

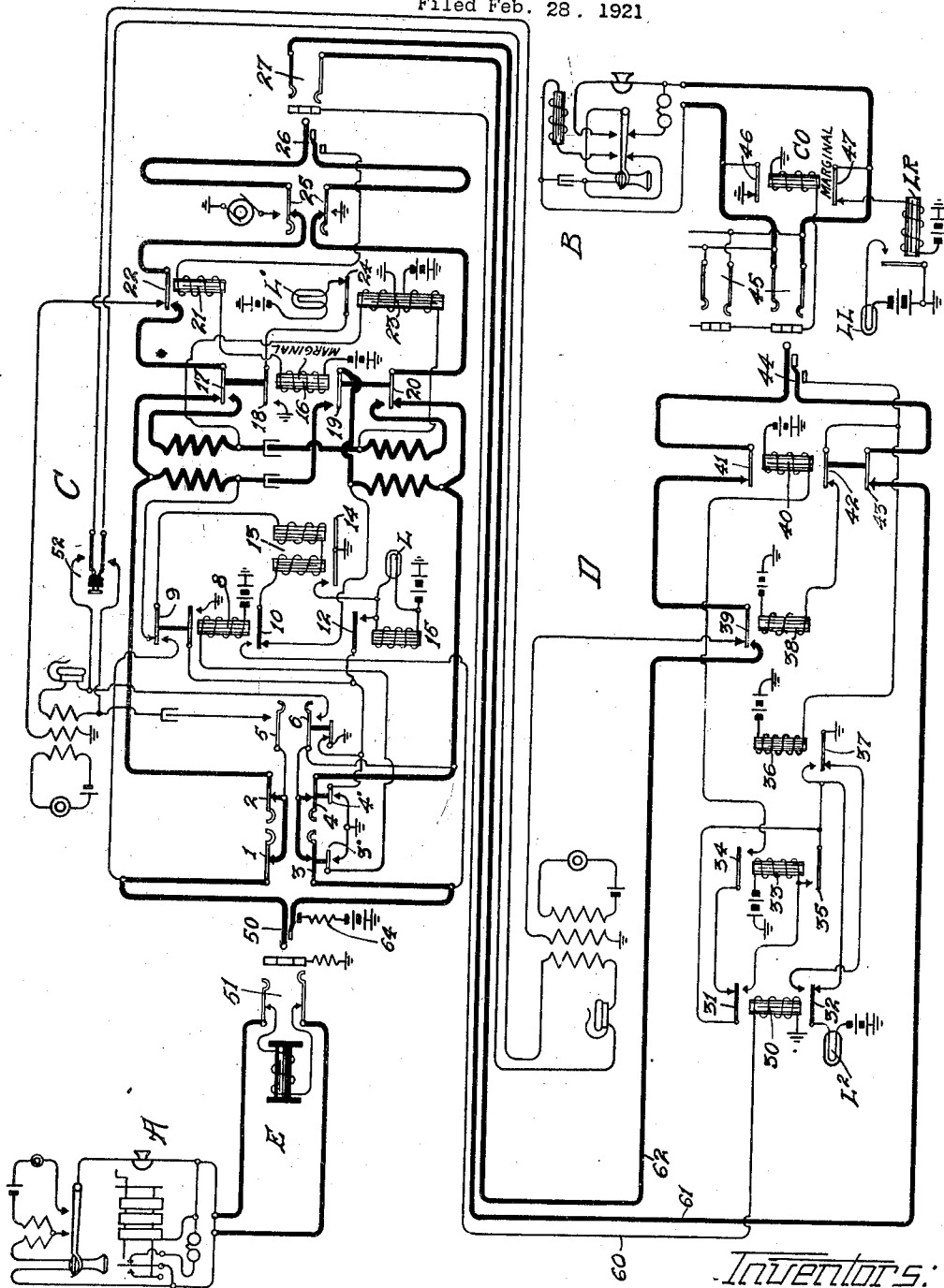
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H. D. CURRIER ET AL

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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 we, HIRAM D. CURRIER and GEORGE R. EATON, citizens of the United States of America, and residents, respectively, of Chicago and Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

Our invention relates more particularly to trunking systems for toll line use and has for one of its objects the provision of an improved method of trunking from a toll line to a local subscriber's telephone line, and also involves the accomplishment of certain novel service functions in a reliable and economical way.

One of the particular features of our invention consists in this, that when a toll call has been carried through from the toll operator by the aid of a second operator (through the medium of a toll service trunk) to a called-for subscriber's local telephone line, and when, at the end of conversation, the said local subscriber replaces his receiver and thus displays a disconnect signal before the toll operator, the latter, in withdrawing her plug from the toll service trunk jack, will free the local subscriber's line so that he may initiate a new call and so that his line will test idle whether or not the plug which his local operator inserted in the jack of his line has been removed.

These and other more detailed features of the invention will be described in the specification and will be pointed out in the appended claims.

We have illustrated our invention in the accompanying drawing, in which we have shown at A a generator-call substation connected by a telephone line with a line circuit E, at the exchange, comprising the usual line drop and spring jack, the latter having cut-off contacts. The just described arrangement, as will be well understood by those skilled in the art, may stand as conventionally symbolizing a toll line circuit.

At C we have illustrated a combination toll cord circuit, which includes an answering plug 50 and a calling plug 26, the latter plug being connected with instrumen-

talities so arranged that it can be used for connecting directly to a common battery local subscriber's line, or to a toll switching trunk circuit such as we illustrated at D, or it may be used for a straight toll-to-toll connection.

At B we have illustrated a common battery subscriber's set connected by its telephone lines with a line circuit at the exchange, including the line relay LR, line lamp LL, cut-off relay CO and multiple jacks 45, all arranged in the usual way, and particular description thereof will be unnecessary.

The drawing as a whole, as will be readily understood, illustrates an arrangement of connection devices, relays and signal apparatus for establishing connection from the substation or toll line A, by means of cord circuit C to the toll switching trunk D, which switching trunk may be an inter-office trunk in a multi-office system, and by means of said trunk D through to the called substation B.

More particularly, the cord circuit C has at its answering end the alternating current relay 13 for operation by generator current over the toll line to actuate the locking relay 15 and display the answering supervisory lamp L. Associated with the calling end of the cord are the two sleeve relays 16 and 21 for operation by current over the sleeve contact of plug 26 when said plug is connected to a spring jack, and it may here be observed that both relays actuate their armatures when the plug is connected to a common battery line or to a toll switching trunk, whereas relay 21 alone will actuate its armature when the plug 26 is inserted into a toll jack 51, the result being that quite a different functioning of the calling end of the cord results when connection is made with a jack connected to a toll line, as compared to that resulting when connection is made to a jack connected with common battery switching means. The cord circuit C also has a supervisory relay 23, which is operated by current over a common battery subscriber's line to efface the signal L' when a called subscriber answers and to again display the said signal when the subscriber replaces his receiver.

The cord circuit C also has the usual operator's telephone set and listening key, the usual cut-out keys, a ringing key and the customary repeating coil inductively uniting the two ends of the circuit.

A toll trunking circuit D is provided at the office in which cord circuit C is located, with a jack 27, and said trunk extends by three conductors to a distant operator's position in which its plug terminal 44 is located. The said trunk circuit D is provided with a sleeve relay 30, which controls the lamp L^2 , as well as the circuit of the relay 33. Connected to the sleeve contact of plug 44 are the two relays 36 and 38 in parallel one with the other, and it is to be noted that relay 36 is of very high resistance; so much so, in fact, that when at a given point in the operation of the system the relay 38 has its circuit open at contact 42, with the result that relays 36 and CO are left alone in series circuit, the relay CO will then receive so little current that it will allow its armatures to be retracted, although relay 36 being of decidedly superior efficiency, will remain with its armature in its operated position. The relay 40 of the circuit D is what is commonly known in the art as a "bust" relay, in that when operated it opens up the talking conductors of the cord and places them on open circuit, so that as far as the operation of the subscriber's line circuit goes, it is as if the plug had actually been withdrawn from the jack of the line.

A more detailed understanding of the invention will be had from the following narrative of operation, in which a call is assumed to come over the toll line from A, by means of alternating current applied thereto, to the line circuit E, throwing the drop at E; in response to which signal the operator at C inserts plug 50 in jack 51, cutting off the said drop at the jack contacts in the usual way. Throwing listening key contacts 5, 6, she inquires what is wanted, and learning that the line is to be connected to substation B at the distant operator's position D, she restores her listening key contacts and actuates her order wire key 52, directly cutting her head telephone into circuit with that of the operator at D.

The operator at C then tells the operator at B over the order wire the number of the subscriber at D that is wanted, and the operator at D assigns the trunk to be used, assumed to be the one represented before the operator at C by the spring jack 27, and it being assumed that the operator at D has found the called line idle by the usual test, the said operator inserts plug 44 into jack 45 of the called line. The operator at C, having received the assignment inserts plug 26 into jack 27. The insertion of plug 44 closes a circuit from battery through

the two relays 36 and 38 in parallel, through the sleeve contact 44, 45, and relay CO of the called line to ground, the latter operating its contacts 46 and 47 to clear the limbs of the called line for talking and ringing. The relay 38 shifts contact 39 to disconnect the test winding of the operator's induction coil, and to extend the talking conductor 62 through to the tip contact of plug 44. Relay 36 shifts its armature contact 37 and will display the signal L^2 , if the operator at C has not already inserted the plug 26.

The insertion of plug 26 into jack 27 closed a circuit from battery through the relays 16 and 21 at C, over the sleeve contact at 26, 27, conductor 60, and through relay 30 to ground, and the relay 30 shifts contact 32 to put out lamp L^2 , if it has been lighted, while contact 31 of relay 30 is shifted to energize the relay 33 by current from battery through said relay, alternate contact 31, to ground to alternate contact 37, the result being that relay 33, by its contact 35, locks itself to said ground at 37, and with the further result that its closed contact 34 places the so-called "bust" relay 40 in condition to be energized at time of disconnection by the closure of normal contact 31, for purposes that will be hereafter more fully described.

The energization of relay 21, at the insertion of plug 26, shifts contact 22, cutting out the test winding of the operator's induction coil, to extend the contact 17 through to the tip contact of plug 26, so that the relay 16 having simultaneously energized and closed alternate contact 17, a conductive circuit is completed from the upper right-hand winding of the repeating coil through to the tip contact of the plug. The shifting of contact 20 on the energization of relay 16 conductively connects the lower right-hand winding of the repeating coil through to the ring contact of the plug, while the shifting of contact 19 connects the two left-hand windings of the repeating coil, so that the voice currents may be transmitted from plug 50 to plug 26 without having to pass through the windings of the alternating current relay 13, which they would otherwise have to do to the great detriment of the talking qualities of the cord circuit. The shifting of armature 18 will, of course, display the calling supervisory signal L^1 for the time being.

The operator at C now shifts her ringing key levers 25 to ring the called-for subscriber, the ringing current passing from generator through alternate contact 25, tip contact at 26, 27, conductor 62, alternate contact 39, tip contact 44, 45, over the substation line and through the condenser and call bell, back over ring contact 45, 44, conductor 61, ring contact 27, 26 to ground

at alternate contact 25. The operator at C having restored contacts 25 and the subscriber at B having removed his receiver in response to the ringing of his bell, thus conductively uniting the two limbs of the telephone line at the substation, the relay 23 at C will be energized by current from battery through its lower winding, the lower winding of the repeating coil, alternate contact 20, the ring contact at 26, 27, over conductor 61 and contact 43, thence through ring contact 44, 45, through substation B, via its impedance coil, back through tip contact 45, 44, conductor 62, tip contact 27, 26, alternate contact 22, alternate contact 17, a winding of the repeating coil and through the upper winding of relay 23 to ground. This energizes relay 23, and armature 24 puts out the supervisory lamp L'.

The subscriber at B and the subscriber at the local battery substation or toll station A are now in conversation, and it will be observed that the subscriber B, by replacing his telephone, can de-energize relay 23 to display supervisory signal L', while generator current over the toll line from A will pass through the tip contact at 51, 50, contacts 1, 2, a winding of the repeating coil, normal contact 9, the alternating current relay 13, normal contact 10, and other winding of the repeating coil contacts 4, 3, the ring contact at 50, 51, and back to generator, so that the relay 13 can be energized by alternating current over the toll line to close contact 14, which energizes relay 15, the latter locking to ground at the ringing key and displaying the answering supervisory lamp L. The two lamps being now displayed, the operator at C has the disconnect signal and withdraws plugs 50 and 26. The withdrawal of 50 obviously frees the toll line, while the withdrawal of plug 26 de-energizes relays 16 and 21 at C and relay 30 at D. The resulting retracting of armature 31 will energize the "bust" relay 40 by current through contact 34, 31, and to ground at 37, and the energization of said relay 40 opens contacts 41 and 43 so that the called-for subscribers' line limbs are both clear of battery and ground at the cord, while the opening of contact 42 has opened the circuit of the relay 38, so that now the only circuit through the cut-off relay CO of the called line is through the high-wound relay 36, which may be of several thousand ohms resistance. The relay 36 will, of course, remain operated, but the relay CO is so constructed that it is unable to retain its armature contacts in their attracted positions when it receives such a slight amount of current as now reaches it through the winding of relay 36. Consequently, the line signaling circuit of substation B is restored to normal by the closure of contacts 46 and 47,

and even if the operator at D takes some time before she withdraws plug 44, the line of B is in the meantime capable of being used as a calling line exactly as if the plug 44 had been withdrawn. It can moreover be used as a called-for line, as if said plug were withdrawn, inasmuch as a slight amount of potential present in the sleeve contact at 44, 45, is insufficient to give any other operator testing a multiple of jack 45 a perceptible busy test click.

Going back a little, the withdrawal of plug 26 causing the de-energization of relay 30 resulted in the retraction of armature 32 and the lighting of lamp L², by current flowing to ground at alternate contact 37. The operator at D observing the signal will withdraw plug 44, de-energizing relay 36, which in turn de-energizes relay 33, which in turn de-energizes relay 40, all in an obvious manner, and all circuits used in the connection are at normal.

It will be evident to one skilled in the art that if the toll call had been for a subscriber having common battery telephone equipment and a line circuit similar to that illustrated in connection with B, with its spring jacks located within reach of the operator who handled the cord circuit C, she could have completed the connection by directly inserting the plug 26 into the spring jack 45 of the local line (after having tested and found it idle), and the relays 16 and 21 would have operated directly in circuit with the cut-off relay of the called line and the supervisory relay 23 would have been under the direct control of the substation switchhook. No more particular reference to the functioning of the circuits when used in this relation is necessary.

If the operator at C at the time she answers the call from A had found that to complete the connection it was necessary to go through to some distant exchange over a toll line having generator call equipment and provided with a line circuit such as that illustrated at E, she would have inserted the plug 26 into a spring jack connected to the outgoing toll line, and having connections precisely like the one shown at 51. It will be observed that the sleeve of the spring jack 51 is connected to ground through a resistance, and this resistance should be rather high, so that when on the insertion of plug 26 sleeve contact 26, 51 is closed and as a result the relays 16 and 21 are placed in series with the resistance 64, the relay 16, being so constructed and adjusted as to be inefficient as compared with relay 21, will not be energized sufficiently to actuate any of its armature switch contacts. The relay 21, however, will energize and close contact 22. The operator rings over the toll line by shifting ringing key contacts 25, and then restores them as before. The result is this, that while in the previously described

connection the conversational currents were, of course, transmitted from one talking station to the other through the medium of the repeating coil at C, in the present case the repeating coil is left entirely out of the talking circuit through the failure of relay 16 to operate. Under the present conditions the voice current will be transmitted from the tip of plug 50 through contacts 1, 2, directly to normal contact 17, through alternate contact 22 and to the tip of plug 26, while the return voice currents will pass from the ring of plug 26 through normal contact 20, through contacts 4 and 3, directly to the ring contact of plug 50. It will be seen further that in this condition of affairs the alternating current relay 13 is bridged across the tip and ring contacts of answering plug 50, and the tip and ring contacts of plug 26, its bridge including the two left-hand windings of the repeating coil, and this bridge is so highly inductive, both on account of the windings of relay 13 and on account of repeating coil windings, as to be practically opaque to voice currents. At the same time alternating current of ringing frequency impressed upon either of the connected toll lines from any sort of station thereon, will serve to actuate the relay 13, which will energize relay 15 and light lamp L to obtain the attention of the operator at C.

If, at any time while a connection is up, the operator at C desires to converse with a person at a station to which her cord circuit is connected by means of plug 26, without permitting the calling station to hear, she will actuate the levers 1 and 3 of her cut-out key, as well as her listening key contacts 5, 6. The opening of contacts 1, 3, disconnects the listening key contacts 5, 6 from the calling line so that the conversation will not be heard while the closure of contact 3' closes an energizing circuit for the relay 8, which by attracting its armatures 10 and 9 maintains the relay 13 connected across the calling line (which relay would otherwise be severed therefrom by the opening of contacts 1, 3) to the end that the calling line may not be without means of securing the operator's attention, if it should be desired to do so during the time that the operator is talking over the called-for line.

Similarly, by shifting her listening key levers 5, 6 and the cut-out key levers 2, 4, and 4' the operator can talk over the calling line without the conversation being heard over the called-for line, and in this case the relay 8 is not energized, it resulting that if the plug 26 is connected to an outgoing magneto toll line, the relay 13 will remain under the control of the called-for toll line, and the station on the outgoing toll line may, by impressing generator current on the

line, obtain the attention of the operator at C, by actuating relay 13 to display signal L, while the said operator at said C is talking over the called line.

While we have herein more particularly illustrated and described one embodiment of our invention, it is to be understood that we intend in the specification and claims not to limit ourselves by any means to the embodiment herein contained, as the invention may be very readily applied in many different ways and for various purposes without departing from the spirit and scope thereof; but what we do claim and desire to secure by Letters Patent of the United States is—

1. In a telephone system having telephone lines of one character terminating at an operator's position, telephone lines of a different character terminating in multiple terminals at another operator's position, connecting means at both operators' positions for cooperating to connect a line of one character with a line of a different character and to render the line busy at the second operator's position, and electromagnetic means at the second operator's position controlled from said first operator's position for causing the line at the second operator's position to test idle while a physical connection of the connecting means and multiple terminal of said line remains.

2. In a telephone system, a magneto telephone line, a common battery telephone line terminating in multiple terminals and individual line switching means normally controllable by current over said common battery line, connecting circuits having connection terminals for interconnecting said magneto telephone line and said common battery telephone line in conversational circuit, the connection terminal applied to one of said multiple terminals rendering said means unresponsive to current over said common battery line, a distant operator's position and electrically operated devices controllable therefrom to render said means responsive while said last connection terminal remains applied to said multiple terminal, means for one of said connecting circuits responsive only to current over said magneto line to signal for a disconnection and non-responsive to current over said common battery line, and ringing means at said distant operator's position for applying ringing current to said common battery line via said connecting circuits.

3. In a telephone system, an A board and a B board and a telephone line having terminals at the B board, said line connected to an operator's circuit at the A board through a plug and jack at said board and through a plug and jack at the B board, ringing means at the A board for signaling the subscriber on said line, and electrical switching means controllable by the op-

erator at the A board to make said line test idle at the B board while the plug at the B board continues in the jack.

4. In a telephone system, a telephone line 5 having multiple terminals, a link circuit connected to one of them, another link circuit connected to the first at its distant end, automatic switching devices controlled from said second circuit to operatively free said 10 line from said first circuit without conductively dissociating said first circuit and the multiple terminal of said line, supervisory means for said second circuit, and a circuit for said supervisory means including said 15 telephone line, said supervisory means controlled by the subscriber on said line to signal for a disconnection.

5. In a telephone system, a telephone line having multiple terminals provided with 20 test contacts, a link circuit connector having a connection terminal at each of its ends, one of said connection terminals applied to one of said contacts rendering them all busy by means of its relatively low resistance 25 connection to a battery, an operator's cord circuit connected to the other of said connection terminals, ringing generator means for said cord circuit for applying ringing current to said telephone lines over said 30 link circuit connector, a high resistance link circuit resistance connection from said battery to said connector and so to said contacts, a relay normally connected between said contacts and a return circuit of said 35 battery and energizable by current over said low resistance connection, a relay in said high resistance connection and energized by current through said first relay, and a distant switching station controlling auto- 40 matic switching means for opening said low resistance connection to restore said first relay while the second continues operated.

6. In a telephone system, a telephone line 45 having multiple test contacts and a line circuit including a relay connected to them and to a source of current, a link circuit having one of its conductors applied temporarily to one of said contacts, said conductor 50 having two branches to the other side of said source, an operator's cord circuit connected to said link circuit, ringing genera-

tor means for said cord circuit for applying ringing current to said telephone line via said link circuit, means controlled from said 55 cord circuit to cause the opening of one branch only while said conductor remains applied to change the test of said line and restore the contacts of said relay, and a circuit for said means including a contact controlled by means in said closed branch for 60 maintaining said means operated.

7. In a telephone system, an operator's cord circuit having a connecting plug, a spring jack having inserted in it said plug, 65 said jack connected to a plug-ended link circuit leading to another operator's position, a telephone line having multiple jacks to one of which said last plug is connected, ringing current means for said operator's 70 cord circuit for applying ringing current to said telephone line via said link circuit, a line-circuit controlling relay for the line energized by current through said plug and jack, said relay receiving said current 75 through parallel connections in said trunk to said plug, and means controlled by the withdrawal of said first plug to open one only of said connections to restore said relay. 80

8. In a telephone system, a connection extending from an A position to a B position and there to a telephone line, ringing generator means at said "A" position for signaling the subscriber on said telephone line, 85 and automatic switching means controlled by the A operator, to restore the control of its line circuit to the line while the connection remains up at the B position.

9. In a telephone system a connection extending from an A position to a B position 90 and there to a telephone line, generator ringing means at said "A" position for signaling the subscriber on the said telephone line, and circuit means at the B position operable from the A position to change the 95 test conditions of said line while the connection remains up at the B board.

Signed by us at Chicago, in the county of Cook and State of Illinois, this 24th day of 100 February, 1921.

HIRAM D. CURRIER.
GEORGE R. EATON.