

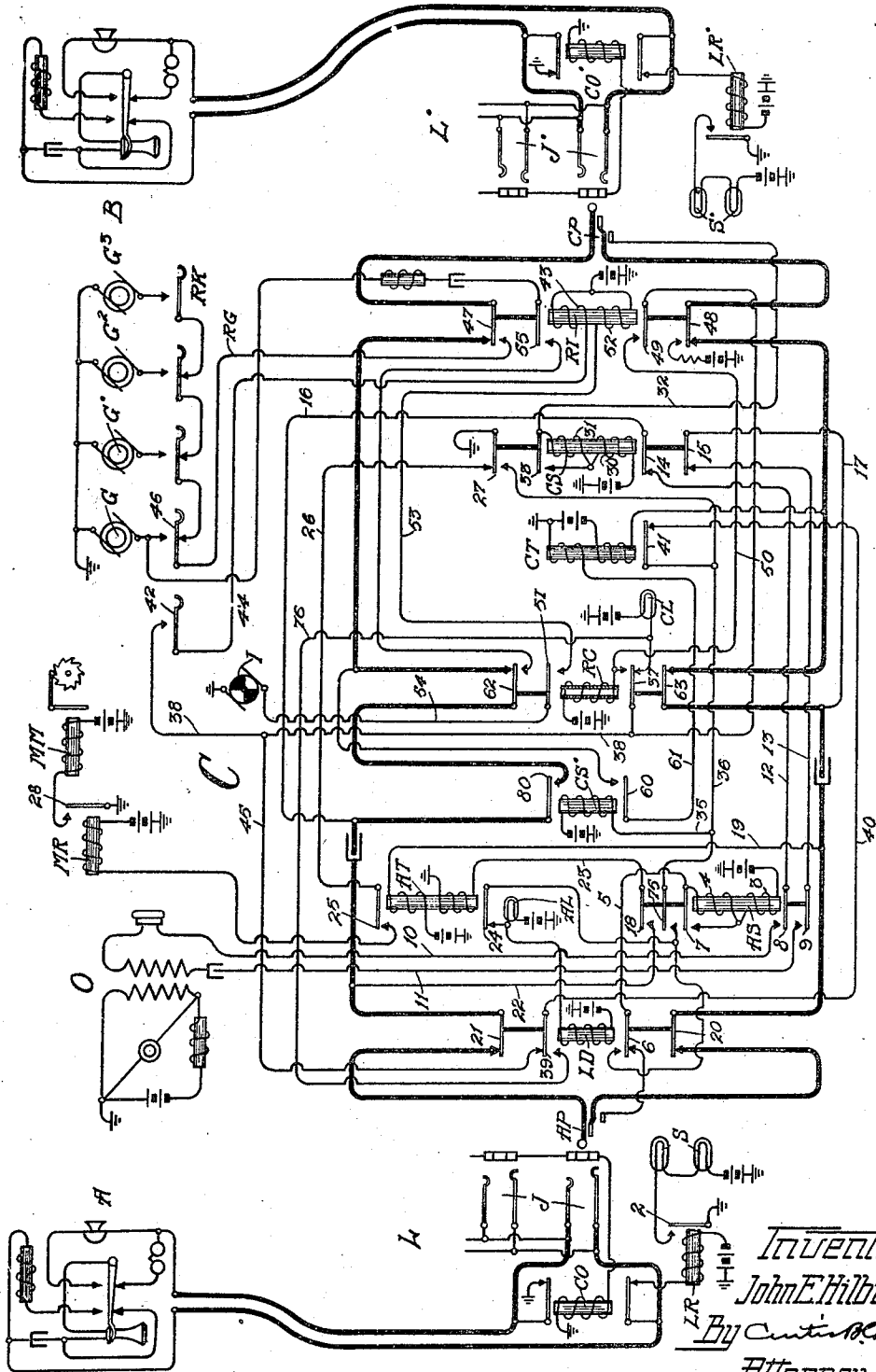
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TELEPHONE SYSTEM

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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, JOHN E. HILBISH, a citizen of the United States of America, resident of La Grange, 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 cord circuits provided with automatic ringing and listening, secret service and instantaneous disconnect and recall, and it is an object of my invention to provide a circuit of the above class which is highly efficient in its operation and in which the subscribers that are interconnected for conversational purposes by means of the cord circuit are provided with absolutely secret service.

In systems of the above character the operator, after establishing a connection, cannot listen in on the conversation. This provides secret service, but this secrecy is limited, as it is possible for a third party to be cut in on the existing connection.

Should a third party desire to converse with the called subscriber that is already in conversation, the operator tests the multiple jack of the line wanted. The wanted line tested is busy, but should the operator pass over the busy test and insert the calling plug of a second cord circuit into the multiple jack of the busy line, the connection thus will cut in the third party on the existing connection, and he may, therefore, listen in. In addition to permitting eavesdropping, should an operator wish to connect a third party to an existing connection for this express purpose, confusion is also created when disconnection takes place when a third party is thus connected, and the feature of secret service is destroyed to a certain extent.

To overcome these objections and limitations of the above class of circuit I have designed a circuit, a feature of which is the provision of a relay provided with high and low resistance windings, and which relay when placed in circuit in establishing a connection closes a low resistance path through itself. A similar relay of a second cord is prevented from operating, due to this low resistance shunt established by the relay of the first cord in the already estab-

lished connection. The failure of the relay of the second cord to operate prevents means from operating to effectively connect a third party in on the conversation. Should a third party attempt to call a calling party that is already in conversational circuit, a relay similar to the one just pointed out acts in the same manner to prevent the relay of the second cord from operating and this prevents the third party from being cut in on the existing connection.

For a more complete understanding of my invention, reference may be had to the accompanying drawing, in which I illustrate diagrammatically a telephone system embodying my invention.

Referring now in general to the circuit arrangement as illustrated in the drawing, I show a calling substation A connecting at the exchange with a line circuit L, which includes a line relay LR, a cut-off relay CO, multiple jacks J and the multiple line lamps S, appearing in the different operators' positions in the exchange switchboard. The cord circuit C for interconnecting subscribers' substations as calling and called lines comprise an answering plug AP and a calling plug CP, the said answering plug AP and the calling plug CP being connected by the heavily marked talking conductors and having condensers interposed. Associated with the answering end of the cord circuit C is an answering sleeve supervisory relay AS and an answering tip supervisory relay AT for controlling the circuit of the answering supervisory lamp AL, and the said relay AS also acts as a test relay for controlling the connection of the operator's set O to the talking conductors of the cord circuit C. A link disconnect relay LD is also associated with the answering end of the cord circuit C and provides the cord circuit C with instantaneous disconnect and recall. Associated with the calling end of the cord circuit C is a calling tip supervisory relay CT and a calling sleeve supervisory relay CS for controlling the circuit of the calling supervisory lamp CL. The calling sleeve supervisory relay CS also controls the disconnection of the operator's set O from the cord conductors of the cord circuit C. A party line ringing key RK is provided for connecting one of a plurality of generators G, G', G² and G³ to the common ringing con-

ductor RG. A ringing control relay RC is provided which controls the application of ringing current, and the relay RC upon energization connects the constantly rotating interrupter I in circuit with the ringing interrupter relay RI, said relay RI being intermittently energized and de-energized to apply ringing current to the called line. A secondary sleeve supervisory relay CS' is provided and energizes along with the calling sleeve supervisory relay CS. Associated with the cord circuit C is a service meter device comprising the meter magnet MM and the meter control relay MR.

To the right of the drawing I have shown a called substation B similar to the substation A, said substation B connecting at the exchange with a line circuit L' comprising the cut-off relay CO', line relay LR', multiple jacks J' and multiple line signals S'.

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

Assuming now that the subscriber at the substation A initiates a call, the removal of the receiver by the subscriber at the substation A brings about the energization of the line relay LR, and the closing of its alternate contact 2 lights the multiple line signals S at the different operators' positions. An idle operator noting the glowing of the line signal S before her position inserts an answering plug AP of the cord circuit C into the multiple jack J of the calling line in her position. The insertion of the answering plug AP into jack J closes a series energizing circuit for the answering sleeve supervisory relay AS of the cord circuit C and the cut-off relay CO of the line circuit L, this circuit extending from battery through the windings 3 and 4 of the answering sleeve supervisory relay AS, 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 relay AS energizing closes, providing the cord circuit C is the first cord to be connected to the line circuit L. A shunt is placed about the high resistance winding 4 of the relay AS, through its alternate contact 7, thus placing the low resistance winding in circuit with the cut-off relay CO, from battery through the winding of the relay 3, its alternate contact 7, over the conductor 5 to ground at the cut-off relay CO, over the previously described path. The relay CO also energizes over this circuit and upon energizing opens the circuit through the line relay LR, and the line relay LR de-energizing opens its alternate contact 2, effacing the multiple line signals S. The relay AS energizing also closes its alternate contacts 8 and 9 to connect the operator's set O to the

cord conductors over conductors 10 and 11, through alternate contacts 8 and 9 of the relay AS, conductors 12 and 13, normal contacts 14 and 15 of the calling sleeve supervisory relay CS and over conductors 16 and 17 to the tip and ring cord conductors of the cord circuit C.

The closing of alternate contact 18 of the relay AS closes an energizing circuit for the answering tip supervisory relay AT, traced from battery, through the upper winding of the relay AT, conductor 19, normal contact 20 of the relay LD, ring contacts of the connected plug AP and jack J, through the closed contacts of the substation switchboard and back through the tip contacts of the connected jack J and plug AP, normal contact 21 of the relay LD, conductor 22, alternate contact 18 of the relay AS, conductor 23, to ground through the lower winding of the relay AT. The relay AT energizing opens its normal contact 24, preventing lighting of the answering supervisory lamp AL at this time. The closing of alternate contact 25 of the relay AT establishes an energizing circuit for the meter relay MR, traced from battery through the winding of the meter relay MR, alternate contact 25 of the relay AT, conductor 26, to ground at normal contact 27 of the calling sleeve supervisory relay CS. The meter relay MR energizing closes its alternate contact 28, closing an energizing circuit for the meter magnet MM and the magnet MM energizing actuates the service meter to register a completed answer.

Should another operator insert an answering plug AP of a second cord into a multiple jack of the calling line after the first operator associated with the cord circuit C has answered the call, the operator of the second cord would not be connected as no effective energizing circuit is established for the answering sleeve supervisory relay AS of the second cord, due to the low resistance path through the winding 3 of the answering sleeve supervisory relay AS of the first cord circuit C, connected to the calling line. The relay AS in the second cord does not energize for the above reason, and the operator's set O is, therefore, not connected to the cord conductors, and the second operator receiving no response withdraws the answering plug AP from the multiple jack of the calling line.

The operator associated with the cord circuit C having been connected to the cord conductors as before described, now inquires the wants of the calling subscriber at the substation A, and assuming that it is the subscriber at the substation B that is wanted, the operator tests the called line in the usual manner as to its idle or busy condition by touching the tip of the calling plug CP to the sleeve of a multiple jack J' associated

with the called line B, and if the said line is busy, the operator will receive the customary busy click in her head receiver.

Assuming that the line called is idle, the operator will insert the calling plug CP into the jack J' of the called line, which insertion closes a series energizing circuit for the calling sleeve supervisory relay CS and the cut-off relay CO' of the line circuit L', over a circuit traced from battery through the windings 30 and 31 of the relay CS, conductor 32, sleeve contacts of the connected plug CP and jack J', to ground through the winding of the cut-off relay CO'. The relay CS energizing closes its alternate contact 33, which places the lower resistance winding 30 of the sleeve supervisory relay CS in series with the relay CO' of the line circuit L', the circuit of the relay CS now being traced from battery through the lower winding 30 which winding is of low resistance, its alternate contact 33 and over conductor 32, to ground through the winding of the cut-off relay CO', and this low resistance series circuit for relay CS and relay CO', shunts the high resistance winding 31 of the said relay CS for purposes as will be presently described.

The opening of normal contact 27 of the relay CS opens the energizing circuit of the meter relay MR, and the meter relay MR de-energizing prevents further registration of the service meter. The opening of normal contacts 14 and 15 of the relay CS disconnects the operator's set O from the cord conductors, and the closing of alternate contact 27 of the relay CS establishes an energizing circuit for the secondary calling sleeve supervisory relay CS', traced from battery through the winding of the relay CS', conductors 35 and 36 to ground at alternate contact 27 of the relay CS, and the said relay CS' energizing its alternate contact 80 is closed closing the tip cord conductor and the further purposes of the relay CS' will be presently described in detail.

The closing of alternate contact 27 also closes an energizing circuit for the calling supervisory lamp CL, traced from battery through the lamp CL, normal contact 37 of relay RC, conductors 38 and 45, normal contact 39 of the link disconnect relay LD, conductor 40, normal contact 41 of the calling tip supervisory relay CT, conductor 36, to ground at alternate contact 27 of the relay CS. The lighting of the lamp CL warns the operator that she has not as yet depressed the ringing key RK to signal the called for subscriber at substation B, and the lamp CL only remains lighted until the operator depresses the ringing key RK to apply ringing current.

The operator now depresses one of the ringing key plungers of ringing key RK

to connect one of the ringing generators G, G', G² or G³ to the common ringing conductor RG to initiate the operation of the automatic ringing equipment. The operation of the end spring 42 of the ringing key RK when the plunger is depressed closes a circuit for the interrupter relay RI from battery, through the upper winding 43 of the relay RI, conductor 44, through the momentarily closed end spring contact 42, conductors 38 and 45, normal contact 39 of the relay LD, conductor 40, normal contact 41 of the relay CT, to ground at alternate contact 27 of the relay CS. The relay RI energizing connects the selected generator, which we will assume is generator G, to the common ringing conductor RG, the circuit being traced from the ungrounded pole of the generator G, through alternate contact 46 of the depressed ringing key plunger, over the common ringing conductor RG, alternate contact 47 of the relay RI, tip contacts of the connected plug CP and jack J', through the condenser and call bell at the called substation B, back through the ring contacts of the jack J' and plug CP, to battery and ground through the alternate contact 48 of the relay RI. This flow of ringing current from the generator G insures a ring of the call bell at the called substation the instant the ringing key RK is depressed. The relay RI energizing closes its alternate contact 49, establishing an energizing circuit for the ringing control relay RC, traced from battery, through the winding of the relay RC, conductor 50, alternate contact 49 of the relay RI, conductors 38 and 45, normal contact 39 of the relay LD, conductor 40, normal contact 41 of the relay CT, conductor 36 to ground at alternate contact 27 of the relay CS. The relay RC energizing closes a locking circuit for itself, traced from battery through the winding of the relay RC, its alternate contact 37, conductors 38 and 45, normal contact 29 of relay LD, conductor 40, normal contact 41 of relay CT, conductor 36, to ground at alternate contact 27 of the relay CS, and the relay RC energizing, its normal contact 37 is opened to efface the calling supervisory lamp CL.

The closure of alternate contact 51 of the relay RC connects the constantly rotating interrupter I in circuit with the ringing interrupter relay RI, traced from battery through the lower winding 52 of the relay RI, over conductor 53, through alternate contact 51 of the relay RC, conductor 54, to ground through the constantly rotating interrupter I. The ringing control relay RI is thus intermittently energized and de-energized to connect ringing current over the previously described path to operate the call bell at the called subscriber's substation B.

A further result due to the intermittent closure of alternate contact 55 of relay RI is the connection of an audible ringing tone to the calling subscriber's line, through alternate contact 55 of the relay RI, to indicate to the calling subscriber that the call bell at the called substation B is being rung.

Upon response of the called subscriber at the substation B, circuit is closed through its calling tip relay CT, traced from battery through the lower winding of the relay CT, normal contact 43 of the relay when the said relay RI is in one of its de-energized positions, through the ring contacts of the connected plug CP and jack J', through the now closed contacts at the substation switchhook at substation B, back through the tip contacts of the connected plug CP and jack J', normal contact 47 of the relay RI, alternate contact 60 of the sleeve relay CS', conductor 61, to ground through the upper winding of the relay CT. The relay CT energizing opens the locking circuit of the ringing control relay RC at its normal contact 41, thereby preventing further applications of ringing current to the called subscriber's line, due to the opening of its alternate contact 51, which disconnects the interrupter I from the ringing interrupter relay RI. The relay RC de-energizing closes its normal contacts 62 and 63, which closes the talking strands of the cord circuit C, and the calling subscriber at the substation A and the called subscriber at the substation B are now in conversational circuit. Said talking circuit may now be traced over the heavily marked conductors.

Assuming now that conversation has terminated, the subscriber at the substation A replacing his receiver upon the switchhook opens the energizing circuit of the answering tip supervisory relay AT, and relay AT de-energizing closes its normal contact 24, closing a circuit for the link disconnect relay LD, traced from battery through the winding of relay LD, normal contact 24 of the relay AT, alternate contact 75 of the answering sleeve supervisory relay AS, conductor 36, to ground at alternate contact 27 of the relay CS. The relay LD energizing opens the series energizing circuit for the answering sleeve supervisory relay AS of the cord circuit C and the cut-off relay CO of the line circuit L at its normal contact 6. The closing of alternate contact 6 of the relay LD establishes a substitute holding circuit for the answering sleeve supervisory relay AS, traced from battery through the lower winding 3 of the relay AS, its alternate contact 7, conductor 5, alternate contact 6 of the relay LD, alternate contact 75 of the relay AS, conductor 36, to ground at alternate contact 27 of the relay CS. The relay AT de-energizing also closes a circuit for the answering super-

visory lamp AL, traced from battery through the lamp AL, normal contact 24 of the relay AT, alternate contact 75 of the relay AS, conductor 36, to ground at alternate contact 27 of the relay CS. A further result due to the energizations of the link disconnect relay LD is the opening of its normal contacts 20, 21, disconnecting the tip and ring conductors of the cord circuit C from the tip and ring conductors of the jack J, thereby operatively dissociating the calling subscriber's line from the cord circuit C.

The called subscriber B replacing his receiver on the switchhook opens the circuit of the calling tip supervisory relay CT at the substation switchhook contacts, and relay CT upon restoration closes its normal contact 41 establishing a circuit for the calling supervisory lamp CL, from battery through the lamp CL, conductor 76, alternate contact 39 of the relay LD, conductor 40, normal contact 41 of the now de-energized relay CT, to ground at alternate contact 27 of the relay CS. The operator noting the glowing of the answering supervisory lamp AL and the calling supervisory lamp CL, removes the answering plug AP of the jack J and the calling plug CP of the jack J'. The withdrawal of the plug CP opens the series energizing circuit for the calling sleeve supervisory relay CS and the cut-off relay CO' of the line circuit L'. The relay CS de-energizing opens its alternate contact 27, allowing the link disconnect relay LD and relay CS' to restore. The answering sleeve supervisory relay AS is also de-energized and brings about the effacement of the supervisory lamps AL and CL. The relays LD and AS upon de-energizing restore the apparatus in the cord circuit C to normal, placing it in condition for use in establishing other connections.

Should the calling subscriber at the substation A desire to recall before the plugs have been removed from the respective jacks J and J', the removal of the receiver by the subscriber at the substation A again brings about the energization of the line relay LR, and the line relay LR upon energization closes its alternate contact 2 to light the multiple line lamps S that appear at the different operators' positions in the exchange switchboard, and any one of a plurality of operators may seize the recall.

Assuming now that the subscriber at the substation A and the subscriber at the substation B are in conversation, as before described, and that another subscriber in the exchange wishes to converse with the subscriber at the substation B. The operator who now attempts to establish the connection tests the multiple jack J' of the wanted substation B. Assuming she receives but does not heed the busy click received, and inserts the calling plug CP of her cord pair

into the busy multiple jack J' associated with the substation B, the calling sleeve supervisory relay CS of her cord will fail to operate due to the low resistance series circuit existing through the sleeve supervisory relay CS of the first cord C (now used in this conversational circuit) and the cut-off relay CO' of the line circuit L' associated with the substation B. This circuit extends from battery through the low resistance winding 30 of the relay CS of the first connected cord circuit C, through alternate contact 33 of the relay CS, conductor 32, sleeve contacts of the connected plug CP and jack J', to ground through the winding of the cut-off relay CO'. The high resistance winding 31 of the relay CS of the first cord C is shunted out, and the calling sleeve supervisory relay CS of the second cord that has now been connected to the multiple jack J' of the busy line associated with the substation B will not operate in series with cut-off relay CO', as the shunt of the low winding 30 of the calling sleeve supervisory relay CS of the cord circuit C renders the calling sleeve supervisory relay CS of the second cord inoperative, as the said relay CS of the second cord will not receive sufficient current to operate it and the relay CS of the second cord failing to energize, its alternate contact 27 is not closed. Therefore, no energizing circuit is established for the secondary sleeve supervisory relay CS' of the second cord, and the relay CS' of the second cord failing to energize, its alternate contact 80 remains open and thus the tip conductor of the second cord circuit that is now connected with the multiple jack J' of the substation B is open at this point and prevents the subscriber that is trying for a connection with the substation B, from listening in on the conversation, even though the calling plug CP of the second cord has been inserted in a multiple jack J' associated with the now talking subscriber at the substation B.

From the foregoing it may be seen that the system of my invention provides absolute secret service, thus preventing any subscriber from being connected in circuit with two talking subscribers and listening in on the conversation.

Assuming a third subscriber wishes to converse with the calling subscriber at the substation A after the said subscriber has been placed in conversational circuit with another substation and the operator attempting to establish this connection passes the busy test on the multiple jack J of the calling line. The answering sleeve relay AS of the cord that already connected is provided with a low resistance series circuit with the cut-off relay CO of the substation A and this low resistance path will operate

the calling sleeve relay CS of the second cord from operating for the same reasons as already stated, and it is therefore seen that the subscriber attempting to establish a call with the now talking subscriber at substation A is prevented from listening in.

While I have illustrated and described my invention in connection with a specific circuit arrangement, I wish it understood that my invention is applicable to circuits other than that shown. Changes and modifications will also readily suggest themselves to those skilled in the art, and I therefore do not wish to be limited to the exact structure shown, but aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for said lines, busy means for busy said connection terminals when connections are made thereto, link circuits for connecting to said terminals to interconnect said lines, an operator's telephone set adapted to be connected to and disconnected from any one of said link circuits, and individual means included in the calling end of said link circuits whereby when one of said link circuits is connected to a connection terminal of a called line a second one of said link circuits cannot be operatively connected to another terminal of the same called line, said means including a relay having a low resistance and a high resistance winding, and which relay through its own contacts disconnects said operator's set from said link circuit.

2. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for each of said lines, operators' link circuits for interconnecting said lines, busy means for busy said connection terminals when connections are made thereto, individual means included in the calling end of said link circuits whereby when one of said link circuits is connected to a connection terminal of a called line a second one of said link circuits cannot be operatively connected to another terminal of the said called line, said means including a relay having a high resistance and a low resistance winding, an operator's telephone set common to said link circuits but normally disconnected therefrom, and a circuit including contacts of said relay for connecting and disconnecting said operator's set and said link circuits, said last circuit forming a part of the talking circuit between said operator's set and said link circuits.

3. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for each of said lines, operators' link circuits for interconnecting

said lines, busyng means for busyng said terminals when connections are made thereto, a sleeve relay for the calling end of said link circuit having a high resistance and low resistance winding and contacts for said relay for short-circuiting said high resistance winding when connection is made with a called line to establish a low resistance circuit for said relay, a second relay controlled by said sleeve relay for controlling the continuity of the link conductor of the said link circuit, an operator's telephone set for said link circuits but normally disconnected therefrom, and a circuit including contacts of said first relay for connecting and disconnecting said operator's set and said link circuits, said last circuit forming a part of the talking circuit between said operator's set and said link circuit.

4. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for each of said lines, operators' link circuits for interconnecting said lines, busyng means for placing a busy potential upon said connection terminals when connections are made thereto, a sleeve relay associated with the calling end of the link circuit having a high and low resistance winding, contacts for said relay for short-circuiting said high resistance winding when connection is made with a called line, whereby when said link circuit is connected to a called line, a second one of said link circuits cannot be operatively connected to another terminal of the same called line due to the low resistance winding of said sleeve relay of the first link circuit that is connected, automatic means for registering the number of calls answered, and a circuit for said automatic means including a contact of said sleeve relay.

5. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for each of said lines, operators' link circuits for interconnecting said lines, busyng means for placing a busy potential upon said connection terminals, an individual sleeve relay associated with the calling end of said link circuits having a high resistance and low resistance winding, contacts for said relay for short-circuiting

said high resistance winding when connection is made with a called line, whereby when said link circuit is connected to a called line a second one of said link circuits cannot be operatively connected to another terminal of the same called line as the low resistance path of the first link circuit prevents the sleeve relay of the second link circuit from operating, a second relay controlled by said sleeve relay for controlling contacts in the conductors of the said link circuits, automatic means for recording the number of calls answered, and a circuit for said automatic means including a contact of said sleeve relay.

6. A telephone system including calling and called subscribers' lines, a plurality of connection terminals for each of said lines, operators' link circuits for interconnecting said lines, busyng means for placing a busy potential upon said connection terminals, a sleeve relay associated with the calling end of said link circuit having a high and low resistance winding, contacts for said relay for short-circuiting said high resistance winding when connection is made with a called line, a second relay controlled by said sleeve relay for controlling the continuity of the link conductor of the said link circuit, a low resistance path for said sleeve relay whereby when said link circuit is connected to said called line a second one of said link circuits cannot be operatively connected to another terminal of the same called line as the low resistance path of the sleeve relay of the first link circuit prevents the sleeve relay of the second link circuit from operating and the second relay of the second link circuit thus remains at normal, preventing the closing of normally open contacts in the link conductors of the second link circuit, an operator's telephone set for said link circuits but normally disconnected therefrom, and a circuit including contacts of said sleeve relay for connecting and disconnecting said operator's set and said first link circuit.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 17th day of June, 1921.

JOHN E. HILBISH.