

1,429,241.

Patented Sept. 19, 1922.
2 SHEETS—SHEET 1.

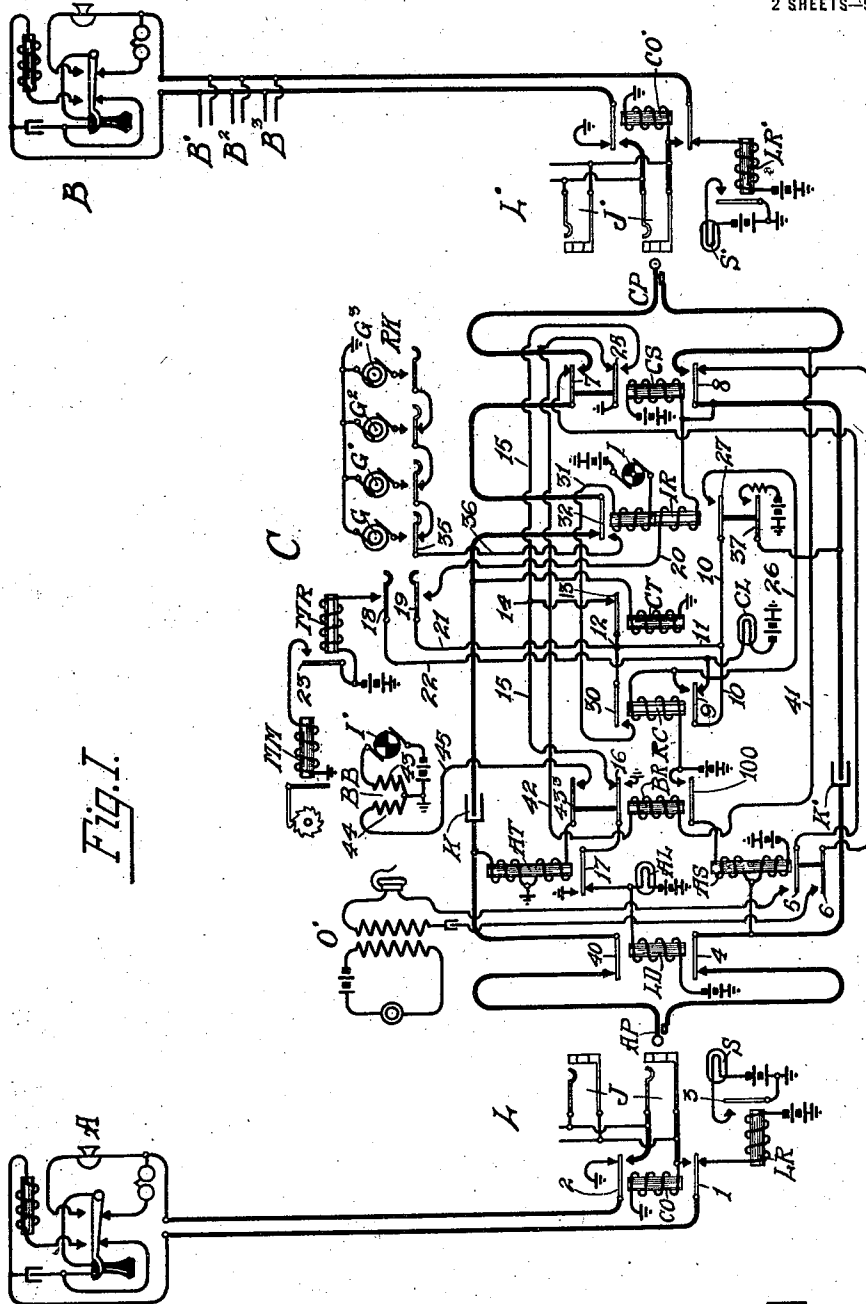


Fig. 1.

Witnesses:
G. A. Yanosowski,
My Borghahn

Inventor:
Jesse F. Hayden
By Curtis S. Camp,
Attorney.

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2 SHEETS—SHEET 2.

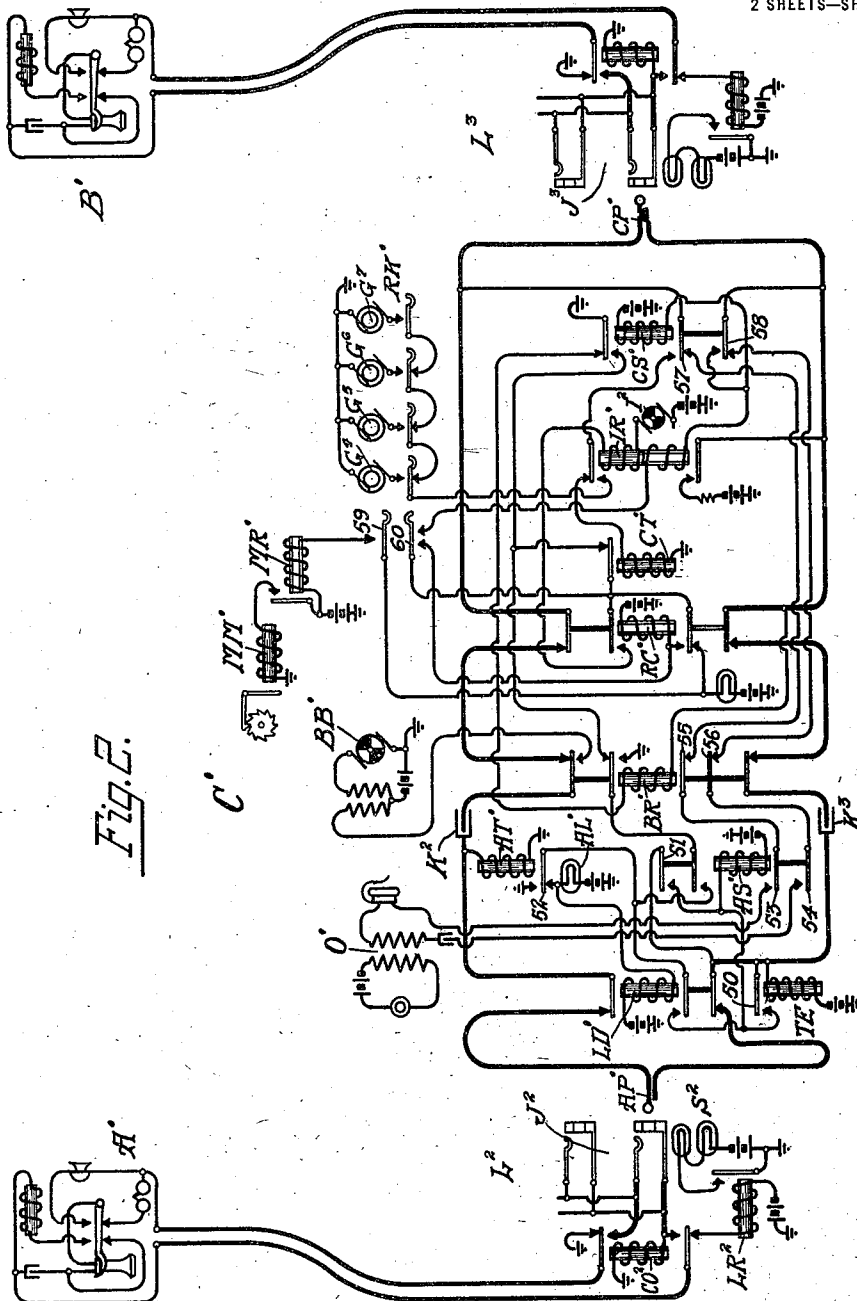


Fig. 2.

Witnesses:
G. A. Janochowski.
W. Berglund

Inventor:
Jesse F. Hayden.
By Curtis Blum
Attorney.

UNITED STATES PATENT OFFICE.

JESSE F. HAYDEN, OF HIGH POINT, NORTH CAROLINA, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed February 12, 1917. Serial No. 148,049.

To all whom it may concern:

Be it known that I, JESSE F. HAYDEN, a citizen of the United States of America, and residing in High Point, county of Guilford, and State of North Carolina, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in which manual link or cord circuits are provided for interconnecting telephone lines, and has to do more particularly with systems of the class in which instantaneous disconnect and recall, automatic ringing and listening, etc., are provided, and has for its object the provision of a new and improved system of the above character.

A feature of my invention is the provision of means for maintaining the operator's set in circuit with the cord circuit, after being automatically connected thereto, until the operator depresses the ringing key at which time the said operator's set is automatically disconnected, thus giving the operator more time to repeat the number and receive the calling subscriber's verification and also act as a check in that as long as the operator's set is in circuit with the link circuit and calling subscriber's line she is aware that she has not as yet depressed the ringing key to signal the called for party.

Another feature is the provision of an automatic busy test in which a busy signal is connected to the calling subscriber's line, should the called for subscriber at a called substation be busy when the operator connects the calling cord with a jack of the called line. No preliminary testing is necessary by the operator, and the mere plugging into the jack of the wanted line operates means to connect the busy signal in circuit with the calling line if the wanted line is busy; and if the said wanted line is idle, the said means remains ineffective. These and other objects of my invention will be more particularly pointed out in the ensuing specification and in the appended claims.

Referring now to the accompanying drawings, I illustrate in Fig. 1 one form to which my invention is adapted, and in:

Fig. 2 I show a modification of the circuit arrangements shown in Fig. 1.

Referring now in general to Fig. 1, it

comprises a calling substation A terminating at the exchange into a line circuit L comprising the usual cut-off relay CO; line relay LR, line signal S and the multiple jacks J. The cord circuit C, for interconnecting calling and called subscribers' lines, comprises an answering plug AP and a calling plug CP, the said plugs AP and CP being connected by the heavily marked conductors and having the condensers K and K¹ interposed. The answering end of the cord circuit C includes an answering sleeve supervisory relay AS and an answering tip supervisory relay AT, the said answering tip supervisory relay AT controlling the lighting of an answering supervisory lamp AL, while the answering sleeve supervisory relay AS, upon energization, connects the operator's set O to the cord conductors. A link disconnect relay LD is also provided which is energized upon the restoration of the receiver upon the switch hook at the calling subscriber's substation and before the calling plug CP is disconnected from its connected jack to permit a recall by a calling subscriber, as will be more fully hereinafter described.

The calling end of the cord circuit C includes a calling sleeve supervisory relay CS and a calling tip supervisory relay CT, the said relay CS energizing upon the depression of a ringing key plunger of the ringing key RK, while the relay CT is energized upon the response of the called subscriber. A ringing interrupter relay IR is provided which relay IR is intermittently energized and de-energized by the interrupter I. A ringing control relay RC is also provided which controls the disconnection of the ringing current. A busy relay BR is provided which is energized upon connection to a busy line to connect busy back apparatus BB to the calling subscriber's line to transmit a busy signal thereto. A calling supervisory lamp CL is provided for supervisory purposes and is not only under the control of the called subscriber but is also under the control of the calling subscriber. A meter relay MR and a meter magnet MM are also provided which are operated upon the actuation of the ringing key RK to register the connections.

To the right of the drawing, I have shown a called substation B similar to the substa-

tion A and connected to a line circuit L¹ including similar apparatus as that of L, the said apparatus bearing the same reference characters but with the suffix prime added.

5 Referring now to Fig. 2, I illustrate another circuit arrangement embodying my invention, and in which the apparatus similar to that of Fig. 1 bears the same reference numerals but with exponents added. To the
10 left of the drawing, I show a calling substation A¹, terminating into a line circuit L², having the usual cut-off relay CO², line relay LR², and the multiple jacks J² and line signals S². The line circuit L² as shown, is
15 known as a multiple line lamp type in which a line lamp S² is provided with each jack so that when a call is initiated a line signal as S² appears before each of the calling line
20 jacks, and any one of a plurality of operators may seize this call to the exclusion of the others.

A cord circuit C¹ is provided having an answering plug AP¹ and a calling plug CP¹, said plugs being connected by the heavily
25 marked conductors and having the condensers K² and K³ interposed. The answering end of the cord circuit C¹ is provided with a high resistance test relay TE, which is energized when connection is made with a
30 calling line to connect the answering sleeve supervisory relay AS¹ in circuit to connect the operator's set O¹. An answering tip supervisory relay AT¹ is provided which energizes to prevent a premature lighting of the
35 answering supervisory lamp AL¹. A link disconnect relay LD¹ is also provided for purposes to be hereinafter set forth. A busy relay BR¹, a ringing control relay RC¹, a calling tip supervisory relay CT¹, an inter-
40 rupter relay IR¹, with its associated interrupter I², a calling sleeve supervisory relay CS¹, a ringing key RK¹, and associated generators G⁴, G⁵, G⁶ and G⁷, a meter relay MR¹, a meter magnet MM¹ and busy back
45 apparatus BB¹ are also shown and perform functions similar to the corresponding parts shown in Fig. 1.

To the right of the drawing, I show a called substation B¹, terminating into a line
50 circuit L³, similar to that of L².

Having described in a general way my invention as illustrated in Figs. 1 and 2, I will now describe more in detail the operation of the circuit arrangement of Fig. 1
55 in completing a connection between a calling subscriber A to a called subscriber B. Assuming now that the subscriber at the substation A initiates a call, the removal of the receiver thereat brings about the energization of the line relay LR from battery
60 through the winding of the relay LR, normal contact 1 of relay CO, through the substation A back to ground at normal contact 2 of relay CO. The line relay LR, upon
65 energization closes its alternate contact 3,

bringing about the lighting of the line signal S. The operator noting the lighted line signal S inserts the answering plug AP into the jack J of the calling line thus closing
70 a series energizing circuit for the cut-off relay CO and the sleeve supervisory relay AS from battery through the lower winding of the relay AS, normal contact 4 of relay LD, sleeve contacts of the connected
75 plug AP and jack J through the winding of relay CO to ground. The relay CO upon energizing closes its alternate contacts 1 and 2 and opens normal contact 1 thereby interrupting the circuit of relay LR, thus effacing the line signal S. The answering tip
80 supervisory relay AT is also energized upon the energization of relay CO, as is readily understood, thus preventing the lighting of the answering supervisory lamp AL. The closing of alternate contacts 5 and 6 of re-
85 lay AS connects the operator's set O to the cord conductors through the said alternate contacts 5 and 6 of relay AS, and the normal contacts 7 and 8 of the calling sleeve super-
90 visory relay CS. The calling supervisory lamp CL is lighted upon the energization of relay AT, the circuit being traced from battery through the lamp CL, normal contact 9 of relay RC, conductor 10, conductor 11 to
95 the point 12 and from the point 12 through normal contact 13 of relay CT to the point 14, then over conductor 15 and normal contact 16 of the busy relay BR to ground at alternate contact 17 of relay AT, the said
100 lamp remaining lighted until the operator depresses the ringing key RK. By arranging the circuit of the calling supervisory lamp in this manner, the operator is always apprised of the next step required to complete the connection. The operator now in-
105 quires 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 inserts the calling plug CP into the multiple jack J¹ of the called
110 substation B without any preliminary testing, and should the line be busy the subscriber receives a busy signal from the busy back apparatus BB, as will be more fully hereinafter described.

Called line idle.

Assuming now that the called line is idle, the insertion of the calling plug CP into the jack J¹ of the called line brings about no
120 circuit changes at this time. The operator now immediately depresses the proper ringing plunger of the ringing key RK to connect the proper frequency from generators G, G¹, G² and G³ to ring the call bell of the
125 called subscriber at the substation B. The depression of the ringing key RK momentarily closes the springs 18 and 19. The momentary closure of the contact 19 of the end springs brings about the energization of the
130

relay CS and the interrupter relay IR over a circuit traced from battery through the winding of the relay CS through the lower winding of the relay IR, conductor 20, alternate contact 19 of the end springs, conductor 21 to the point 12 and from the point 12 through the normal contact 13 of relay CT to the point 14, then over conductor 15, through normal contact 16 of relay BR to ground at alternate contact 17 of relay AT. The momentary closure of contact 18 establishes an energizing circuit for the meter relay MR traced from battery through the winding of the relay MR, the closed contact 18 of the end springs, conductor 22, the normal contact 9 of relay RC, conductors 10 and 11 to the point 12, normal contact 13 of relay CT to the point 14, then over conductor 15, and through normal contact 16 of relay BR to ground at alternate contact 17 of relay AT. The closing of alternate contact 23 of meter relay MR establishes an energizing circuit for the meter magnet MM traced from battery through the alternate contact 23 of MR and through the winding of meter magnet MM to ground. The magnet MM upon energization operates the register mechanism to count a connection. The closing of alternate contact 8 of relay CS establishes a series energizing circuit for relay CS and cut-off relay CO¹ of line circuit L¹ over a circuit traced from battery through the winding of the relay CS, the alternate contact 8 of relay CS, sleeve contacts of the connected plug CP and jack J¹, and through the winding of relay CO¹ to ground. The opening of normal contacts 7 and 8 of relay CS disconnects the operator's set O from the cord conductors and connects the calling plug to the answering plug.

The closing of alternate contact 27 of relay IR brings about the energization of the ringing control relay RC over a circuit traced from battery through the winding of the relay RC, conductor 26, the alternate contact 27 of relay IR, conductors 10 and 11 to the point 12, through normal contact 13 of relay CT to the point 14, then over conductor 15 to ground at alternate contact 25 of relay CS. Relay RC, upon energizing, closes a locking circuit for itself traced from battery through the winding of relay RC, its alternate contact 9, conductors 10 and 11, to the point 12, normal contact 13 to the point 14, and conductor 15 to ground at alternate contact 25 of relay CS. The closing of alternate contact 30 of the relay RC closes an interrupting circuit for the interrupter relay IR, from battery through the interrupter I, through the upper winding of relay IR, conductor 31, the alternate contact 30 of relay RC to the point 12, through normal contact 13 of relay CT to the point 14, then over conductor 15 to ground at alternate contact 25 of relay CS. Upon the ini-

tial energization of relay IR brought about by the momentary closure of the end springs, ringing current is connected to the called line immediately upon the depression of said ringing key plunger of the ringing key RK, thus producing an instantaneous preliminary first ring. This instantaneous first ring is brought about by the closing of alternate contact 32 of relay IR, which is closed upon the momentary energization of relay IR, due to the closing of end spring contact 19, and the lower winding being slowing-acting is slow to release so that the ringing current is connected for a short period. The interrupter I is then introduced into circuit with the upper winding of relay IR due to the closure of alternate contact 30 of relay RC. The interrupter I is thus connected in circuit to intermittently energize and deenergize the relay IR, thus connecting and disconnecting ringing current through alternate contact 32 of relay IR to the called line. The opening of normal contact 9 of relay RC brings about the effacement of the calling supervisory lamp CL, thus notifying the operator that the called subscriber is being rung. The path for ringing current may be traced from the ungrounded pole of generator G, which we will assume is the generator connected to the alternate contact 35 of the ringing key plunger, through conductor 36, alternate contact 32 of the relay IR, alternate contact 7 of the relay CS, the sleeve contacts of the connected plug CP and jack J¹, through the call bell and condenser at the called substation B, back through sleeve contacts of the connected jack J¹ and plug CP, alternate contact 8 of relay CS through the alternate contact 37 of relay IR to battery and ground, the called subscriber being thus intermittently signalled.

Upon the response of the said called subscriber at the substation B, an energizing circuit for the calling tip supervisory relay CT is established, traced from ground through the winding of relay CT, normal contact 32 of relay IR (when relay IR is in its de-energized positions), the alternate contact 7 of relay CS, the tip contacts of the connected plug CP and jack J¹, through the now closed contacts of the substation switch hook, back through the sleeve contacts of the connected plug CP and jack J¹, alternate contact 8 of relay CS and through the winding of relay CS to ground. The opening of normal contact 13 of relay CT brings about the de-energization of the relays RC and IR, which then restore to normal. The subscribers are now in conversational circuit, said talking circuit being traced over the heavily marked conductors.

Assuming that conversation has terminated, the subscribers replace their receivers upon their respective switch hooks, bringing about the de-energization of the supervisory

relays AT and CT. The relay AT upon restoration, brings about the lighting of the answering supervisory lamp AL from battery through the said lamp AL, the normal contact 17 of relay AT, normal contact 16 of relay BR and conductor 15 to ground at alternate contact 25 of relay CS. A further result due to the de-energization of relay AT is the energization of disconnect relay LD over a circuit traced from battery through the winding of said relay LD, contact 17 of relay AT, contact 16 of relay BR and alternate contact 25 of relay CS to ground. Relay LD, upon energizing, opens the link circuit strand at its contacts 4 and 40, thus permitting the cut-off relay CO of the calling subscriber's line to de-energize and place line relay LR in position to be operated by the calling subscriber. The closing of normal contact 13 of relay CT closes a circuit for the lamp CL traced from battery through the said lamp CL, normal contact 9 of relay RC, conductors 10 and 11 to the point 12, through the normal contact 13 of relay CT to the point 14, and then over conductor 15 to ground at alternate contact 25 of relay CS. The operator noting the two supervisory signals AL and CL knows that conversation has terminated, and therefore withdraws plugs AP and CP from their respective jacks, bringing about the restoration of the relays AS and CS and the relays CO and CO¹. The apparatus is now at normal and not available for establishing other connections.

Assuming that the subscribers have finished conversation and have replaced their receivers upon their respective switch hooks, but that the operator has not restored the link circuit plugs to their plug seats and that the original calling subscriber now wishing to initiate a recall removes his receiver from the switch hook. The removal of the receiver from the switch hook brings about the lighting of the line signal S due to the energization of the line relay LR, and the lighting of the said line signal S notifies the operator that a recall is desired. The same operator may now seize the recall by removing the calling plug CP from its connected jack, bringing about the de-energization of the relay CS which opens the circuit of relay LD at alternate contact 25. Relay LD restoring now permits the relays AT and AS to again energize, and the closing of alternate contacts 5 and 6 of relay AS again connects the operator to the cord conductors so she may again inquire the wants of the recalling subscriber.

Called line busy.

Assuming now that the called substation B is busy, as either a calling or called subscriber, the operator plugs into the line in the usual manner and the line being busy,

the sleeve of the jack has a battery potential upon it which causes the busy relay BR to energize over a circuit traced from the said battery on the sleeve of the busy jack, through the sleeve contact of the plug CP, over conductor 41, through the winding of the relay BR, and over conductor 42 to ground at normal contact 25 of relay CS, (the relay CS being in its de-energized position due to the fact that the operator has not depressed the ringing key RK). Should the operator depress the ringing key in case the line is busy, this connection does not connect ringing current to the wanted line, due to the fact that normal contact 16 of relay BR is open, thus preventing relays IR and CS from energizing. The relay BR, upon energizing, closes its alternate contact 43 thereby associating the busy back apparatus BB with the calling line. A local circuit for the busy back apparatus BB extends from ground through the interrupter I¹ and through the primary winding 43 of an induction coil to battery and ground. The interrupted current in this circuit induces a current in the secondary winding 44 which travels from battery through said secondary winding 44 over conductor 45, through alternate contact 43³, and through the lower winding of the relay AT to ground. The current in this circuit induces a current in the upper winding of the relay AT which is transmitted to the calling subscriber at the substation A, notifying the said subscriber thereat that the called line is busy. A further result due to the energization of relay BR is the closure of a circuit through the upper winding of relay AS over a circuit traced from battery through alternate contact 100 and the said upper winding of relay AS to ground. The current in the upper winding flowing in the opposite direction to that in the lower winding causes the relay AS to de-energize and disconnect the operator's telephone set at its contacts 5 and 6. The calling subscriber receiving the busy signal replaces his receiver upon the switch hook thus causing relay AT to de-energize and close a circuit through link disconnect relay LD and supervisory signal AL over a path extending from ground at alternate contact 16 of relay BR through normal contact 17 of relay AT and then over multiple paths through lamp AL and disconnect relay LD. The relay LD energizes and disconnects the calling subscriber's line from the cord circuit thus placing the subscriber's line apparatus in condition to make a recall. The operator then withdraws the answering and calling plugs from the connected spring jacks permitting the link circuit apparatus to restore to normal.

Having described in detail the operation of the apparatus shown in Fig. 1 of the accompanying drawings, I will now describe

more or less in general the operation of the system shown in Fig. 2 of the drawings.

A subscriber at the substation A¹ desiring to call removes his receiver to establish a circuit for the line relay LR² whereby the line signals S² before the different associated jacks are lighted. The first operator to seize the call by the insertion of an answering plug AP¹ into one of the calling line jacks connects the high resistance test relay TE and cut-off relay CO² in series, effecting the energization of the relay TE. The closing of alternate contact 50 of relay TE connects the comparatively low resistance answering sleeve supervisory relay AS¹ in series with the cut-off relay CO² whereby the relay AS¹ energizes, closing its alternate contact 51 to connect its winding direct to the sleeve strand of the cord independent of the contacts of the test relay TE. Therefore, should the test relay TE restore due to the shunting of its winding by the comparatively low resistance of relay AS¹, relay AS¹ still remains energized through its locking contact 51 due to the flow of current through the winding of relay AS¹ over the calling line, and through the answering tip supervisory relay AT¹. The answering tip supervisory relay AT¹ energizes to interrupt its normal contact 52 and thus prevents a premature lighting of the answering supervisory lamp AL¹ and also prevents the energization of the link disconnect relay LD¹. Also, responsive to the energization of relay AS¹, its alternate contacts 53 and 54 are closed to connect the operator's set O¹ in bridge of the talking conductors of the cord through normal contacts 55 and 56 of the relay BR¹ and normal contacts 57 and 58 of relay CS¹. Should the second operator insert an answering plug AP into another jack of the calling line, subsequent to the insertion of the first plug, the test relay TE of the second cord does not energize due to the shunting of its winding by the relay AS¹ of the first cord so that the second operator is unable to communicate with the calling subscriber because her telephone set does not connect with the calling line. Therefore, this second operator withdraws her answering plug AP from the jack of the calling line. The first operator having ascertained that connection is desired with the substation B¹, inserts the calling plug CP¹ into a multiple jack J³ of the wanted line without any preliminary testing, and should the called line be busy as a calling or called line, the busy relay BR¹ is operated due to the battery potential upon the sleeve of the busy jack, thus connecting a busy back apparatus BB¹ to notify the calling subscriber of the busy condition of the line B¹, as previously described in connection with the apparatus of Fig. 1.

Assuming that the called line is idle, the operator depresses a key plunger of the ringing key RK¹ to connect one of the generators G⁴, etc., of the proper frequency to ring the call bell of the called subscriber at substation B¹ to the called line. The end springs 59 and 60 are momentarily closed, the closure of contact 59 brings about the operation of the meter relay MR¹ which in turn operates the meter magnet MM¹ to register a connection as described in connection with Fig. 1. The closure of contact 60 of the end springs brings about energizing circuits for the calling sleeve supervisory relay CS¹, the interrupter relay IR¹, and the ringing control relay RC¹ as described in connection with Fig. 1.

The operation of the circuit in extending the call to the called substation B¹ is similar to that of Fig. 1, as is also the operation when connection is made with the busy line. The operation of the recall apparatus is also similar to that described in Fig. 1, and I, therefore, do not deem a further description of the system of Fig. 2 necessary in view of the extended description of Fig. 1.

In working out my invention, I have shown two circuit arrangements to which my invention is adapted, but I contemplate using it in connection with other circuits than that shown. It will also be apparent that changes and modifications will readily occur to those skilled in the art after becoming familiar with my invention, and I therefore do not desire to be limited to the exact structures as shown and described, but aim to cover all that which comes within the spirit and scope of the appended claims.

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

1. A telephone system including a calling and a called subscriber's line, a link circuit for connecting said lines, an operator's telephone, a relay for connecting said operator's telephone to the link circuit, a relay for disconnecting said operator's telephone from the link circuit, audible busy means for said link circuit, and a busy test relay operable only if the called line is busy for rendering said latter relay inoperative and to connect the audible busy means in circuit with the calling subscriber's line.

2. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in conversational circuit, an operator's telephone set, automatic means for connecting said operator's telephone set to said link circuit, automatic means for disconnecting said operator's telephone set from said link circuit, audible busy means for said link circuit, a busy test relay for testing the called subscriber's line, and for connecting said audible busy means in circuit with the calling subscriber's line, and a circuit for said

automatic disconnecting means controlled by said busy test relay for rendering said disconnect means inoperable only when the called line is busy.

3. A telephone system including an operator's link circuit, an answering and a calling supervisory signal for said link circuit, a subscriber-controlled answering supervisory relay, a subscriber-controlled calling supervisory relay, circuits for said answering and calling supervisory signals controlled by said answering supervisory relay, and a second circuit for said calling supervisory signal controlled by said calling supervisory relay in response to a control exercised at the called substation.

4. A link circuit including a subscriber-controlled answering supervisory relay and a subscriber-controlled calling supervisory relay, a pair of supervisory signals for said link circuit, circuits for said signals controlled by said answering supervisory relay, and a second circuit for one of said supervisory signals controlled by said calling supervisory relay in response to a control exercised at the called substation.

5. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for establishing connection between said lines, automatic ringing apparatus associated with said link circuit for signaling the called substation, an operator's telephone set, an answering sleeve relay responsive to the connection of said link circuit to said calling line for connecting said operator's set with said link circuit, a calling sleeve relay for disconnecting said operator's set from said link circuit, a ringing key for connecting said ringing apparatus to the called line and for operatively energizing said calling sleeve relay, and a locking circuit for said calling sleeve relay including a contact of said calling sleeve relay.

6. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in conversational circuit, a calling supervisory signal for said link circuit, a relay controlled by the calling subscriber for closing an operating circuit for said supervisory signal, means for opening said circuit, and a relay controlled by the called subscriber for closing a second circuit for said supervisory signal.

7. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in telephonic circuit, a supervisory signal for said link circuit, means controlled by the calling subscriber for closing an operating circuit for said supervisory signal, signaling means for signaling the called substation, means for actuating said signaling means and for effacing said supervisory signal, and

means controlled by the called subscriber for again closing an operating circuit for said supervisory signal.

8. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines in a conversational circuit, a supervisory signal for said link circuit, a relay under the control of the calling subscriber for closing an operating circuit for said supervisory circuit, ringing apparatus for signaling the called substation, means for initiating operation of said ringing apparatus and for effacing said supervisory signal, and a relay under the control of the called subscriber for again closing an operating circuit of said supervisory signal.

9. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines in a conversational circuit, a supervisory signal for said link circuit, a relay under the control of the calling subscriber for closing an operating circuit for said supervisory circuit, ringing apparatus for signaling the called substation, means for initiating operation of said ringing apparatus and for effacing said supervisory signal, a relay under the control of the called subscriber for again closing an operating circuit of said supervisory signal, and operator controlled means for again effacing said supervisory signal.

10. A telephone system including a called telephone line, a two-conductor link circuit having a calling end for connecting thereto, a calling sleeve relay for said link circuit, ringing apparatus for said link circuit for signaling the called substation, means for initiating operation of said ringing apparatus, a circuit for said calling sleeve relay controlled by said means, and means for preventing said calling sleeve relay from operating when the called line is busy and connection is made thereto.

11. A telephone system including a called telephone line, a two-conductor link circuit having a calling end for connecting thereto a calling sleeve relay for said link circuit normally disconnected from the calling plug, manually controlled means including a ringing key for energizing said calling sleeve relay and for connecting it to the said calling plug, and ringing means including a pair of relays and energizing circuits for said pair of relays, said energizing circuits including a contact of said calling sleeve relay when said calling sleeve relay is connected to said calling plug.

12. A telephone system including a called telephone line, a two-conductor link circuit having a calling end for connecting to said called line, ringing apparatus for said link circuit, means for initiating an operation of said ringing apparatus, a calling sleeve re-

lay, and a circuit for said last relay closed responsive to an operation of said means for connecting said last relay to said calling end.

13. A telephone system including a subscriber's line, a link circuit provided with a terminal for connection to said line, a relay associated with said link circuit and adapted to be connected to said terminal through one of its own contacts, a ringing key, and means controlled by an operation of said key for connecting said relay to said terminal.

14. A telephone system including subscribers' lines, a link circuit for interconnecting said lines, a busy test relay for said link circuit for applying a busy signal to the calling line when connection is made with a busy called line and for applying signaling current to the called line when connection is made with an idle called line, and a disconnect relay under substation control adapted upon energization to operatively disconnect a subscriber's line from said link circuit.

15. A telephone system including subscribers' telephone lines, a link circuit for interconnecting said lines, a busy signaling device, a ringing current device, a busy test relay for said link circuit operative to connect current from said busy signaling device to a calling line or for permitting current from said current generating device to be applied to a called line, and disconnect means under substation control operative upon actuation to disconnect a subscriber's line from the link circuit.

16. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in conversational circuit, ringing apparatus for said link circuit, a key for actuating said ringing apparatus, busy signaling apparatus, an operator's telephone set, automatic means for connecting said operator's telephone to said link circuit, automatic means for disconnecting said operator's telephone from said link circuit when said key is actuated to operate said ringing apparatus, and a busy test relay for said link circuit for causing either ringing current to be applied to said called line or busy current to said calling line dependent upon the idle or busy condition of the called line connected with.

17. A telephone system including subscribers' telephone lines, a link circuit for interconnecting said lines, a ringing current device, a busy signaling device, a ringing key, an operator's telephone set, automatic means for connecting said operator's set to said link circuit, means controlled by said ringing key for disconnecting said operator's set from said link circuit, and a busy test relay for either applying current from said

busy device to a calling line or for permitting current from said ringing current device to be connected to a called line.

18. A telephone system including an operator's link circuit, an operator's telephone set, a relay for connecting said operator's telephone set to said link circuit, a second relay for disconnecting said operator's telephone set from said link circuit, a calling and a called subscriber's line, means responsive to the connection of said link circuit to said calling subscriber's line to actuate said first relay, and means actuated upon connection of said link circuit to said called subscriber's line to either actuate said second relay or to de-energize said first relay.

19. A telephone system including an operator's link circuit, automatic means for connecting said operator's telephone to said link circuit, other automatic means for disconnecting said operator's telephone from said link circuit, means for actuating said first automatic means, and other means for either restoring said first automatic means or for operating said second automatic means to disconnect said operator's telephone set from said link circuit, said last means being dependent upon the busy or idle condition of the called line.

20. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in conversational circuit, an operator's telephone set, a relay for connecting said operator's telephone set to said link circuit and a second relay for disconnecting said operator's telephone set from said link circuit, means for energizing said first relay responsive to the connection of said link circuit to said calling subscriber's line, and means responsive to the connection of said link circuit to said called subscriber's line to either energize said second relay or to de-energize said first relay, depending upon the idle or busy condition of said called line.

21. A telephone system including a calling subscriber's line and a called subscriber's line, an operator's link circuit, an answering plug for said link circuit normally connected with the talking strands of said link circuit, busy test apparatus for said link circuit adapted when said link circuit is connected to said called subscriber's line to either furnish the calling subscriber's line with a busy signal or to signal the called subscriber, and automatic means controlled by the calling subscriber and said busy test apparatus for disconnecting said calling subscriber's line from said link circuit prior to the disconnection of said answering plug from said calling subscriber's line.

22. A telephone system including a calling and a called subscriber's line, an operator's cord circuit provided with an answering plug normally connected with said link

circuit, busy test means operative responsive to the connection of said cord circuit to said called subscriber's line to either permit the signaling of the called substation or to send back a busy signal to the calling subscriber's substation, and means controlled over the calling subscriber's line and by said busy test means for automatically disconnecting said calling subscriber's line from said cord circuit prior to the disconnection of said answering plug from said calling subscriber's line.

23. A telephone system including an operator's link circuit, automatic means for connecting said operator's telephone to said link circuit, other automatic means for disconnecting said operator's telephone from said link circuit, means for actuating said first automatic means, and other means for either restoring said first automatic means or for operating said second automatic means.

24. A telephone system including subscribers' telephone lines, a link circuit for connecting said lines in conversational circuit, an operator's telephone set, a differential relay, means responsive to the connection of said link circuit to the calling one of said subscribers' lines to close a circuit through one of the windings of said differential relay, thereby energizing the same to connect said operator's telephone set to the link circuit, and means responsive to the connection of said link circuit to the called one of said subscribers' lines to close a circuit through the other winding of said differential relay, thereby causing the same to de-energize and disconnect the operator's set from the link circuit, said last means being operable only when said link circuit is connected to a busy called line.

25. A telephone system including a calling and a called subscriber's line, a link circuit, a relay provided with a pair of differential windings for said link circuit, an operator's telephone set, means for closing a circuit through one of the windings of said differential relay to cause the same to connect said operator's telephone set to said link circuit, and means for closing a circuit through the other winding of said differential relay to cause the same to disconnect said operator's telephone set from said link circuit, said last means being operable only when said link circuit is connected to a busy called line.

26. A telephone system including a pair of subscribers' telephone lines, a two-conductor link circuit for connecting said telephone lines, subscriber-controlled means for disconnecting one of said telephone lines from said link circuit, an operator's set, automatic means including a differential relay for connecting and disconnecting said operator's set to said link circuit, said differential relay

only operable to disconnect said operator's set from said link circuit when the link circuit is connected to a busy line, another relay operable to disconnect said operator's set when the link circuit is connected to an idle line, and automatic busy test means for the said link circuit only operable upon connection of said link circuit to the called one of said subscriber's lines to either transmit an audible busy signal to the calling one of said lines or to permit the application of ringing current to the called one of said lines.

27. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, an operator's telephone set, automatic means including a differential relay for connecting and disconnecting said operator's telephone set and said link circuit, and automatic busy test means for said link circuit operable upon connection of said link circuit to the called one of said subscribers' lines to either transmit an audible busy signal to the calling one of said lines or to permit the application of ringing current to the called one of said lines.

28. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, an operator's telephone set, a relay for connecting said operator's telephone set to said link circuit, a second relay, automatic busy test means for said link circuit operative to de-energize said first relay to disconnect the operator's telephone set from said link circuit if said called line tests busy or for operating said second relay to disconnect said operator's set from said link circuit if the called line tests idle.

29. A telephone system including a calling subscriber's line and a called subscriber's line, a cord circuit for connecting said subscriber's lines in telephonic circuit, an operator's telephone set, means responsive to the connection of the cord circuit to the calling subscriber's line to connect said operator's telephone set to the strands of the cord circuit, means responsive to the connection of said cord circuit to the called one of said subscribers' lines, providing the said called subscriber's line is busy, to disconnect said operator's set from said cord circuit, and other means operable when said cord circuit is connected to said called subscriber's line, providing said called subscriber's line is idle, to disconnect said operator's set from said cord circuit.

30. A telephone system including a pair of subscribers' telephone lines, a link circuit for interconnecting said lines, an operator's telephone set, automatic means for connecting said operator's telephone set to said link circuit, and two different automatic means for disconnecting said operator's telephone

set from said link circuit, one of said automatic means operable only if the called line is busy, and the other of said automatic means operable only if the line is idle.

- 5 31. A telephone system including a link circuit, an operator's telephone set, automatic means for connecting said telephone set to said link circuit, automatic means for
10 disconnecting said telephone set from said link circuit and only operable when the called line is busy, and other automatic

means for disconnecting said telephone set from said link circuit, and only operable when the called line is idle.

Signed by me at High Point, in the county 15 of Guilford and State of North Carolina, in the presence of two witnesses.

JESSE F. HAYDEN.

Witnesses:

V. L. HUNT,
D. N. WILBOUR.