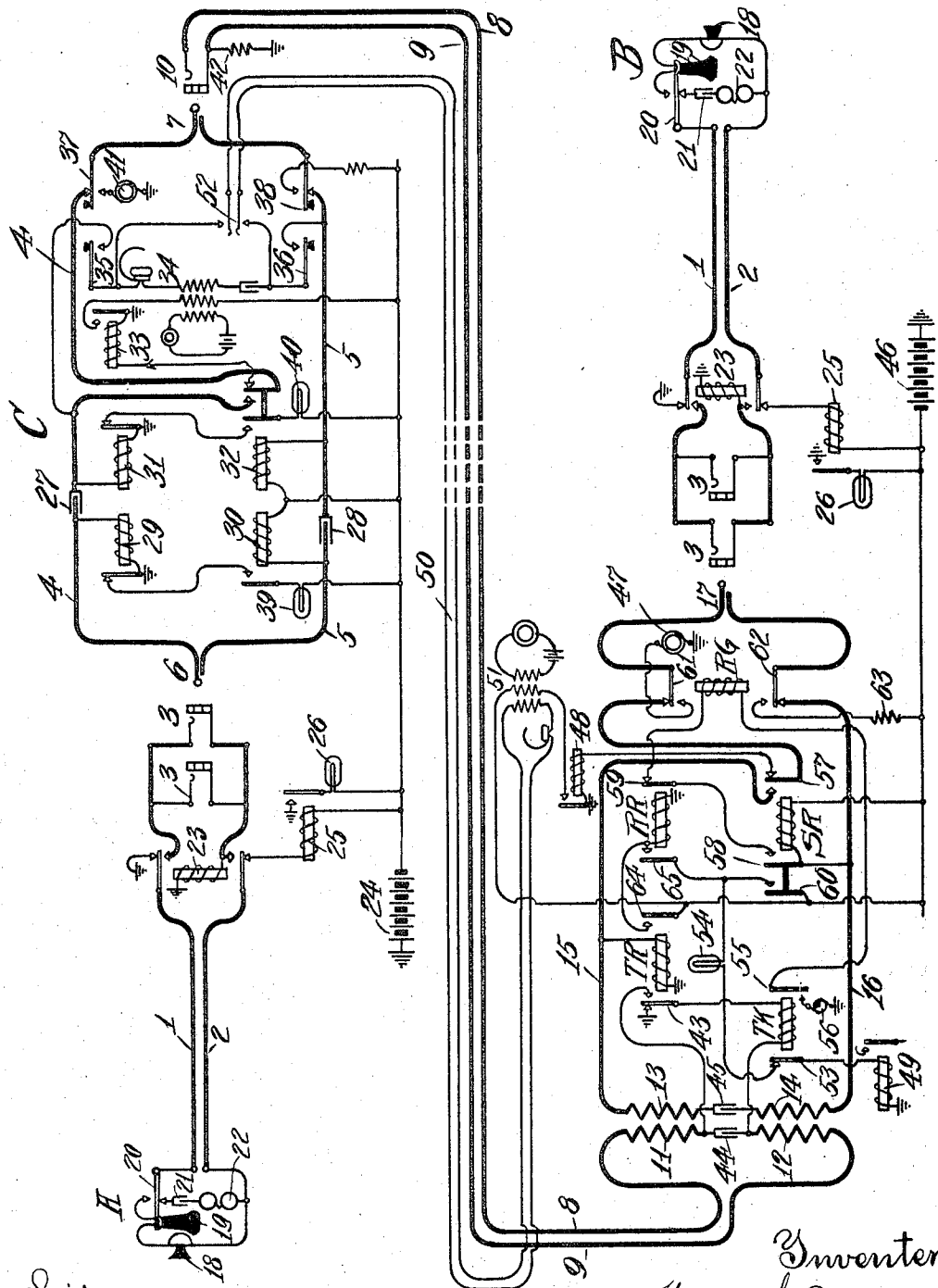


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TELEPHONE SYSTEM.
APPLICATION FILED JUNE 28, 1909.

1,150,055.

Patented Aug. 17, 1915.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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Specification of Letters Patent.

Patented Aug. 17, 1915.

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To all whom it may concern:

Be it known that I, HARRY W. MUNSELL, a citizen of the United States, residing in Indianapolis, county of Marion, State of Indiana, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

The present invention relates to telephone systems generally, and more particularly to the circuits and apparatus for applying ringing current to the called-for line to signal the called-for party. In systems of this sort, the connection of a link-circuit to the called line for the purpose of completing the connection from the calling line to the called line is followed by the application of ringing current to actuate the bell of the called party, and such current is applied either continuously or intermittently until the called party responds to the call, whereupon the source of current is disconnected from the line. In these systems, the application of ringing current may require the operation of a ringing key, or may be brought about by the mere insertion of the connecting plug into the jack of the called-for line. In the form of my invention herein disclosed, this latter method of operation is employed.

The principal object of the present invention is to provide a novel arrangement of the character indicated, which shall be positive in operation and economical to manufacture by reason of its simplicity and fewness of parts.

In carrying out my invention, I preferably employ a link-circuit which may be either a cord-circuit or a trunk-circuit, having five principal relays; one a ringing or "flip-flop" relay for connecting the ringing source in circuit; a second controlled from the calling line end of the circuit; a third actuated upon connecting the opposite end of the link-circuit to the called-for line; a fourth operated after such connection, in response to the removal of the called-for party's receiver from its hook; and a fifth for discontinuing the application of ringing current.

The several novel circuit arrangements which constitute my invention will be best understood upon reference to the accompanying drawing, taken in connection with the following detailed description, while the

scope of the invention will be more particularly pointed out in the appended claims.

In the drawing, I have illustrated, in diagram, a telephone system having a trunk-circuit constructed and arranged according to my invention. Although thus illustrated, it will be apparent that my invention is applicable to cord-circuits as well as trunk-circuits. In this diagram, A and B designate substation circuits of calling and called lines, respectively, which extend by limbs 1, 2 to different exchanges, where they are provided with suitable multiple jacks 3. At one exchange, a link-circuit C, of well known construction, is employed. In this circuit, the tip and sleeve strands 4, 5 terminate at the left in tip and sleeve contacts of the answering plug 6, and at the right in tip and sleeve contacts of the connecting plug 7. Trunk conductors 8 and 9 extend between the exchanges. These conductors terminate at their outgoing ends in tip and sleeve contacts of multiple jacks 10, and at their incoming ends in the windings 11 and 12 of a repeating coil whose companion windings 13, 14 are connected to the tip and sleeve trunk strands 15 and 16 which terminate in tip and sleeve contacts of connecting plug 17, which is adapted to be inserted into a multiple jack 3 of the called line. It is with this latter section of the trunk-circuit that the novel ringing circuits are associated. It will be understood that the diagram illustrates the apparatus and circuits which are brought into play in establishing a conversational circuit from substation A as a calling substation, to substation B as the called substation. In establishing this connection, the operator, having control of the cord-circuit C, is known as the "A" operator, while that operator in the distant exchange, having control of the connecting plug 17, is known as the "B" operator. This general arrangement of trunking between exchanges is old in the art and forms no part of my invention.

Each substation is provided with the usual transmitter 18, receiver 19, switch-hook 20, condenser 21, and ringer 22. When the parts are in normal position, a path for alternating current is supplied through condenser 21 and ringer 22 to actuate the latter, and when the receiver is off its hook, an alternate path for battery current is provided

through transmitter 18 and receiver 19. At each exchange, line limb 1 is normally connected through contacts of a cut-off relay 23 to the grounded pole of the battery 24, and the line limb 2 is normally connected to the opposite pole of said battery through contacts of the cut-off relay 23 and the winding of line relay 25, which controls line lamp 26.

In the cord-circuit, strands 4 and 5 are, as usual, conductively divided by condensers 27 and 28 and are provided with tip and sleeve answering supervisory relays 29, 30, calling tip and sleeve supervisory relays 31, 32, test relay 33, operator's set 34, listening key levers 35, 36, and ringing key levers 37, 38. Relays 29 and 30 jointly control the answering supervisory lamp 39, and relays 31, 32 the calling supervisory lamp 40, while the ringing key is adapted to connect the generator 41 in circuit with a called line whenever said cord-circuit is used in connecting directly to a called line instead of to the trunk-circuit, such as illustrated in the diagram. When connection is made to the latter, the ringing key and associated generator are not used. In the trunk-circuit, the sleeve strand 9 is connected to the grounded pole of the battery through impedance coil 42. At the opposite end of this strand, a trunk relay TK is included in a branch normally connected to the grounded pole of the battery via contact 43 of tip relay TR. A similar branch extends from the corresponding end of the trunk conductor 8 to a normally open contact of relay TR. Condensers 44 and 45 conductively separate the windings 11, 12 and 13, 14 of the repeating coil. Tip relay TR is connected between the grounded pole of battery 46 and tip strand 15, and a sleeve relay SR is similarly connected between the opposite pole of said battery and the sleeve strand 16 of the trunk-circuit. A ringing or "flip-flop" relay RG controls the continuity of the strands 15, 16 and the application of ringing current from the generator 47, while a release relay RR cooperates with the other relays of the circuit in discontinuing the application of the ringing current. A test relay 48 and a pilot relay 49 are also provided. Transmission is obtained between the "A" and "B" operators through the order-wire circuit 50, which connects the "B" operator's set 51 with the "A" operator's set 34 through the agency of a key 52 under the control of the "A" operator. The test relay 48, as usual, controls the circuit through the tertiary winding of the induction coil of the operator's set. Now, if it be assumed that a party at substation A desires to converse with a party at substation B, the former will remove his receiver 20 from its hook and thereby energize his line relay 25 to light line lamp 26 as a signal to the operator that a call is being made. The operator will respond by inserting answering plug 6 into answering jack 3 of that line and thereby actuate cut-off relay 23 to extend the limbs 1, 2 to the jack terminals and to disconnect the line relay 25. This act will also energize supervisory relays 29 and 30, the former over the line circuit, and the latter through the cut-off relay and over the line circuit in parallel, as is well known. By depressing listening key levers 35, 36, the "A" operator will learn that connection is desired with a subscriber whose line terminates at the distant exchange. She will then actuate her key 52 to bring the "B" operator's set 51 into circuit with her set 34 and receive, from her, instructions as to the trunk to be used in making the connection. Upon this assignment of a trunk, the "A" operator will immediately insert the connecting plug 7 into a jack 10 of the assigned trunk. This act energizes supervisory relay 32 and trunk relay TK. The circuit by which this is accomplished extends from the live pole of battery 24, through relay 32, sleeve strand 5, plug and jack sleeve contacts and impedance coil 42 to the return side of the battery; another path of current extending from the sleeve contact of the jack, over conductor 9, through repeating coil winding 12, trunk relay TK, and normal contact 43 to the grounded side of the battery. As a result of the operation of relay 32, supervisory lamp 40 will be lighted and, as will be seen hereinafter, remains lighted until the called-for party responds by removing his receiver from its hook. The actuation of trunk relay TK opens contact 53 and thereby opens the path through trunk lamp 54 and pilot relay 49. The operation of this relay also closes its contact 55 and thereby completes a portion of the circuit for ringing relay RG, through interrupter 56, to the grounded pole of the battery. As soon as the "B" operator has designated the trunk for the first operator to plug into, she at once tests the line of the called party by touching the tip contact of plug 17 against a test jack contact of the wanted line and, in case the same is busy, obtains a circuit through test relay 48 which produces the customary "click" in her receiver as an indication that the line is busy. In such event, the calling party is so advised through the "A" operator. If, however, the wanted line is found to be idle, then the "B" operator will insert plug 17 into a multiple jack 3 of the line running to substation B. The establishment of this connection energizes the sleeve relay SR and the cut-off relay 23 of the called line over a circuit extending from the live pole of battery 46, through relay SR, sleeve strand 16, plug and jack sleeve contacts and relay 23

to the return side of the battery. The operation of the latter relay, as before explained, extends the line limbs to the jack terminals and disconnects the line relay 25.

5 On the other hand, the operation of sleeve relay SR, by its contact 57, disconnects the test relay 48 and unites portions of the tip strand 15 and, by its contact 58, completes the circuit through the ringing relay RG.

10 This circuit, completely traced, extends from the live pole of the battery 46, through relay SR, closed contacts 58, 59, relay RG, closed contact 55, and interrupter 56 to the opposite pole of the battery. The closing of

15 contact 60 of relay SR at this time performs no useful function. The energization of relay RG, however, interrupts the strands 15 and 16 at normal contacts 61, 62, and connects the ringing generator 46 in circuit.

20 The presence of the interrupter 56 in the circuit of relay RG causes it to intermittently connect the ringing generator in circuit. During the ringing interval, the ringing circuit may be traced from the live pole of the grounded generator 47, through

25 alternate contact 61, plug and jack tip contacts, line limb 1, switch-hook 20, condenser 21, ringer 22, line limb 2, jack and plug sleeve contacts, alternate contact 62, protective resistance 63, and thence to ground

30 through the battery 46. During this ringing interval, the circuit through the sleeve relay SR and cut-off relay 23 is interrupted, but current is supplied for the latter relay

35 through protective resistance 63 and the alternate contact 62 of relay RG. Likewise, sleeve relay SR is maintained energized by reason of the circuit through its winding and that of relay RG, before traced.

40 During the non-ringing interval, the sleeve side of the circuit is connected to the live pole of the battery through the winding of relay SR, while the tip side is connected to the opposite pole of the battery through the

45 winding of tip relay TR. As a result of this, the removal of the receiver at substation B causes the operation of tip relay TR, the circuit for the latter being completed during the non-ringing interval from the

50 live pole of battery 46, through relay SR, to the sleeve side of the circuit, thence through the substation transmitter and receiver to the tip side of the circuit, and finally through tip relay TR to the opposite

55 pole of the battery. The operation of relay TR destroys the initial energizing circuit for trunk relay TK, but provides another which is also instrumental in operating tip relay 31 of the cord-circuit C of operator

60 "A", as an indication to her that the called party has responded. This circuit extends through the sleeve relay of cord-circuit C and trunk relay TK, as before traced, and thence, instead of to ground through normal

65 contact 43, through alternate contact 43, re- peating coil winding 11, trunk conductor 8, jack and plug tip contacts, strand 4, and finally through tip relay 31 to the opposite pole of the battery. Since tip relay TR controls tip relay 31 in this connection, it

70 will be seen that as soon as the called party at the end of conversation restores his receiver, tip relay 31 will be deenergized and lamp 40 lighted. Similarly, the restoration of the receiver at substation A will

75 cause supervisory lamp 39 to light, and upon the establishment of this condition, operator "A" will take down the connection. But to return to the operation of tip relay TR, it will be found that said relay

80 discontinues the application of ringing current by operating release relay RR. The closing of contact 64 of relay TR completes a circuit for relay RR, and the latter is

85 locked up over a circuit extending through closed contact 60 of relay SR, and closed contact 65 of relay RR. The operation of relay RR opens contact 59 and thereby deenergizes relay RG, thus disconnecting the

90 generator 47 and maintaining the strands 15 and 16 continuous. In this condition, conversation may be carried on between stations A and B over the heavily marked circuit. Transmission current will be supplied

95 to the transmitter at station A from battery 24, through sleeve relay 30 to the sleeve side of the circuit, and from the same battery, through tip relay 29, to the tip side of the circuit. Similarly, transmission current

100 will be supplied to the transmitter at substation B from battery 46, through sleeve relay SR to the sleeve side of the circuit, and from the same battery, through tip relay TR, to the tip side of the circuit. At

105 the end of conversation, the restoration of the receivers to their hooks at stations A and B will cause the lighting of supervisory lamps 39 and 40 before the "A" operator, as just explained, and she will remove the

110 plugs 6 and 7 from jacks 3 and 10, respectively. As a result, cut-off relay 23 of the calling line will be deenergized and the circuit of that line will return to normal. On the other hand, trunk relay TK will be deenergized and the circuit will be completed

115 through lamp 54 via closed contact 60 of relay SR and closed contact 53 of relay TK. This circuit will also include the pilot relay 49. As a result of the display of the pilot signal and the signal 54, the "B" operator

120 will remove connecting plug 17 from jack 3 of the called line, and both the trunk-circuit and the circuit of the called line will assume their normal conditions, thus leaving all the parts of the apparatus at normal and ready for another connection.

125 It will be apparent that in carrying out my invention, certain alterations and modifications may be made in the apparatus and circuits without departing from the spirit 130

and scope of my invention. I therefore do not wish to be limited to the specific matter illustrated, but aim to cover, by the terms of the appended claims, all such alterations and modifications.

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

1. A telephone system comprising telephone lines, a link-circuit for use in establishing connection between said lines, a source of ringing current, a relay for controlling the connection of said source to the called telephone line and conductively disuniting the opposite ends of the link circuit, a pair of relays for controlling the circuit of said former relay, a control circuit for one relay of said pair extending to one end of said link-circuit, a control circuit for the other relay of said pair extending to the other end of said link-circuit, and switching mechanism free from ground at the substitution of said called line for rendering the circuit of the first said relay ineffective.
2. A telephone system comprising telephone lines, a link-circuit for use in establishing a conversational circuit between a calling line and a called line, a source of ringing current, a relay for controlling the connection of said source to the called line, a pair of relays for controlling the circuit of said former relay, a control circuit for one relay of said pair operated upon making connection with one end of said link-circuit, and a control circuit for the other relay of said pair operated upon making connection with the other end of said link-circuit.
3. A telephone system comprising telephone lines, a link-circuit for use in establishing a conversational circuit between a calling line and a called line, a source of ringing current, a relay for controlling the connection of said source to the called line and conductively disuniting the opposite ends of the link circuit, a pair of relays for controlling the circuit of said former relay, a control circuit for one relay of said pair including a portion of the talking circuit extending to one end of said link-circuit, a control circuit for the other relay of said pair including a portion of the talking circuit extending to the other end of said link-circuit, and switching means controllable at the called line for rendering one of said control circuits effective, said switching means being free from ground connection.
4. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a pair of talking conductors uniting the ends of said link circuit, a source of ringing current, a first relay for controlling the connection of said source to said line, a second relay and a third relay each connected to a strand of said link-circuit, a circuit for actuating said second relay upon establishing connection to

said line, a circuit for actuating said third relay upon the response of the called party, a circuit for actuating said first relay, a fourth relay for opening said latter circuit upon the operation of said third relay, and a locking circuit for said fourth relay controlled by said second relay.

5. A telephone system comprising a telephone line; a link-circuit for establishing connection to said line having five control relays, a first relay controlled from the calling end of the link-circuit, a second relay operated upon the connection of said link-circuit to said line, a third relay actuated upon the operation of said first and second relays, a fourth relay actuated upon the response of the called party, and a fifth relay actuated upon the operation of said fourth relay to deenergize said third relay, a source of ringing current, and connections from said source to said connected line controlled by said third relay.

6. A telephone system comprising a telephone line; a link-circuit for establishing connection to said line having five control relays, a first relay controlled from the calling end of the link-circuit, a second relay operated upon the connection of said link-circuit to said line, a third relay actuated upon the operation of said first and second relays, a fourth relay actuated upon the response of the called party, and a fifth relay actuated upon the operation of said fourth relay to deenergize said third relay, a source of ringing current, connections from said source to said connected line controlled by said third relay, and a signal controlled by said first and second relays.

7. A telephone system comprising telephone lines, a link-circuit for use in establishing connection between said lines, a relay actuated in response to a control exercised at the calling end of said link-circuit, a second relay actuated in response to a control exercised at the called end of said link-circuit, a circuit closed through contacts of said relays, a source of ringing current, means for connecting said source to the called line in response to the closing of said latter circuit, and switching means free from ground connection actuated upon the response of the called subscriber to disconnect said source.

8. A telephone system comprising telephone lines, a link-circuit for use in establishing connection between said lines, a relay actuated in response to a control exercised at the calling end of said link-circuit, a second relay actuated in response to a control exercised at the called end of said link-circuit, a third relay actuated in response to a control exercised at the connected called station, a circuit closed through contacts of said first and second relays, and means for applying ringing current to the called line

in response to the closing of said latter circuit and for disconnecting said application in response to the operation of said third relay.

- 5 9. A telephone system comprising telephone lines, a link-circuit for use in establishing connection between said lines, a relay actuated in response to the establishment of connection with the calling end of
10 said link-circuit, a second relay actuated in response to the establishment of connection at the called end of said link-circuit, a circuit closed through contacts of said relays, a source of ringing current, and means for
15 connecting said source to the called line in response to the closing of said latter circuit.

10. A telephone system comprising telephone lines, a link-circuit for use in establishing connection between said lines, a relay actuated in response to the establishment of connection with the calling end of
20 said link-circuit, a second relay actuated in response to the establishment of connection at the called end of said link-circuit, a third relay actuated upon response of the called party, a circuit closed through contacts of
25 said first and second relays, and means for applying ringing current to the called line in response to the closing of said latter circuit and for discontinuing said application
30 in response to the operation of said third relay.

11. A telephone system comprising a telephone line, a link-circuit for connecting to
35 said line, a source of ringing current, a relay for controlling the connection of said source to said connected line, and a second relay operative in response to the connection of said link-circuit to said line to close a
40 path through both said relays.

12. A telephone system comprising a tele-

phone line, a link-circuit for connecting to said line, a source of ringing current, a relay for controlling the connection of said source to said connected line, a second relay
45 operative in response to the connection of said link-circuit to said line to close a path through both said relays, and a third relay for completing the circuit through said latter relays.
50

13. A telephone system comprising a telephone line, a line relay and a cut-off relay therefor, a link-circuit for connecting to said line, a source of ringing current, a relay for controlling the connection of said
55 source to said connected line, a second relay, a circuit closed through said second relay and said cut-off relay upon the connection of said link-circuit to said line, and a branch path through said control relay in
60 parallel to that through said cut-off relay controlled in part by said second relay.

14. A telephone system comprising a telephone line, a line relay and a cut-off relay therefor, a link-circuit for connecting to
65 said line, a source of ringing current, a relay for controlling the connection of said source to said connected line, a second relay, a circuit closed through said second relay and said cut-off relay upon the connection of
70 said link-circuit to said line, a third relay, and a branch path through said control relay in parallel to that through said cut-off relay controlled by said second and third relays jointly.
75

In witness whereof, I hereunto subscribe my name this 24th day of June, 1909.

HARRY W. MUNSELL.

Witnesses:

CHARLES H. BAILEY,
CHESTER F. BAILEY.