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TELEPHONE SYSTEM.

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My invention relates to telephone systems, and more particularly to that system wherein manually operated cord or link circuits are employed for interconnecting subscribers' telephone lines in conversational circuit.

A feature of my invention is the provision of a cord or link circuit which may be used for interconnecting common battery telephone lines, or for interconnecting magneto telephone lines, or for interconnecting common battery telephone lines and magneto telephone lines.

Another feature of my invention is the provision of means whereby the exchange operator is prevented from listening in on a conversation between two subscribers on common battery telephone lines.

Still another feature of my invention is the provision of means whereby the calling or called subscriber may initiate a new call, even though the connection of the preceding call remains established, and obtain the attention of the same operator who answered the preceding call.

Still a further feature of my invention is the provision of means whereby the subscribers on magneto lines may signal for a disconnection.

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

For a more complete and better understanding of my invention, reference may be had to the accompanying drawing.

Referring now in general to the drawing, I show a common battery calling substation A, and a common battery called substation 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 lamp signals S and S'. The jacks of the line are distributed among different operators' positions, and there is a line signal for each jack at the operator's position so that when a call is initiated over the line, the line signal at the operator's position is lighted, and one of a plurality of operators may seize the call to the exclusion of the other operators.

A local battery or magneto calling substation D and a local battery or magneto

called substation E are also shown terminating, respectively, at the exchange in line circuits L² and L³. The line circuits L² and L³ comprise, respectively, jacks LJ and LJ', and line drop signals DS and DS'. The signals DS and DS' are adapted to operate respectively when the subscribers at substation D and E initiate a call, to indicate to the operator at the exchange that a call has been initiated and that her services are desired.

The cord or link circuit C of my invention for interconnecting any two of the substations A, B, D and E, as calling and called lines, is provided with an answering plug AP and a calling plug CP, the said answering plug AP and calling plug CP being operatively connected by the heavily marked conductors having the repeating coil RC and condensers K and K' interposed. The answering end of the cord has a sleeve relay SR which energizes when the plug AP is inserted into a jack J, provided, however, that the plug AP of another cord is not already engaging a jack J, as will be pointed out more clearly in the ensuing specification. Relay SR will not energize when the plug AP is inserted into a jack LJ of a magneto line, due to the fact that the sleeve contact of jack LJ is free from ground. An answering supervisory relay AR is provided for controlling the operation of an answering supervisory signal AS. An operator's listening key LK is provided for connecting the operator's telephone set O to the cord circuit C, and an operator's disconnect relay ODR is provided for preventing the operator from connecting her telephone set O to the cord C under certain conditions, to provide secret service between subscribers' lines, under certain conditions, as will be pointed out later. A relay RR is provided which is bridged across the talking conductors of the cord C, and is operable to control the operation of the operator's disconnect relay ODR, and also to be controlled over a magneto telephone line to effect the operation of the supervisory signal AS to signal for a disconnection and also to signal for a recall, as will be later pointed out more in detail. A ringback key RB and a generator RG are provided for applying ringing current to the calling subscriber's line to signal him when the called-for subscriber

has answered, in case the calling subscriber replaces his receiver upon the switchhook after informing the operator of his wants.

The calling end of the cord C is provided with a sleeve relay SR' which energizes when the calling plug CP is inserted into one of the multiple jacks J' provided a plug AP or CP of another cord circuit is not already engaging one of the jacks J'. The relay SR' will not, however, operate when the plug CP is inserted into a jack LJ' of a magneto line, as the sleeve of the jack LJ' is free from ground. A calling supervisory relay CR is provided for controlling the operation of the supervisory signal CL. A relay RR' is provided for also controlling the operation of the operator's disconnect relay ODR, and also for effecting operation of the supervisory signal CL, when the plug CP is connected to a jack of a magneto line to indicate a disconnection and to also indicate a recall, which will be fully described later.

A ringing control relay RCR is provided, which energizes when the operator depresses fully the ringing key RK, to bring about the energization of an interrupter relay IR, and to also connect an interrupter device I in circuit with the lower winding of the interrupter relay, whereby said relay IR is caused to be intermittently operated to connect ringing current to the called subscriber's line from one of the ringing frequency generators G, G', G² and G³. The signal CL lights as soon as the calling plug CP is inserted into the jack J', and remains lighted until the operator depresses the ringing key RK; the burning lamp CL thus serving at this time as a signal to notify the operator that ringing current has not been connected to the called line. The lamp CL also serves to notify the operator when the called subscriber has replaced his receiver upon its switchhook.

When the plug CP is inserted into a jack LJ', relay SR' fails to energize, and in this case ringing current will only be applied to the called line so long as the ringing key RK is in its fully depressed position, as there will be no locking circuit provided for maintaining the ringing control relay RCR energized to close a circuit for relay IR, when the key RK is not in its fully depressed position. In this instance, the operator will depress fully key RK each time ringing current is applied to the called line terminating in jack LJ'.

Referring now more in detail to the operation of my invention, I will first describe the operation of my cord in interconnecting common battery subscribers' telephone lines. Assuming that the subscriber at substation A desires to converse with the subscriber at substation B, he will remove his receiver from its switchhook, thus closing a circuit

for the line relay LR, traced from battery, through the winding of said relay LR, normal contact 1 of cut-off relay CO, line limb 2, the now alternate closed switchhook contacts of substation A, line limb 3, and to ground through normal contact 4 of relay CO. Relay LR energizes over this circuit and closes its normally open contact 5, thereby closing a circuit for the line lamps S, traced from battery, through said lamps S, the now closed contact 5 of relay LR to ground. The lamps S will be lighted over this circuit at a plurality of operators' positions. Assuming that the operator at cord circuit C is the first one to answer 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 SR, the circuit being traced from battery, through the low resistance winding 6 and high resistance winding 7 of said relay SR, conductor 8, sleeve contacts of plug AP and jack J to ground through the winding of cut-off relay CO. The closure of alternate contact 9 of relay SR shunts out the high resistance winding 7 and closes a low resistance circuit for relay SR, traced from battery through the low resistance winding 6 and alternate contact 9 of relay SR, and over the previously traced circuit. The cut-off relay CO in the line circuit L energized in series with relay SR over the first circuit traced and will be maintained energized over the last traced circuit so long as the plug AP remains in the answering jack J, thereby taking line relay LR from under the control of the subscriber at substation A. Relay SR upon energizing closes a circuit for the answering supervisory relay AR, traced from battery through the lower winding of said relay AR, alternate contact 10 of relay SR, winding c of repeating coil RC, normal contact 11 of key RB, ring contacts of plug AP and jack J, through the alternate closed switchhook contacts of substation A, tip contacts of jack J and plug AP, normal contact 12 of key RB, winding a of repeating coil RC, alternate contact 13 of relay SR, to ground through the upper winding of relay AR. Relay AR energizing opens its normally closed contact 14 to prevent the premature lighting of the supervisory lamp AS.

The operator at cord circuit C having inserted the plug AP into the multiple jack J, will operate the listening key LK to connect her telephone set O to the cord circuit C, and will then inquire the wants of the calling subscriber at substation A. The operator's set O is connected to the cord C over the following circuit, point 15 of the tip conductor of said cord, conductor 16, alternate contact 17 of listening key LK, normal contact 18 of relay ODR, receiver of operator's

set O, normal contact 19 of relay ODR, alternate contact 20 of the listening key LK, conductor 21, to point 22 of the ring conductor of cord C.

5 Should another operator attempt to answer this same call initiated from substation A, subsequently to the insertion of the plug AP of cord circuit C into the answering jack J, the said other operator will be prevented
10 from connecting her telephone set in circuit with the calling subscriber's line even though she does operate her listening key. Thus secret service is provided between the operator at cord C and the subscriber at sub-
15 station A, which is effected in this manner: The relay SR of the cord at the second operator's position will not energize in this instance, due to the shunt placed about the high resistance winding 7 of relay SR of
20 the second operator's cord circuit C by the low resistance circuit of the relay SR of the first operator's cord, and this low resistance circuit will shunt the low and high resistance windings of the relay SR of the second
25 operator's cord circuit to render the same inoperative as long as the plug AP of the cord C remains in the jack J. The relay SR of the second operator's cord circuit failing to energize, a circuit will be closed for
30 the relay RR of the second operator's cord circuit, traced from the battery potential on the ring contact of the multiple jack, which is in multiple circuit with the answering
35 jack J of the calling line, ring contact of the answering plug of the second operator's cord circuit, normal contact 11 of key RB, ring conductor and winding c of the repeating
40 coil RC of the second cord circuit, winding of relay RR, normal contact 13 of relay SR, of the second cord, winding a of the repeating coil RC, tip conductor, normal contact
45 12 of key RB and tip contact of the answering plug of the said second operator's cord circuit, and to ground at the tip contact of the said multiple jack which is in
50 multiple circuit with the answering jack J of the calling line. Relay RR of the second operator's cord circuit energizing over this circuit will close its alternate contacts,
55 which will provide an energizing circuit for the second operator's disconnect relay ODR associated with said second operator's cord circuit, when the second operator operates
60 her listening key to connect her telephone set in circuit to permit her to converse with the calling subscriber at substation A, the circuit for said relay ODR of the second cord
65 circuit being traced from battery through the winding of relay ODR, normal contact 23 of listening key LK, conductors 24 and 25 to ground through the alternate contacts
of relay RR of the said second operator's cord circuit. Relay ODR of the second operator's cord circuit energizing over the above traced circuit will open its normally

closed contacts 18 and 19, thereby disconnecting the second operator's telephone set from her cord circuit connected to the calling subscriber's line, which will prevent the second operator from conversing with the call-
70 ing subscriber at substation A. The second operator failing to receive a response upon inquiring the wants of the calling subscriber, will know that the call has been seized by
75 another operator, and will disconnect her cord circuit from the multiple jack of the calling line, whereupon the said relays RR and ODR of the second operator's cord circuit will restore to normal.

Thus, from the foregoing described opera-
80 tion, it is at once apparent that an operator attempting to answer a call after the call has been seized by another operator, will be prevented from establishing an operative
85 connection between her telephone set and the calling line due to the operation of relays RR and ODR of the cord circuit of the said operator attempting to answer the call subsequently to another operator.

Reverting now to when the operator at
90 the cord circuit C inquires the wants of the calling subscriber at substation A, and as it has been assumed that the subscriber at substation B is wanted, the operator will
95 make the usual test to determine the idle or busy condition of the called line by touching the tip of the calling plug CP to the sleeve of the multiple jack J', and should
100 the said called line be busy, there will be battery potential upon the sleeve of said jack J', which will give the operator of cord C a click in the ear, in the well-known
105 manner, to notify her of the busy condition of the called line, whereupon she will inform the calling subscriber of the busy condition
110 of the called line and will then withdraw the plug AP from the jack J, whereupon the cord C restores to normal. Assuming, however, that the called line is idle, the
115 operator will fail to receive a click in her ear, and will insert the calling plug CP into the jack J' of the called line. Upon the
120 insertion of the plug CP into the jack J', an energizing circuit is closed for the sleeve relay SR' as follows: battery, through the upper low resistance winding 28 and lower
125 high resistance winding 29, conductor 30, sleeve contacts of plug CP and jack J' to ground through the winding of cut-off relay CO'. Relay CO' energizes over this circuit
130 to take the line relay LR' from the control of the called subscriber at substation B, and relay SR' energizing over this circuit closes its alternate contact 31, thereby
135 shunting out its lower high resistance winding 29 and establishes a low resistance circuit for itself, traced from battery, through the upper low resistance winding 28 of said
140 relay SR', alternate contact 31 of relay SR', and over the previously traced circuit. The

calling supervisory lamp signal CL will light and continue to burn until the operator depresses a plunger of the ringing key RK to connect ringing current to the called line, the circuit for said lamp signal being traced from battery, through the said lamp CL, normal contact 32 of the ringing control relay RCR, alternate contact 33 of relay SR', normal contact 34 of the calling supervisory relay CR to ground. The lighting of lamp CL in this instance serves to indicate to the operator that ringing current has not been applied to the called subscriber's line. The operator will now depress one of the plungers of the ringing key RK to connect the proper ringing frequency generator in circuit to apply ringing current to the called subscriber's line, and assuming that generator G' is of the proper frequency to which the call bell at the called substation B is responsive, the operator depressing the plunger of the ringing key RK corresponding to generator G' to its fully depressed position, a circuit will be closed for the ringing control relay RCR, which may be traced from battery through the winding of said relay RCR, conductor 35, alternate contact 36 of relay AR, alternate contact 37 of relay SR, conductor 38, alternate end spring contact 39 of ringing key RK, when the said plunger of ringing key RK is in its fully depressed position; conductor 40, to ground through normal contact 34 of relay CR. Relay RCR energizing over this circuit opens its normal contact 32, thereby opening the circuit of the lamp signal CL, and also closes a locking circuit for itself through its alternate contact 32, said locking circuit being traced from battery, through the winding of said relay RCR, conductor 35, alternate contact 36 of relay AR, alternate contact 37 of relay SR, conductor 38, alternate contact 32 of relay RCR, conductor 42, alternate contact 33 of relay SR' to ground through normal contact 34 of relay CR. When the plunger of the key RK is fully depressed and relay RCR energizes, a circuit is closed for the interrupter relay IR to cause said relay IR to energize to connect the generator G' in circuit with the called line even though a non-conducting segment of the constantly rotating interrupter device I is in circuit with the lower winding of said relay IR, whereby ringing current is instantaneously applied to the called line when the plunger key RK is fully depressed and relay RCR operates. The circuit for said relay IR may be traced from battery, through the upper winding of the relay IR, alternate contact 43 of relay RCR to ground through the alternate end spring contact 44 of the ringing key RK. Relay IR will remain energized over this circuit so long as the plunger is in its fully depressed position to close alternate contact 44, and the relay AR remains energized. Another circuit is provided for the interrupter relay IR traced from battery through the lower winding of relay IR, alternate contact 45 of relay RCR to ground through a conducting segment of the constantly rotating interrupter device I. When alternate contact 44 of key RK is opened, relay IR will be intermittently energized and de-energized over the last traced circuit to intermittently apply ringing current to the called line to operate the call bell at substation B.

The circuit for the ringing current may be traced as follows: from ground, through the frequency generator G', alternate closed contact 52 and normal contact 53 of the ringing key RK, conductor 54, alternate contact 49 of the interrupter relay IR, tip contacts of plug CP and jack J', through the call bell at substation B, ring contacts of jack J' and plug CP, to ground through alternate contact 48 of relay IR. A reverberative ringing tone is also communicated to the calling subscriber to apprise him of the fact that the called for subscriber is being signaled, the circuit for this reverberative ringing tone being from ground through the generator G³, conductor 55, alternate contact 56 of relay IR, winding *b* of the repeating coil RC, alternate contact 50 of relay SR' to ground through the upper winding of relay CR, whereupon the said reverberative ringing tone will be induced into the winding *a* of the repeating coil RC and then transmitted through the calling substation A. Should the subscriber at the substation A replace his receiver upon its switchhook before the called-for subscriber at substation B removes his receiver in response to his call bell, the further application of ringing current to the called line will be automatically discontinued, due to the fact that the supervisory relay AR which is controlled by the calling subscriber at substation A will de-energize when the calling subscriber replaces his receiver, and relay AR, restoring to normal, opens its alternate contact 36, thereby opening the locking circuit of relay RCR to cause the same to restore, which in restoring opens the circuit through the lower winding of the interrupter relay IR whereupon the relay IR immediately restores to its normal position to prevent the further application of ringing current to the called line. Assuming, however, that the calling subscriber at A does not replace his receiver before the called-for subscriber responds, after the removal of the receiver at substation B, and when relay IR is in de-energized position, as will be the case during a non-ringing period, a circuit will be closed for the calling supervisory relay CR, traced from battery, through the lower winding of the relay CR, alternate contact 47 of relay SR', winding *d* of the repeating

coil RC, normal contact 48 of relay IR, ring contacts of plug CP and jack J', through the now closed alternate switchhook contacts of the substation B, tip contacts of jack J' and plug CP, normal contact 49 of relay IR, winding *b* of repeating coil RC, alternate contact 50 of relay SR', to ground through the upper winding of relay CR. Relay CR will energize over this circuit and will open its normally closed contact 34, thereby opening the locking circuit of the ringing control relay RCR, whereupon said relay RCR will restore, as pointed out above, to prevent another energization of relay IR, whereby further application of ringing current to the called subscriber's line is prevented.

The subscribers at substations A and B are now in conversational circuit, which may be traced over the heavily marked conductors. Should the operator at cord circuit C attempt to listen in on the conversation by operating her listening key RK, she is prevented from doing so by the operation of the relay ODR, which will energize to open its normally closed contacts 18 and 19. The circuit for said relay ODR may be traced from battery, through the winding of the relay ODR, alternate contact 23 of the listening key LK, conductor 24, alternate contact 58 of relay CR, conductor 59, alternate contact 60 of listening key LK, alternate contact 14 of relay AR to ground. Thus, it is clear that the operator cannot connect her telephone set in circuit so as to listen in on the conversation between the subscribers at substations A and B. In case the subscriber at substation A replaces his receiver upon its switchhook, supervisory relay AR will restore and open its alternate contact 14, thereby opening the circuit of relay ODR at alternate contact 14. Should the operator now operate her listening key LK, her telephone set O will be connected to the cord C, which will enable the operator to communicate with the subscriber at substation B, provided said subscriber has not replaced his receiver upon its switchhook. In case the subscriber at substation B replaces his receiver upon its switchhook, supervisory relay CR will restore and open its alternate contact 34, thereby opening the circuit of the relay ODR. The operator may now operate her listening key LK without causing the energization of relay ODR, and connect her telephone set O to the cord circuit C, which will enable her to converse with the subscriber at substation A, providing said subscriber at A has not replaced his receiver upon its switchhook. Thus, it is clear that the operator will only be able to connect her telephone set O to the cord circuit C when one or both of the subscribers at A and B has or have replaced the receiver upon its switchhook, but cannot connect

said telephone set O to the cord C when both the calling and called subscribers have their receivers off their respective switchhooks.

Assuming now that conversation has terminated, and the subscribers at A and B have replaced their receivers upon their respective switchhooks, supervisory relays AR and CR will restore to close circuits for the supervisory lamps AS and CL, respectively, the circuit for lamp AS being established from battery through the said lamp AS, alternate contact 60 of relay SR, to ground through normal contact 14 of relay AR, and the circuit for the lamp CL being from battery through the said lamp CL, normal contact 32 of relay RCR, conductor 42, alternate contact 33 of relay SR' to ground through normal contact 34 of relay CR. The supervisory lamps AS and CS will light over these circuits, and the operator observing them, will know that conversation has terminated and will withdraw the plugs AP and CP from the jacks J and J', respectively, whereupon the cord circuit C restores to normal, and the cut-off relays CO and CO' restore to normal.

It sometimes occurs that after the calling subscriber has stated his wants to the exchange operator, he replaces his receiver upon its switchhook and awaits a call from the operator when she has the called-for subscriber on the line, and the operator may signal back the calling subscriber by operating a ringback key RB which will close its alternate contacts 11 and 12 to connect the ringing generator RG to the said calling subscriber's line to signal the calling subscriber.

Reverting now to when the operator at cord C tested to determine the idle or busy condition of the called line B, and assuming that said called-for line is found busy, but that the operator disregards its busy condition and inserts the calling plug CP into the jack J' and even though the listening key LK is in its operated position, the operator at cord circuit C will be prevented from listening in on the conversation at the called-for subscriber's line, due to the fact that relay SR' of cord C will not energize since the low and high resistance windings of the relay SR' of cord C will be shunted by the low resistance circuit of a sleeve relay SR of another cord circuit already connected to another jack which is in multiple circuit with the calling jack J', if the called-for line is busy as a calling line, and in case the called-for line is busy as a called line, the low and high resistance windings of relay SR' of cord circuit C will be shunted by the low resistance circuit of a sleeve relay SR' of another cord circuit already connected to a jack of the called-for line which jack is in multiple circuit with the calling jack J'. Relay SR' failing to energize, relay

RR' will energize over a circuit traced from battery potential present on the ring contact of the jack J', which battery potential is provided from another cord circuit already connected to the called-for subscriber's line ring contact of plug CP, normal contact 48 of the relay IR, winding *d* of repeating coil RC, through the winding of said relay RR', normal contact 62 of relay RCR, normal contact 50 of relay SR', winding *b* of the repeating coil RC, normal contact 49 of relay IR, tip contact of plug CP, and to the other side of battery at the tip contact of the calling jack J', which is in multiple circuit with the jack to which the other cord circuit is connected. Relay RR' energizing, closes its alternate contacts 63, thereby closing a circuit for the operator's disconnect relay ODR which will energize and open its normally closed contacts 18 and 19 to prevent the operator from listening in on the conversation even though she does operate her listening key LK. The circuit for the said relay ODR may be traced from battery, through the winding of said relay ODR, alternate contact 23 of the listening key LK, conductor 24, to ground through alternate contacts 63 of relay RR'. Thus, it is clear that I have provided means for preventing an operator of a cord circuit from listening in on a busy called-for line. Having described my cord circuit for interconnecting common battery subscribers' telephone lines, I will now describe the operation of my cord circuit in interconnecting magneto subscriber telephone lines.

Assuming that the subscriber at the magneto substation D initiates a call by operating the hand generator *g* at his substation D, the drop signal DS will operate to indicate to the operator at cord circuit C that her attention is desired, the circuit for the drop signal DS being from one side of the generator *g* at substation D, line limb 74, normal contact 75 of jack LJ, through the winding of said signal DS, normal contact 76 of jack LJ, line limb 77, and to the other side of the generator *g* through the alternate contact 78 of said generator, which alternate contact 78 will be closed when the generator *g* is operating. The operator observing the operated signal DS will insert the answering plug AP of the cord C into the answering jack LJ which will open normal contacts 75 and 76, and at the same time automatically restore the signal DS to normal, and she will then throw her listening key LK to connect her telephone set to the cord C, as described in the foregoing part of this specification. The sleeve relay SR will not energize when the plug AP is connected to the jack LJ of a magneto line, since there is no ground connected to the sleeve of said jack LJ, and since relay SR fails to energize, the supervisory relay AR will not ener-

gize at this time. The operator at cord C will now inquire the wants of the calling subscriber at substation C, and assuming that the subscriber at substation E is wanted, the operator will insert the calling plug CP of cord C into the jack LJ' of the called-for subscriber's line E, whereupon the plug CP opens the normally closed contacts 75' and 76' of said jack LJ' to remove the signal DS' from the control of called-for subscriber E. The sleeve relay SR' will not operate when the plug CP is inserted into the jack LJ', since the sleeve of said jack LJ' is free from ground, and as the relay SR' fails to energize, no circuit is established for the supervisory lamp signal CL and the said signal will not burn in this instance before the ringing key RK is operated, as was the case when the cord C was connected to a common battery telephone line. The operator will now operate one of the plungers of the ringing key RK to apply ringing current to the called-for subscriber's line, and assuming that the call bell at the called-for substation E is responsive to ringing current from the frequency generator G, the plunger of the ringing key RK corresponding to generator G will be operated, and when in its fully operated position, the alternate end spring contacts 39 and 44 of the ringing key RK will be closed, thereby closing an energizing circuit for the ringing control relay RCR. The circuit for the ringing control relay RCR is from battery, through the winding of said relay RCR, conductor 35, normal contact 37 of relay SR, conductor 38, alternate contact 39 of the end spring of key RK, to ground, through the normal contact 34 of relay CR. Relay RCR energizes over this circuit and closes its alternate contact 43, whereby a circuit is closed for the interrupter relay IR traced from battery through the upper winding of said relay IR, alternate contact 43 of relay RCR, alternate contact 44 of the end spring of the ringing key RK to ground. The relays RCR and IR remained energized over the above traced circuits to apply ringing current to the called-for subscriber's line E, so long as the plunger of the ringing key RK is fully operated to close the alternate end spring contacts 39 and 44 of said ringing key RK, but when the operator removes her finger from the plunger, the same will restore to open the said alternate contacts 39 and 44, thereby opening the circuits of the relays RCR and IR to cause the same to restore to prevent the further application of ringing current to the called-for subscriber's line. The ringing control relay RCR is not provided with a locking circuit in the present connection, as was the case when the plug CP was connected to a jack of a common battery line, due

to the fact that relay SR' does not energize to close a locking circuit for said ringing control relay RCR. Since relay RCR does not lock up, it is obvious that the interrupter relay IR will not operate intermittently to apply ringing current to the called-for line, and that it will be necessary to close the alternate end spring contacts 39 and 44 of the ringing key RK each time ringing current is applied to the called-for subscriber's line, that is, each time ringing current is applied to the called-for subscriber's line, the operator must operate the plunger of the ringing key RK to its fully operated position. The circuit for the ringing current may be traced from ground, through generator G, alternate contact 53 of ringing key RK, conductor 54, alternate contact 49 of relay IR, tip contacts of plug CP and jack LJ', call bell and normal contact 80 of substation E, ring contacts of jack LJ' and plug CP, to ground through the alternate contact 48 of relay IR. When the end spring contacts 39 and 44 of the ringing key RK are opened, the relay IR will de-energize first and then relay RCR will de-energize, since it is slow-acting due to its construction, so that when ringing current ceases to be applied to the called subscriber's line, a circuit will be closed for the ringing current stored in the condenser associated with the call bell at the substation E and also for the line capacity, traced from the ring contacts of jack LJ' and plug CP, normal contacts 48 and 95 of relay IR, alternate contact 62 of relay RCR, normal contact 50 of relay SR', where it is discharged into the repeating coil RC. This circuit just traced provides a discharging circuit for said stored ringing current to prevent the operation of relay RR' when relay RCR restores. A reverte ring tone is also transmitted to the calling subscriber at substation D to notify him that the called-for subscriber is being signaled, over circuit traced from ground, through generator G³, alternate contact 56 of relay IR, winding *b* of the repeating coil RC, normal contact 50 of relay SR', alternate contact 62 of relay RCR, to ground through the alternate contact 95 of relay IR. The operator may leave her key LK operated until she hears a response from the called-for subscriber at substation E whose response she will hear during a silent period or when the ringing key RK and the relay IR are in their normal positions, whereupon she restores it to normal.

The talking circuit for the calling and called subscribers at substations D and E may be traced over the heavily marked conductors.

When conversation has terminated and the subscribers have replaced their receivers upon their respective switchhooks and ring

off by operating their hand generators *g* and *g'*, supervisory signals AS and CL will light to indicate to the operator that conversation has terminated. Assuming that the calling subscriber at substation D has replaced his receiver upon its switchhook and operates his hand generator *g*, relay RR will energize over a circuit traced from one side of the generator *g* at substation D, tip contacts of jack LJ and plug AP, normal contact 12 of ringback key RB, winding *a* of repeating coil RC, normal contact 13 of relay SR, through the winding of said relay RR, winding *c* of RC, normal contact 11 of RB, ring contacts of plug AP and jack LJ, alternate contact 78 to the other side of the generator *g*. Relay RR energizing over this circuit closes its alternate contacts 85, thereby closing a circuit for the supervisory relay AR traced from battery, through the lower winding of said relay AR, normal contact 10 of relay SR, normal contact 86 of listening key LK to ground through alternate contact 85 of relay RR, and relay AR energizing over this circuit closes a locking circuit for itself which may be traced over the previously traced circuit up to point 87 and then to ground through alternate contact 14 of said relay AR, and a circuit is also closed for the supervisory signal AS, traced from battery, through the signal AS, normal contact 60 of relay SR, normal contact 85 of relay RR (which relay RR will restore when the hand generator *g* at substation D is no longer operated), alternate contact 14 of relay AR to ground. The lamp AS will burn over this circuit to notify the operator at cord C that the calling subscriber has replaced his receiver, and that the connection is no longer desired.

The subscriber at substation D upon replacing his receiver upon its switchhook will ring off to cause the energization of the relay RR', traced from the hand generator *g'* at substation E, tip contacts of jack LJ' and plug CP, normal contact 49 of relay IR, winding *b* of the repeating coil RC, normal contact 50 of relay SR', normal contact 62 of relay RCR, through the winding of relay RR', winding *d* of RC, normal contact 48 of relay IR, ring contacts of plug CP and jack LJ', alternate contact 80 and to the other side of the hand generator *g'*. Relay RR' energizing over this circuit, closes an energizing circuit for the supervisory relay CR, traced from battery through the lower winding of said relay CR, normal contact 47 of relay SR, normal contact 90 of the listening key LK, conductor 91, to ground through alternate contact 63 of relay RR', and relay CR energizing over this circuit will close its alternate contact 34 and lock up to ground through the said alternate contact 34 of relay CR. Relay CR

energizing also closes a circuit for the calling supervisory signal CL traced from battery through the signal CL, normal contact 32 of relay RCR, normal contact 33 of relay SR', normal contact 92 of relay RCR, normal contact 63 of relay RR' (relay RR' restoring when generator g' ceases operating) to ground through alternate contact 34 of relay CR. The supervisory signal CL lights over this circuit to notify the operator that the subscriber at substation D has replaced his receiver upon its switchhook. The operator observing the two burning signals will operate her listening key LK to open its normally closed contacts 86 and 90 to open the circuits of supervisory relay AR and CR, respectively, to cause said relays to restore and open the circuits of the supervisory signals AS and CL, and will then restore said key and then withdraw the plugs AP and CP from their respective jacks LJ and LJ', whereupon the system is restored to its normal position.

Reverting back now to when the subscriber at substation D replaced his receiver upon its switchhook and operated his hand generator g , to cause relay RR to energize, relay AR energizing and remaining energized, and the supervisory signal AS burning after relay RR restores, now should the subscriber at substation D desire to initiate another call or communicate with the operator at cord C, he may do so by operating his hand generator g , to again effect the energization of relay RR, which will remain energized so long as the generator g is operated, and relay RR energizing will open its normally closed contact 85, thereby opening the circuit of the supervisory signal AS to cause the effacement of said signal AS. The operator observing the effacement of said signal AS, will know that the subscriber at substation D has initiated another call, and will take care of it in the same manner as hereinbefore described. The subscriber at substation E may recall and signal the operator at cord C in the same manner, by operating his hand generator g' to cause the energization of relay RR' to bring about the effacement of the supervisory signal CL to indicate to the operator that the subscriber at substation E has initiated a call and she will take care of the call in the usual manner, as pointed out in the foregoing specification.

The operation of my cord circuit C is the same as described above when used for interconnecting a common battery telephone line, and a magneto telephone line, that is, either end of the cord C will operate in the same manner when connected to a common battery telephone line as described in the foregoing specification when connection is made with a common battery telephone line, and will operate in the same manner when

connected to a magneto line, as set out above in describing its connection with a magneto telephone line.

From the foregoing specification, it will be clearly understood how the cord C of my invention will operate when used for interconnecting a common battery telephone line, and a magneto telephone line, so that a description of the same is not deemed necessary.

Having described a particular embodiment and circuit arrangement of my invention, it is to be understood that I do not wish to be limited to the exact embodiment and circuit arrangement as described and shown, as many modifications and changes will readily suggest themselves to those skilled in the art, but I intend to cover all modifications and changes which may 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. In a telephone system including telephone lines, a link circuit for interconnecting the same, an operator's telephone set normally disconnected from said link circuit, a manually operated key for connecting said telephone set to said link circuit and means for automatically disconnecting said telephone set from said link circuit, even though said key is operated, when said link circuit is connected to a busy telephone line or when the calling and called subscribers' lines interconnected by said link circuit are in closed circuit.

2. In a telephone system including telephone lines, a link circuit for interconnecting the same, an operator's telephone set, a manually operated key for operatively connecting said operator's telephone set to said link circuit, electromagnetic means for disconnecting said telephone set from said link circuit when said link circuit is connected to a busy line or when two subscribers of said lines are in conversational circuit through the medium of said link circuit, when said key is operated.

3. In a telephone system including a calling and a called subscriber's telephone line, a link circuit for interconnecting said telephone lines, an operator's telephone set normally disconnected from said link circuit, a key for connecting said telephone set to said link circuit, means for said link circuit for automatically disconnecting said telephone set from said link circuit when both the calling and called subscribers have their receivers removed from their respective switchhooks and said key is in its operated position, automatic ringing means for said link circuit for signalling the called subscriber, and automatic means controlled by the calling subscriber for automatically disconnecting ringing current from the called line

prior to the response of the called subscriber.

4. In a telephone system including a calling and a called subscriber's telephone line, a link circuit for interconnecting said lines, an operator's telephone set, a manually operated key for connecting said telephone set to said link circuit when only one subscriber on said telephone lines has his receiver removed from its switchhook, means for automatically disconnecting said telephone set from said link circuit when said link circuit is connected to a busy telephone line or when the calling and called subscribers' lines are in closed circuit, electromagnetic means for preventing the connection of said telephone set to said link circuit when both the calling and called subscribers have their receivers removed from their respective switchhooks and said key is operated, automatic ringing means for said link circuit for signalling the called subscriber, and automatic means controlled by the calling subscriber for automatically disconnecting ringing current from the called line prior to the response of the called subscriber.

5. In a telephone system including calling and called subscribers' telephone lines, a plurality of cord circuits having manual connecting terminals at each of their ends for interconnecting said lines, an operator's telephone set for said cord circuits but normally disconnected therefrom, a manually operated key for connecting said telephone set to any one of said cord circuits when the same is connected to an idle subscriber's telephone line, and automatic means for disconnecting said telephone set from said link circuit when said link circuit is connected to a busy line and the calling and called subscribers' lines are in closed circuit and for preventing the connection of said telephone set to said cord circuit when the said cord circuit is connected to a busy subscriber's telephone line and said key is operated.

6. In a telephone system including calling and called subscribers' telephone lines appearing in multiple jacks before a plurality of operators' positions, an individual group of link circuits for each operator's position having manual connection terminals for interconnecting said calling and called telephone lines via said multiple jacks, an operator's telephone set for each group of link circuits and normally disconnected therefrom, a manually operated key for connecting said telephone set to any one of said link circuits to which said telephone set is individual, means for automatically disconnecting said telephone set from said link circuit when said link circuit is connected to a busy telephone line or when the calling and called subscribers' lines are in closed circuit, and electromagnetic means for preventing the connection of said telephone set to one of said link circuits when said one

link circuit is connected to one of said telephone lines subsequently to the connection of another link circuit to said one telephone line and the key of said one link circuit is operated.

7. In a telephone system including a calling and a called telephone line, a link circuit for interconnecting said lines, an operator's set for said link circuit but normally disconnected therefrom, manually operated means for connecting said telephone set to said link circuit, electromagnetic means for preventing the connection of said telephone set to said link circuit when the calling and called subscribers have their receivers removed from their respective switchhooks, said last means inoperative when one of said subscribers has replaced his receiver upon its switchhook, automatic means for said link circuit for signalling the called subscriber, and automatic means controlled by the calling subscriber for automatically disconnecting ringing current from the called line prior to the response of the called subscriber.

8. In a telephone system including a calling telephone line and a called telephone line, a link circuit for interconnecting said lines, supervisory signals for said link circuit, electromagnetic means including a pair of relays for providing secret service in said link circuit when interconnecting the calling and called subscribers' lines and both have their receivers removed from their respective switchhooks, said means controlled over said telephone lines for causing said signals to operate to signal for a disconnection, and to also operate to signal for a recall, automatic ringing means for said link circuit for automatically signaling the called subscriber, means associated with said ringing means for providing an instantaneous first ring upon the application of ringing current, and automatic means controlled by the calling subscriber for automatically disconnecting ringing current from the called line prior to the response of the called subscriber.

9. In a telephone system including common battery telephone lines and magneto telephone lines, a link circuit for interconnecting any two of said lines, an operator's telephone set for said link circuit but normally disconnected therefrom, manual means for connecting said telephone set to said link circuit, electromagnetic means for said link circuit for preventing the connection of said telephone set to said link circuit when said link circuit is connected to a busy common battery line or when the calling and called subscribers on common battery lines interconnected by said link circuit have their receivers removed from their switchhooks, supervisory signals for said link circuits, said electromagnetic means operable

over magneto lines when said link circuit is connected to a magneto line, to effect the operation of said signals to signal for disconnection or to signal for a recall.

- 5 10. In a telephone system including common battery telephone lines and magneto telephone lines, a link circuit for interconnecting said telephone lines, an operator's telephone set, electromagnetic means for
10 said link circuit for preventing the operator from listening in on a conversation through said telephone set and link circuit when said link circuit is connected to a busy common battery telephone line or when said link circuit
15 is interconnecting two common battery telephone lines, and the subscribers on these lines have their receivers removed from their switchhooks, and supervisory signals for said link circuits, said electromagnetic
20 means controlled over said magneto telephone lines, when said link circuit is connected to said magneto lines, to effect the operation of said signals to signal for disconnection or to signal for a recall.
- 25 11. In a telephone system including common battery telephone lines and magneto telephone lines, a link circuit for interconnecting any two of said telephone lines, a pair of relays operable to provide secret
30 service on said link circuit when connected to a common battery line having another link circuit already connected to said common battery line or when connected to two common battery lines and the subscribers
35 thereon have their receivers disengaging their switchhooks, and supervisory signals for said link circuit, said pair of relays controlled over magneto lines when said link circuit is connected to magneto lines to

effect operation of said signals to signal for 40 disconnection or for a recall.

12. In a telephone system including telephone lines of different character, link circuits for interconnecting said telephone lines, supervisory signals for said link circuits, automatic means including a pair of 45 relays for each of said link circuits for providing secret service on said link circuits when connected to busy telephone lines of one class or when interconnecting telephone lines 50 of said one class and both the calling and called subscribers thereon have their receivers removed from their respective switchhooks, said pair of relays operable when the link circuits are connected to telephone lines of a different class to effect operation 55 of said signals to signal for disconnection or to signal for a recall.

13. In a telephone system including telephone lines of different classes, a link circuit for interconnecting any two of said telephone lines, a pair of relays bridged across the talking conductors of said link circuit, another relay for said link circuit controlled by said pair of relays for providing secret 60 service on said link circuit when said link circuit is connected to telephone lines of one class, and supervisory signals for said link circuit, said pair of relays operable to effect operation of said signals to signal for disconnection or recall when said link circuit 70 is connected to telephone lines of another class.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 27th day 75 of December, 1922.

BERT A. WALLACE.