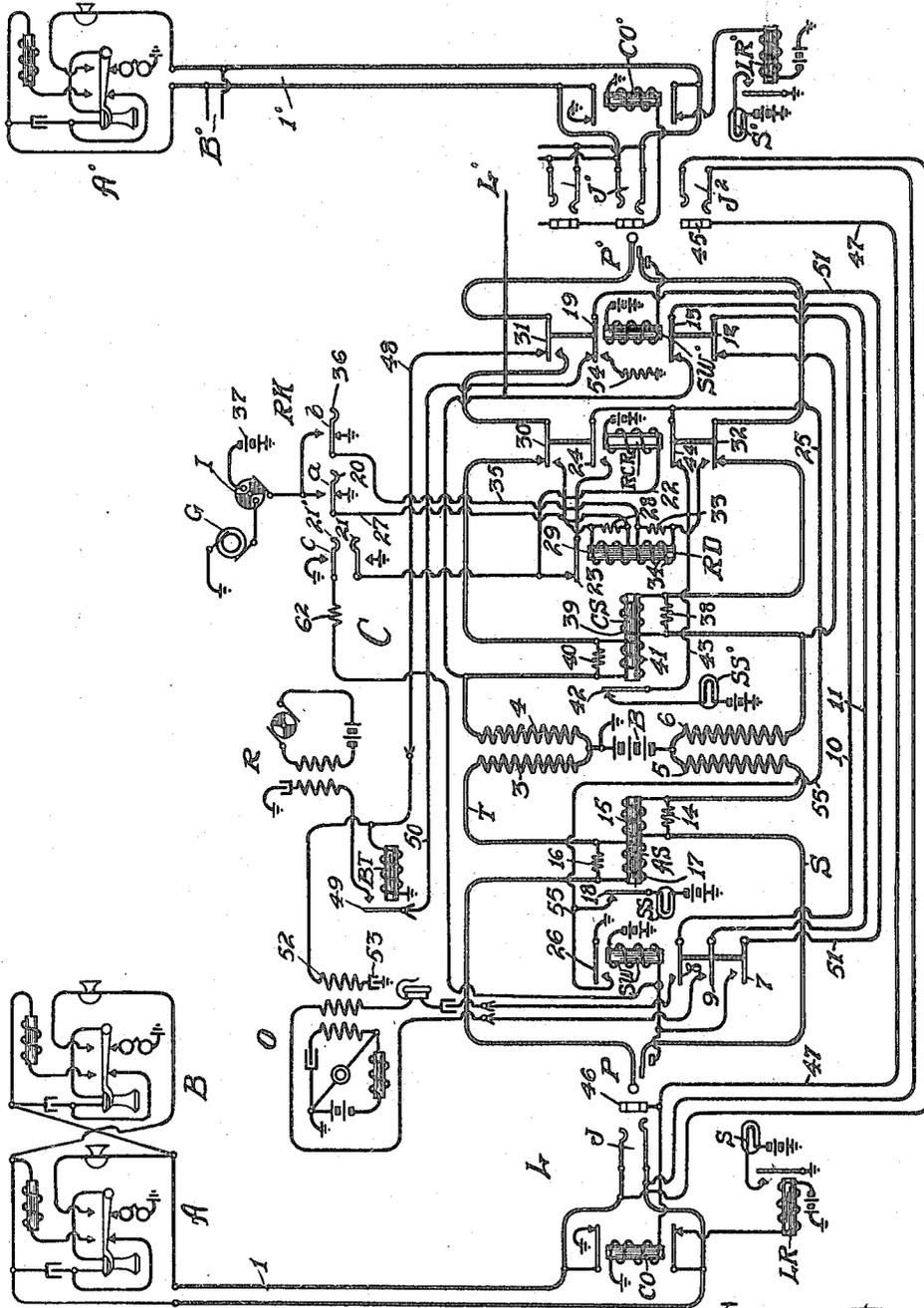


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 REVERTING BUSY TEST FOR TELEPHONE SYSTEMS.  
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# UNITED STATES PATENT OFFICE.

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REVERTING BUSY-TEST FOR TELEPHONE SYSTEMS.

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*To all whom it may concern:*

Be it known that I, HIRAM D. CURRIER, a citizen of the United States of America, resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Reverting Busy-Tests for Telephone Systems, of which the following is a specification.

My invention relates to reverte busy test systems for party line telephone exchange systems being directed more particularly to such systems as employ common battery cord circuits, an object being to provide a system having a common test relay adapted for connecting the reverte test tone to the cord circuit which is being used and whereby such test tone is again disconnected from the cord circuit by a relay which operates when the calling plug is inserted into a jack of the wanted line.

For a better understanding of my invention reference is to be had to the accompanying drawing, in which: two telephone lines 1 and 1<sup>1</sup> are shown, each line being of the party line type and having a plurality of substations A and B on the line 1, and A<sup>1</sup> and B<sup>1</sup> on the line 1<sup>1</sup>. The substation bells are connected to the tip and sleeve sides of the line and to ground so that either station may be rung selectively although of course other types of ringing systems may be used. The line 1 terminates in a line circuit L which comprises a line relay LR, a cut-off relay CO, a line signal S and jacks J. Line 1<sup>1</sup> terminates in a line circuit L<sup>1</sup> similar to that of L, and bearing the same reference numerals, but with the suffix prime added.

The cord circuit C comprises answering and calling plugs P and P<sup>1</sup> united by the heavily marked tip and sleeve conductors T and S. An answering supervisory relay AS is associated with the answering end of the cord and controls a supervisory signal SS. A switching relay SW is also associated with the answering end for connecting the operator's set O to the cord circuit and controlling the reverte test tone lead 51. I also provide a repeating coil RC which comprises the windings 3, 4, 5 and 6.

In connection with the calling end of the cord circuit I provide a calling supervisory relay CS which controls a supervisory signal SS<sup>1</sup>. A switching relay SW<sup>1</sup> is also associated with the calling end and discon-

nects reverte tone test and operator's telephone O from the cord circuit.

Automatic ringing control is provided including a ringing control relay RCR, ringing disconnect relay RD, and a party line ringing key RK having independently operable ring ng plungers *a* and *b* and common contacts 21 and 21<sup>1</sup>. When a ringing plunger is fully depressed into ringing position one of the ringing contacts is operated as are also the common contacts 21 and 21<sup>1</sup>. When the operator removes the pressure from the depressed plunger it restores to its indicating position and maintains the connected ringing contacts in their alternate position, but restores the common contacts 21 and 21<sup>1</sup> to their normal position. Contacts 21<sup>1</sup> are effective to initially energize relay SW when plug P has been withdrawn and calling plug P<sup>1</sup> inserted in calling a substation back on a calling line. When a ringing plunger is depressed the relay RCR is energized and locks up to apply ringing current to the called line from a generator G through an interrupter I. When the party answers the disconnect relay RD operates to disconnect the ringing current.

In connection with party lines systems it is desirable to provide a reverte busy test tone so that an operator may know when a subscriber at a calling substation is calling for a substation on his own line. To this end my invention is particularly directed, and the reverte tone is so arranged that when an operator places the tip of the calling plug P<sup>1</sup> upon the test contact of a jack J<sup>2</sup> connected to calling line, a busy tone relay BT which is common to a position operates to connect reverte tone apparatus R to the contact of the answering plug P whereby if the calling plug P<sup>1</sup> is touching a jack multiply connected to the jack in which a plug P is inserted a distinctive tone is transmitted to the operator.

Having described in general the apparatus employed in the preferred embodiment of my invention, its operation when establishing a connection between a calling and called substation will now be described.

Assuming that the substation A on the line 1 desires to call, the receiver thereat is removed which closes a circuit for the line relay LR and upon its energization its alternate contact is closed to light the line signal

S. The operator in response to the lighted signal inserts the answering plug P into the answering jack J of the calling line establishing an energizing circuit for the cut-off relay CO and the switching relay SW in series through the third contacts of the connected plug P and jack J. Relays CO and SW are energized, cut-off relay CO interrupting the circuit of the line relay LR which deenergizes and effaces the line signal S. Upon the energization of relay SW its alternate contacts 8 and 9 are closed connecting the operator's telephone over conductors 10 and 11 and normal contacts 12 and 13 of switching relay SW<sup>1</sup> in bridge of talking conductors T and S of the cord circuit C. Relay SW by its alternate contact 7 also connects the test tone lead 51 to the test contacts of the calling line. The answering supervisory relay AS is also energized when the plug P is inserted into the jack J, the circuit being traced from battery B, winding 5 of repeating coil RC, the non-inductive shunt 14 and the winding 15 of the relay AS in multiple, conductor S, sleeve contacts of the plug P and jack J, through the substation tip, contacts of the plug P and jack J, conductor T, the non-inductive shunt 16 and the winding 17 of relay AS in multiple, conductor T, through the winding 3 of repeating coil RC to ground. The relay AS operating opens its normal contact 18 to prevent the supervisory signal SS from lighting.

The operator's telephone having been automatically connected with the cord circuit C by the operation of relay SW, the operator ascertains the wants of the calling subscriber and assuming it is the substation A<sup>1</sup> of the line 1<sup>1</sup> that is wanted, tests the called line to determine its idle or busy condition in the usual manner and finding the called line idle inserts the plug P<sup>1</sup> into the jack J<sup>1</sup> whereupon a series circuit for the switching relay SW<sup>1</sup> and the cut-off relay CO<sup>1</sup> is established, being traced from battery through the winding of relay SW<sup>1</sup>, the third contacts of the plug P<sup>1</sup> and jack J<sup>1</sup>, through the winding of relay CO<sup>1</sup> to ground. Relays SW<sup>1</sup> and CO<sup>1</sup> are energized, relay SW<sup>1</sup> interrupting its normal contacts 12 and 13 causing the disconnection of the operator's telephone from the cord circuit C and also opens its normal contact 19 to operatively disassociate the revertive tone from the cord circuit C. The relay CO<sup>1</sup> energizing removes the substation control of its line signal.

Now if the called line is busy, there is a battery connection to the third contacts of the connected jacks and when the tip of the plug P<sup>1</sup> touches the third contact an energizing circuit for relay BT is established, but this is only incidental when a line different than the calling line is being tested, the

revertive tone circuit not being effective and so the operator only receives the usual busy click.

Continuing with the previous part of the description, the operator having inserted the plug P<sup>1</sup> depresses the plunger *a* to its fully depressed position thereby actuating its ringing contacts 20 and also the common contacts 21 and 21<sup>1</sup>. Responsive to the closing of the contact 21 of the end springs, a circuit for the ringing control relay RCR is established traced from battery through the winding of relay RCR to ground at alternate contact 21. Relay RCR then establishes a locking circuit for itself traced from battery, conductor 22, normal contact 23 of the relay TR, alternate contact 24 of relay RCR, conductor 25, alternate contact 26 of relay SW to ground. The closure of contact 21<sup>1</sup> at this time has no effect upon SW or CO due to resistance 62. The operator now releases the pressure on the actuated key plunger *a* to restore it to its ringing position and also allowing the end spring 21 to assume its normal position, but in the ringing position the contact 20 of the key remains in its alternate position to connect ringing current to the called line. This is traced from the ungrounded pole of the generator G through interrupter I, alternate contact 20, conductor 27, non-inductive shunt 28 and the winding 29 of relay RD in multiple, alternate contact 30, conductor T, alternate contact 31, conductor T, tip contacts of the plug P<sup>1</sup> and jack J<sup>1</sup>, the condenser and call bell of the called substation to ground. Thus the call bell of the called substation is intermittently rung through the agency of the interrupter I until the call is answered.

The subscriber in answering closes an energizing circuit for the relay RD, this energizing circuit for the relay RD being established whether the receiver is removed during the ringing or a silent period, by generator or battery as is well known in the telephone art. The circuit for the relay RD is traced from either the battery 37 or generator G as the case may be, conductor 27 through the non-inductive shunt 28 and winding 29 of relay RD in multiple, alternate contact 30, alternate contact 31, tip contacts of the plug P<sup>1</sup> and jack J<sup>1</sup>, closed contacts of the switch hook of the called substation back through the sleeve contacts of the jack J<sup>1</sup> and plug P<sup>1</sup>, alternate contact 32, non-inductive shunt 33 and winding 34 in multiple, conductor 35 to ground at normal contact 36 of the ringing plunger *b*. The relay RD is energized momentarily and opens its normal contact 23 which interrupts the locking circuit of the relay RCR thus disconnecting the ringing current from the called line. A circuit for the relay CS is now established traced from battery B, the

winding 6 of the repeating coil RC, the non-inductive shunt 38 and winding 39 of CS in multiple, conductor S, normal contact 32, sleeve contacts of the plug P<sup>1</sup> and jack J<sup>1</sup>, through the substation, tip contacts of the jack J<sup>1</sup> and plug P<sup>1</sup>, alternate contact 31, normal contact 30, non-inductive shunt 40 and the winding 41 in multiple, winding 4 to ground. The substations are now connected in a conversational circuit, the circuit being traced over the heavily marked conductors.

The subscribers having finished conversation replace their receivers upon their respective switch-hooks. The calling subscriber replacing his receiver opens the circuit of the relay AS, the relay restoring again closing its normal contact 18 to light the supervisory signal SS. The called subscriber replacing his receiver opens the circuit for the relay CS and in restoring it again closes its normal contact 42 lighting the signal SS<sup>1</sup>. The operator observing the lighted signals SS and SS<sup>1</sup> withdraws the plugs P and P<sup>1</sup> from the jacks J and J<sup>1</sup>. The withdrawal of the plug P opens the series circuit for relays CO and SW, the relay SW restoring opening its alternate contact 26 and effacing the signals SS and SS<sup>1</sup>. The withdrawal of the plug P<sup>1</sup> opens the series circuit for relays CO<sup>1</sup> and SW<sup>1</sup>, both restoring.

Now as to the operation of the revertive busy test circuit let us assume that in answering plug P has been inserted into the jack J in response to a call over the line 1, the operation of relays AS and SW is the same as before described, and assuming that the calling subscriber wants connection with another substation on the same line, the operator not knowing that the calling and called substations are on the same line will place the tip of calling plug P<sup>1</sup> against the third or test contact 45 of a multiple jack J<sup>2</sup> of the wanted line. This test contact is connected to battery with the test contact 46 of the jack J, the third contact of the plug P and the winding of relay SW. Therefore, when the operator places the plug P<sup>1</sup> against the jack J<sup>2</sup>, a circuit is established for relay BT from battery at the said test contact 46 of J, conductor 47, test contact 45 of the jack J<sup>2</sup>, tip contact of plug P<sup>1</sup>, normal contact 31, conductor 48, winding of relay BT to ground. Relay BT therefore closes its alternate contact 49 connecting the revertive tone from the apparatus R over the conductor 50, normal contact 19, conductor 51, alternate contact 7, the third contacts of the plug P and jack J, conductor 47, test contact 45 of jack J<sup>2</sup>, tip contact of the plug P<sup>1</sup>, normal contact 31, conductor 48, winding 52 of the operator's induction coil and condenser 53 to ground. The undulations of current in the tertiary winding of the operator's induc-

tion coil are therefore induced into the secondary winding and operator receives the characteristic tone and knows that the wanted substation is on the same line with the calling substation.

The operator therefore asks the calling subscriber to replace his receiver upon its switch hook while the called substation is being rung. The subscriber at the calling substation having replaced his receiver, the operator removes the plug P from the jack J, and inserts the calling plug P<sup>1</sup> into the jack J<sup>2</sup>. The removal of the plug P from the jack J allows the relay CO of line circuit L and the relays SW and AS of cord circuit C to restore to normal but the insertion of the plug P<sup>1</sup> into the jack J<sup>2</sup> closes a series circuit for the relays SW<sup>1</sup> and the cut-off relay CO traced from battery through the winding of SW<sup>1</sup>, the third contacts of the plug P<sup>1</sup> and jack J<sup>2</sup>, conductor 47, the third contact of jack J and the winding of cut-off relay CO to ground. The relay SW<sup>1</sup> upon energization opens its normal contact 19 to interrupt the individual revertive tone conductor 50. The operator now depresses the proper ringing key thereby closing contacts 21<sup>1</sup> which establishes an initial energizing circuit for SW which closes its alternate contact 26 and establishes a circuit for the signal SS, while the closing of its alternate contact 7 furnishes a locking circuit over conductor 51 and alternate contact 19 to ground. Ringing current is thus also applied to the called line in a manner as before described.

When either the calling or called subscriber removes his receiver, the relay RD is operated momentarily to open the circuit of the relay RCR to disconnect the ringing current in the manner as already described. The relay CS is also energized by current over the line 1 and the signal SS remains lighted during conversation, but this only takes place in a revertive call that is when a calling party is calling a substation on the same line.

When the subscribers have finished their conversation and upon replacing both receivers upon their respective switch-hooks, the relay CS again restores which results in the display of the supervisory signal SS<sup>1</sup> as before described. The operator noting the signals SS and SS<sup>1</sup> removes the plug P<sup>1</sup> from the jack J<sup>2</sup> which removal restores the apparatus to normal.

From the foregoing it will be seen that I have provided a system with a revertive test tone employing a common test relay which has its test tone contacts connected in common to the answering terminal of all of the associated link circuits, but all of the individual connections extending from the contacts of the test relay are controlled as contacts of both the answering and calling

switching relays so as to prevent confusion and improper application of the revertive tone.

In applying my invention I have used a particular form of operator's link circuit but I contemplate employing it in connection with other types of cord circuits. It will also be apparent that many changes and modifications will readily occur to those skilled in the art after an understanding of my invention and therefore I do not desire to be limited to the exact construction as shown and described, but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described my invention what I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including telephone lines, an operator's link circuit having answering and calling ends, a switching relay for each end of the link circuit operable upon connection of the associated end with the telephone lines, a test relay connected to the calling end and operable in testing a busy called line, a test tone apparatus connected to contacts of the test relay, and a connection extending from said test relay to the answering terminal of the cord circuit including normally closed contacts of the calling switching relay and normally open contacts on the answering switching relay.

2. A telephone system including telephone lines, operators' link circuits having answering and calling ends, a switching relay for each of the calling ends of the link circuits operable upon connection of such ends with telephone lines, a test relay common to said links and connected to the calling terminal of said link circuits, a test tone apparatus connected to the contacts of the test relay, and connections extending from the contacts of the test relay to normally closed contacts on each of the switching relays and to corresponding answering ends of the link circuits.

3. A telephone system including telephone lines, an operator's link circuit having answering and calling ends, test tone apparatus, a test relay connected to the calling end of the link and operable when testing a busy called line, a relay associated with the answering end of the cord and operable when said end is connected to a telephone line, and circuit connections extending from said test tone apparatus through contacts on said test relay and normally open contacts on said other relay whereby said apparatus is connected to the answering terminal of the cord circuit only when said answering end is connected with a telephone line.

4. A telephone system including telephone lines, operators' link circuits having

answering and calling ends, a test relay having its winding connected in common with the calling terminal of each of the link circuits, test tone apparatus connected to one of a pair of normally open contacts on the test relay, a switching relay for each of the calling ends of the link circuits operable upon connection of such ends with telephone lines, connections extending from the other one of said pair of contacts on the test relay to normally closed contacts on each of the switching relays, and connections extending from the normally closed contacts on each of the switching relays to the corresponding answering terminal.

5. A telephone system including party telephone lines, an operator's link circuit having answering and calling ends, a switching relay at each end of the link circuit operable upon connection of its end with a telephone line, supervisory signals for the link circuit operable through normally open contacts of the answering switching relay, a ringing key for signaling the called substation when the calling terminal is connected to the line of a wanted substation, and a connection extending from contacts on said ringing key to the answering switching relay to effect its energization when only the calling terminal of the link circuit is in use.

6. A telephone system including party telephone lines, an operator's link circuit having answering and calling ends, a switching relay at the answering end of said link circuit, a calling supervisory signal under the control of said switching relay, a ringing key for signaling the called substation, and a connection extending from contacts on said ringing key to said switching relay to effect its energization thereby effecting said supervisory signal when said link circuit is used for revertive calls.

7. A telephone system comprising party telephone lines, a link circuit provided with answering and calling ends, a switching relay associated with the answering end, a supervisory signal associated with the calling end and controllable by said switching relay, a ringing key for said link circuit, and contacts controlled by said ringing key for energizing said switching relay whereby said relay when operated controls said supervisory signal, when said link circuit is used to make revertive calls.

8. A telephone system including telephone lines, a link circuit having answering and calling ends, a switching relay associated with each end of said link circuit, means controlled by said relays for automatically connecting and disconnecting an operator's set with said link circuit, test tone apparatus, and contacts controlled by said relays for operatively connecting and disconnecting said test tone apparatus with a contact

of the answering terminal of said link circuit.

9. A telephone system including telephone lines, a link circuit provided with answering and calling terminals for interconnecting said lines, a switching relay for each end of the link circuit operable upon connection of the associate end with the telephone lines, tone test apparatus, and a connection extending from said tone test apparatus to a contact of the answering terminal of said link circuit controllable by said switching relays.

10. A telephone system including telephone lines, a link circuit provided with answering and calling terminals for interconnecting said lines, a switching relay for each end of the link circuit operable upon connection of the associate end with the telephone lines, tone test apparatus, and means controlled by said switching relays for con-

necting and disconnecting the said test tone apparatus with a contact of the answering terminal of said link circuit.

11. A telephone system comprising party telephone lines, a link circuit having answering and calling ends, a switching relay at the answering end of said link circuit, a supervisory signal at the calling end of said link circuit, a ringing key for signaling the called substation, and a connection extending from said ringing key to said switching relay whereby said switching relay when operated exerts control over said supervisory signal.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

H. D. CURRIER.

Witnesses:

GEORGE E. MUELLER,  
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."