

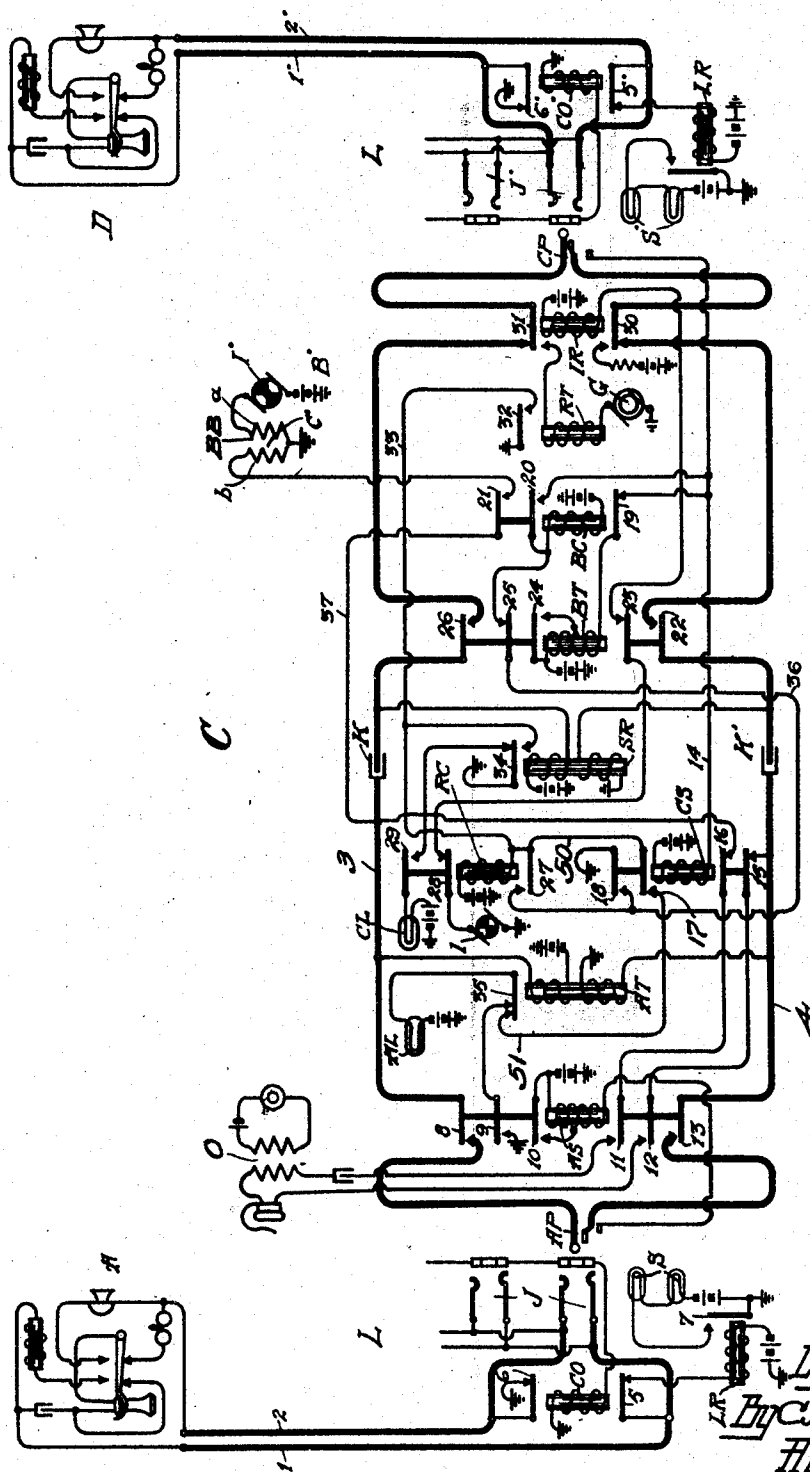
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TELEPHONE SYSTEM

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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, LEROY D. KELLOGG, a citizen of the United States of America, resident of Deerfield, in the county of Lake 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 in which manual link or cord circuits are provided for interconnecting telephone lines, and has to do more particularly with so-called multiple line lamp systems in which automatic listening, secret service, automatic ringing, dark key shelf, etc., are provided, and has for its object a new and improved system of the above character.

A feature of my invention is the provision of a new and improved link or cord circuit wherein an audible busy-back signal is connected to the cord circuit upon the insertion of the calling plug into one of the multiple jacks of the called line upon which jack there is a busy potential due to the called line already being in use. In my invention I provide a cord circuit and a busy-back signal which I have so arranged that the operator is not required to test the multiple jacks of the called line to determine their busy or idle condition before inserting the calling plug of the cord circuit into the multiple jack of the called line as in the prior systems; but in my invention when the operator learns the want of the called subscriber she inserts the calling plug of a cord circuit into the multiple jack of the desired called subscriber without making the usual preliminary busy test of the multiple jacks. Should there be a busy potential on the said multiple jacks, a relay is operated to connect a busy-back signal in circuit with the calling substation to indicate to the calling subscriber by an audible sound that the called line is busy whereupon the calling party replaces his receiver upon its switchhook, which causes both the answering and calling supervisory lamps to light, thus notifying the operator to take down the connection; but should there be no busy potential upon the said multiple jacks, the said relay will not operate and ringing current will be automatically and intermittently applied to the call bell of the called substation.

Another feature of my invention is the

absence of a ringing key and the provision of a ringing circuit arrangement wherein ringing current is automatically and instantaneously applied to the called substation upon the insertion of the calling plug into the calling jack, providing the called line is idle, without the assistance of the switchboard operator.

For a more complete understanding of my invention, reference may be had to the accompanying drawing in which I show a well-known common battery substation A connected by line limbs 1 and 2 to a line circuit L. Multiple jacks J are distributed among different operators, each multiple jack having a line signal S associated therewith. The usual line relay LR for operating the line signals S and the usual cut off relay CO for effacing the said line signals are provided.

The cord circuit C comprises an answering plug AP and a calling plug CP which are connected by the heavily marked talking conductors 3 and 4 having condensers K and K' interposed. Associated with the answering end of the cord circuit C is the double wound answering supervisory sleeve relay AS which is energized in series with the cut off relay CO of the line circuit L when the plug AP is inserted into the jack J. Supervisory sleeve relay AS energizing, connects the operator's telephone set to the cord circuit C and closes a locking circuit through one of its upper alternate contacts, thus shunting out its upper high resistance winding which prevents a second operator from seizing the call, as will be more fully explained in the ensuing specification. An answering supervisory tip relay AT and an answering supervisory lamp AL are also shown, the relays AS and AT controlling the circuit of said lamp AL.

Associated with the calling end of the cord circuit C is a sleeve relay CS which energizes upon the insertion of the calling plug CP into the multiple jack J' of the line circuit L'. I also show a busy test relay BT and a busy back control relay BC, said busy test relay BT energizing to prevent the operation of relay BC from connecting busy-back signal BB to the cord circuit in case the calling plug CP is inserted in a multiple jack J' free from busy potential, but in case the said multiple jack J' has a busy potential thereon, re-

lay BT will fail to energize thus permitting the relay BC to energize to connect the busy back signal BB to the cord circuit C, as will be more fully hereinafter described.

5 A ringing generator G, interrupter relay IR and interrupter I are also provided for automatically and intermittently applying ringing current to the call bell of the called
10 substation D. I also show a ringing trip relay RT which operates to close an energizing circuit for the ringing control relay RC. Should the called subscriber respond during a ringing period, relay RC operating disconnects the ringing current from the called
15 line. I also show a calling supervisory relay SR and a calling supervisory lamp CL, said relay SR controlling the circuit of said lamp CL. Relay SR energizes upon the removal of the receiver from the switchhook
20 at the called substation D and should this removal of the receiver occur during a non-ringing or silent period, it is obvious that relay RC will energize to disconnect the ringing current from the called line.

25 To the right of the drawing I show a called substation D connected by the line limbs 1' and 2' to the line circuit L' similar to that of L and having the same reference characters, but with the suffix prime added.

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

Assuming that the subscriber at the sub-
35 station A initiates a call, the removal of the receiver thereat closes a circuit for the line relay LR traced from battery, through the winding of said relay LR, normal contact 5 of the cut off relay CO, line limb 1, through
40 the now closed contacts of the raised switchhook of the substation A, line limb 2, normal contact 6 of relay CO to ground. Line relay LR energizing closes its alternate contact 7 which causes the multiple line
45 lamps S to burn over a circuit traced from battery, through the signals S, alternate contact 7 of relay LR to ground and other side of battery. An operator noting the burning line signal will insert the answering plug AP
50 of the cord circuit C into the multiple jack J, whereupon answering supervisory sleeve relay AS energizes in series with the cut off relay CO of the line circuit L over a circuit extending from battery, through both
55 windings of relay AS, sleeve contacts of the plug AP and jack J to ground through the winding of cut off relay CO. Cut off relay CO energizing opens its normally closed contacts 5 and 6, thus permitting the restoration of the line relay LR whereby the line signals are effaced. Upon the relay AS energizing it closes its alternate contacts 8, 9,
60 10, 11, 12 and 13, thus connecting the operator's telephone set O to the talking conductors 3 and 4 of the cord circuit CO, the re-

lay also shunting out its upper high resistance winding and locking itself up through said alternate contact 10, over a circuit traced from battery, alternate contact 10, and lower winding of relay AS and over the
70 previously described circuit. The relay AS provides busy potential to the multiple jacks J of the calling line, thus rendering them busy against incoming calls. Upon the insertion of the plug AP into the jack J, a circuit was closed for the supervisory tip relay
75 AT, extending from battery, through the upper winding of relay AT, conductor 3, alternate contact 8, of relay AS, tip contacts of plug AP and jack J through the calling substation A, ring contacts of plug
80 AP and jack J, alternate contact 13 of relay AS, conductor 4, to ground through the lower winding of relay AT. Relay AT energizing prevents the premature burning of lamps AL and CL thus providing a dark
85 key shelf.

Before proceeding further with the description of the connection, I will describe briefly the arrangement for excluding operators who may subsequently attempt to answer the call from the same line. Assuming that a second operator inserts a plug AP into another jack J of this calling line, subsequent to the insertion of the first plug, this
90 second operator's telephone will not be connected to the calling line, since the upper high resistance winding of the sleeve relay AS of the second cord is connected in multiple with the sleeve relay AS of the first
95 cord, which relay, having its upper high resistance winding shunted, shunts the sleeve relay of the second cord and prevents it from actuating, thereby preventing the operator's set of the second cord from being
100 connected to the cord circuit and calling line. The second operator not receiving any reply to her inquiry will know that the call has been seized by another operator.

Again taking up the first connection, the
110 operator, after learning the want of the calling subscriber A, and assuming that he desires a connection with the subscriber at substation D, and further assuming the called line to be idle, will without testing the
115 multiple jack J' to determine its idle or busy condition, as is the usual practice, insert the calling plug CP into the jack J' whereupon the calling sleeve relay CS is energized in series with the cut off relay CO'
120 of the line circuit L' over a circuit traced from battery, winding of relay CS, line 14, sleeve contacts of plug CP and jack J' to ground through the winding of cut off relay CO' of line circuit L'. Relay CS energizing disconnects the operator's telephone
125 set O from the cord circuit at contacts 15 and 16 which are now open, while cut off relay CO' energizing opens its normally closed contacts 5' and 6' which will prevent the
130

line signals S' from lighting when the subscriber at the called substation removes the receiver from the switchhook. When the plug CP was inserted into the jack J', an energizing circuit was established for the double wound busy test relay BT extending from battery, through both windings of said relay BT, normal contact 19 of the busy-back connecting relay BC, sleeve contacts of plug CP and jack J' to ground through the cut off relay CO'. Relay BT energizing shunts out its upper high resistance winding and closes a locking circuit for itself through its alternate contact 24 and lower winding and over the previously described circuit. Relays CS and BT now provide busy potential to the multiple jacks J' of the called line, thus rendering them busy against incoming calls. The opening of normally closed contact 25 of relay BT opens a contact in the energizing circuit for relay BC before the latter has time to energize, thus preventing its operation to connect the busy back signal BB in circuit with the calling substation A. Interrupter relay IR will now energize and de-energize to intermittently connect ringing current to the called line, the circuit being traced from battery, through the winding of said relay IR, alternate contact 23 of relay BT, normal contact 28 of ringing control relay RC, through the live segments of the constantly rotating interrupter I to ground. The ringing current circuit includes the circuits of battery B, alternate contact 30 of relay IR, ring contacts of plug CP and jack J', line limb 2', call bell and condenser of the substation D, line limb 1', tip contacts of the plug CP and jack J', alternate contact 31 of relay IR, winding of ringing trip relay RT, generator G to ground. The ringing trip relay RT does not operate over this circuit due to the combined high resistance of the call bell and condenser of the substation D which prevents the flow of sufficient current to operate said relay RT. The call bell of the substation D will continue to be intermittently rung until the subscriber thereat removes his receiver and should he do so during a ringing period, the closure of the alternate switchhook contacts permits sufficient current to flow through the winding of relay RT to energize it causing relay RT to close its alternate contact 32, thus establishing an energizing circuit for the ringing control relay RC traced from battery, winding of said relay RC, line 33, alternate contact 32 of relay RT to ground, relay RC then locking up through its alternate contact 27, and alternate contact 18 of relay CS to ground. Relay RC operating opens its normal contact 28 thus opening the circuit of interrupter relay IR which is instantly prevented from further operating to connect ringing current to the called substation D. Should the

subscriber at substation D remove his receiver during a non-ringing or silent period, supervisory relay SR will energize to open its normal contact 34 to prevent the premature lighting of the lamp CL and to close its alternate contact 34 to close an energizing circuit for the ringing control relay RC. The supervisory relay SR energizes over a circuit traced from battery upper winding of relay SR, cord conductor 3, alternate contact 26 of relay BT, normal contact 31 of relay IR, tip contacts of plug CP and jack J', through the alternate contacts of the now raised switchhook of the called substation D, ring contacts of plug CP and jack J', normal contact 30 of relay IR, cord conductor 4, alternate contact 22 of relay BT to ground through the lower winding of relay SR. Relay RC energizing over a circuit extending from battery, winding of said relay RC, alternate contact 34 of relay SR to ground, locks itself up through its alternate contact 27 to ground through alternate contact 18 of relay CS, thus opening the circuit for the interrupter relay IR at normal contact 28 of said relay RC to prevent the further application of ringing current to the called substation D as hereinbefore described. Thus I provide a system wherein ringing current is automatically and intermittently connected to the called telephone line and automatically disconnected upon the removal of the receiver from the switchhook at the called substation D whether it be during a ringing period or a non-ringing period.

The subscribers at substations A and B are now in conversational circuit, which may be traced over the heavily marked lines.

Assuming that the subscribers A and B have finished their conversation, the subscriber at substation A replacing the receiver upon the switchhook, opens the energizing circuit of the supervisory relay AT at the switchhook contacts of substation A, which restoring closes its normal contact 35 thus causing the lamp AL to light over a circuit traced from battery, through the said lamp AL, normal contact 35 of relay AT, alternate contact 9 of relay AS to ground, but lamp CL does not light because relay SR is now operated. The subscriber at substation D replacing his receiver upon the switchhook opens the energizing circuit of the relay SR at the switchhook contacts of substation D, and the said relay SR restoring closes its normal contact 34 which causes the lamp CL to burn over a circuit from battery, through said lamp CL, alternate contact 29, normal contact 34 of relay SR to ground. The operator noting the burning of the two lamps AL and CL will know that the conversation has terminated and will withdraw the plugs AP and CP from

the multiple jacks J and J' whereupon the apparatus of the cord circuit is returned to its normal position.

Assuming now that the multiple jack J' has a busy potential placed thereon, due to another cord circuit being connected to one of the multiple jacks J' of the called line, the operator inserts the calling plug CP into another multiple jack J' of the same line, and relay CS will energize over the same circuit as before traced but the busy test relay BT of the cord circuit C will not operate since the busy test relay of the first cord already connected to one of the multiple jacks J' has operated, shunting out its upper high resistance winding and closing a low resistance locking circuit for itself which is in multiple with the high resistance winding of relay BT of the second cord, thus preventing the flow of sufficient current to energize the said relay BT of the second cord circuit. Relay BT failing to energize busy back connecting relay BC will operate to connect the busy back signals BB to the calling substation A over a circuit traced from battery, winding of relay BC, normal contact 25 of relay BT, line 36, alternate contact 18 of relay CS to ground whereupon relay BC energizing closes a locking circuit for itself traced from battery, winding and alternate contact 20 of relay BC, sleeve contacts of plug CP and jack J' to ground through cut off relay CO' of line circuit L'. The busy-back signaling current may be traced from battery B', through the interrupter I' of the busy-back signal BB, through the winding *a* of the induction coil *c'* to ground. This current will be induced into the other winding *b* of the induction coil *c'* and will flow through alternate contact 21 of relay BC, line 37, conductor 3, alternate contact 8 of relay AS, tip contacts of plug AP and jack J, through the receiver of the substation A, ring contacts of plug AP and jack J, alternate contact 13 of relay AS, conductor 4, to ground through the lower winding of relay AT. It is obvious that ringing current will not be connected to the called line since relay BT failing to operate no circuit is closed for the interrupter relay IR. The subscriber at the substation hearing the busy-back signal will know that the called line is busy and will replace the receiver upon the switchhook, thus opening the circuit of the supervisory relay AT at the switchhook contacts causing said relay AT to restore to close its normal contact 35, whereupon lamp AL will light over a circuit traced from battery, through said lamp AL, normal contact 35 of relay AT, alternate contact 9 of relay AS to ground. The relay AT restoring closes an energizing circuit for the relay RC traced from battery through the winding of relay RC, conductor 50, alternate contact 17 of relay CS, con-

ductor 51, normal contact 35 of the relay AT, to ground at alternate contact 9 of relay AS. Relay RC energized over this circuit, and the closing of its alternate contact 29 lights the calling supervisory lamp traced from battery through said lamp CL, alternate contact 29 to ground at normal contact 34 of relay SR. The operator noting the two burning lamps knows that the connection is no longer required and will withdraw the plugs AP and CP from the multiple jacks J and J' causing the apparatus to return to its normal position.

Should the calling subscriber hang up before the called subscriber answers, the relay RC will be energized through back contact 35 of relay AT. Relay RC energizing locks itself to ground at contact 18 of relay CS. A further result due to the energization of relay RC is the opening of its contact 28 to prevent further operation of ringing interrupter relay IR, thus preventing further operation of the called party's bell.

From the foregoing specification it is thus seen that I have provided a system wherein it is not required that the switchboard operator make a preliminary test of the called line to determine its busy or idle condition before inserting the calling plug into a multiple jack of the called line, but on the contrary she will insert the calling plug into the calling jack, and should the line be busy the ringing current is prevented from being connected to the called line, and an audible busy back signal is at once received by the calling subscriber. It is further seen that I have arranged a system wherein no ringing key to be operated by the operator is provided, but that ringing current is automatically, intermittently and instantly connected to the called line provided it is idle and free from busy potential.

Although I have shown a preferred embodiment of my invention for the purpose of illustrating and describing my invention, I do not wish to be limited to the exact structure shown, as many modifications and changes may be made by those skilled in the art, but 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 Letters Patent is:

1. A telephone system including busy and idle telephone lines, an operator's cord circuit having an answering end and a calling end, a pair of relays one for each end of said cord circuit, means for energizing said relays respectively when their respective ends of said cord circuits are connected to idle lines, and preventing their energization when connected to busy lines. busy back

means automatically connected to said answering end when said calling end is connected to a busy line, and telephonic transmission circuits having contacts controlled directly by the armatures of said relays.

2. A telephone system including idle and busy telephone lines, an operator controlled link circuit provided with busy-back means and ringing means normally disconnected from said link circuit, a pair of electromagnets associated with the calling end of said circuit, the one disconnecting the operator's telephone set when connection is made to a called for line whether idle or busy, the other magnet having a high and low resistance winding and sensitive to the idle or busy condition of the called for line to effect the connection of said busy back apparatus or said ringing apparatus according as the line is busy or idle.

3. A telephone system including idle and busy telephone lines, an operator controlled link circuit having apparatus at its calling end to automatically send a busy signal to the calling subscriber when said circuit is connected to a busy called line and control the connection of ringing current to an idle called line when said circuit is connected thereto, a calling supervisory signal for said link circuit, means for preventing a change in its normal indication when the called subscriber answers, and for changing its indication when he replaces his receiver.

4. A telephone system including idle and busy telephone lines, an operator controlled link circuit, having busy test apparatus associated with its calling end and serving to automatically extend a busy signal to a calling subscriber when said circuit is connected to a busy line or to automatically apply ringing current to an idle called line, a pair of supervisory signals for said operator for control by the calling and called subscribers respectively, and means for preventing the display of either supervisory signal while said busy signal is being received or said ringing current is being applied and said called subscriber's receiver is off its switch-hook.

5. A telephone system including idle and busy telephone lines, and an operator controlled link circuit adapted for connection to a terminal of a busy line and when so connected serving to automatically extend a busy signal to the calling line without signaling said operator, and a pair of supervisory signals for said operator, both said signals having their indications changed by the calling subscriber replacing his receiver in response to said signal.

6. An operator controlled link circuit having a terminal serving when connected to a busy called line to actuate mechanism to extend a busy signal to a connected calling subscriber without signaling said operator,

or when connected to an idle called line to automatically extend ringing current to the idle called line without any further work on the part of the operator, a pair of supervisory signals inert while said signals are being received and lighted when said calling subscriber replaces his receiver in response to said busy signal and automatic means for connecting the operator in conversational circuit with the calling line.

7. A telephone system including an operator controlled link circuit and a calling supervisory signal therefor, a relay for said circuit energized by the replacing of the receiver at a calling substation on failure to secure a response, said relay also energized by a response at the called substation, and mechanism controlled by said relay for displaying said signal.

8. A telephone system including an operator controlled link circuit and a supervisory signal for said operator, a relay adapted to assume a certain operative condition on the replacing of the receiver at the calling substation, and the same condition on removal of the receiver at the called substation, said relay controlling said signal, and automatic means actuated on connection of said link circuit with a busy called line to signal the calling substation.

9. A telephone system including telephone lines, an operator controlled link circuit connected to a calling line, a pair of supervisory signals for said circuit, busy test apparatus for the calling end of said circuit effective on its connection to a busy line to automatically transmit a busy indication to the calling station, and means effective by the replacing of the receiver at the calling station to change the indications of both said supervisory signals.

10. A telephone system including a pair of connected telephone lines, a relay controlling the application of ringing current, said relay energizing and locking by the response of the called subscriber or by the replacing of the receiver at the calling substation whichever occurs first, and a supervisory signal circuit controlled by said relay.

11. A telephone system including a pair of telephone lines interconnected by an operator controlled link circuit, a pair of supervisory signals and means preventing the display of either when the calling station receiver is off the hook and the called station receiver is on the hook, and prior to the response at the called station, test apparatus effective automatically on connection with the called line to transmit a busy signal to the calling station or a call signal to the called station according to the busy or idle condition of the connected called line, automatic means for automatically connecting the operator to the link circuit and in conversational circuit with the calling telephone

line, and a pair of relays for said link circuit for preventing other link circuits from being operatively connected to the same lines interconnected by said link circuit.

5 12. An operator's link circuit having a relay for energization to disconnect ringing current from said link, a supervisory relay effective on its de-energization to energize said relay, another supervisory relay effective on its energization to energize said relay.

10 13. An operator's link circuit having a relay for energization to disconnect ringing current from said link, a supervisory relay effective on its de-energization to energize said relay, another supervisory relay effective on its energization to energize said relay, a pair of relays, one associated with each said first mentioned relays and controlling their circuits, means for operating said pair of relays respectively over circuits of fixed resistance, and upon their operation altering the resistance of their circuits.

15 14. In a telephone system including telephone lines, a link circuit for connecting to said lines, busy tone apparatus, ringing apparatus, a relay adapted to energize when said link circuit is connected to an idle called line to automatically and intermittently apply ringing current to said connected line, said relay non-responsive when connection is made with a busy called line,

whereby said busy tone apparatus is connected in circuit with the calling subscriber to notify him that the called-for line is busy, and a pair of relays for said link circuit for preventing other link circuits from being operatively connected to said lines interconnected by said link circuit.

15 15. In a telephone system including telephone lines, a link circuit for interconnecting the same, a busy tone device and automatic ringing means for said link circuit, a double-wound relay responsive when said link circuit is connected to an idle called line to operate said ringing means to apply ringing current to the called line, a single-wound relay responsive when connection is made with a busy called line to connect said busy tone device in circuit with the calling subscriber to inform him of the busy condition of said busy called line, said double-wound relay remaining inert when connection is made with a busy called line, and a pair of relays for said link circuit for preventing other link circuits from being operatively connected to said lines interconnected by said link circuit, said double-wound relay comprising one of said relays.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 16 day of September, 1921.

LEROY D. KELLOGG.