 of ringing control re-

lay RC, conductor 32 and through the lower winding of the supervisory relay SR' to battery.

The closing of alternate contact 30 of the relay AM establishes a locking circuit for itself from ground through its alternate contact 30, through the winding of the said relay AM to battery over the previously described path. The closing of alternate contact 33 of the relay AM establishes an energizing circuit for the meter magnet MM traced from ground through said alternate contact 33 and the winding of the magnet MM to battery. The magnet MM energizing causes the register to move one step to register a call answered by the operator associated with the cord circuit C.

The operator, having been connected to the cord conductors, now inquires the wants of the calling subscriber at the substation A, and assuming that it is the subscriber at the substation B that is wanted, the operator tests the multiple jack J' of the called line as to its idle or busy condition, and if the said line is busy, the sleeve of the jack is of a battery potential and the operator will receive an impulse of current through the winding 34 of induction coil IC and through the winding 35 of the retardation coil RA to ground. This induces an impulse of current into the winding 36 of the induction coil IC to produce the usual busy click in the head receiver of the operator's set.

Assuming that the line is idle, the operator inserts the calling plug CP into the multiple jack J' of the called line B, closing a series energizing circuit for the sleeve relay SL' of the cord circuit C and the cut-off relay CO' of the line circuit L', the circuit being traced from battery, through the winding of the relay SL', conductor 37, normal contact 38 of relay LD', conductor 39, normal contact 40 of relay H, conductor 41, sleeve contacts of the connected plug CP and jack J', and through the winding of the cut-off relay CO' to ground. The opening of normal contact 19 of the relay SL' opens the energizing circuit of the listening relay LS, and said relay LS restoring opens its alternate contacts 20 and 21 to disconnect the operator's set O from the cord conductors. The opening of alternate contact 21 of the relay LS interrupts the locking circuit of the answering meter relay AM.

The closing of alternate contact 26 of the relay SL' establishes a circuit for the calling supervisory lamp CL, traced from battery through the answering supervisory lamp CL, normal contact 42 of relay RC, conductor 43, conductor 44, normal contact 45 of relay LD, conductor 46, normal contact 47 of ringing trip relay RT, normal contact 48 of supervisory relay SR', and conductor 49 to ground at alternate contact

26 of relay SL', the said supervisory lamp CL remaining lighted until the operator depresses party line ringing key RK. The operator now depresses the proper ringing key plunger of the party line ringing key to its fully depressed position to close the end spring contact 50 and to connect the proper ringing generator G, G', G<sup>2</sup> or G<sup>3</sup> to signal the called for subscriber at the substation B. The closing of alternate contact 50 of the end springs brings about the energization of the interrupter relay IR, during the interval that the key is held down, over a circuit traced from battery through the lower winding 51 of the relay IR, conductor 52, alternate contact 50 of the end spring, conductor 43, conductor 44, normal contact 45 of relay LD, conductor 46, normal contact 47 of relay RT, normal contact 48 of SR', and conductor 49 to ground at alternate contact 26. The closing of alternate contact 53 of relay IR connects ringing current from the generator G, which we will assume is the generator selected to ring the call bell of the subscriber at substation B, giving an instantaneous first ring to the called subscriber's call bell. The closing of alternate contact 54 of relay IR establishes an energizing circuit for the ringing control relay RC, traced from battery through the winding of the said relay, conductor 55, alternate contact 54 of relay IR, conductor 44, normal contact 45 of relay LD, conductor 46, normal contacts 47 and 48 of relays RT and SR', respectively, and conductor 49 to ground at alternate contact 26 of relay SL'.

The closing of alternate contact 42 of relay RC establishes a locking circuit for the said relay RC, traced from battery through the winding of the said relay RC, its alternate contact 42, conductor 43, over conductor 44, and over the above-traced path to ground at alternate contact 26 of the sleeve relay SL'. The opening of normal contact 42 of relay RC effaces the calling supervisory signal CL. The closing of alternate contact 56 of relay RC connects interrupter I to the upper winding of the interrupter relay IR, the circuit being traced from ground, through the constantly rotating interrupter I, alternate contact 56 of relay RC, conductor 57, and through the upper winding 58 of the interrupter relay IR to battery. The relay IR is thus intermittently energized and deenergized to connect ringing current from generator G to the called line over a circuit traced from the ungrounded pole of the generator G, through alternate contact 59 of the depressed ringing key plunger, conductor 60, through the winding of the ringing trip relay RT, conductor 61, conductor 62, alternate contact 53 of the relay IR, tip contacts of the connected plug CP and jack J', through the con-

denser and call bell at the called substation B, back through ring contacts of the connected jack J' and plug CP, through alternate contact 63 of relay IR, conductor 64, through alternate contact 65 of relay RC, and through resistance 66 to battery 67 and ground.

The closing of alternate contact 68 of the interrupter relay IR transmits a ringing tone to the calling subscriber at substation A, the ringing tone being traced from the low frequency generator G<sup>3</sup>, which is of 16 cycles, over conductor 69, conductor 70, through resistance 71, condenser 72, alternate contact 68 of relay IR, conductor 73, alternate contact 74 of relay RC, normal contact 11 of relay LD, tip contacts of the connected plug AP and jack J, through the receiver at the calling substation A, back through the ring contacts of the connected plug AP and jack J, normal contact 10 of relay LD, conductor 9, through the winding of the supervisory relay SR to battery and ground, giving the calling subscriber at substation A an audible signal notifying him that the called subscriber at substation B is being signaled. The called subscriber at the substation B is thus automatically signaled until he answers in response to his call signal, or until the calling subscriber replaces his receiver before the said called subscriber answers.

The non-inductive winding W which is in multiple with the winding of the ringing trip relay RT is only connected to the low frequency of ringing current, say the 16 cycles of current. Should the operator have depressed the ringing key plunger to connect the ringing generator G<sup>3</sup>, which we will say is the generator delivering 16 cycles of ringing current, the depression of this ringing plunger will release any other of the ringing key plungers that are in indicating position, the ringing current from the ringing generator G<sup>3</sup> being traced from the ungrounded pole of the generator G<sup>3</sup> through the serially closed ringing plunger contacts of the ringing key RK to the point 75, part of the current passing over conductor 60, through the winding of relay RT, conductors 61, to the point 76, and thence over the conductor 62 through alternate contact 53 of relay IR, tip contacts of the connected plug CP and jack J', through the condenser and call bell of the called substation, back through ring contacts of the connected plug CP and jack J' alternate contact 63 of relay IR, conductor 64, alternate contact 65 of relay RC and resistance 66 to battery 67 and ground. The other path for the ringing current extends from point 75 over conductor 177, through alternate contact 178 of ringing key plunger, the non-inductive winding W, and over conductor 61 to the point 76 and thence over

conductor 62, over the previously described path to battery 67 and ground. Without this resistance W, should the low frequency current pass through the winding of relay RT, the said relay might chatter, and there would be a liability of opening the locking circuit of the ringing control relay RC which would bring about the premature disconnection of ringing current from the called line.

Should the calling subscriber replace his receiver before the called subscriber answers, the supervisory relay SR will restore, due to the interrupted switch hook contacts at the calling substation A. The closing of normal contact 14 of the supervisory relay SR establishes an energizing circuit for the link disconnect relay LD, traced from battery through the winding of said relay, conductor 77, normal contact 14 of relay SR, conductor 78, alternate contact 79 of relay SL, conductors 80 and 81, to ground at alternate contact 19 of relay SL'. The closing of alternate contact 5 of relay LD establishes a substitute circuit for the sleeve relay SL, the circuit having been opened at normal contact 5. The said circuit may be traced from battery, through the lower winding 2 of the relay SL, alternate contact 7, conductor 4, alternate contact 5, conductor 82, normal contact 83 of the key K, conductor 78, alternate contact 79, conductors 80 and 81, to ground at alternate contact 19. The opening of normal contact 45 of relay LD opens the locking circuit of the ringing control relay RC, which relay deenergizes to open its normal contact 56 to disconnect the interrupter I from the interrupter relay IR. The relay IR restores to normal, opening its alternate contact 53 to prevent further application of ringing current to the called line. The closing of alternate contact 45 establishes a circuit for the calling supervisory lamp CL, traced from battery through the said lamp CL, conductor 84, alternate contact 45 of relay LD, conductor 46, normal contacts 47 and 48 of relays RT and SR', respectively, and conductor 49 to ground at alternate contact 26 of relay SL'. The closing of normal contact 14 of the relay SR establishes an energizing circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, over conductor 77, normal contact 14 of said relay, conductor 78, alternate contact 79 of relay SL, and conductors 80 and 81 to ground at alternate contact 19. The two supervisory lamps AL and CL being lighted, indicate to the operator that the calling subscriber has replaced his receiver.

Should the subscriber at the called substation B answer during a silent period, that is, when the relay IR is in a deenergized condition, the removal of the receiver at the called substation B closes a circuit

for the supervisory relay SR' which may be traced from battery through the lower winding of said relay SR', conductor 32, normal contact 85 of relay LD', normal contact 63 of relay IR, ring contacts of the connected plug CP and jack J', through the now closed contacts of the substation switch hook, back through tip contacts of the connected plug CP and jack J', normal contact 53 of relay IR, conductor 86, normal contact 87 of relay H, conductor 88, alternate contact 89 of relay SL', conductor 90, normal contact 91 of relay LD', and through the upper winding of the relay SR' to ground. The opening of normal contact 48 of the relay SR' interrupts the locking circuit of the ringing control relay RC, which relay de-energizes to open its alternate contact 56, and the opening of the said alternate contact 56 disconnects the ringing interrupter I from the upper winding of the relay IR. The said relay IR now remains at normal, thus preventing further application of ringing current to the called subscriber's line. The closing of alternate contact of relay SR' establishes an energizing circuit for the conditioning relay D, which relay D prepares the circuit of link disconnect relay LD' so that the said relay may operate when the calling subscriber and called subscriber replace their receivers. The circuit for the relay D may be traced from battery through the lamp CL, normal contact 42 of relay RC, conductor 43, conductor 44, normal contact 45 of relay LD, conductor 46, normal contact 47 of relay RT, alternate contact 48 of relay SR', normal contact 100 of relay D, lower winding 101 of relay D, conductor 102, normal contact 103 and conductor 81 to ground at alternate contact 19 of relay SL'. The closing of alternate contact 100 of relay D closes a locking circuit for itself traced from battery through the upper winding 104 of relay D, alternate contact 100, through lower winding 101 of relay D, conductor 102, normal contact 103, and conductor 81 to ground at alternate contact 19 of relay SL'.

Should the calling subscriber answer during a ringing interval, the ringing current is interrupted due to the actuation of the ringing trip relay RT. The circuit for relay RT extends from the ungrounded pole of the generator G, through the alternate contact 59, conductor 60, through the winding of the said relay RT, conductor 61, conductor 62, alternate contact 53 of relay IR, tip contacts of the connected plug CP and jack J', through the now closed contacts of the substation switch hook, back to the ring contacts of the connected plug CP and jack J', alternate contact 63 of relay IR, conductor 64, alternate contact 65 of relay RC, resistance 66 and battery 67 to ground. The



removal of the receiver at the called substation D permits battery to flow through the winding of the relay RT to bring about the energization of the relay RT. The relay RT energizing opens its normally closed contact 47 to interrupt the locking circuit of the ringing control relay RC. The relay RC restoring disconnects the ringing interrupter I from relay IR to prevent further applications of ringing current to the called line. The closing of normal contacts 53 and 63 of the relay IR brings about the energization of the supervisory relay SR', as previously described, and the closing of alternate contact 48 of relay SR' energizes relay D, as above described.

The called and calling subscribers at the substations A and B are now in conversational circuit, the talking circuit being traced over the heavily marked conductors. After the subscribers have finished conversation, they replace their receivers upon their respective switch hooks, causing the supervisory relays SR and SR' to restore, due to the opening of the switch hook contacts at the respective substations. The relay SR upon restoring closes its normal contact 14, establishing an energizing circuit for the link disconnect relay LD, traced from battery through the winding of the said relay, normal contact 14 of relay SR, conductor 78, alternate contact 79 of relay SL, and conductors 80 and 81 to ground at alternate contact 19 of relay SL'. The relay LD energizing disassociates the calling line from the strands of the link circuit and closes a locking circuit for the relay SL, said locking circuit of the relay SL being traced from battery through the winding 2, alternate contact 7 of SL, conductor 4, alternate contact 5 of relay LD, conductor 82, normal contact 83 of the key K, conductor 78, alternate contact 79 of relay SL, and conductors 80 and 81 to ground at alternate contact 19 of the sleeve relay SL'. The called subscriber restoring his receiver upon the switch hook opens the energizing circuit of the supervisory relay SR' at the switch hook contacts, and the restoration of the supervisory relay SR, as above described, brings about an energizing circuit for the link disconnect relay LD', traced from battery through the winding of the said relay LD', alternate contact 92 of the relay D, conductor 93, alternate contact 94 of relay SL, conductor 95, conductor 77, normal contact 14 of relay SR, conductor 78, alternate contact 79 and conductors 80 and 81 to ground at alternate contact 19 of sleeve relay SL'. The relay LD' energizing disassociates the called line from the link conductors of the cord circuit C, and the closing of alternate contact 91 of the relay LD' establishes a locking cir-

cuit for the sleeve relay SL', traced from battery through the winding of the relay SL', conductor 37, alternate contact 91 of relay LD', conductor 90, alternate contact 89, conductor 88, normal contact 87 of relay H, normal contact 53 of relay IR, and tip contacts of the connected plug CP and jack J' to ground at normal contact 96 of the cut-off relay CO' of the link circuit L'.

The opening of normal contact 38 of the relay LD' opens the initial energizing circuit of the sleeve relay SL', but the relay SL', being slow to release, holds up momentarily, allowing the substitute locking circuit to be established through the alternate contact 91 of the link disconnect relay LD'. The closing of normal contacts 14 and 48 of the supervisory relays SR and SR' brings about the lighting of the answering and calling supervisory lamps AL and CL, as previously described.

The operator noting the two lighted signals removes the answering plug AP and calling plug CP from their respective jacks J and J', and the removal of the plug CP from the jack J' of the called line opens the energizing circuit of the sleeve relay SL', and the opening of alternate contact 19 of the sleeve relay SL' opens the energizing circuit of the link disconnect relay LD and the sleeve relay SL. The opening of alternate contact 19 also opens the locking circuit of the relay D, and the relay D upon its energization opens the circuit of the link disconnect circuit LD' at alternate contact 92 of the relay D. The opening of alternate contact 26 of the relay SL' opens the circuit of the calling supervisory lamp CL, and the opening of alternate contact 19 of relay SL' opens the circuit of the answering supervisory lamp AL. The operator withdraws the answering plug AP from the jack J and the apparatus used in establishing a connection between the calling subscriber A and the called subscriber B is now at normal and available for establishing other connections.

Assuming now that the subscribers at the calling and called substations A and B have finished conversation, and before the plugs AP and CP have been withdrawn from their respective jacks J and J' the subscriber at the substation A wishes to recall, the removal of the receiver at the substation A brings about the energization of the line relay LR of the line circuit L and the closure of the alternate contact of relay LR brings about the lighting of the multiple line signals S. The recall as initiated by the subscriber at the substation A may be seized by the operator who handled the initial connection, or by an operator at another position.

Assuming that the operator who originally established the connection seizes the recall, the said operator associated with the cord

circuit C actuates the recall key K and then withdraws the calling plug CP from the jack of the called line. The actuation of the key K opens the locking circuit of the relay SL at the normal contact 83 of the key K, and the relay SL upon de-energizing opens its alternate contact 79 to open the energizing circuit of the link disconnect relay LD. The opening of normal contact 103 of the key K opens the circuit of the relay D. The relay LD upon restoring to normal closes its normal contacts 10 and 11, again closing the cord conductors. The closing of normal contact 5 of relay LD again establishes an energizing circuit through the sleeve relays SL and the cut-off relay CO of the line circuit L traced from battery through the windings 2 and 3 of the relay SL to ground at cut-off relay CO, as previously described, and the closing of alternate contact 7 of the relay SL establishes a circuit through the low resistance winding of relay SL which shunts the high resistance winding 3 of the said relay SL to prevent a second operator from seizing the call, as already described.

The energization of relay CO opens the circuit of the relay LR which restores and effaces the multiple line signals S. The closing of alternate contact 8 of relay SL establishes an energizing circuit for the supervisory relay SR over the line. The calling plug CP having been removed brings about the de-energization of the sleeve relay SL', and the closing of its normal contact 19 again establishes an energizing circuit for the listening relay LS as previously described. The operator's set is now connected to the cord conductors and she can now inquire the wants of the recalling subscriber at the substation A. The operator now tests the line wanted by the recalling subscriber and the connection from this point is the same as previously described, and a further description is not deemed necessary.

Should another operator other than the one associated with the cord circuit C answer the recall before the operator of the cord circuit C can seize it, the low resistance path through the winding of the sleeve relay SL of the second cord that is connected to the recalling line prevents the relay SL of the cord circuit C from operating for the reason as already described, and the operator at the cord circuit C failing to receive a response knows that the call has been answered and withdraws the plug AP from the jack J.

Again assuming that the subscribers at substations A and B have finished conversation and replace their receivers upon their respective switch hooks, and before the plugs AP and CP have been withdrawn from their respective jacks J and J' the subscriber at the called substation B wishes to recall. The

removal of the receiver at the substation B closes an energizing circuit for the line relay LR', through the substation switch hook contacts, and the closing of alternate contact of relay LR' brings about the lighting of the multiple line signals S'. The operator at the cord circuit C should, preferably, remove the calling plug from the jack of the called line. However, the operator at the cord circuit C may seize the call, or an operator associated with another cord may seize it. The operator associated with the cord circuit C in seizing the call actuates the key K and the opening of normal contact 103 of the key K allows the relay D to restore to normal; and the opening of alternate contact 92 of the relay D opens the energizing circuit for the link disconnect relay LD'; and the closing of normal contacts 85 and 185 closes the continuity of the cord conductors. The opening of alternate contact 91 of relay LD' opens the circuit of the sleeve relay SL' to ground at normal contact 96 of the cut-off relay CO'. The sleeve relay SL' being slow to release is momentarily held energized to again close a series energizing circuit for the sleeve relay SL' and the cut-off relay CO', circuit being traced from battery through the winding of the relay SL', conductor 37, normal contact 38 of the relay LD', conductor 39, normal contact 40, conductor 41, sleeve contacts of the connected plug CP, and jack J', through the winding of the relay CO' to ground. The opening of normal contact 83 of the key K opens the energizing circuit of the sleeve relay SL, and the opening of its alternate contact 79 opens the energizing circuit of the link disconnect circuit LD. The relay LD, upon de-energizing, again closes the circuit for the sleeve relay SL to ground through the cut-off relay CO, as previously described.

The key K being actuated, a circuit for the listening relay LS is established to connect the operator's set O to the cord conductor, traced from battery through the upper winding 120 of the relay LS, conductor 121, alternate contact 122 of key K, conductor 123, conductor 124, normal contact 48 of relay SR', which is now at normal, until disconnect relay LD' de-energizes and connects relay SR' to the subscriber's line, and conductor 49 to ground at alternate contact 26 of relay SL'. A circuit is also established through the lower winding 16 of the listening relay LS from battery through the winding 16, conductor 17, alternate contact 15, conductor 18, conductor 125, alternate contact 126, conductor 77, normal contact 14, conductor 78, alternate contact 79 of relay SL, and conductors 80 and 81 to ground at alternate contact 19 of relay SL'. The listening relay LS, upon energization, closes its alternate contacts 20 and 21 to connect the operator's set to the cord conductors, and



she may now inquire the wants of the calling subscriber at the substation B. The reestablishment of a connection from the calling subscriber at the substation B with that of another subscriber is readily apparent from the previous description. Should a second operator seize the call as initiated by the subscriber at the called substation B, she merely plugs into a multiple jack J' with the answering cord of one of her cord circuits. If the call has already been seized by the operator at C, the second operator will not be able to energize the relay SL of her cord circuit due to the battery potential upon the sleeve of the multiple jack J' from the first operator's cord circuit. However, if no such potential is found, the second operator inserting her answering plug into a multiple jack of the line places a battery potential upon the sleeve of the jack J' to which the calling plug CP of the cord circuit C is still connected. This closes an energizing circuit for relay H, the circuit of relay H being traced from ground, through the winding of relay H, conductor 127, alternate contact 38 of relay LD', normal contact 40 of relay H, conductor 41, and the sleeve contact of the plug CP to battery at the sleeve of the jack J'. The closing of alternate contact 87 of the relay H closes a substitute energizing circuit for the sleeve relay SL' whose circuit was opened at the normal contact 87 due to the energization of the relay H. The substitute circuit for relay SL' extends from ground through alternate contact 87 of relay H over conductor 88, alternate contact 89 of relay SL', conductor 90, alternate contact 91 of relay LD', conductor 37, and through the winding of relay SL' to battery and ground. The sleeve relay SL' is thus held operated over this substitute path, should a second operator seize the call of the substation B to hold certain of the relays of the cord circuit C in an actuated position until the operator at the cord circuit C withdraws the plugs AP and CP from their connected jacks to restore the apparatus of said cord circuit C to normal. The relay H upon energizing closes a locking circuit for itself direct to the sleeve of the jack J'. Relay H energizing also closes a circuit for relay D.

From the above description, it may be seen that the subscriber at the called substation may only call after the calling subscriber has replaced his receiver for the reason that should the called subscriber at the substation B in answering a call fumble his receiver in removing it from the switch hook, thereby accidentally closing the switch hook contacts and then again opening them, and finally closing them in answering the call, the relay LD' cannot be energized when the switch hook contacts are accidentally closed as the relay SR is energized over the calling line and its normal contact 14 is open, pre-

venting a circuit from being closed through the link disconnect relay LD'. The relay LD' remaining at normal, the cord conductors are not opened, and this prevents the line circuit from being disassociated from the cord circuit C, and relay LR' fails to operate, thereby preventing the lighting of the multiple line signals S'.

While I have described my invention operating in connection with a certain circuit arrangement, I do not wish to be limited to the same as changes and modifications may readily suggest themselves to those skilled in the art, and I therefore aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting said operator's telephone to, and for disconnecting said operator's telephone from, said link circuit, and means controlled jointly by said calling and called subscribers for disassociating said link circuit from one only of said subscribers' lines.

2. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting said operator's telephone to, and for disconnecting said operator's telephone from, said link circuit, means controlled solely by said calling subscriber for disconnecting his line from said link circuit, and means controlled by said called subscriber for disconnecting his line from said link circuit.

3. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting said operator's telephone to, and for disconnecting said operator's telephone from, said link circuit, automatic ringing means for said link circuit, operator controlled means for associating said automatic ringing means with the called one of said subscriber's lines, means controllable by said operator controlled means for insuring that the called subscriber will receive a ring as soon as said operator controlled means is operated, and subscriber controlled means for disconnecting said called subscriber's line from said link circuit, said last means being operable when the calling one of said subscribers signals for disconnection.

4. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting said

operator's telephone to, and for disconnecting said operator's telephone from, said link circuit, automatic ringing means for said link circuit, operator controlled means for associating said automatic ringing means with the called one of said subscribers' lines, means controllable by said operator controlled means for insuring that the called subscriber will receive a ring as soon as said operator controlled means is operated, means controlled by said calling subscriber for disconnecting his telephone from said link circuit, and means controlled by said calling subscriber for disconnecting the called subscriber's line from said link circuit.

5. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, link circuit means for preventing said link circuit from connecting to a line if another link circuit is operatively connected to the line, subscriber controlled means controlled over one of said lines independent of any control exercised over the other line for disconnecting said link circuit from said subscriber's line, link disconnect means associated with the calling end of said link circuit, subscriber controlled means controllable over the other of said lines for conditioning said disconnect means for disconnecting said link circuit from said other line, said last means being operable when said first line has signaled for disconnection.

6. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, link circuit means for preventing said link circuit from connecting to a line if another link circuit is operatively connected to the line, subscriber controlled means controlled over one of said lines independent of the other line for disconnecting said link circuit from said subscriber's line, subscriber controlled means controllable over the other of said lines for conditioning means for disconnecting said link circuit from said other line, said last means being under the joint control of said subscribers.

7. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, link circuit means for preventing said link circuit from connecting to a line if another link circuit is operatively connected thereto, subscriber controlled means for disassociating said subscribers' lines from said link circuit, the means for disassociating one of said subscribers' lines from said link circuit being entirely under the control of one of said subscribers, while the means for disassociating the other of said subscribers' lines from said link circuit is under the joint control of both of said subscribers.

8. A telephone system including a pair of subscribers' telephone lines, a link circuit

for connecting said lines having sleeve relays, electromagnetic means solely under the control of one of said subscribers for disassociating his line circuit from said link circuit, automatic means for disassociating said link circuit from the other of said subscribers' lines, said automatic means being under the joint control of both of said subscribers, and means for maintaining said sleeve relays energized when said lines are disconnected from said link circuit.

9. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit provided with manually-controlled terminals for connecting said lines, sleeve relays for said link circuit, electromagnetic means under the sole control of the calling subscriber for disconnecting his line from said link circuit, electromagnetic means under the joint control of the calling and called subscribers for disconnecting said link circuit from said called subscriber's line, and means for maintaining said sleeve relays energized when said lines are disconnected from said link circuit.

10. A telephone system including a pair of subscribers' lines, a link circuit for connecting said lines, terminals for said link circuit, talking conductors normally connecting contacts of said terminals, automatic means for disconnecting said subscribers' lines from said link circuit, only one of said subscribers being able to actuate said automatic means to disconnect said subscribers' lines from said link circuit.

11. A telephone system including a pair of subscribers' lines, a link circuit for connecting said lines, automatic means for disconnecting said link circuit from one of said lines, an operator's telephone, a listening relay for said link circuit, means responsive to connection of said link circuit to a calling one of said lines to energize said listening relay to connect the operator's set to the link circuit, means responsive to the connection of said link circuit to a called one of said lines for de-energizing said relay to disconnect the operator's set from said link circuit, automatic means for disconnecting said link circuit from the other of said lines, said first automatic means being controllable at the will of one of said subscribers, and said second automatic means being under the joint control of both of said subscribers.

12. A telephone system including a calling and a called subscriber's telephone line, a link circuit for connecting said lines, an operator's telephone, a listening relay for said link circuit, means responsive to connection of said link circuit to a calling one of said lines to energize said listening relay to connect the operator's set to the link circuit, means responsive to the connection of

said link circuit to a called one of said lines for de-energizing said relay to disconnect the operator's set from said link circuit, subscriber controlled means for disconnecting said calling subscriber's line from said link circuit, automatic means for disconnecting the said called subscriber's line from said link circuit, the said first means being operable at the will of the calling subscriber, and said second means being operable by one of said subscribers, but only after the other of said subscribers has first exercised a control thereof.

13. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, link circuit means for preventing connection of a second link circuit to a calling subscriber's line when answering a call therefrom if the first link circuit is operatively connected to said subscriber's line to answer a call therefrom, automatic means for disconnecting said link circuit from said calling subscriber's line, automatic means for disconnecting said link circuit from said called subscriber's line, said first means being operable when the calling subscriber replaces his receiver, and said second means being also operable when the calling subscriber replaces his receiver.

14. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, movable terminals for said link circuit, talking strands for said link circuit normally connecting contacts of said terminals, sleeve relays for said link circuit, automatic means solely under the control of said calling subscriber for disconnecting said link circuit from said calling subscriber's line independent of any means controlled over the other subscriber's line, automatic means controllable by said calling subscriber for disconnecting said called subscriber's line from said link circuit, and means for maintaining said sleeve relays energized after the subscribers' lines have been disconnected from the link circuit.

15. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines having sleeve relays, automatic means under the control of said calling subscriber for disconnecting said link circuit from said calling subscriber's line, automatic means controllable by said calling subscriber for disconnecting said called subscriber's line from said link circuit, said last means being controllable by said calling subscriber only after said called subscriber has conditioned a relay for operation, and means for maintaining said sleeve relays energized after the subscribers' lines have been disconnected from the link circuit.

16. A telephone system including a call-

ing subscriber's line and a called subscriber's line, a link circuit for connecting said lines, automatic means for disconnecting said called subscriber's line from said link circuit, and a relay in said link circuit operable responsive to the connection of another link circuit to said called subscriber's line.

17. A telephone system including a called subscriber's telephone line, a link circuit for connection thereto, means controlled over said subscriber's line for disconnecting said link circuit from said subscriber's line, a relay for said link circuit, and a circuit for said relay controllable by the connection of a second link circuit to said subscriber's line.

18. A telephone system including a called subscriber's telephone line, a link circuit for connection thereto, subscriber controlled means for disconnecting said link circuit from said subscriber's line, thereby rendering said subscriber's line available for connection, a relay for said link circuit, and means responsive to the connection of a second link circuit to said subscriber's line to operate said relay.

19. A telephone system including a subscriber's telephone line, a link circuit for connection thereto, subscriber controlled means for disconnecting said link circuit from said subscriber's line, thereby rendering said subscriber's line available for connection, a relay for said link circuit, and means responsive to the connection of a second link circuit to said subscriber's line to operate said relay, said relay upon energizing closing a locking circuit for itself controllable by the second of said link circuits.

20. A telephone system including a called subscriber's telephone line, a link circuit for connection thereto, subscriber controlled means for disconnecting said link circuit from said subscriber's line, thereby rendering said subscriber's line available for connection, a relay for said link circuit, and means responsive to the connection of a second link circuit to said subscriber's line to operate said relay, said relay being operable to prevent said first link circuit from being again associated with said subscriber's line.

21. A telephone system including a subscriber's telephone line, a link circuit for connection thereto, subscriber controlled means for disconnecting said link circuit from said subscriber's line, means in said link circuit operable responsive to the connection of a second link circuit to said subscriber's line, said means being operable to prevent interference with the connection of said second link circuit to said subscriber's line.

22. A telephone system including a called subscriber's telephone line, a link circuit for connection thereto, movable terminals for

said link circuit, talking strands for said link circuit normally connecting contacts of said terminals, subscriber controlled automatic means for disconnecting said link circuit from said line, and means for said link circuit associated with and controlled over the calling end of said link circuit and operable by the connection of a second link circuit and said line for preventing said first link circuit from again being operatively associated with said line.

23. A telephone system including a subscriber's telephone line, a link circuit for connection thereto, subscriber controlled automatic means for disconnecting said link circuit from said line, and means for said link circuit for preventing said link circuit from again being operatively associated with said line, said last means being operated responsive to the connection of a second link circuit to said line.

24. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, means controlled jointly by said calling and called subscribers for disassociating said link circuit from one of said lines, a relay for said link circuit, and a circuit for said relay controllable by the connection of a second link circuit to one of said subscribers' lines.

25. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, means controlled jointly by said calling and called subscribers for disassociating said link circuit from one of said lines, a relay for said link circuit, and means responsive to the connection of a second link circuit to one of said subscribers' lines to operate said relay, said relay upon energizing closing a locking circuit for itself to prevent said first link circuit from being

again associated with the said subscriber's line.

26. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, subscriber-controlled means controlled over one of said lines for disconnecting said link circuit from said subscriber's line, subscriber-controlled means controllable over one of said lines for disconnecting said link circuit from the other line, said last means being operable when said first line signals for disconnection, a relay for said link circuit, and a circuit for said relay controllable by the connection of a second link circuit to one of said lines.

27. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, electromagnetic means under the control of one of said subscribers for disassociating his line circuit from said link circuit, automatic means for disassociating said link circuit from the other of said subscribers' lines, said automatic means being under the joint control of both of said subscribers, a relay for said link circuit, and a circuit for said relay controllable by the connection of a second link circuit to said last subscriber's line.

28. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, electromagnetic means under the control of said subscribers for disassociating their lines from said link circuits, a relay for said link circuit, and means responsive to the connection of a second link circuit to one of said lines for energizing said relay.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 28th day of June, 1918.

CHARLES SPARKS.