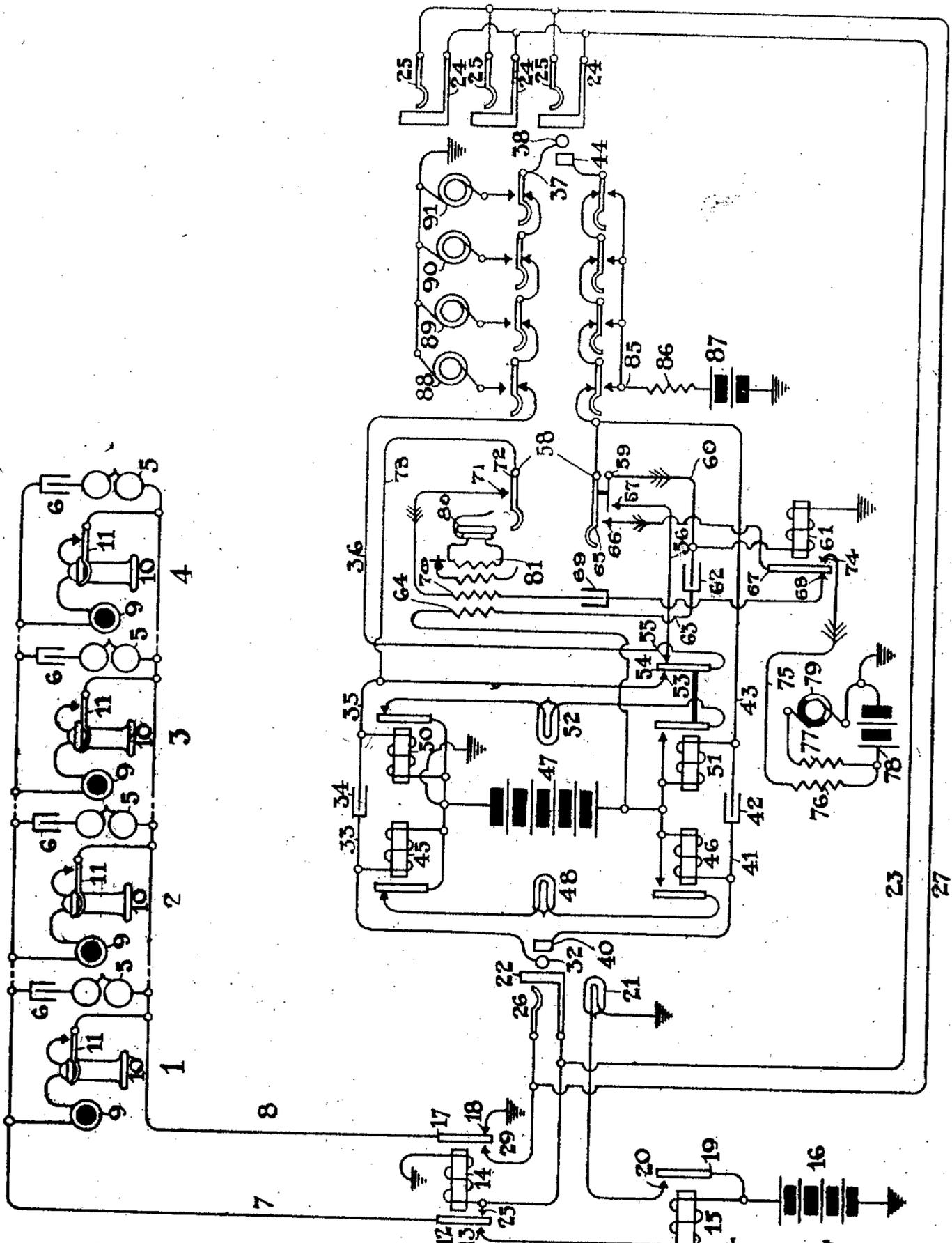


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 TESTING SYSTEM FOR PARTY LINES.
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UNITED STATES PATENT OFFICE.

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TESTING SYSTEM FOR PARTY-LINES.

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To all whom it may concern:

Be it known that we, DWIGHT A. LAWVER and CLIFFORD C. BRADBURY, citizens of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Testing Systems for Party-Lines, of which the following is a specification.

Our invention relates to telephone systems, and particularly to the means of testing the idle or busy condition of telephone lines having a plurality of substations connected thereon. In a party line telephone system it is the common practice to designate each substation by a specific number, no matter whether there is but one or a plurality of substations located on a line. Therefore, a subscriber having obtained the number of a desired subscriber from the telephone directory ordinarily has no means of knowing whether or not the desired substation is connected upon the same line with his own. In telephone systems of the common battery or central energy type it is ordinarily impossible to sound the annunciator at one of the substations upon a telephone line while the receiver at another substation upon the same line is off the switch-hook. It, therefore, becomes necessary when one subscriber desires another subscriber on the same line for the operator to request the calling subscriber to replace his receiver upon the switch hook until the desired subscriber has been called.

In order that the operator will know that the desired substation is located upon the same telephone line with the calling substation, we provide means for producing a distinctive tone which shall be heard by the operator only when she is testing one of the multiple jacks of the same line which is calling. An arrangement has been proposed to operate with a system using three conductor cords and three conductor multiple jacks; and it is the object of the present invention to produce an arrangement which may be successfully operated in connection with two conductor cord circuits, and it is the further object of our invention to accomplish the desired end in a simple, efficient and economical manner.

Our invention is illustrated in the accompanying drawing which represents a four party telephone line and the connecting cir-

cuit for establishing a connection therewith, all of the apparatus being illustrated in its normal or unactuated condition.

Each of the substations 1, 2, 3 and 4 is provided with the annunciator 5; and condenser 6 in a permanent bridge between the line conductors 7 and 8, and with the transmitter 9 and receiver 10 in a bridge maintained normally open by contacts of the switch hook 11. At the central office, line conductor 7 is connected through the contacts 12 and 13 of cut-off relay 14, and the coil of line relay 15 with the live pole of battery 16, and line conductor 8 is connected through contacts 17 and 18 of cut-off relay 14 with earth. The line relay 15 has the normally open contacts 19 and 20 adapted when closed to complete the circuit of the line lamp 21. The sleeve contact 22 of the answering jack is connected through conductor 23 with the sleeve contacts 24 of the multiple jacks, and also the inside contact 25 of cut-off relay 14 and with the coil of the relay, the other terminal of the coil of said relay being connected with earth. The tip contact 26 of the answering jack is connected through conductor 27 with the tip contacts 28 of the multiple jacks and also with the normally open inside contact 29 of cut-off relay 14.

The cord circuit for use with this line has tip and sleeve talking strands, the tip strand extending from the tip contact 32 of the answering plug through conductor 33, condenser 34, conductors 35 and 36 and the series contacts of the ringing key 37 to the tip contact 38 of the calling plug, and the sleeve strand extending from the sleeve contact 40 of the answering plug through conductor 41, condenser 42, conductor 43 and the series contacts of ringing key 37 of the sleeve contact 44 of the calling plug.

The answering supervisory relays 45 and 46 are connected in a bridge between the answering ends of the tip and sleeve conductors 33 and 41, this bridge containing the battery 47 which may be the same as the battery 16. These supervisory relays cooperate to control the circuit of supervisory signal 48, the relay 46 controlling normally open contacts and the relay 45 controlling normally closed contacts in the circuit of said signal.

The calling supervisory relays 50 and 51

are similarly connected in a bridge between the tip and sleeve conductors 35 and 43 upon the calling side of condensers 34 and 42, this bridge also containing battery 47. Relays 50 and 51 cooperate to control the circuit of the calling supervisory signal 52, relay 51 controlling normally open contacts and relay 50 controlling normally closed contacts in the circuit of said signal. The relay 51 also controls the contacts 53, 54 and 55, contacts 53 and 54 maintaining a normal break between the portions 35 and 36 of the tip talking strand, and contacts 54 and 55 normally connecting the portion 36 of the tip talking strand with conductor 56 which extends to the normally open auxiliary contact 57 of the operator's ringing key 58. The other normally open auxiliary contact 59, adapted to connect with contact 57 when the listening key is actuated, is connected through conductor 60 with the coil of the high resistance test relay 61, the other terminal of the coil of said relay being connected with earth. Conductor 60 is also connected through the condenser 62 with conductor 63 which is in turn connected through the tertiary winding 64 of the operator's induction coil with the live pole of battery 47. The spring 65 of the operator's listening key 58 is directly connected with the sleeve conductor 43 of the calling end of the cord circuit, and is adapted by the actuation of the key to be connected through contact 66 with the contact 67 of test relay 61, and through the normally closed contact 68 of relay 61, condenser 69, secondary 70 of the operator's induction to the contact 71 of the operator's listening key 58, the contact 72 of said key being connected through conductor 73 with the tip talking strand 35 of the cord circuit. The spring 67 of relay 61 is adapted to connect with contact 74 of said relay when the relay is actuated, this contact connecting through conductor 75 and the secondary 76 of the tone producing transformer to the live pole of battery 47, the primary 77 of said transformer and the high frequency current interrupter 79 being connected in series with said battery. The operator's receiver 80 is connected in a series circuit with the winding 81 of the operator's induction coil. The normally disconnected sleeve contacts 85 of the operator's ringing key are connected in multiple and through the non-inductive resistance 86 and the battery 87 to earth. The normally disconnected tip contacts of the operator's ringing key are connected with the ringing generators 88, 89, 90 and 91, these generators being adapted to furnish distinctive current for selectively operating the annunciators at the different subscribers' stations. In the operation of the system thus described, presuming the subscriber in charge

of substation 1 desires another subscriber upon this same line, he removes his receiver 10 from the switch hook 11 and thus completes a circuit from the live pole of battery 47 through the coil of line relay 15, contacts 13 and 12 of cut-off relay 14, line conductor 7, transmitter 9, receiver 10, switch hook 11, line conductor 8 and contacts 17 and 18 of cut-off relay 14 to earth. The current in this path actuates line relay 15 closing its contacts 19 and 20 and completing the circuit of the line signal 21.

Upon the display of signal 21 the operator inserts her answering plug into the answering jack designated by the signal 21, and thus completes a circuit from the live pole of battery 47 through the coil of supervisory relay 46, sleeve contacts 40 and 22 of the plug and jack and the coil of cut-off relay 14 to ground. The actuation of relay 14 connects the limbs of the telephone line directly with the tip and sleeve contacts of the jacks, and interrupts the circuit of the line relay 15, which relay therefore resumes its normal condition causing the line signal 21 to be effaced. A circuit is also completed through the coil of supervisory relay 46, sleeve contacts 40 and 22 of the plug and jack, contacts 25 and 12 of cut-off relay 14, line conductor 7, transmitter 9, receiver 10, switch hook 11, line conductor 8, contacts 17 and 29 of cut-off relay 14, tip contacts 28 and 32 of the jack and plug and the coil of supervisory relay 45 to the ground pole of battery 47. The current in this path actuates both relays 46 and 45, leaving the supervisory signal 48 still in its effaced condition.

The operator now actuates her listening key 58 completing a circuit from the spring 65 through contact 66, contacts 67 and 68 of relay 61, condenser 69, secondary 70 of the operator's induction coil, contacts 71 and 72 of the operator's listening key 58, and conductor 73, this circuit being in a bridge of the talking strands of the cord circuit. The number of the desired line is now obtained in the usual way, the voice currents through winding 70 of the induction coil being inductively reproduced in winding 81 and in receiver 80. The answering and multiple jacks being located in different parts of the switchboard and bearing no visible relation to one another, the operator thus far does not know that the desired substation is located upon the same telephone line as that of the calling subscriber. According to the usual procedure, the operator now lifts her calling plug and touches its tip contact with the sleeve or test contact of one of the multiple jacks of the desired subscriber's line. If this line was not that of the calling subscriber but was otherwise busy, its sleeve or test contact 24 would be at a potential higher than that of earth, and current would there-

fore flow over the tip 38 through the series contacts of the operator's ringing key 37, conductor 36, contacts 54 and 55 of relay 51, conductor 56, contacts 57 and 59 of the now actuated listening key 58, conductor 60 and through the coil of the high resistance test relay 61 to ground. The current in this path would cause the actuation of relay 61 and also would cause a discharge of condenser 62 which would cause a rush of current through the tertiary winding 64 of the operator's induction coil. The impulse of current through the tertiary of the operator's induction coil would cause a click in the operator's receiver which would indicate to her that the line was busy. However in the case here illustrated the sleeve of the jack tested will be busy due to the fact that the calling end of this same cord circuit is connected with the answering jack of this same line. The operation of the test relay 61 will therefore open up the circuit of the secondary of the operator's induction coil and will connect the distinctive tone from the secondary 76 of the tone producing transformer through conductor 75, contacts 74 and 67 of test relay 61, the now closed contacts 66 and 65 of the listening key 58, conductor 43, condenser 42, conductor 41, sleeve contacts 40 and 22 of the answering plug and jack, conductor 23, sleeve contact 24 of the multiple jack, tip contact 38, conductor 36, contacts 54 and 55 of supervisory relay 51, conductor 56, contacts 57 and 59 of listening key 58, conductor 60, condenser 62, conductor 63 and the tertiary winding 64 of the operator's induction coil to the live pole of battery 47. This distinctive current will cause a tone to be produced in the operator's receiver which is only heard when the operator tests the multiple jack of the same line with which the answering end of her cord circuit is connected.

The particular object of the break contacts 67 and 68 of relay 61 is to prevent a false signal being given to the operator when testing a busy line which is not made busy by the connection of the calling end of this particular cord circuit with a jack of the line. If contacts 67 and 68 were not interrupted a false test would be received in the following manner: Current from the source 78 would flow through conductor 75, contacts 74 and 67 of relay 61, from contact 66 to contact 68 which would in this case be permanently connected, through condenser 69, winding 70 of the operator's induction coil, contacts 71 and 72, conductor 73, conductor 35, the coil of relay 50 to ground, giving a false test to the operator. When the operator has thus determined that the desired subscriber's station is located upon the same line with the calling subscriber's station, she informs the calling subscriber of this condition and asks him to replace his

receiver upon the switch hook until the desired subscriber has been called. As soon as the supervisory signal 48 is displayed, due to the interruption of the circuit through the coil of relay 45, when the calling subscriber replaces his receiver upon the hook, the operator actuates the proper ringing key to selectively call the desired subscriber. Before doing this, however, the operator removes her answering plug from its connection with the answering jack so that the ringing current will not be shunted through the coil of the answering relay 45. The remaining part of the supervision is accomplished by means of the calling end of the cord circuit. Relays 50 and 51 are now both actuated, the current for the transmitters of both of the substations being furnished through the coils of these relays. When both the subscribers replace their receivers upon the hooks, the circuit of relay 50 is interrupted, and this relay resumes its normal position, completing the circuit of supervisory signal 52 which indicates to the operator that the conversation has been terminated. She therefore removes her calling plug from its connection with the multiple jack and thus interrupts the circuit of relays 51 and 14, causing all of the apparatus to return to its normal condition.

It will be noted that the relay 61, condensers 62 and 69, and the operator's induction coil and receiver are common to all of the cord circuits controlled by one operator and that the tone producer 79 and the transformer associated therewith are common to all of the operators of the exchange. Branch wires are shown on the drawing to indicate the points at which the testing apparatus becomes common to the particular cord circuit only. The contacts of the listening key 58 are used in this case to separate the common apparatus from the particular cord circuit. It is to be understood that other methods may be adopted for connecting this special apparatus with the cord circuit in use, whereby the advantage of having but one test relay for a plurality of cord circuits may be accomplished, and it is to be understood that we do not wish to be unduly limited to the particular means here shown for accomplishing this result. Other modifications of this circuit may be obviously made without departing from the spirit or scope of our invention.

We claim:

1. In a testing system, the combination with a telephone line having a busy testing-terminal, of an operator's testing contact for testing the busy condition of the line, a cord circuit having its answering end connected with the line, a testing circuit including a portion of the answering end of the sleeve talking strand of said cord circuit closed when a busy line is tested, and a suitable de-

vice for interrupting the current flow in said circuit, whereby when said line is tested a special tone is produced in the operator's receiver, said device being normally disconnected from the cord circuit by contacts of the operator's listening key, substantially as described.

2. In a testing system, the combination with a telephone line having a busy testing terminal, of a plurality of cord circuits, an operator's testing contact for testing the busy condition of the line, an alternating current testing circuit, an electromagnetic device for connecting said circuit with the sleeve voice current conductor when a busy line is tested, a pair of normally open contacts adapted to be closed during testing in the circuit between the contacts of said electromagnetic device and the sleeve voice current conductor, whereby a single magnetic device may be used with a plurality of cord circuits, substantially as described.

3. In a testing system, the combination with a telephone line having a busy testing terminal, of an operator's testing contact for testing the busy condition of the line, an oscillating current testing circuit, a common conductor, a switch for connecting said circuit with said common conductor during testing, and a second switch for connecting said common conductor with the sleeve strand of the particular cord circuit then in use during testing, whereby said first mentioned switch may be common to a plurality of cord circuits, substantially as described.

4. In a testing system for telephone lines, the combination with a cord circuit in which the sleeve voice current strand is connected with the test contacts of the line during the connection of the cord with the line, of a special test current source adapted to be connected with the sleeve voice current strand during testing, an operator's receiving circuit bridged between voice current strands of the cord circuit, and means to interrupt said receiving circuit whenever said special test producing device is connected with the sleeve strand of the cord circuit to prevent the current from said test producing device from giving a false test to the operator, substantially as described.

5. In a testing system for telephone lines, the combination with a cord circuit having tip and sleeve voice current strands, of an operator's induction coil, a special test current source adapted to be connected with the sleeve talking strand during testing, the current from said source passing over the sleeve of the cord circuit, the sleeve contacts of the answering and multiple jacks of a calling telephone line, the tip of the calling end of the cord circuit and a winding of the operator's induction coil, and means to prevent current from said special test producing device from passing through a winding

of the operator's induction coil over any other path, substantially as described.

6. In a telephone testing system, the combination with a cord circuit having tip and sleeve voice current conductors, of an operator's listening key associated with the cord circuit, an operator's receiving circuit adapted to be bridged between the talking strands of the cord circuit when the key is actuated, a source of distinctive current adapted to be connected with the sleeve of the cord circuit during testing, and means to interrupt the operator's receiving circuit to prevent current from said source from passing through said operator's receiving circuit during testing and thereby producing a false signal in the operator's receiver, substantially as described.

7. In a testing system for telephone lines, the combination with a cord circuit having tip and sleeve voice current conductors, of an operator's receiving circuit bridged between said conductors for conversational purposes, a test conductor including the calling end of the tip strand of said cord circuit, a source of distinctive current adapted to be connected with the sleeve voice current conductor of said cord circuit during testing, the distinctive current from said source being adapted to be heard in the operator's receiver only when the tip of the calling plug is touched to the test contact of the same telephone line with which the sleeve of the answering plug is connected, substantially as described.

8. In a testing system for telephone party lines, the combination with a cord circuit having tip and sleeve voice current conductors, of a testing circuit for said cord circuit, a supervisory relay for the cord circuit actuated when the calling end of the cord circuit is connected with the jack of a telephone line, normally closed contacts of said relay in said testing circuit, an operator's listening key, normally open contacts of said listening key adapted to be included in said testing circuit during testing, a relay having its coil connected with one of said contacts of said listening key and adapted to be actuated by the test current in said testing circuit, a source of distinctive current adapted to be connected with the sleeve voice current conductor of the cord circuit by the actuation of said relay, the circuit from said source to the sleeve strand of the cord circuit passing through normally open contacts of said listening key, said relay being adapted to interrupt the operator's receiving circuit back of the point at which the distinctive current is connected with the sleeve of the cord circuit, whereby current from the distinctive source will not be heard by the operator during the testing of a line other than the calling telephone line, substantially as described.

9. In a testing system, the combination with a telephone line having a plurality of subscribers connected therewith, of a plurality of testing terminals connected with one of the talking strands of said line during conversation, a distinctive current source, means for connecting said source with the test contacts of said telephone line during testing, means whereby the operator may receive a signal from said distinctive source when testing one of the multiple jacks of said line, and means to prevent the operator from receiving a signal from said source when testing one of the multiple jacks of another telephone line, substantially as described.

10. In a telephone testing system, the combination with a cord circuit having tip and sleeve voice current conductors, of a calling line, a distinctive current source adapted to be connected with the sleeve strand of the cord circuit for producing a special test when one of the multiple jacks of the calling line is tested, and a relay common to a plurality of cord circuits for connecting said distinctive current source with the sleeve conductor of the cord circuit during testing, substantially as described.

11. In a telephone testing system, the combination with a cord circuit having tip and sleeve voice current conductors, of a source of distinctive current, a common conductor, means common to a plurality of cord circuits for connecting said distinctive source with said common conductor during testing, and means individual to said cord circuit for connecting said common conductor with the sleeve strand of the cord circuit during testing, whereby the operator will receive a distinctive current from said source when testing one of the multiple jacks of the calling telephone line, substantially as described.

12. In a testing system, the combination with a telephone line having a busy testing terminal, an operator's testing contact for testing the busy condition of the line, a distinctive current source, an electro-magnetic device common to a plurality of cord-circuits for connecting said source with the sleeve voice current conductor when a busy line is tested, said source being adapted to produce a special tone in the operator's receiver when said line is the calling telephone line with which the answering end of the cord circuit is connected, substantially as described.

13. In a telephone testing system, the combination with a cord circuit, of a calling line, a distinctive current source adapted to be connected with the sleeve strand of the cord circuit for producing a special test when one of the multiple jacks of the calling line is tested, and a relay common to a plurality of cord circuits for connecting said distinctive current source with the sleeve

conductor of the cord circuit during testing, substantially as described.

14. In a testing system, the combination with a telephone line having a busy testing terminal, of an operator's testing contact for testing the busy condition of the line, a testing circuit including a portion of the talking circuit of the answering end of the cord adapted to be closed when a busy line is tested, means associated with said circuit for interrupting the current flow therein, whereby when said circuit is closed a special tone is produced in the operator's receiver, and means whereby a signal of different character will indicate when a different line has been tested, substantially as described.

15. In a testing system, the combination with a telephone line having a busy testing terminal, of an operator's testing contact for testing the busy condition of the line, a cord circuit for making connection with the line, a testing circuit including a portion of the answering end of the sleeve talking strand, closed when a busy line is tested, a suitable current interrupter associated with said circuit for interrupting the current flow therein, whereby when a busy line is tested a special tone is produced in the operator's receiver, said special tone indicating a different condition of the tested line from that indicated by the usual test, substantially as described.

16. In a testing system, the combination with a telephone line having a busy testing terminal, of an operator's testing contact for testing the busy condition of the line, an alternating current testing circuit, an electromagnetic device for connecting said circuit with the answering end of the sleeve voice current conductor when a busy line is tested, said circuit being adapted to produce a special tone in the operator's receiver, and means whereby a signal of different character will indicate when a different line has been tested, substantially as described.

17. In a testing system, the combination with a telephone line having a busy testing terminal, of a cord circuit for making connection with the line, an operator's testing contact for testing the busy condition of the line connected with the tip strand of the cord circuit, and an alternating current testing circuit including a portion of the answering end of the sleeve talking strand, said circuit being adapted to produce a special tone in the operator's receiver when a busy line is tested, said special tone indicating a different condition of the tested line from that indicated by the usual test, substantially as described.

18. In a testing system, the combination with a telephone line having a busy testing terminal, of a cord circuit for making connection with the line, an operator's testing contact for testing the busy condition of the

line, an alternating current testing circuit including a portion of the sleeve strand of the cord circuit, and a line conductor, means for closing said circuit when a busy line is tested, said circuit being adapted to produce a special tone in the operator's receiver, and means to prevent the operator from receiving a signal from said tone when testing another line, substantially as described.

19. In a testing system, the combination with a telephone line having a busy testing terminal, of a cord circuit for making connection with the line, an operator's testing contact associated with the tip strand of the cord/circuit for testing the busy condition of the line, and an induced alternating current testing circuit including the sleeve strand of the cord circuit and a line conductor, said circuit being adapted to produce a special tone in the operator's receiver when a busy line is tested, said special tone indicating a different condition of the tested line from that indicated by the usual test, substantially as described.

20. In a testing system, the combination with a telephone line having a busy testing terminal, of a cord circuit for making connection with the line, an operator's testing contact for testing the busy condition of the line, a direct current testing circuit, an alternating current testing circuit including a sleeve strand of the cord circuit and a portion of one line conductor, electromagnetic means for closing both said circuits when a busy line is tested, said alternating current circuit being adapted to produce a special tone in the operator's receiver, and means to prevent the operator from receiving a signal from said tone when using the direct current test, substantially as described.

21. In a testing system, the combination with a plurality of substations located upon a telephone line, of a plurality of connecting contacts for said line at the central office, a cord circuit, a testing terminal associated with said cord circuit, a signal circuit adapted to be closed over said testing terminal when said line is in connection with a second cord circuit, a different signal circuit adapted to be closed over said testing terminal and a portion of the talking circuit of the answering end of the cord circuit, when said line is in connection with the answering end of said first cord circuit, said testing circuits transmitting signals of different characteristic sounds to the operator, and means to prevent the operator from receiving the last signal when the condition

of the line tested requires the operator to receive the first signal only, substantially as described.

22. In a testing system, the combination with a telephone line, of a plurality of substations upon said line, and a plurality of test contacts for said line at the central office, a cord circuit, a testing terminal associated with said cord circuit, a signal circuit adapted to be closed over said testing terminal and the answering end of the sleeve talking strand of a cord circuit when it is connected with the test contact of the calling line, and means whereby a signal of different character will indicate when a different telephone line has been tested, substantially as described.

23. In a testing system, the combination with a telephone line, of a plurality of substations upon said line, and a plurality of testing contacts for said line at the central office, a cord circuit, a testing terminal associated with said cord circuit, a busy test circuit adapted to be closed when the cord test terminal is connected to the test terminal of the busy line, a tone signal circuit adapted to be closed over a portion of the answering end of the sleeve talking strand when said line is busy by its connection with the answering end of said cord circuit, and means to prevent the operator from receiving said tone signal when said line is busy by its connection with another cord circuit, substantially as described.

24. In a testing system, the combination with a telephone line having a plurality of subscribers connected therewith, of a plurality of testing terminals connected with one of the talking strands of said line during conversation, means for connecting a distinctive current with the test contact of said telephone line when one subscriber of said line requests connection with a second subscriber of the same line, a direct current test adapted to be used when a subscriber on said line requires connection with a subscriber on another line, and means to prevent the operator from receiving a signal from said distinct current when using the direct current test, substantially as described.

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

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Witnesses:

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