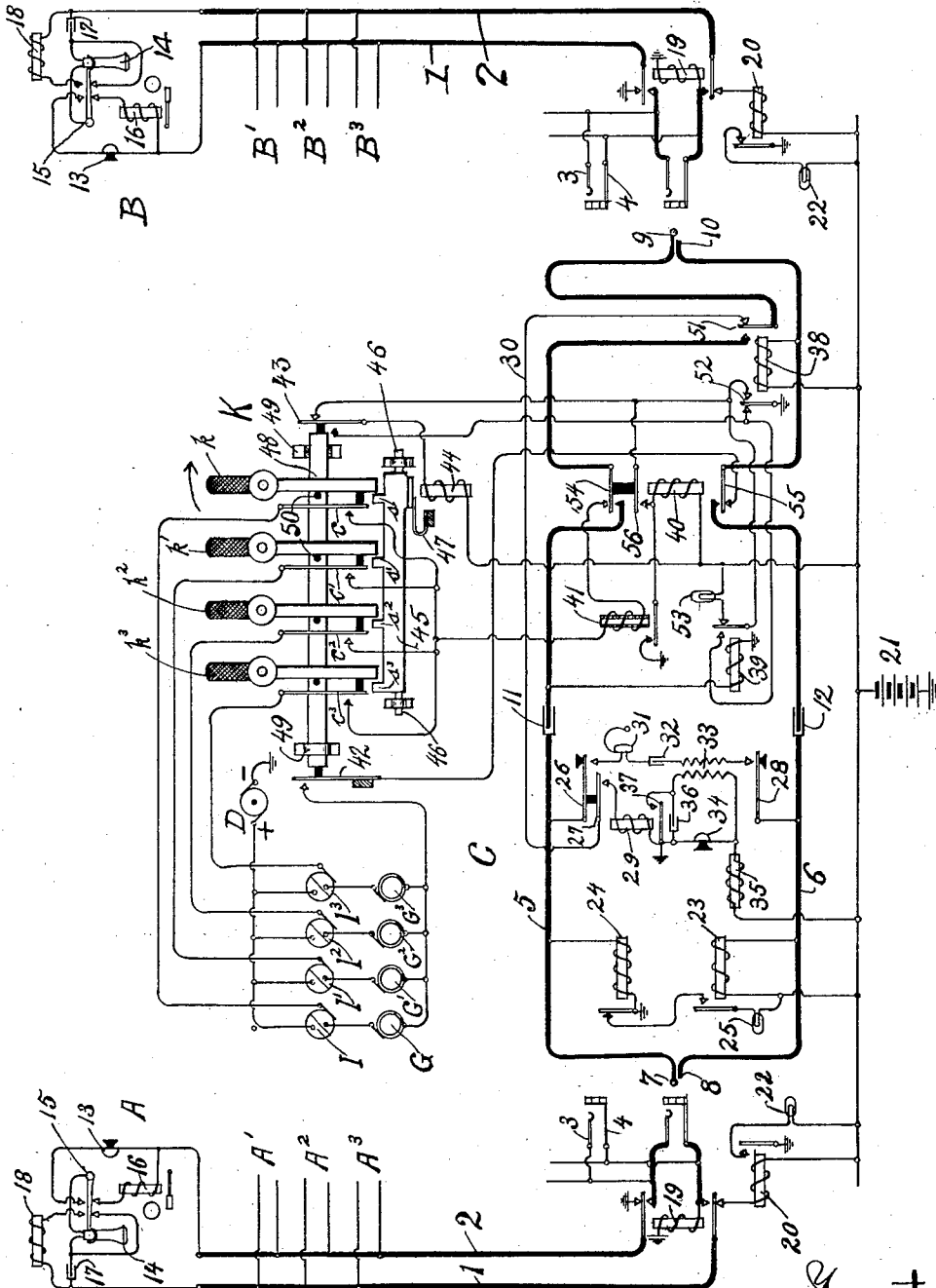


H. G. WEBSTER.
TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

1,023,900.

Specification of Letters Patent.

Patented Apr. 23, 1912.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

The present invention is concerned with that feature of telephone systems which has to do with the application of ringing current to a called telephone line. In systems employing this feature, the act of connecting to the called line so as to complete the connection between the calling and called line is followed by the application of ringing current to the called line, which is applied either continuously or intermittently until the called party responds to the call by removing his receiver from its hook, whereupon the source of ringing current is disconnected.

The principal object of my invention is to provide circuits and apparatus of this type which shall be simple, economical to manufacture, and efficient in operation.

In carrying out my invention, I provide a ringing key or other device for applying ringing current to the circuit and arrange to normally lock it against operation and to retain it locked until the called line has been connected to. This act of connection frees the key for manipulation, but as soon as it is thrown to its actuated position it is again locked and so held until the called party responds to the call, whereupon the key is again released and restored to normal. I also provide a novel arrangement of circuit connections and relays which cooperate with the key structure in the connection and disconnection of the ringing source.

The complete nature of the invention will be more fully understood upon reference to the accompanying drawing, and the patentable features will be particularly pointed out in the appended claims.

In the said drawing, I have illustrated the simple circuits of a manual telephone exchange, provided with party lines and employing ringing circuits and apparatus constructed and arranged according to my invention. The substations A and B have their circuits shown in full and are connected by line limbs 1 and 2 to the exchange, where they are provided with multiple jack terminals 3, 4, which are adapted to be

united to the link-circuit C, whose strands 5, 6 terminate at the left in the tip and sleeve contacts 7 and 8 of an answering plug, and at the right in similar contacts 9 and 10 of a calling plug. The strands are provided with the usual condensers 11 and 12 which conductively divide the circuit into an answering end and calling end. As will hereinafter more fully appear, the novel ringing circuits are associated with the calling end of the link-circuit. Each substation is provided with the usual transmitter 13, receiver 14, switch-hook 15, call-bell 16, condenser 17, and induction coil 18. A normally closed path for ringing current extends through the bell 16 and condenser 17, and the transmitter 13 is included in a normally open path. Each line is shown provided with four substations, in the one instance designated A, A', A², A³, and in the other B, B', B², B³. At the exchange the line limb 1 is connected through a normally closed contact of cut-off relay 19, line relay 20, to the negative pole of grounded battery 21, while the line limb 2 is connected through other normally closed contacts of cut-off relay 19 to the grounded pole of said battery. Line relay 20 controls line lamp 22. At the answering end of the cord-circuit, sleeve supervisory relay 23 and tip supervisory relay 24 are connected in bridge of the strands 5 and 6 with the battery 21 interposed. These relays jointly control the answering supervisory lamp 25. This end of the link-circuit is also provided with the listening key contacts 26, 27 and 28, which are adapted, when depressed, to connect the test relay 29 through conductor 30 to the tip contact of the calling plug and to include the head receiver 31, condenser 32, and secondary of induction coil 33 in bridge of the strands 5, 6. The operator's transmitter 34 is included in series with an impedance coil 35 and the battery 21. The secondary winding of induction coil 33 and condenser 36 are included with the transmitter 34 in a local talking circuit. Test relay 29 is provided with a normally open contact 37 which is adapted to short-circuit the condenser 36 for test purposes.

At the calling end of the link-circuit, where the novel ringing circuits are located, I provide the usual sleeve supervisory relay 38 included in a branch between the sleeve side of the link-circuit and the live pole of

the battery 21, and the usual tip supervisory relay 39 included in circuit between the strand 5 and the opposite, or grounded, pole of the battery 21. I also provide a control relay 40, whose circuit is adapted to be controlled by a second relay 41, included in a bridge between the strands 5 and 6 of the link-circuit, the bridge including also contacts of the ringing device K and a suitable source of ringing current. The relay 41 is so constructed that it will not respond to alternating current, the said relay only energizing and attracting its armature when a path for direct current is closed there-through. The relay 41 is a so-called sluggish relay momentarily holding its armature attracted after its energizing circuit is opened. The ringing device K in the present instance comprises four key levers k, k', k^2, k^3 , adapted severally to close branches in the ringing bridge through generators G, G', G², G³. These parallel branches also include commutators or interrupters I, I', I², I³, which intermittently interrupt the paths through the ringing generators and substitute in the bridge a direct current source, such as the direct current generator D. The generators G, G', G², G³ supply alternating current to different frequencies, and the call-bells 16 at the different substations on each line are tuned so as to respond, one to each frequency. Thus, for example, if the generator G is connected to line, the call-bell at substation B, and that only, will respond, while the call-bells at stations B', B², B³ will respond to currents from generators G', G², G³, respectively. The key levers k, k', k^2, k^3 are adapted to be moved so as to close ringing contacts c, c', c^2, c^3 , so as to connect generators G, G', G², G³, respectively, in circuit, the branch beyond the generators being closed by a common contact 42. A contact 43 is also provided to control a locking relay 44 which, when energized, rocks the locking bar 45 about its pivots 46, so as to remove the stops s, s', s^2, s^3 from their normal positions, in which they prevent movement of the key levers k, k', k^2, k^3 , respectively. A spring 47 restores the locking bar and associated stops to their normal positions upon the deenergization of magnet 44. A sliding bar 48, passing through guides 49, actuates the contacts 42, 43 in response to the movement of any of the key levers k, k', k^2, k^3 . This action is brought about through the agency of pins 50, which engage these levers. The spring contact 42 is of sufficient strength to restore the bar 48 to its normal position, when it is relieved of the pressure of the actuated levers.

If it be assumed that a party at substation A desires to converse with a party at substation B, then the line lamp 22 of the calling line is illuminated in the usual way by the energization of line relay 20, the cir-

cuit being completed out over the line through the induction coil 18, through switch-hook 15 and transmitter 13 of substation A and back to ground at the exchange. The operator answers the call in the usual way by inserting the answering plug into the answering jack of the calling line, thereby closing the circuit for the sleeve supervisory relay 23 and the cut-off relay 19, through the sleeve contacts of the answering plug and jack. The energization of the cut-off relay disconnects the line relay 20 and puts out the line lamp 22 and at the same time extends the limbs of the calling line to the link-circuit strands. The energization of cut-off relay 19 also provides a path in parallel with the cut-off relay through the substation and the tip supervisory relay 24, thereby preventing illumination of the answering supervisory lamp 25. Upon depressing her listening key levers 26, 28, the operator obtains the order from the calling party and tests the adjacent multiple jack of the called-for line, extending to station B. If the line be busy, there will be a potential upon the sleeve contact 4 of the jacks of that line by reason of the connection of one of them to the sleeve contact 10 of some other link-circuit, and accordingly the touching of tip contact 9 to such jack for the purpose of testing will cause a flow of current via conductor 30, through test relay 29, which will produce a "click" in the operator's receiver to advise her of such busy condition. If the line be idle, there will be no such indication and she will insert the calling plug into the tested jack of the called line. Upon this insertion, the sleeve supervisory relay 38 and the cut-off relay 19 will be energized over a local circuit through the sleeve contacts of the plug and jack.

The energization of cut-off relay 19 will extend its line limbs to the jack terminals and disconnect the line relay. The energization of relay 38 by its contact 51 will disconnect the test relay 29 from the tip contact 9 and complete the strand 5 from that contact to the contacts of control relay 40. On the other hand, the energization of relay 38 will move contact 52 to its alternate position and thereby complete a circuit for the calling supervisory lamp 53 which, as usual, is included in a branch extending through a normally closed contact of the tip relay 39. The closing of this ground at contact 52 of relay 38 will also energize locking relay 44 over a circuit including normal contact 43, thereby removing the normal obstructions to the operation of the key levers k, k', k^2, k^3 . Thus we see that these key levers cannot be operated until the link-circuit has been connected to the called line. The next act on the part of the operator is to depress the appropriate key lever to apply that genera-

tor current which is to actuate the call-bell of the desired substation. In the present instance, we may assume that this lever is the lever k and that the proper current for ringing the call-bell at station B will be derived from generator G. Upon throwing the upper end of key lever k to the right, ringing contacts c and 42 are closed so as to include interrupter I and generator G in bridge of the strands. This ringing bridge, which includes the interrupter I and generator G, connects with the strands 5 and 6 at the normally closed contacts 54, 55 of control relay 40. It will be apparent that if any of the other key levers had been operated, a like bridge would have been completed through the corresponding generator. As the interrupter I rotates, this bridge through the ringing generator is intermittently closed and current of the proper frequency to ring the call-bell at station B is applied to the called line. During the interval when the interrupter I breaks the bridge through the generator G, it provides an alternative bridging path through the direct current source D. This bridge terminates on the one hand, as before, in the normally closed contact 54 of control relay 40, and on the other hand in the ground connection from generator D to the ground connection of the cut-off relay of the called line and the ground connection of battery 21, it being noted that the polarity of the generator D and the battery are such as to produce a cumulative effect when thus connected in bridge. The ringing circuit, when completely traced, extends from the lower pole of generator G, through closed contact 42, normal contact 55, sleeve plug and jack contacts, line limb 1, condenser 17 and call-bell 16 at the substation, line limb 2, jack and plug tip contacts, alternate contact 51, normal contact 54, relay 41, closed contact c , and interrupter I to the opposite pole of generator G. During the non-ringing interval, there is no circuit for direct current until the called party responds. The movement of key lever k , in addition to closing the ringing contacts, interrupted the energizing circuit of locking magnet 44 and allowed the locking bar 45 to return to its normal position, so that stop s , now engaging the right hand of the lower end of the lever k , holds the ringing contacts in their actuated position. Thus ringing current is applied intermittently to the called line. As soon as the called party responds by removing his receiver from its hook, a circuit for direct current extends from the live pole of grounded generator D, through interrupter I, closed contact c , relay 41, normal contact 54, alternate contact 51, plug and jack tip contacts, line limb 2, transmitter 13, switch-hook 15, coil 18, limb 1, and to ground by two paths, one through the cut-off relay 19, and the other through jack and

plug sleeve contacts, sleeve supervisory relay 38, and battery 21. The closing of this circuit energizes the relay 41 and thereby completes a circuit for control relay 40 which locks itself up through its own contact 56 and contact 52 of relay 38. The voltage of the generator D and battery 21 may be so proportioned that when the called subscriber removes his receiver from its switch-hook the cut-off relay will be retained energized, although a momentary dropping off of its armature will not interfere with the proper operation of the relays 41 and 40. The operation of the control relay disconnects the ringing bridge at contacts 54, 55, and joins the normally disconnected sections of strands 5 and 6. The completion of strand 5 results in the operation of the tip supervisory relay 39 by current flowing over a path extending from the live pole of battery 21, through sleeve supervisory relay 38, over the sleeve side of the circuit, through the transmitter at the substation and back over the tip side of the circuit through the tip supervisory relay. The energization of the latter extinguishes the calling supervisory lamp 53 and closes a circuit for locking magnet 44 which extends from the live pole of battery 21, through magnet 44, alternate contact 43, alternate contact of the tip supervisory relay 39 and alternate contact 52 of the sleeve supervisory relay 38. Magnet 44 is thereby energized to remove stop s from its engagement with the right-hand side of lever k , and thereby allow the latter and the bar 48 to be restored to normal under the tension of return spring 42. This movement of bar 48 restores contact 43 to its normal position and thereby interrupts the circuit of magnet 44 just completed, and accordingly locking bar 45 returns to its normal locking position. At the end of conversation, the restoration of the parties' receivers to their hooks causes the illumination of supervisory lamps 25 and 53, by reason of the deenergization of the tip supervisory relays 24 and 39, and the operator takes down the connection.

In carrying out my invention, it will be obvious that many alterations and modifications may be made in the structure of the apparatus and arrangement of the circuits without departing from the spirit and scope of the invention.

It will also be apparent that the circuits I have herein illustrated may be as well applied to a trunking circuit in contradistinction to the cord-circuit illustrated. The ringing contracts of the keys k , k' , k^2 , k^3 , may also be actuated by other means. Likewise, many changes may be made in the circuits without altering the functions of the system and without departing from the spirit of the invention. I therefore do not wish to be limited to the specific matter shown, but

aim to cover such alterations and modifications by the terms of the appended claims.

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

5 1. A telephone system comprising a telephone line, a link-circuit for establishing connection with said line, a ringing current source, contacts for connecting said source to said line to transmit ringing current
10 thereover, means normally operative to hold said contacts against operation, electromagnetic means for freeing said contacts in response to the connection of said link-circuit to said line, and circuit connections effective
15 upon a subsequent operation of said contacts to cause said electromagnetic freeing means to lock said contacts in their actuated position.

20 2. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts for connecting said source to said line to transmit ringing current thereover, a stop for preventing the operation of said
25 contacts, an electromagnet for removing said stop from its preventing position, circuit connections and a source of current for operating said magnet to remove said stop in response to the connection of said link-circuit to said line, and circuit connections
30 effective upon a subsequent operation of said contacts to cause said magnet to lock said contacts in their actuated position.

35 3. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, a ringing key for connecting said source to said line to transmit ringing current thereover, a stop normally lying in the
40 path of movement of said key to prevent its operation, an electromagnet for removing said stop from its normal position to permit the operation of said key, circuit connections and a source of current for operating
45 said magnet upon the connection of said link-circuit and line, and circuit connections effective upon a subsequent operation of said contacts to cause said magnet to lock said contacts in their actuated position.

50 4. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current there-
55 over, means normally operative to hold said contacts against operation, electromagnetic means for freeing said contacts by closing a circuit over a portion of the connected link-circuit and line, and circuit connections
60 effective upon a subsequent operation of said contacts to cause said electromagnetic freeing means to lock said contacts in their actuated position.

65 5. A telephone system comprising a telephone line, a link-circuit for establishing

connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current there-
over, a stop normally operating to prevent the operation of said contacts, electromag- 70 netic means for removing said stop from its normal position in response to the connection of said link-circuit and line, and means responsive to the subsequent operation of said contacts to cause said electro- 75 magnetic means to again operate said stop to lock said contacts in their actuated position.

6. A telephone system comprising a telephone line, a link-circuit for establishing
80 connection to said line, a source of ringing current, a key for applying current from said source to said line, means for preventing the operation of said key until said link-circuit is connected to said line and
85 circuit connections effective upon a subsequent operation of the key whereby said key is locked in its actuated position.

7. A telephone system comprising a telephone line, a link-circuit for establishing
90 connection to said line, a source of ringing current, normally locked ringing contacts for applying current from said source to said line, electromagnetic means operated upon the connection of said link-circuit to
95 said line to unlock said contacts, circuit connections effective responsive to the subsequent operation of said contacts whereby said electromagnetic means are actuated to lock said contacts in their actuated position. 100

8. A telephone system comprising a telephone line, a link-circuit for establishing
connection to said line, a source of ringing current, normally locked ringing contacts
105 for applying current from said source to said line, electromagnetic means for unlocking said contacts by completing a circuit over a portion of the connected link-circuit and line, and circuit connections whereby
110 said electromagnetic means are responsive to the subsequent operation of said contacts to lock said contacts in their actuated position.

9. A telephone system comprising a telephone line, a link-circuit for establishing
115 connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current there- over, a stop normally operating to prevent the operation of said contacts, electromag- 120 netic means for removing said stop from its normal position, means for actuating said electromagnetic means by closing a circuit over a portion of the connected link-circuit and line, and means responsive to the subse- 125 quent operation of said contacts to again operate said electromagnetic means to cause said stop to lock said contacts in their actuated position.

10. A telephone system comprising a 130

called telephone line, a link-circuit for connecting to said line, a source of ringing current, normally locked ringing contacts for applying said source to the connected line, means dependent upon the connection of said link-circuit to said line to free said ringing contacts, circuit connections effective upon the subsequent operation of said contacts whereby said contacts are locked in their actuated position, and means dependent upon the response of the called party to again free said contacts.

11. A telephone system comprising a called telephone line, a link-circuit for connecting to said line, a source of ringing current, ringing contacts for applying current from said source to said line, locking mechanism normally preventing the operation of said contacts, an electromagnet for controlling said mechanism, a circuit dependent upon the connection of said link-circuit and line, for causing said magnet to free said contacts, means actuated by the subsequent operation of said contacts to operate said magnet to lock said contacts in their actuated position, and means dependent upon the response of the called party to again operate said magnet to free said contacts.

12. A telephone system comprising a called telephone line, a link-circuit for connecting to said line, a source of ringing current, contacts for applying current from said source to said line, locking mechanism normally preventing the operation of said contacts, a control magnet for said mechanism, means dependent upon the connection of said link-circuit and line, to energize said magnet to free said contacts, means for interrupting said circuit upon the subsequent operation of said contacts to lock said contacts in their actuated position, and means actuated upon the response of the called party to again momentarily energize said magnet to free said contacts.

13. In a telephone system, a connected link-circuit and telephone line, a source of ringing current, ringing contacts for applying current from said source to said line, locking mechanism for said contacts, a magnet energized to hold said mechanism out of locking position, and means for interrupting the circuit of said magnet upon the actuation of said contacts, whereby said contacts are locked in their actuated position.

14. In a telephone system, a connected link-circuit and telephone line, a source of ringing current, ringing contacts for applying current from said source to said line, locking mechanism for said contacts, a magnet energized to hold said mechanism out of locking position, means for interrupting the circuit of said magnet upon the actuation of said contacts, whereby said contacts are locked in their actuated position, and means

for freeing said contacts upon the response of the called party.

15. A telephone system comprising a telephone line, a connection terminal for said line having a plurality of contacts, a link-circuit having two terminal contacts—and two only—for coöperatively engaging said connection terminal, a source of ringing current, ringing contacts for applying current from said source to said line, locking mechanism for said contacts, a magnet energized upon the connection of said link-circuit and line, to hold said mechanism out of locking position, and means for interrupting the circuit of said magnet upon the actuation of said contacts, whereby said contacts are locked in their actuated position.

16. A telephone exchange system comprising a link-circuit at the exchange, a called telephone line, connection terminals for connecting said link-circuit and line, a control relay, a manually operated ringing key, a source of ringing current connected to the link-circuit strands through normally open contacts of said key and normally closed contacts of said relay, and a second relay multiply connected to a link circuit strand for energizing said relay to cut off said ringing source upon the response of the called party.

17. A telephone exchange system comprising a link-circuit at the exchange, a telephone line extending to a called station, connection terminals for uniting said link-circuit and line, a manually operated ringing key, a control relay, ringing connections extending from opposite sides of said link-circuit through normally open contacts of said key and normally closed contacts of said relay, a source of ringing current, a source of direct current, a commutator for alternately connecting said sources through said ringing connections to said line, a call-bell in a normally closed path for ringing current at the called station, a normally open switch in a path for direct current at said station, a relay in said ringing circuit responsive only to current flowing through the direct current path at said station, and a circuit closed by said relay to operate said control relay to interrupt said ringing connections.

18. A telephone exchange system comprising a link-circuit at the exchange, a telephone line extending to a called station, connection terminals for uniting said link-circuit and line, a call-bell and switch at said station, a control relay through normally open contacts of which the link-circuit strands extend, ringing connections extending through normally closed contacts of said relay, a ringing current source, a manually operated key having ringing contacts for connecting said source through said connections to said line to actuate said call-bell,

and a relay and circuit connections for energizing said control relay upon the closing of said switch at said station, whereby the ringing current source is disconnected and the sections of the link-circuit strands united.

19. A telephone system comprising a telephone line, a link-circuit, a manually operated key for applying ringing current to the line when connected to said link-circuit, a control relay having normally open contacts through which said link-circuit strands extend, a second relay, a control circuit therefor connected as a branch of a talking strand of said link circuit, a switch for conductively uniting the telephone line limbs to operate said second relay, and means actuated by said second relay to operate said control relay to unite the normally disconnected link-circuit strands.

20. A telephone system comprising a telephone line, a two-conductor link-circuit said two conductors being talking strands, a source of ringing current, connections with said source, a control relay having normally open contacts through which said talking strands extend and normally closed contacts through which said ringing connections extend, a relay connected in a branch conductor of a talking strand of the cord circuit and operated upon the response of the

called party to actuate said control relay to disconnect said ringing current source and to unite the normally disconnected talking strands, and means for subsequently holding conversation over the connected link-circuit and line.

21. A telephone system comprising a two-limb telephone line, a connected link-circuit having two talking strands, a control relay having normally open contacts through which said strands extend, sources of ringing and direct current, means for connecting said sources alternately in bridge of said line through normally closed contacts of said control relay, a second relay included in said bridge operative only upon a flow of current from said direct current source, a switch for conductively uniting the line limbs to cause such a flow, and means responsive to the energization of said second relay to actuate said control relay to interrupt said bridges and complete the normally discontinuous talking strands, said actuation also deenergizing said second relay.

In witness whereof, I hereunto subscribe my name this 15th day of Mch, 1909.

HARRY G. WEBSTER.

Witnesses:

J. G. KELLOGG,

CAROLYN WEBER.