

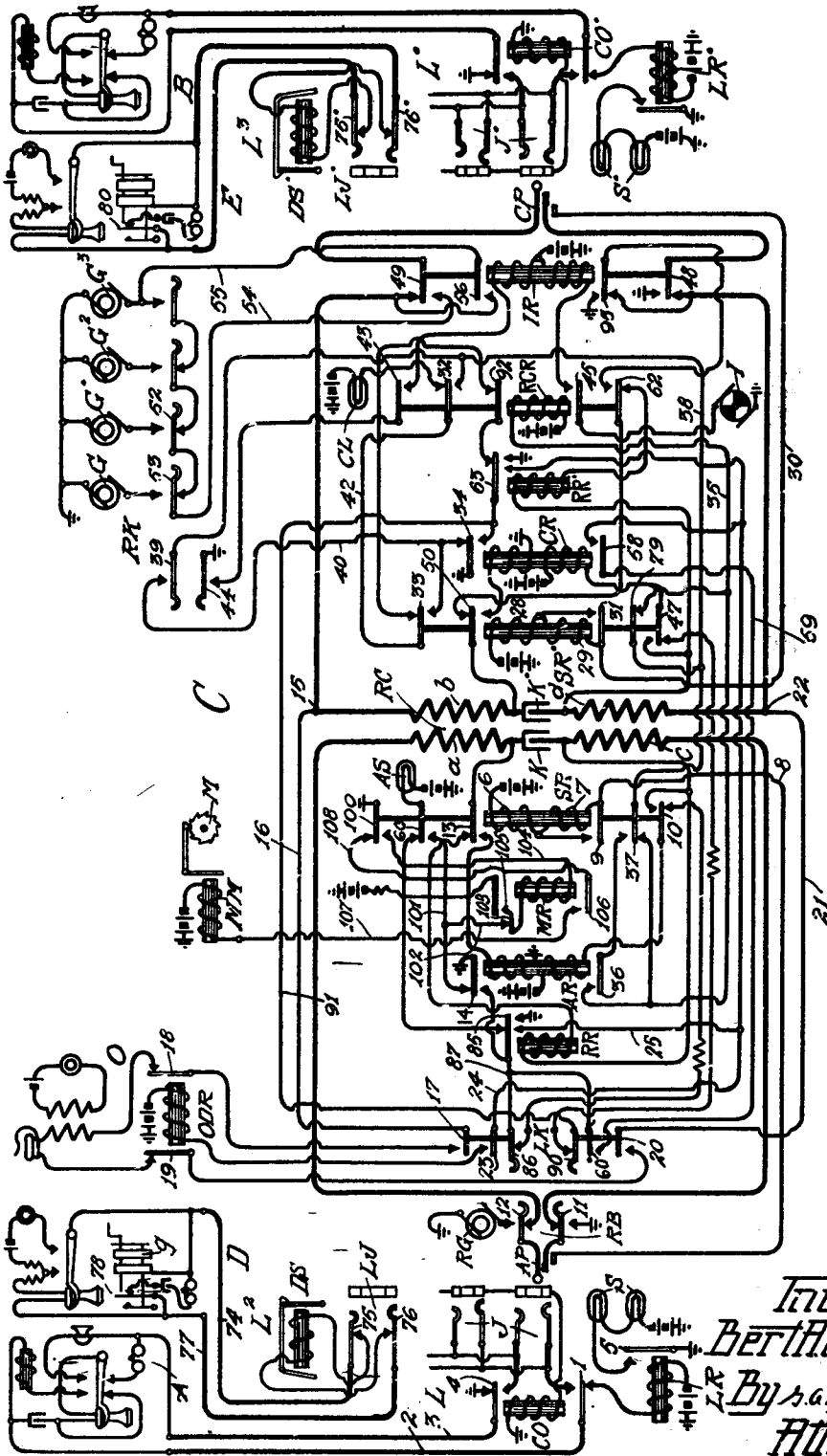
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TELEPHONE SYSTEM

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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 common battery telephone lines, or for interconnecting magneto lines, or for interconnecting common battery telephone lines and magneto lines.

A feature of my invention is the provision of a meter circuit associated with the cord circuit which is adapted to automatically register answered calls when the answering end of the cord is connected to a common battery calling line.

Another feature of my invention is the provision of means in the meter circuit which prevents the meter from registering should the operator attempt to register false calls by inserting an answering plug of a cord pair into the jack of a noncalling line.

Another feature of my invention is the provision of means whereby the meter relay fails to operate should a second operator attempt to answer a call from a calling common battery subscriber's line subsequent to the connection of the first operator thus preventing the registration of an answered call.

The above features, as well as others not specifically pointed out, will be more fully hereinafter described.

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 different operators' positions at which the subscriber's line terminates so that when a call is initiated over the line, the line signal at the different positions 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 cir-

cuits 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 substations 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 or CP 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 ring back 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.

A meter relay MR is also associated with the answering end of the cord circuit C and is energized when the relay SR is energized, and this energization of the relay MR takes place only when the answering plug AP is connected with a calling common battery line and when the relays SR and AR are energized as will be more clearly pointed out in the ensuing specification. The meter relay MR upon energization closes a locking circuit for itself and places the meter magnet MM which is common to a group of cords in condition to be energized when the operator disconnects the answering plug AP from the calling common battery line at the termination of conversation to operate the meter M to register an answered common battery call.

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 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 and to remove the shunt around the meter relay MR.

5 The relays SR and AR having energized, an energizing circuit for the meter relay MR is closed traced from battery through the answering supervisory lamp AS, alternate contact 60 of relay SR conductors 101 and
10 102, normal contact 103 of relay MR, through the winding of relay MR, conductor 104, to ground at alternate contact 100 of relay SR. The meter relay MR is energized over this circuit and the closing of
15 its make before break contact 105 closes a locking circuit for itself traced from battery, its make before break contact 105 through the winding of relay MR to ground at alternate contact 100 of relay SR. The closing
20 of alternate contact 106 of the meter relay MR places the meter magnet MM in condition to be energized to operate the meter M at the proper time as will be fully hereinafter described.

25 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
30 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,
35 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.

40 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
45 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
50 substation 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
55 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 operator's cord circuit to render the same in-
60 operative as long as the plug AP of the cord C remains in the jack J. The relay SR of the second cord circuit failing to energize its alternate contacts 50 and 100 remain open
65 and therefore no energizing circuit is estab-

lished for the meter relay MR so that the meter relay MR is not affected when a second operator attempts to answer the same call subsequent to the insertion of an answering plug by the first operator. The relay
70 SR of the second operator's cord circuit failing to energize, a circuit will be closed for the relay RR of the second operator's cord circuit, traced from the battery potential on the ring contact of the multiple jack,
75 which is in multiple circuit with the answering 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
80 repeating 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 12 of key RB and tip contact of the
85 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 multiple circuit with the answering jack J of the calling line. Relay RR of the second
90 operator's cord circuit energizing over this circuit will close its alternate contacts, which will provide an energizing circuit for the second operator's disconnect relay ODR associated with said second operator's cord
95 circuit, when the second operator operates 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
100 circuit being traced from battery through the winding of relay ODR, alternate contact 23 of listening key LK, conductors 24 and 25 to ground through the alternate contact 85 of relay RR of the said second operator's cord circuit. Relay ODR of the second
105 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
110 calling subscriber's line, which will prevent the second operator from conversing with the calling subscriber at substation A. The second operator failing to receive a response upon inquiring the wants of the calling sub-
115 scribe, will know that the call has been seized by 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 operation, it is at once apparent that an operator attempting to answer a call after the call
125 has been seized by another operator, will be prevented from establishing an operative connection between her telephone set and the calling line due to the operation of relays RR and ODR of the cord circuit of the
130

said operator attempting to answer the call subsequently to another operator.

Reverting now to when the operator at 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 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 the said called line be busy, there will be battery potential upon the sleeve of said jack J', which will give the operator at cord C the usual busy click, in the well-known manner, to notify her of the busy condition of the called line, whereupon she will inform the calling subscriber of the busy condition of the called line and will then withdraw the plug AP from the jack J, whereupon the cord C restores to normal. The removal of the answering plug AP from the line allows relays AR and SR to deenergize to bring about the operation of the meter magnet MM and in turn the meter M to register an answered call as will be more fully described in the ensuing specification. The withdrawal of the plug also causes the meter relay to deenergize. Assuming, however, that the called line is idle, the operator will not receive a click in her ear, and she will therefore insert the calling plug CP into the jack J' of the called line. Upon the insertion of the plug CP into the jack J', an energizing circuit is closed for the sleeve relay SR' as follows: from battery through the upper low resistance winding 28 and lower 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 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 shunting out its lower high resistance winding 29 and establishing a low resistance circuit for itself, traced from battery, through the upper or low resistance winding 28 of said 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 as yet 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 at 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 also 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 deenergized 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 rever-
 5 tive 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 rever-
 10 tive ringing tone being from ground through the generator G³, conductor 55, alternate contact 56 of relay IR, winding *b* of the repeat-
 15 ing coil RC, alternate contact 50 of relay SR' to ground through the upper winding of relay CR, whereupon the said rever-
 20 tive ringing tone will be induced into the wind-
 ing *a* of the repeating coil RC and then transmitted through the calling substation A. Should the subscriber at the substation
 25 A replace his receiver upon its switchhook before the called-for subscriber at substa-
 tion B removes his receiver in response to his call bell, the further application of ring-
 30 ing current to the called line will be auto-
 matically discontinued, due to the fact that the supervisory relay AR which is con-
 35 trolled by the calling subscriber at substa-
 tion A will deenergize when the calling sub-
 40 scription replaces his receiver, and relay AR,
 restoring to normal, opens its alternate con-
 45 tact 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
 50 IR whereupon the relay IR immediately re-
 stores to its normal position to prevent the
 55 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
 60 responds, after the removal of the receiver
 at substation B, and when relay IR is in its
 deenergized position, as will be the case
 during a non-ringing period, a circuit will
 be closed for the calling supervisory relay
 65 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 con-
 70 tacts 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
 75 above, to prevent another energization of re-

lay IR, whereby further application of ring-
 ing 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 conduc-
 70 tors. Should the operator at cord circuit
 C attempt to listen in on the conversation
 by operating her listening key LK, she is
 prevented from doing so by the operation of
 75 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
 80 relay ODR, alternate contact 23 of the lis-
 tening key LK, conductor 24, alternate con-
 tact 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
 85 her telephone set in circuit so as to listen
 in on the conversation between the sub-
 scribers at substations A and B. In case
 the subscriber at substation A replaces his
 receiver upon its switchhook, supervisory
 90 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
 95 to the cord C, which will enable the oper-
 ator to communicate with the subscriber
 at substation B, provided said subscriber
 has not replaced his receiver upon its switch-
 100 hook. 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
 105 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
 110 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 re-
 115 placed 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 re-
 120 spective switchhooks.

Assuming now that the conversation has
 terminated, and the subscribers at A and B
 have replaced their receivers upon their re-
 spective switchhooks, supervisory relays AR
 and CR will restore to close circuits for
 125 the supervisory lamps AS and CL, respec-
 tively, the circuit for lamp AS being es-
 tablished from battery through the said
 lamp AS, alternate contact 60 of relay SR,
 to ground through normal contact 14 of
 130

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 CL 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.

When the operator of the cord circuit C removes the answering plug AP from the jack J of the calling line upon the termination of conversation the relay SR deenergizes and the opening of its alternate contact 100 opens the locking circuit of the meter relay MR but as the relay MR is slow to release it is held momentarily energized after its locking circuit is opened. The closure of normal contact 100 of relay SR thus establishes an energizing circuit for the meter magnet MM traced from battery, through the winding of meter magnet MM, conductor 107, alternate contact 106 of the meter relay MR, conductor 108 to ground at normal contact 100 of relay SR. The meter magnet MM is energized to operate the meter mechanism M to register an answered call from a calling common battery line at A. Meter relay MR and meter magnet MM also deenergize immediately thereafter.

It sometimes occurs that after the calling subscriber has stated his wants to the exchange operator, he replaces his receiver upon his 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 contact 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. Should the operator of the cord circuit attempt to operate the meter M by inserting an answering plug AP of a cord circuit C in the jack J of a non-calling line to register false answered connections she will be prevented from operating the meter M in the following manner. When the answering plug AP is inserted into the jack J of a non-calling line the relay SR of the cord circuit used and the cut off relay CO of the line circuit associated with the jack J are energized as before described. The relay SR upon energization closes its alternate contacts 10 and 13 but the relay AR does not energize as the circuit for the relay AR is not completed through the switchhook contacts of a calling common battery substation as A. As the relay AR remains deenergized its normal contact 14 remains closed and a ground to ground connection is closed through the meter relay MR traced from ground at normal contact 14 of the relay AR, conductors 101 and 102, normal con-

tact 103 of relay MR, through the winding of relay MR, conductor 104 to ground at alternate contact 100 of relay SR. This ground to ground connection just traced
 5 shunts out the battery which is fed through the lamp AS to operate the relay MR when the answering plug AP is connected to the jack J of a calling common battery line and as the relay MR remains deenergized
 10 due to this ground to ground shunt just traced its alternate contact 106 remains open and when the operator again withdraws the plug from the jack J of the non-calling common battery line the relay SR
 15 deenergizes. The closing of normal contact 100 of relay SR does not affect the meter magnet MM as before described as the meter relay MR remains deenergized and as its alternate contact 106 remains
 20 open the meter magnet MM is not affected. Thus it is seen that the operator cannot cause the meter magnet MM to operate to register false calls as only such calls as have been established with a calling common bat-
 25 tery subscriber are registered and then only after the answering plug AP has been disconnected from the jack of the calling line.

Referring again to the attempt of a second operator to answer a call from a calling common battery subscriber subsequent to the first
 30 operator, the relay SR of the second cord fails to operate as previously described and as its alternate contacts 60 and 100 remain open no energizing circuit for the meter
 35 relay MR is closed and no registration of the meter takes place when a second operator attempts to answer a call after the first operator has seized the call.

Having described my cord circuit for interconnecting common battery subscribers' telephone lines, I will now describe the operation of my cord circuit in interconnecting
 40 magneto subscriber telephone lines.

Assuming that the subscriber at the
 45 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
 50 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
 55 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
 60 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 listen-
 65 ing 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 sleeve of said jack LJ, and since relay SR fails to energize, the super-
 70 visory relay AR will not energize at this time. The relay SR as just described does not operate when the cord circuit C is connected to a calling magneto line as D and therefore the meter relay MR is not effected
 75 as alternate contacts 60 and 100 of relay SR remain open and no registration of answered calls are made when the calling line is a magneto line. The operator of cord C will now inquire the wants of the
 80 calling subscriber at substation D 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
 85 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
 90 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
 95 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
 100 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 ring-
 105 ing 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
 110 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
 115 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
 120 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
 125 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
 130 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
 5 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
 10 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
 15 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
 20 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
 25 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
 30 IR, tip contacts of plug CP, and jack LJ', call bell and normal contact 80 at substation E, ring contacts of jack LJ' and plug CP, to ground through the alternate contact 48
 35 of relay IR. When the end spring contacts 39 and 44 of the ringing key RK are opened the energizing circuits for relays IR and RCR are opened simultaneously but the relay IR will deenergize first and then relay
 40 RCR will deenergize, 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
 45 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
 50 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
 55 relay RCR restores. A revertive ringing tone is also transmitted to the calling subscriber at substation D to notify him that the called-for subscriber is being signaled, over a circuit traced from ground, through
 60 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
 65 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
 70 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.
 75

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
 80 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
 85 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
 90 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
 95 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
 100 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
 105 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
 110 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 be actuated by current flowing
 115 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 E upon replacing his receiver upon its switchhook will
 120 ring off to cause the energization of 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
 125 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
 130

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 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 supervisor 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.

From the foregoing specification, it will be clearly understood that the meter relay MR will only operate when the answering end of the cord C is connected to a common battery calling line and further that the meter magnet MM will operate when the connection is taken down after the termination of conversation. It is also clear that the meter M will only register such answered connections as are established with a calling common battery line and that it is impossible for the operator to register false answered connections by inserting an answering plug AP of a cord C into the jack J of a non-calling line.

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.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a telephone system including telephone lines, a link circuit having an answering plug and a calling plug for interconnecting the same, a meter relay and a meter magnet associated with said link circuit, the answering plug of said link circuit adapted to be connected to a calling common battery telephone line to operate said meter relay to condition means for a subsequent operation of said meter magnet, said answering plug adapted to be disconnected from said telephone line upon the termination of the call to cause the operation of said meter magnet.

2. In a telephone system including telephone lines, a link circuit having an answering plug and a calling plug for interconnecting the same, a meter relay and a meter magnet associated with said link circuit, the answering plug of said link circuit adapted to be connected to a common battery telephone line to operate said meter relay to condition means for a subsequent operation of said meter magnet, said answering end of said link circuit adapted to be disconnected from said telephone line to cause said meter magnet to operate to register an answered call.

3. In a telephone system including telephone lines, a link circuit for interconnecting the same, a meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit adapted to be connected to a calling common battery subscriber's line to operate said sleeve relay, a supervisory relay controllable by said sleeve relay and over said calling common battery line, said sleeve relay operating said meter relay to condition means for a subsequent operation of said meter magnet to register an answered call.

4. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit adapted to be connected to a calling common battery line to cause said sleeve relay to operate, a supervisory relay controlled by said sleeve relay and over said calling common battery line, said sleeve relay operating said meter relay after said supervisory relay operates, and a locking circuit for said meter relay, said meter relay conditioning means for a subsequent operation of said meter magnet, said link circuit adapted to be disconnected from said calling line to cause said meter magnet to operate to register an answered call.

5. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit adapted to be connected to a calling common battery line to operate said sleeve relay, a supervisory relay controlled by said sleeve relay and over said calling line, said supervisory relay adapted to be energized to cause said meter relay to operate, a locking circuit for the said meter relay, and means controlled by said meter relay and said sleeve relay for operating said meter magnet to register an answered call.

6. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a slow acting meter relay and a meter magnet associated with said link circuit, a sleeve relay,

said link circuit adapted to be connected to a calling common battery line to cause said sleeve relay to operate, a supervisory relay controlled by said sleeve relay and over said calling line, said supervisory relay adapted to be energized to cause said meter relay to operate and a locking circuit for the said meter relay, said slow acting meter relay conditioning switching means for a subsequent operation of said meter magnet, said link circuit adapted to be disconnected from said calling common battery line to deenergize said sleeve relay to permit said meter magnet to energize to register an answered call.

7. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a slow to release meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit adapted to be connected to a calling common battery line to operate said sleeve relay, a supervisory relay controlled by said sleeve relay and said calling line, said supervisory relay adapted to be operated to permit said meter relay to operate and a locking circuit for said meter relay, said slow to release meter relay conditioning switching means for a subsequent operation of said meter magnet, said link adapted to be disconnected from said calling common battery line to deenergize said sleeve relay to permit said meter magnet to energize through switching means of said sleeve relay and said switching means of said slow to release meter relay to register an answered call.

8. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit, adapted to be connected to the jack of an idle or noncalling common battery line to cause said sleeve relay to operate, a supervisory relay associated with said link circuit, said sleeve and supervisory relays controlling the operation of said meter relay, said supervisory relay remaining inert when said link is connected to said jack of said idle or noncalling line, a shunt controlled by said supervisory relay to maintain said meter relay inert to prevent said meter relay energizing when said link circuit is connected to an idle or noncalling line.

9. In a telephone system including telephone lines, a link circuit for interconnecting lines of different character, a meter relay and a meter magnet associated with said link circuit, a sleeve relay for said link circuit, said link circuit adapted to be connected to a jack of an idle or non-calling common battery line to cause said sleeve relay to operate, a supervisory relay for said link circuit remaining inert when said link is connected to

said idle or non-calling line, a shunt controlled by said supervisory relay to maintain said meter relay inert to prevent said meter relay energizing subsequent to the removal of said link from said jack.

10. In a telephone system including telephone lines of different character and a link circuit for interconnecting the same, a meter relay and a meter magnet associated with said link circuit, a sleeve relay for said link circuit, said link adapted to be connected to a jack of a busy or calling line or a jack of an idle or non-calling common battery line to cause said sleeve relay to operate, a supervisory relay for said link circuit controlled by said sleeve relay and over the connected calling common battery line, said supervisory relay remaining inert when said link is connected to an idle or noncalling line and energizing when said link circuit is connected to a calling line, a shunt controlled by said supervisory relay to maintain said meter relay inert to prevent said meter relay energizing subsequent to the removal of said link from the jack of an idle or noncalling line to prevent said meter magnet energizing to register a false answered call.

11. A telephone system including telephone lines, a link circuit having an answering plug and a calling plug for interconnecting the same, a meter relay and a meter magnet associated with said link circuit, a sleeve relay, said link circuit adapted to be connected to a calling telephone line to cause said sleeve relay to operate, a supervisory relay controlled by said sleeve relay and over said calling line, said supervisory relay adapted to be energized to cause said meter relay to operate to condition means for the subsequent operation of said meter magnet, said link circuit adapted to be disconnected from said telephone line to permit said meter magnet to energize to register an answered call.

12. In a telephone system including telephone lines terminating at different operator's positions at a central exchange, link circuits for interconnecting said telephone lines, a meter relay and a meter magnet, a sleeve relay in each of said link circuits, said link circuits adapted to be connected to a calling telephone line to cause said sleeve relay to operate to condition means including said meter relay to cause the subsequent operation of said meter magnet, said link circuit adapted to be disconnected from said telephone line to cause said sleeve relay to de-energize to cause said meter magnet to operate to register an answered call, a second link circuit adapted to be connected to the same calling telephone line, the sleeve relay in said second link circuit remaining inert when said second link circuit is connected to said telephone line subsequent to the connection of the first link circuit to the same calling telephone line whereby the meter

magnet in the second link circuit is prevented from operating upon the disconnection of the second link circuit from the telephone line to falsely register an answered call.

13. In a telephone system including telephone lines, terminating at a central exchange at different operator's positions, link circuits for interconnecting said telephone lines, a sleeve relay in each of said link circuits, one of said link circuits adapted to be connected to a calling common battery telephone line to cause said sleeve relay to operate, a supervisory relay controlled by said sleeve relay and over said calling line, an operator's set, a listening key adapted to connect said set to said link circuit, a meter relay and a meter magnet, said supervisory relay adapted to energize to cause the operation of said meter relay to condition means for the subsequent operation of said meter magnet to register an answered call, a second link circuit adapted to be connected to said calling common battery telephone line, an operator's disconnect relay, means in said second link circuit adapted to cause the energization of said operator's disconnect relay to prevent the connection of the second operator's set to the said link circuit.

14. In a telephone system including a calling line and a called line, a link circuit for interconnecting said lines, a sleeve relay, a meter relay and a meter magnet, said link circuit adapted to be connected to said calling line to cause said sleeve relay to operate, a supervisory relay controlled by said sleeve relay and over said calling line, an operator's set, a listening key adapted to connect said operator's set to said link circuit, a second supervisory relay controlled over said called line, an operator's disconnect relay, said first supervisory relay adapted to be energized to cause the energization of said meter relay to condition means for the subsequent operation of said meter magnet, said operator's disconnect relay adapted to be energized through the contacts of said supervisory relays when said listening key is operated subsequently to the energization of said second supervisory relay, said link circuit adapted to be disconnected from said calling line to cause the said meter magnet to energize to register an answered call.

15. In a telephone system including telephone lines, a link circuit having an answering plug and a calling plug for interconnecting said telephone lines, an operator's set, a listening key for connecting said operator's set to said link circuit, an operator's disconnect relay adapted to render said listening key ineffective to connect said operator's set to said link circuit, said calling plug adapted to be connected to a busy line to cause means in said link circuit to operate to permit the energization of the operator's

disconnect relay to render said listening key ineffective to connect said operator's set to said link circuit whereby said operator's set is prevented from connecting with said link
5 circuit.

16. In a telephone system including telephone lines, a link circuit having an answering plug and a calling plug for interconnecting said telephone lines, an operator's set, a
10 listening key for connecting said operator's set to said link circuit, an operator's disconnect relay adapted to render said listening key ineffective to connect said operator's set to said link circuit, said calling plug adapted
15 ed to be connected to a busy line to cause

means in said link circuit to operate to permit the energization of the operator's disconnect relay to render said listening key ineffective to connect said operator's set to
said link circuit whereby said operator's set 20 is prevented from connecting with said link circuit, said calling plug adapted to be connected to an idle line, said means in said link circuit remaining inoperative and said operator's disconnect relay remaining in- 25 operative to permit the said operator's set to be connected to said link circuit.

In testimony whereof I have signed this specification.

BERT A. WALLACE.