

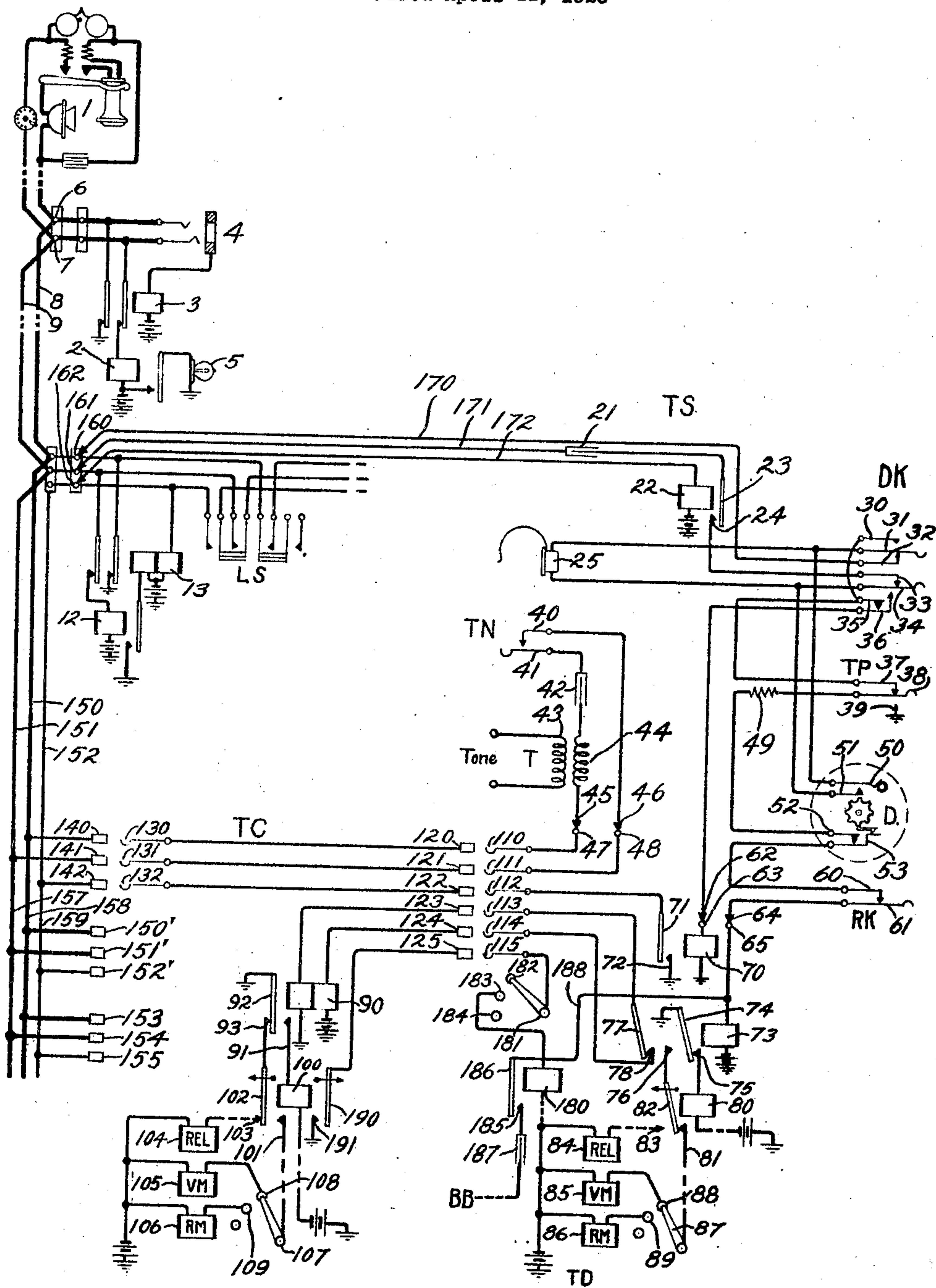
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TESTING SET FOR TELEPHONE SYSTEMS

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UNITED STATES PATENT OFFICE.

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TESTING SET FOR TELEPHONE SYSTEMS.

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To all whom it may concern:

Be it known that I, EMIL JACOBSEN, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Testing Sets for Telephone Systems, of which the following is a specification.

This invention relates to systems for testing electrical conductors and more particularly the conductors of automatic telephone systems.

In automatic telephone systems the subscribers' lines may terminate as calling lines at the central office either in automatic line switches or in the banks of automatic line finder switches and these lines also appear as called lines in the banks of connectors. The tip, ring and sleeve terminals of each line of a group are connected by a set of conductors to the called tip, ring and sleeve terminals, respectively, in the group of connectors having access to this line. In checking this interconnecting wiring prior to "cut-over"; that is, prior to transferring the subscribers' lines from the manual to the automatic central office equipment, it has been the practice to employ the services of two people, one at the connector multiple, the other at the line switches or finders as the case may be, and by some suitable buzzer arrangement to test each conductor for its continuity and to see that it is properly placed. This method is cumbersome and in addition requires the joint services of at least two testers. Another objection to this method is that it is at times detrimental to the telephone service, as care is not always exercised in making a test to make sure that the circuit to be tested is not in use by a subscriber.

The object of this invention is to allow one tester to accomplish the results hitherto requiring the joint services of at least two testers, and without in any way affecting the service on existing conversational connections.

In accordance with the invention, the tester is provided with manual means for connecting a testing set to any set of conductors interconnecting the incoming and outgoing terminals of the subscribers' lines, this testing set being preferably connected to said set of conductors at the line switches, and automatic switching apparatus is provided

at the connectors having access to multiples of the lines under test, the tester being provided with a sender for setting said automatic switching apparatus to pick out the said multiples, whereupon by applying signaling current thereto at the connectors he can determine by means in the test set responsive to this signaling current whether or not the interconnecting wiring is in proper condition.

A feature of this invention is the provision of means for automatically notifying the tester that the line under test is busy, to prevent his testing the wiring associated therewith and thus interfering with an existing connection.

Referring to the drawing the invention is illustrated in the cut-over of a telephone system from a manual to an automatic telephone system.

In the drawing a typical subscriber's station 1, is shown connected at 6 and 7 to the usual equipment consisting of a line relay 2, a cut-off relay 3, jack 4 and lamp 5 required in an existing manual telephone system. At points 160 and 161 the same line is shown connected by means of leads 8 and 9 to the well-known Keith line switch equipment LS, in a full mechanical step-by-step machine switching system, prior to the cut-over from a manual to a mechanical system. By means of the leads 150, 151 and 152 the line is extended to multiples 140, 141, and 142 of a test connector TC, such as is shown for example in Smith & Campbell's Automatic Telephony, first edition at page 355, (Fig. 251). By means of conductors 157, 158, 159 the line is multiplied to connector terminals 150', 151', 152' and 153, 154, 155 in the connector banks. The test set TS is equipped with two sets of leads, one set, 170, 171 and 172 connecting to a subscriber's line at the line switch frame LS, while the other set, 45, 46, 62 and 64, is intended for use in conjunction with a test distributor TD, such as is shown, for example, in the publication cited.

The test set TS is also equipped with a dial D, a tone transformer T, a receiver 25, a relay 22, and a group of keys DK, TP, RK and TN, connected in a particular manner to accomplish certain specific results which will be hereinafter more fully explained.

It is believed that the invention will be

fully understood from the following detailed description of its operation.

The tester connects the clips associated with leads 45, 46, 62 and 64 of the test set TS, to terminals 47, 48, 63 and 65, respectively, of the test distributor TD, and the clips associated with leads 170, 171 and 172 of the test set TS to terminals 160, 161 and 162, respectively, at the line switch frame LS.

With the test set connected in this manner, the following circuit is closed to operate relays 70 and 73, free pole of battery, 73, 65, 64, 61, 60, 53, 52, 49, 38, 37, 35, 36, 70, ground. Relays 70 and 73 operate, the latter establishing a circuit from grounded battery through the winding of slow-release relay 80 front contact 75 and armature 74 of relay 73 to ground, operating relay 80. The dialing key DK is now operated opening the circuit previously traced at its contacts 36 and 35 and connecting contacts 30 and 36 to contacts 31 and 34, respectively, thus connecting the receiver 25 in series with the circuit previously described through relays 70 and 73. The key DK is so arranged that contacts 36 and 34, and 30 and 31, are closed before contacts 35 and 36 are opened, thus preventing the momentary release of relays 70 and 73 whenever the key DK is operated or released.

When the dial D is moved off normal, the off-normal contacts 50 and 51 are closed thus short-circuiting the receiver 25 during the impulsing period. As the dial returns to normal the impulse springs 52 and 53 are alternately opened and closed, thus alternately opening and closing the circuit through relay 73, which follows the impulses. Relay 80 being slow to release will remain operated as relay 73 periodically releases during the impulsing period. Each time relay 73 releases, a circuit is established from grounded battery through the vertical magnet 85, side switch wiper contact 88 and brush 87, front contact 81 and armature 82 of relay 80, back contact 76 and armature 74 of relay 73 to ground, operating the vertical magnet 85 of the test distributor TD. Each time the vertical magnet 85 operates, the selector rod (not shown) carrying the brushes 110 to 115, inclusive, will be moved upward one step. When the dial returns to normal relay 73 remains operated and the circuit through the vertical magnet 85 is held open at the back contact of relay 73. The side switch magnet (not shown) thereupon causes the brushes 87 and 181 to advance, the former disconnecting the vertical magnet 85 at contact 88, and preparing the circuit for the rotary magnet 86 at contact 89. When the second digit is dialed relay 73 functions in the manner previously described, and a circuit is established from grounded battery

through the winding of the rotary magnet 86 side switch wiper contact 89 and brush 87, front contact 81 and armature 82 of relay 80, back contact 76 and armature 74 of relay 73 to ground, thus operating the rotary magnet 86 and causing it to rotate the selector rod carrying the brushes 110 to 115, inclusive, over the contacts in the level selected. We will assume that the digits dialed correspond to the level and terminal of the test connector circuit TC and that the brushes 110 to 115, inclusive, of the test distributor circuit TD are now resting on the contacts 120 to 125, inclusive, leading to the test connector circuit TC.

If the test connector circuit TC is busy, relay 100 is operated and a circuit will be established from battery through the winding of relay 180 of the test distributor circuit TD, side switch contact 183 and brush 181, brush 115, and contact 125, armature 190, and front contact 191 of relay 100 to ground, operating relay 180. Relay 180 when operated connects busy back tone from lead BB, through condenser 187, front contact 185 and armature 186 of relay 180, leads 188 and 64, contacts 61 and 60 of the release key RK, impulse spring contacts 53 and 52 of the dial D, resistance 49, contacts 38 and 37 of the test private key TP, contacts 30 and 31 of the dialing key DK, receiver 25, contacts 34 and 36 of the dialing key DK, winding of relay 70 to ground. The ground on multiple 125 will hold the escape magnet of the side switch operated in the well known manner to prevent the side switch from moving to position 3. The busy back will produce a tone in receiver 25 as an audible indication that the test connector circuit selected is busy.

If the test connector circuit TC is not busy when the dial returns to normal, the circuit through the rotary magnet 86 will be opened at back contact 76 of relay 73 and the side switch magnet (not shown) will cause brush 87 to advance, disconnecting the rotary magnet 86 at contact 89.

With the brushes 110 to 115, inclusive, of the test distributor circuit TD resting on the contacts 120 to 125, inclusive, associated with the test circuit TC, the leads from the test distributor TD are now extended by means of the brushes 110 to 115 and contacts 120 to 125 to the test connector circuit TC. A circuit will now be established from grounded battery in the test connector circuit TC, through the right winding of relay 90, contact 124 and brush 114, front contact 78 and armature 77 of relay 73 in the test distributor circuit TD, brush 113 and contact 123, left winding of relay 90 to ground, operating relay 90. Relay 90 operated, establishes through its front contact 91 and armature 92 a circuit to operate slow to re-

lease relay 100. When the third digit is dialed, relay 73 follows the impulses as before, and each time relay 73 releases, the circuit through relay 90 is alternately opened and closed at armature 77 and contact 78 of relay 73, causing relay 90 to follow the impulses. Relay 100 being slow to release remains operated throughout the impulsing period. Each time relay 90 releases, a circuit is established from grounded battery through the vertical magnet 105, side switch wiper contact 108 and brush 107, front contact 101 and armature 102 of relay 100, back contact 93 and armature 92 of relay 90 to ground, operating the vertical magnet 105 of the test connector circuit TC. Each time the vertical magnet 105 operates the test connector rod (not shown) carrying the brushes 130, 131 and 132 will be moved upward one step. When the dial returns to normal, relays 73 and 90 remain operated, and the circuit through the vertical magnet 105 is held open. The side switch magnet (not shown) of the test connector circuit TC thereupon causes brush 107 to advance to prepare the circuit for the rotary magnet 106 at contact 109. When the final digit is dialed, relays 73 and 90 function in the manner previously described and a circuit is established from grounded battery, through the winding of the rotary magnet 106 of the test connector circuit TC, side switch wiper contact 109 and brush 107, front contact 101 and armature 102 of relay 100, back contact 93 and armature 92 of relay 90 to ground, thus operating the rotary magnet 106 and causing it to rotate the brushes 130, 131 and 132 over the contacts in the level selected. When the dial returns to normal the circuit through the rotary magnet 106 is held open, and the side switch magnet (not shown) thereupon causes the brush 107 to advance to position 3.

We will assume that the third and fourth digits dialed correspond to the level and terminal of the subscriber's line shown in the drawing, therefore the brushes 130, 131 and 132 of the test connector circuit TC are resting on contacts 140, 141 and 142, respectively. A circuit is now established consisting of two parallel paths, one from grounded battery through the winding of relay 22, in the test set circuit TS, lead 172 to terminal 162 and the other from grounded battery at the right winding of relay 13 in the line switch circuit LS to terminal 162, where the parallel paths join, lead 152, contact 142 and brush 132 of the test connector circuit TC, contact 122 and brush 112 of the test distributor circuit TD, armature 71 and contact 72 of relay 70 to ground, operating relays 22 and 13. Relay 13 operates and disconnects the subscriber's line relay 12 from the circuit. Relay 22 operates and extends lead 171 through condenser 21, ar-

mature 23, and front contact 24 of relay 22 to contact 33 of the dialing key DK. When the dialing key DK is restored to normal, relays 70 and 73 are again connected directly in series, under control of contacts 36 and 35 of the dialing key DK and a bridge at the line switch frame is established from terminal 160 of the line switch frame LS, lead 170, contacts 32 and 31 of the dialing key DK, receiver 25, contacts 34 and 33 of the dialing key DK, front contact 24 and armature 23 of relay 22, condenser 21, lead 171 to terminal 161 at the line switch frame LS. Thus receiver 25 is connected in bridge with the subscriber's line under test to enable the tester to determine by listening in whether or not the line selected is busy before proceeding to test thereon. If the line selected is busy, the tester may either wait until the parties disconnect or transfer the test set TS to some other line in the group and repeat the operation described. Assuming the line is not busy the tester operates the tone key TN of the test set TS, thus establishing a second bridge across the subscriber's line at the connector group over lead 150, contact 140 and brush 130 of the test connector circuit TC, contact 120 and brush 110 of the test distributor circuit TD, lead 45, winding 44 of the transformer T, condenser 42, contacts 41 and 40 of the tone key TN, lead 46, brush 111 and contact 121 of the test distributor circuit TD, brush 131 and contact 141 of the test connector circuit TC, to lead 151 of the subscriber's line. If leads 150 and 151 are closed between terminals 160 and 161 of the line switch frame LS and contacts 140 and 141 of the multiple bank of the test connector circuit TC, the bridge through receiver 25 will be connected to the bridge through winding 44 of the transformer T, thus establishing a complete circuit and the interrupted current in winding 43 of transformer T will be induced in the associated winding 44, thus producing a tone in the receiver 25 of the test set TS as an audible indication that leads 150 and 151 interconnecting the incoming and outgoing switches are properly closed. To check conductor 152, the tester operates the test private key TP as well as the tone key TN thus opening at contacts 37 and 38 of the test private key TP, the circuit originally established through relays 70 and 73 in series. Relay 70 releases, but a new circuit to ground at contacts 38 and 39 of the test private key TP, is established to prevent relay 73 from releasing. When relay 70 releases, ground on its front contact 72 is removed from armature 71, thus opening the parallel circuits through relay 13 of the line switch circuits LS, and relay 22 of the test set circuit TS. Relay 22 releases opening the circuit previously described through receiver 25 and winding 44 of the transformer

T in series, thus removing the tone from receiver 25 which removal is an indication to the tester that the brush 132 of the test connector circuit TC and relay 22 of the test set
 5 TS are connected to opposite ends of the same conductor and that said conductor is properly connected at either end. When the tester is satisfied that the line is properly connected, the release key RK is operated, opening the circuit through relay 73,
 10 which releases. When relay 73 releases two circuits are opened, one through relay 80 at front contact 75, and the other through relay 90 at front contact 78, of relay 73. When
 15 relay 80 releases a circuit is closed from grounded battery through the release magnet 84 of the test distributor circuit TD, back contact 83 and armature 82 of relay 80, back contact 76 and armature 74 of relay 73
 20 to ground, operating release magnet 84 of the test distributor circuit TD and restoring the test distributor TD to normal. In like manner when relay 90 releases, the circuit through relay 100 of the test connector circuit TC is opened, releasing relay 100, and
 25 closing the circuit to operate release magnet 104 of the test connector circuit TC, thus restoring the test connector circuit TC to normal. The test clips associated with
 30 leads 170, 171 and 172 of the test set are now removed terminals 160, 161 and 162, respectively, of the line under test and connected to a similar group of terminals associated with another line at the same line switch frame
 35 and tests are conducted in the same manner as before.

Although the invention has been illustrated as applied to an automatic telephone system, it is not so limited but is applicable wherever it is desired to test the continuity of electrical conductors.

What is claimed is:

1. In a signaling system, a plurality of sets of conductors, a test operator's set,
 45 means controlled by the test operator for connecting said test set to any set of conductors, automatic switching apparatus associated with said test set having access to multiples of said conductors, an impulse
 50 sender for controlling said apparatus to connect with said multiples, a source of signaling current, means for connecting the same to the selected conductors, and a device associated with said test set responsive
 55 to said signaling current.

2. In a signaling system, a plurality of sets of conductors, a test set, means for connecting said test set to any set of conductors, automatic switching apparatus associated
 60 with said test set comprising a plurality of automatic switches, an impulse sender for controlling one of said switches to select another and the latter to select a multiple of said set of conductors, a source of signaling current, means for connecting the
 65

same to the selected set of conductors, a device associated with said test set responsive to said signaling current, a source of busy tone current, and means automatically operated by the busy condition of said second
 70 switch for connecting said busy tone source to said device.

3. In a signaling system, a plurality of sets of conductors comprising a pair of conductors and a test conductor, a test operator's set including an electro-responsive device, means controlled by the test operator for connecting said test set to any set of conductors, means for connecting the
 75 electro-responsive device included in said test set to any test conductor, automatic switching apparatus associated with said test set, an impulse sender for controlling said apparatus to connect with a multiple of
 80 said desired set of conductors, a source of signaling current, means for connecting the same to said pair of conductors, a device responsive thereto, and means for remotely controlling at will the electro-responsive device aforesaid to remove said source of signaling current from or connect it to said
 85 pair of conductors.

4. In a telephone system, a plurality of subscribers' lines, a test operator's set including a relay, manual switches controlled by
 90 said operator for connecting said test set to any line, a test distributor and a test connector for said test set, a dial for controlling said test distributor and test connector to connect the latter with the multiples of said
 95 line, a source of tone current, means for connecting the same to said line through said test distributor and connector, a device in the test set responsive thereto, and a device for remotely controlling at will the relay
 100 in said test set to remove said tone current from or connect it to said line.

5. In an automatic telephone exchange system, a central office, subscribers' lines, a group of automatic switches wherein said
 105 lines terminate as calling lines, a group of automatic switches wherein said lines terminate as called lines, wiring interconnecting the calling and called terminals of said lines, a test operator's set adapted to be
 110 connected by the operator to the terminals of a given line at the said first switch group, a test connector adapted to be connected to the terminals of the same line at the said second switch group, means for impressing
 115 signaling current on the wiring of the selected line via said test connector, and a device associated with said test set responsive thereto if said wiring is continuous.

6. In an automatic telephone exchange system, a central office, subscribers' lines, a group of automatic switches wherein said
 120 lines terminate as calling lines, a group of automatic switches wherein said lines terminate as called lines, wiring interconnect-
 125

ing the calling and called terminals of a given line comprising a pair of conductors interconnecting the talking terminals and a conductor interconnecting the test terminals of said line, a test operator's set adapted to be connected by the operator to the terminals of a given line at the said first switch group, a test connector adapted to be connected to terminals of the same line at the said second switch group, a source of signaling current, a circuit including said test conductor and a relay adapted to connect said source to said pair, and a device associated with said test set responsive thereto if said wiring is continuous.

7. In an automatic telephone exchange system, a central office, subscribers' lines, a group of automatic switches wherein said lines terminate as calling lines, a group of automatic switches wherein said lines terminate as called lines, wiring interconnecting the calling and called terminals of a given line comprising a pair of conductors interconnecting the talking terminals and a conductor interconnecting the test terminals of said line, a test set adapted to be connected to the terminals of a given line at the said first switch group, a test connector adapted to be connected to terminals of the same line at the said second switch group, a source of signaling current, a circuit including said test conductor and a relay adapted to connect said source to said pair, a device associated with said test set responsive thereto, and a manual switch controlling said circuit.

8. In an automatic telephone exchange system, a central office, subscribers' lines, a group of automatic switches wherein said lines terminate as calling lines, a group of automatic switches wherein said lines terminate as called lines, wiring interconnecting the calling and called terminals of a given line comprising a pair of conductors interconnecting the talking terminals and a conductor interconnecting the test terminals of said line, a test set adapted to be connected to the terminals of a given line at the said first switch group, a test connector adapted to be connected to terminals of the same line at the said second switch group, a tone bridge, a circuit including said test conductor and a relay adapted to connect said tone bridge to said pair, a bridge including a telephone receiver, a manual switch for connecting said bridge to the other end of said pair to respond to said tone current if said pair is continuous.

9. A testing system for testing sets of conductors between the calling and called terminals of a subscriber's line comprising a test operator's set, means controlled by the operator for connecting said test set to any set of conductors, automatic switching apparatus associated with said test set having access to a multiple of said set of conductors,

an impulse sender for controlling said apparatus to connect with said multiple, a source of signaling current, means for connecting the same to the selected set of conductors and a device associated with said test set responsive to said signaling current.

10. A testing system for testing a plurality of sets of conductors comprising a test set, means for connecting said test set to any set of conductors, automatic switching apparatus associated with said test set comprising a plurality of automatic switches, an impulse sender for controlling one of said switches to select another and the latter to select a multiple of said set of conductors, a source of signaling current, means for connecting the same to the selected set of conductors, a device associated with said test set responsive to said signaling current, a source of busy tone current, and means automatically operated by the busy condition of said second switch for connecting said busy tone source to said device.

11. A testing system for testing a plurality of sets of conductors, each set consisting of a pair of conductors and a testing conductor, comprising a test set including an electro-responsive device, means for connecting the test set to any set of conductors, means for connecting the electro-responsive device included in the test set to any test conductor, automatic switching apparatus associated with the test set, an impulse sender for controlling the apparatus to connect it to a multiple of the connected set of conductors, a source of signaling current, means for connecting the same to said set of conductors, a device responsive thereto, and means for remotely controlling at will the electro-responsive device aforesaid to remove the source of signaling current from or connect it to said pair of conductors.

12. A testing system for testing a plurality of telephone lines comprising a test operator's set including a relay, manual switches controlled by the operator for connecting the test set to any line, a test distributor and a test connector for the test set, a dial for controlling the test distributor and test connector to connect the latter with a multiple of said line, a source of tone current, means for connecting the same to said line through the test distributor and connector, a device in the test set responsive to the tone current, and a device for remotely controlling at will the relay in the test set to remove the tone current from or connect it to said line.

13. A testing system for testing a plurality of subscribers' lines comprising a central office, a group of automatic switches wherein said lines terminate as calling lines, a group of automatic switches wherein said lines terminate as called lines, wiring, interconnecting the calling and called terminals of said lines, a test operator's set adapted to

be connected by the operator to the terminals of a given line at said first switch group, a test connector adapted to be connected to the terminals of the same line at said second switch group, means for impressing signaling current on the wiring of the selected line via said test connector and

a device associated with said test set responsive thereto if said wiring is continuous.

In testimony whereof, I have signed my name to this specification this 4th day of April 1923. 10

EMIL JACOBSEN.