

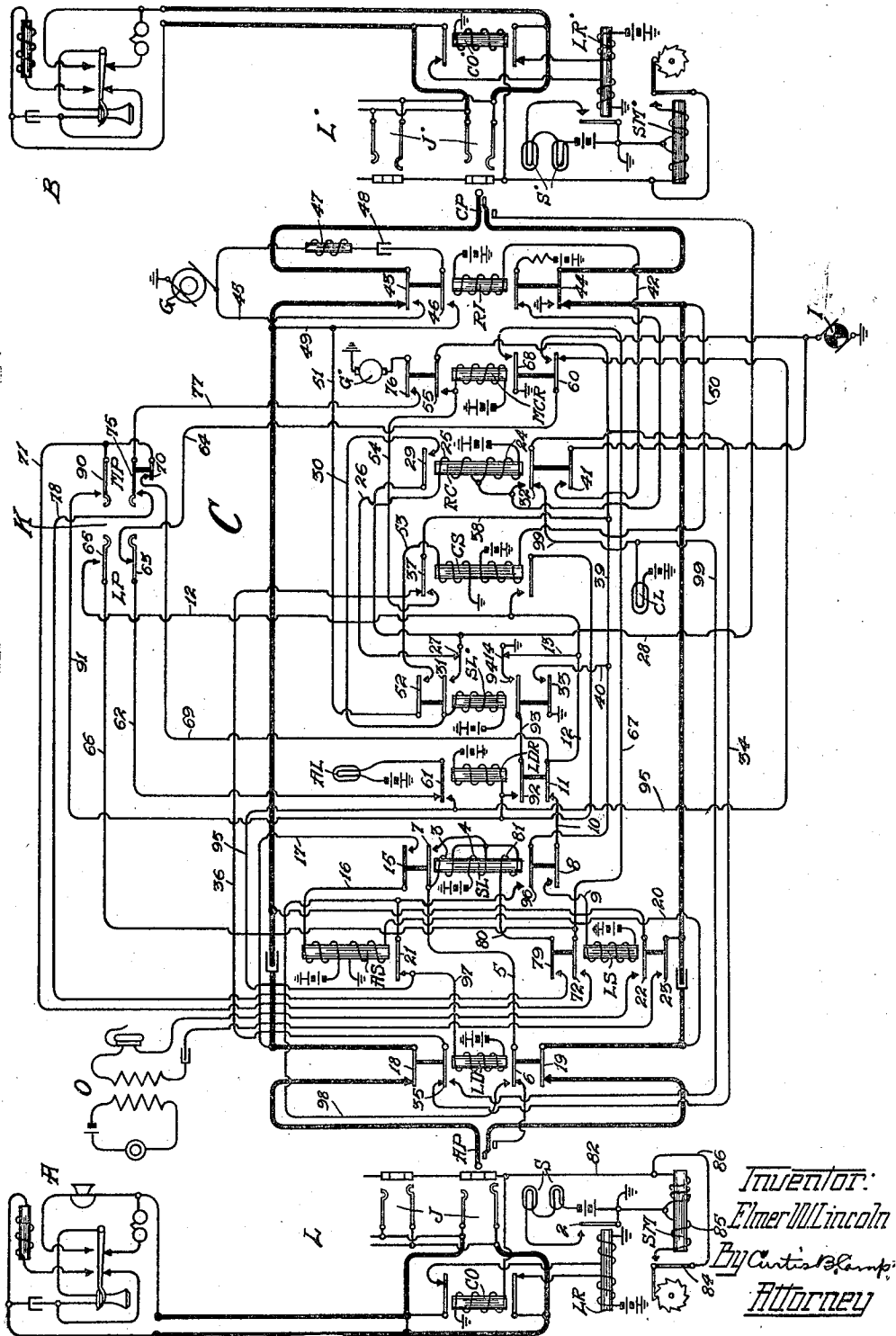
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E. W. LINCOLN

TELEPHONE SYSTEM

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, ELMER W. LINCOLN, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with measured service systems for telephone lines, whereby a call initiated by a subscriber at a calling substation and the obtaining of a response at a called substation is recorded by a service meter individual to the line of the calling substation, and an object of my invention is the provision of an improved circuit arrangement for accurately recording completed connections from a calling substation.

A feature of my invention is the provision of means whereby the service meter associated with the calling substation is only actuated when the connection established from a calling substation is in conversational circuit with the desired party.

Another feature of my invention is the provision of a key individual to each cord circuit of an operator's position, whereby the key must first be thrown to its listening position, which actuates means whereby the operator's set is connected to the cord conductors so that she may determine whether the calling party has been connected to the right called party, and this actuation of the key to its listening position conditions apparatus so that if the call is found to be rightly established the actuation of the key to its metering position will actuate the means for bringing about the registration of the completed connection upon the service meter associated with the calling substation.

Another feature of my invention is the provision of a distinctive signal which is actuated when the called party answers, to notify the operator that the established connection is awaiting registration upon the meter.

The above features, as well as others, will be more fully hereinafter described, and for a more complete understanding of my invention reference may be had to the accompanying drawing, in which I illustrate my

invention operating in connection with a suitable telephone system.

In the drawing I illustrate the calling substation A connected at the exchange with a line circuit L, comprising the usual line relay LR, cut-off relay CO, multiple answering jacks J and multiple line signals S. The jacks of the lines are distributed among the different operators' positions, and there is a line signal S for each jack J, so that when the call is initiated over any line the line signals S at the various operators' positions are lighted and any one of a plurality of operators may seize the call to the exclusion of the others. In addition to this line circuit apparatus I associate a service meter SM with the line circuit, and this meter is actuated to record the completed calls of the calling substation A with which the service meter SM is associated.

The cord circuit C for interconnecting substations is provided with an answering plug AP and a calling plug CP, the said answering and calling plugs AP and CP being connected by the heavily marked talking conductors. The answering end of the cord circuit C is provided with the sleeve relay SL, which is energized in series with the cut-off relay CO of the line circuit L when the answering plug AP is inserted into the jack of the calling line. An answering supervisory relay AS is also provided which is energized over the line, and a listening relay LS which is energized to connect the operator's set O to the cord conductors. A link disconnect relay LD is provided, which is energized when the calling subscriber replaces his receiver upon the switchhook to disconnect the cord conductors from the connected line circuit associated with the calling substation so as to permit the calling substation to recall without awaiting the withdrawal of the answering plug AP from the jack J. The sleeve relay SL is provided with high resistance and low resistance windings and upon the actuation of the relay SL the high resistance winding is shunted, providing secret service. The shunting of this high resistance winding prevents the sleeve relay SL in another cord from being energized, should another operator attempt to answer the call after it has been seized by an operator, so that an operator at another cord attempting to seize

the call after the first operator has connected to the calling line is prevented from communicating with the subscriber, as the shunt of the low winding of the relay SL of the first cord prevents relay SL of the second cord from operating. As the second operator is not connected to the calling line, due to the relay SL of the second cord remaining at normal, her operator's set is not connected to the cord conductors, and she, therefore, does not receive a response from the calling subscriber and withdraws the answering plug of her cord pair from the connected jack.

A ringing control relay RC is provided, which is energized when the calling plug CP is inserted into the jack of the called line, and the relay RC energizing closes a circuit for the sleeve relay SL', the sleeve relay SL' remaining energized until the plug CP is withdrawn from the jack of the called line. A ringing interrupter relay RI is also provided, which is energized upon the energization of the ringing control relay RC to connect the constantly rotating interrupter I in circuit with the said relay RI to intermittently energize and de-energize the said relay to connect ringing current to the called line from the ringing generator G.

A calling supervisory relay CS is provided, which is energized upon the response of the called subscriber. A meter control relay MCR and a listening disconnect relay LDR are also provided for purposes as will be more fully hereinafter described. Answering and calling supervisory lamps AL and CL are also provided for the usual supervisory purposes. The answering supervisory lamp AL is also provided with means for flashing it to give the operator a distinctive signal when the called subscriber has answered to notify her that the call is to be registered. A key K, individual to the cord, is also provided, which is the usual two-way key, and is provided with a listening position LP and the metering position MP, for purposes as will also be more fully hereinafter described.

To the right of the drawing I have illustrated a called substation B, connected at the exchange with the line circuit L', comprising the cut-off relay CO', line relay LR', multiple jacks J' and multiple signals S'. In addition is provided the service meter SM' associated with the called line, for registering completed connections that are initiated from the substation B.

Having described in general the apparatus embodied in my invention, I will now describe more in detail the operation of my invention as illustrated.

Assuming now that the subscriber at the substation A initiates a call, the removal of the receiver closes an energizing circuit for the line relay LR of the line circuit L from

battery, through the left-hand winding of the relay LR, through the substation and back to ground through the right-hand winding of the said relay LR. The line relay energizing closes its alternate contact 2, establishing a circuit through the multiple line lamps S at a plurality of the operator's positions.

Assuming that it is the operator associated with the cord circuit C that answers the call, the insertion of the answering plug AP into the jack of the calling line establishes a series energizing circuit for the cut-off relay CO of the line circuit L and the sleeve relay SL of the cord circuit C, over a circuit traced from battery through windings 3 and 4 of the sleeve relay SL, conductor 5, normal contact 6 of the link disconnect relay LD, sleeve contacts of the connected plug AP and jack J, to ground through the winding of the cut-off relay CO. The cut-off relay CO energizing opens the energizing circuit for the line relay LR, which relay restores and effaces the multiple line signals S. The sleeve relay SL energizing closes its alternate contact 7, and the holding circuit for the sleeve relay SL may now be traced from battery through the middle winding 4 of the relay SL, its alternate contact 7, and over the previously described path to ground through the cut-off relay CO. The upper, high resistance, winding 3 of the relay SL is shunted, this arrangement providing for secret service, as the sleeve relay SL of a second cord circuit will not operate in series with the cut-off relay CO as the shunt of the low-wound winding 4 of the sleeve relay SL of the first cord circuit renders inoperative the relay SL of any second cord circuit that may be connected by its operator. The closure of alternate contact 8 of the relay SL establishes an energizing circuit for the listening relay LS, traced from battery through the winding of the relay LS, conductor 9, alternate contact 8 of relay SL, conductor 10, normal contact 11 of the listening disconnect relay LDR, conductors 12 and 13, to ground at normal contact 14 of the sleeve relay SL'. The closing of alternate contact 15 of the relay SL closes an energizing circuit for the answering supervisory relay AS, traced from battery through the upper winding of the relay AS, conductor 16, alternate contact 15 of relay SL, conductor 17, normal contact 18 of the link disconnect relay LD, tip contacts of the connected plug AP and jack J, through the substation, back through the sleeve contacts of the connected jack J and plug AP, normal contact 19 of the relay LD, conductor 20, to ground through the lower winding of the relay AS. The relay AS is thus bridged across the cord conductors, supplying talking battery to the calling substation. The listening relay LS

energizing closes its alternate contacts 22 and 23 to connect the operator's set O to the cord conductors, and the operator may now inquire the wants of the calling subscriber.

Should another operator attempt to seize the call after the operator associated with the cord C is connected thereto, the low resistance path of the winding 4 of the sleeve relay SL prevents the relay SL of the second cord from operating, and the relay SL of the second cord circuit failing to operate, the listening relay LS of the second cord remains at normal and the operator's set O of the second cord is not connected across the cord conductors. The second operator failing to receive a response when she answers knows that the call has been answered by another operator and withdraws the plug of her cord circuit from the jack of the calling line appearing at her position.

The cut-off relay CO of the line circuit L and the service meter magnet SM are multiply connected to the sleeve contact of the jack J, but the service meter magnet SM does not energize over this circuit, due to the high resistance of the said service meter magnet SM. The operator having received the number of the wanted subscriber from the calling subscriber at the substation A, and assuming that it is the subscriber at substation B that is wanted, the operator tests the multiple jack of the called line B in the usual manner by placing the tip of the calling plug CP to the sleeve of the multiple jack J, and if the line is busy the operator will receive the customary busy click.

Assuming that the line is idle, the operator inserts the calling plug CP into the jack J' of the called line B, and its insertion closes a series energizing circuit for the ringing control relay RC and the cut-off relay CO' of the line circuit L' from battery through the windings 24 and 25, conductor 26, normal contact 27 of the sleeve relay SL', conductor 28, sleeve contacts of the connected plug CP and jack J', to ground through the winding of the cut-off relay CO' of the line circuit L'. The closing of alternate contact 29 of the relay RC establishes an energizing circuit for the sleeve relay SL', traced from battery, through the winding of the relay SL', conductor 30, through alternate contact 29 of the relay RC, conductor 28, sleeve contact of the connected plug CP and jack J' to ground through the cut-off relay CO'. The sleeve relay SL' upon energizing closes its alternate contact 31, establishing a locking circuit for itself, traced from battery through the winding of said relay SL', its alternate contact 31, conductor 28, the sleeve contacts of the connected plug and jack CP and J' to ground through the cut-off

relay CO'. The opening of normal contact 27 of relay SL', upon its energization, opens the initial energizing circuit for the relay RC, but due to the closure of alternate contact 32 of the relay RC and the closure of alternate contact 33 of the relay SL', a substitute energizing circuit is established for the said relay RC, traced from battery through the lower winding 24 of the relay RC, alternate contact 32 of the relay RC, conductor 34, normal contact 35 of the link disconnect relay LD, conductor 36, normal contact 37 of the calling supervisory relay CS, conductors 38, 39 and 40, to ground at alternate contact 33 of the sleeve relay SL'. The opening of normal contact 32 of the relay RC opens the circuit of the calling supervisory signal CL and prevents said lamp from lighting at this time. The relay SL' energizing opens its normal contact 14, interrupting the energizing circuit for the listening relay LS and the relay LS restoring its alternative contacts 22 and 23 are opened to disconnect the operator's set O from the cord conductors.

The closing of contact 41 of the relay RC establishes an energizing circuit for the ringing interrupter relay RI, traced from battery through the winding of the relay RI, conductor 42, through contact 41, to ground through the constantly rotating interrupter I, and the ringing interrupter relay RI is thus intermittently energized and de-energized to open and close its contacts 43 and 44. The closing of alternate contact 43 of the relay RI connects the ringing generator G to the cord conductors. The ringing current which is transmitted to the called substation B may be traced from the ungrounded pole of the ringing generator G, conductor 45, alternate contact 43 of the relay RI, the tip contacts of the connected plug CP and jack J', through the call bell and condenser at the called substation B, ring contacts of the connected plug CP and jack J', to ground through the alternate contact 44 of the relay RI. The closing of alternate contact 46 of the relay RI also gives the calling subscriber an audible tone, notifying him that the called-for subscriber is being signaled, said audible tone being traced from the generator G through the coil 47 and condenser 48, through alternate contact 46 of the relay RI, conductor 49, back to the calling substation A.

The subscriber at the substation B, in response to his signal, removes his receiver from the switchhook, and upon the closure of normal contacts 43 and 44 of the relay RI during one of the de-energizations of the said relay, an energizing circuit is established for the calling supervisory relay CS, traced from battery through the lower winding of the relay CS, conductor

50, normal contact 44, the ring contacts of the connected plug CP and jack J', through the now closed contacts at the substation switchhook, back through the tip contacts of the connected jack J', and plug CP, normal contact 43 of the relay RI, conductors 49 and 51, alternate contact 52 of the relay SL', conductor 53 to ground through the upper winding of the relay CS. The relay CS upon energization opens its normal contact 37, opening the circuit of the ringing control relay RC, and the said relay RC upon deenergization opens its alternate contact 41, disconnecting the interrupter I from the ringing interrupter relay RI, thus preventing further energizations and de-energizations of the ringing interrupter relay RI, and the relay RI now remains at normal. The closing of alternate contact 37 of the supervisory relay CS establishes an energizing circuit for the meter control relay MCR, traced from battery through the winding of the relay MCR, conductor 54, through the alternate contact 37 of the relay CS, conductors 38, 39 and 40, to ground at alternate contact 33 of the relay SL'. The meter control relay MCR energizing closes its alternate contact 55 to establish a locking circuit for itself, traced from battery through the winding of the said relay MCR, its alternate contact 55, conductors 39 and 40 to ground at alternate contact 33 of the relay SL'.

The closing of alternate contact 60 of the relay MCR establishes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, normal contact 61 of the listening disconnect relay LDR, conductor 62, normal contact 63 of the key K, conductor 64, alternate contact 60 to ground through the constantly rotating interrupter I. This circuit, closed for the answering supervisory lamp through the interrupter I, brings about the flashing of the said lamp AL and indicates to the operator that the called for subscriber at the substation B has answered and that the subscriber at the calling substation A and the subscriber at the called substation B are now in conversational circuit and that the call which has been initiated by the calling subscriber at the substation A is ready to be registered. Before the call can be registered the operator must actuate the key K to the left to place it in listening position LP, which actuates means which again connects the operator's set O to the cord conductors so that she may listen in on the connection and find out whether the connection established is the connection that was called for, or whether there was a mistake made in the called party's number. Should this be the case, the operator removes the calling plug from the jack and inserts it into the proper jack of the wanted line. The actuation of the key K to its LP position closes an energizing circuit for the listening relay LS (which it will be remembered, was restored when the sleeve relay SL' energized due to the insertion of the calling plug CP into the jack J' of the called line), from battery through the winding of the listening relay LS, alternate contact 8 of the relay SL, conductor 10, normal contact 11 of the listening disconnect relay LDR, conductor 12, alternate contact 65 of the key K, conductors 66 and 67, to ground at alternate contact 68 of the relay MCR. The listening relay LS upon energization closes a locking circuit for itself, traced from battery through the winding of the relay LS, alternate contact 8 of the relay SL, conductor 10, normal contact 11 of the relay LDR, conductor 69, normal contact 70 of the key K, conductor 71, alternate contact 72 of the listening relay LS, conductor 67 to ground at contact 68 of the relay MCR. The closing of alternate contacts 22 and 23 of the listening relay LS again connects the operator's set O to the cord conductors, and she may now listen in on the conversation; and assuming that the right connection has been set up and that the subscriber at the substation A and the subscriber at the substation B are now in conversational circuit, the operator now actuates the key K, by moving it to the right into its metering position MP, to bring about the registration of a completed call on the service meter SM associated with the calling subscriber at the substation A. The key K is so constructed that when moved to its metering position MP its normally open contact 75 is closed first, and the closing of this contact 75 closes a circuit for the service meter SM associated with the calling substation A, traced from the ungrounded pole of the direct current generator G', alternate contact 76, conductor 77, alternate contact 75 of the key K, conductor 78, alternate contact 79 of the listening relay LS, conductor 80, winding 81 of the sleeve relay SL, alternate contact 7 of the relay SL, conductor 5, normal contact 6 of the link disconnect relay LD, sleeve contacts of the connected plug AP and jack J, conductor 82, through the magnet of the service meter SM to ground. The direct current generator G' may be from eighty to one hundred volts and is for operating the meter magnet. The purpose of the lower winding 81 of relay SL is for maintaining the relay SL energized and since the current flowing through conductor 80 is eighty to one hundred volts and the current from battery through the middle winding 4 of said relay SL is of a lower voltage, the said relay SL would drop back due to this difference in the voltage, for in this case the current through conductor 80 will tend to overcome the current through

the winding 4, and in order to prevent the de-energization of said relay, winding 81 is provided. The service meter magnet is energized over this circuit and attracts its armature 84, which is associated with the usual registering mechanism, well known in the art, and causes the meter to register a completed call. The closing of alternate contact 84 of the service meter magnet closes a locking circuit for itself, traced from ground through the winding 85 of the magnet, alternate contact 84, conductors 86 and 82, the sleeve contacts of the connected plug AP and jack J, normal contact 6 of the relay LD, conductor 5, alternate contact 7 of the relay SL, through the winding 4 of the relay SL to battery. The service meter magnet is locked up over this circuit and another registration of the service meter cannot be brought about due to this lock-up condition of the magnet, and the service meter SM will remain in such condition until the cord plug AP is disconnected from the jack J, which will restore the circuit to normal and place the meter in condition to register another call, or when the link disconnect relay LD operates to operatively disassociate the cord circuit from the calling subscriber's line, which will open the circuit of said meter relay at normal contact 6 of relay LD, as will be more fully hereinafter described.

The closing of contact 90 of the key K when moved to its metering position MP establishes an energizing circuit for the listening disconnect relay LDR, traced from battery through the winding of the said relay LDR, conductor 91, alternate contact 90 of the key K, conductor 71, alternate contact 72 of the listening relay LS, conductor 67, to ground at alternate contact 68 of the meter control relay MCR. The relay LDR energizing closes its alternate contact 92, establishing a locking circuit for itself traced from battery through the winding of the relay LDR, its alternate contact 92, conductor 93, to ground at alternate contact 94 of the relay SL'. The opening of normal contact 11 of the relay LDR opens the energizing circuit of the listening relay LS, and the relay LS restores to normal and again disconnects the operator's set O from the cord conductors at its contacts 22 and 23, preventing the operator from again coming in on the connection, thus providing secret service after the completed call has been registered upon the meter of the calling substation A.

The key K is constructed so that the contact 75 is closed first in order that a flow of generator current from generator G' may be transmitted to the magnet of the service meter SM to register the same, and, as this circuit extends through alternate contact 79 of the listening relay LS, this relay must

be held up momentarily so that this short impulse of generator current may be transmitted to the said magnet. Thus, contact 75 is closed before contact 90 and as soon as contact 90 is closed the circuit for the listening disconnect relay LDR is established, and the opening of normal contact 11 opens the circuit of the listening relay LS to disconnect the operator's set O from the cord conductors, and the opening of alternate contact 79 of relay LS prevents further generator current from flowing through the magnet of the service meter SM.

The key K when actuated into listening position MP, as previously described, opens normal contact 63, which interrupts the flashing circuit of the answering supervisory lamp AL, and when the key K is thrown to its metering position MP, the listening disconnect relay LDR is energized, and the opening of its normal contact 61 opens the circuit of the answering supervisory lamp AL and prevents its further flashing. The calling subscriber at the substation A and the called subscriber at the substation B are now in conversational circuit, the said circuit being traced over the heavily marked conductors.

From the previously description it may be seen that the operator cannot again get in on the connection after moving the key K into its metering position MP, as the listening disconnect relay is now energized and locks up to ground through the alternate contact 94 of relay SL', and relay SL' remains energized until the calling plug CP is withdrawn from its connected jack at the termination of conversation, and further registering of the meter SM is also prevented due to the opening of alternate contact 79 of listening relay LS, and subsequent operations of the key K will not effect further actuations of the service meter SM nor effect the reconnection of the operator's set O to the cord conductors.

Assuming that the subscribers A and B have finished conversation, the subscriber at the substation A replacing his receiver upon the switchhook, opens the energizing circuit through the answering supervisory relay AS at the switchhook contacts, and the closing of normal contact 21 of the answering supervisory relay AS establishes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, alternate contact 61 of the relay LDR, conductor 95, normal contact 21 of relay AS, alternate contact 96 of the sleeve relay SL, conductors 39 and 40 to ground at alternate contact 33 of the sleeve relay SL'. The closing of normal contact 21 of the relay AS also establishes an energizing circuit for the link disconnect relay LD, traced from battery through the winding

of the said relay LD, conductor 97, normal contact 21 of relay AS, alternate contact 96 of the sleeve relay SL, conductors 39 and 40 to ground at alternate contact 33, and the relay LD energizing opens its normal contacts 18 and 19, disconnecting the cord conductors of the cord circuit from the line circuit L, and allows the cut-off relay CO to restore, for purposes as will be presently described. The sleeve relay SL has its initial energizing circuit opened at the normal contact 6 of the relay LD, but a substitute energizing circuit is established for it, traced from battery through the winding 4 of the relay SL, alternate contact 7 of relay SL, conductor 5, alternate contact 6 of the relay LD, conductor 98, through its alternate contact 96, conductors 39 and 40, to ground at alternate contact 33 of the sleeve relay SL'.

The replacing of the receiver at the called substation B interrupts the energizing circuit of the calling supervisory relay CS at the switchhook contacts, and the closing of normal contact 37 establishes an energizing circuit for the calling supervisory signal CL, traced from battery, through lamp CL, alternate contact 35 of the relay LD, conductor 36, normal contact 37 of the relay CS, conductors 38, 39 and 40, to ground at alternate contact 33 of the sleeve relay SL'. Should the called subscriber at B have replaced his receiver first, the de-energization of the calling supervisory relay CS closes an energizing circuit for the calling supervisory signal CL, traced from battery, through the lamp CL, conductor 99, normal contact 32, conductor 34, normal contact 35 of the relay LD, to ground at alternate contact 33; and when the calling subscriber at the substation A replaces his receiver, the circuit of the said lamp CL extends through the alternate contact 35 of the relay LD, as previously described. The operator noting the two lighted supervisory signals AL and CL knows that conversation has terminated and withdraws the answering plug AP and calling plug CP from their respective jacks J and J'.

Assuming that the calling subscriber at the substation A wishes to recall after he has hung up, but before the plugs AP and CP have been withdrawn from their respective jacks J and J', the removal of the receiver at the calling substation A will bring about the energization of the line relay LR, as before described.

Upon the energization of the link disconnect relay LD, its normal contact 6 was opened, opening the series energizing circuit for the cut-off relay CO and the sleeve relay SL, and the cut-off relay CO, due to this interruption of its circuit, restores to normal, and the closing of its normal contacts again places the line relay LR under the

control of the calling substation A, and the energization of the line relay LR, due to the removal of the receiver at the recalling substation A, brings about the closing of its alternate contact 2, which again lights the multiple line signals S before a number of operators' positions, and any one of a plurality of operators or the operator that originally handled the call may answer this recall.

Assuming that a connection has been established between a calling subscriber at the substation A and the subscriber at the substation B, and that the call signal at the substation B is being actuated and that the calling subscriber at the substation A replaces his receiver upon the switchhook before the subscriber at the substation B answers, the replacement of the receiver at the calling substation A opens the energizing circuit of the answering supervisory relay AS, and the closing of normal contact 21 of the relay AS establishes an energizing circuit for the link disconnect relay LD, as previously described, and the relay LD energizing opens its normal contacts 18 and 19 and disconnects the cord conductors from the line circuit L of the calling substation A. The opening of normal contact 35 of the link disconnect relay LD opens the locking circuit of the ringing control relay RC, and the ringing control relay RC de-energizing, its alternate contact 41 is opened, interrupting the circuit for the ringing interrupter relay RI, disconnecting the constantly rotating interrupter I from the circuit of the said relay RI, and the relay RI restoring to normal, its alternate contact 43 is opened, preventing further application of ringing current to the call bell at the called substation B. Thus, the calling subscriber at the substation A controls the disconnection of ringing current to the called substation B any time before the subscriber thereat answers. The closing of normal contact 21 of relay AS also establishes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, normal contact 61 of relay LDR, conductor 62, normal contact 63 of the key K, conductor 64, normal contact 60 of relay MCR, conductor 95, normal contact 21 of relay AS, alternate contact 96 of relay SL, conductors 39 and 40 to ground at alternate contact 33 of relay SL', and the closing of alternate contact 35 of the relay LD closes an energizing circuit for the calling supervisory lamp CL, as previously described. Moreover, the opening of normal contact 6 of relay LD effectively disassociates the meter magnet SM from the circuits of the cord C, so that it is impossible for a call to be recorded against the calling substation under these circumstances. The operator noting the two lighted signals, withdraws the

answering plug AP from the jack J, and the calling plug CP from the jack J'.

Returning now to the point where the calling subscriber at the substation A has replaced his receiver and the called subscriber at the substation B has replaced his after the termination of conversation, the two supervisory lamps AL and CL are lighted, as previously described, and the operator noting the two lighted signals withdraws the plugs from the jacks. The withdrawal of calling plug CP from the jack J' opens the energizing circuit of the sleeve relay SL, and the sleeve relay SL restoring to normal opens its alternate contact 33, and the interruption of this alternate contact 33 opens the locking circuit of the meter control relay MCR. The interruption of alternate contact 33 also interrupts the energizing circuit of the sleeve relay SL of the answering end of the cord circuit C, and the opening of alternate contact 96 of the sleeve relay SL opens the energizing circuit of the link disconnect relay LD, and the withdrawal of the answering plug AP and jack J of the calling line disconnects the cord circuit from the line circuit L, and the apparatus used in establishing the connection between the calling substation A and the called substation B is now at normal and available for use in establishing other connections.

The energization of the link disconnect relay LD upon the replacement of the receiver at the calling substation A, as previously described, opens its normal contact 6, and the opening of its contact 6 interrupts the locking circuit which extends through the left-hand winding 85 of the magnet of the service meter SM and the magnet of the service meter now restores to normal so that, should the calling subscriber at the substation A wish to recall, the removal of the receiver at the substation permits the lighting of the line signals S, so that when another call from the recalling substation A to that of a called line has been established, the operator that has established this recall connection may actuate the service meter to register a call against the said recalling subscriber.

Should the operator attempt to register a call by actuating the key K into its metering position MP before first moving it to its listening position, no energizing circuit would be established for the listening relay LS, as the contact 65 of the key K must be closed to establish an energizing circuit for the relay LS. The relay LS remains at normal, and as contact 79 remains open no impulse of generator current from the generator G is transmitted to the magnet of the service meter SM. The relay LDR also remains at normal as no energizing circuit

is closed for it due to the relay LS remaining unenergized, and as its contact 72 fails to close, relay LDR remains at normal. It is thus seen that the key K must be moved to its listening position first before the call can be registered.

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

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

1. A telephone system including a pair of connected telephone lines, an operator actuated service meter, means for giving the operator a special signal that a call is ready to be metered, and automatic means controlled by the calling subscriber for automatically severing the connection of said pair of lines.

2. A telephone system including a pair of connected telephone lines, an operator controlled service meter, a special signal means actuated by the response of the called subscriber to attract the operator's attention to the duty of metering, and automatic means controlled by the calling subscriber for automatically severing the connection of said pair of lines.

3. A telephone system including a pair of connected telephone lines, a switchboard operator controlled service meter, an answering supervisory signal and means for flashing it to signal the operator to operate said service meter, said means effective on the response of the called subscriber.

4. In a telephone system, an answering supervisory signal displayed by a switching operation performed at the called substation, and automatic means controlled by the calling subscriber for rendering said signal non-responsive to the operation performed at said called substation.

5. In a telephone system, an answering supervisory lamp, interrupter means at the exchange for flashing it, a switch at the called substation for operation to connect said means in circuit with said lamp, and automatic means controlled by the calling subscriber for preventing the connection of said means in circuit with said lamp.

6. A telephone system including a pair of connected telephone lines, a service meter, operator actuated switch means for operating the same, and a relay for excluding the operator's telephone from the connection, said relay controlled by said switch means.

7. A telephone system including a pair of

telephone lines, an operator controlled link circuit for connecting them having an operator's telephone set automatically connected with the calling line on connection of said link circuit and line, and a manually operated listening key for said link circuit effectively operable after the response of the called subscriber.

8. In a telephone system having operators to connect the lines, means automatically effective on connection made with the called line to disconnect the operator's telephone set, a switch at the called substation for giving the operator access to the connection, and automatic means for freeing the calling line from the called line.

9. In a telephone system, an operator controlled link circuit connecting a pair of lines, an operator actuated meter, and switch means effective on actuation of said meter to maintain the operator's talking set excluded from the connection.

10. A telephone system including a pair of telephone lines connected by an operator controlled link circuit, a listening key giving the operator access to the completed connection, an operator controlled service meter, and a switch effective on actuation of said meter to render said key ineffective for listening.

11. In a telephone system a manually operated listening key effectively operable after the called subscriber's response, a service meter and means for actuating it, said means serving to operatively disable said listening key.

12. In a secret service telephone system, means for allowing an operator access to a completed connection to see if the call is ready for metering, and switching devices preventing her talking set thereafter from being connected.

13. In a telephone system, a calling line and an operator controlled link circuit having a listening relay automatically effective on connection of said link circuit and said line, a called line for connection with said calling line over said circuit, a relay controlled over the called line when said lines are connected and an electrically operated service meter having a circuit controlled jointly by said relays.

14. In a telephone system, an electrically operated service meter, a pair of connected telephone lines, an operator's listening key, a relay controlled by the response of the called subscriber, and an operator's switch for actuating said meter effective only by the throwing of said key to listening position following the control of said relay af-

fect by the response of the called subscriber.

15. A telephone system including a telephone line, an electrically controlled service meter, an operator controlled link circuit, said meter operable over a circuit including a conductor of said link circuit, a conductor individual to said line, switch means controlled from the substation of said line to open said conductor of said link circuit, said link circuit remaining connected with said line, and a combined listening and meter control key for said link circuit for controlling said service meter after the response of the called subscriber.

16. A telephone system including a telephone line, an electrically controlled service meter, a link circuit temporarily connected with said line, a service meter circuit including a portion of said link and a terminal contact of said line, means controlled by the substation switchhook to cause said line to test idle while said link circuit is connected therewith, a contact of said means in said service meter circuit, and a combined listening and meter control key for said link circuit for controlling said service meter after the response of the called subscriber.

17. A telephone system including a calling line, an operator controlled link circuit, a relay for said link circuit serving to automatically connect the operator's telephone with said line on connection of said link circuit and line, an electrically operated service meter in a circuit including a switch contact of said relay, and means for operating said meter.

18. In a telephone system, a pair of connected telephone lines, an electrically controlled service meter, an operator's telephone set, means for connecting it to a completed connection, devices at the exchange controlled by the response of the called subscriber, a circuit for said meter effectively operable only after the connecting of said telephone set, following the control of said devices by the response of the called subscriber.

19. A telephone system including a pair of connected telephone lines, an electrically operated service meter, a manually operated switchboard operator's switch for actuating said meter, an operator's telephone set, and automatic switching devices effective by the operation of said switch to exclude said telephone set from the connection.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 27th day of May, 1921.

ELMER W. LINCOLN.