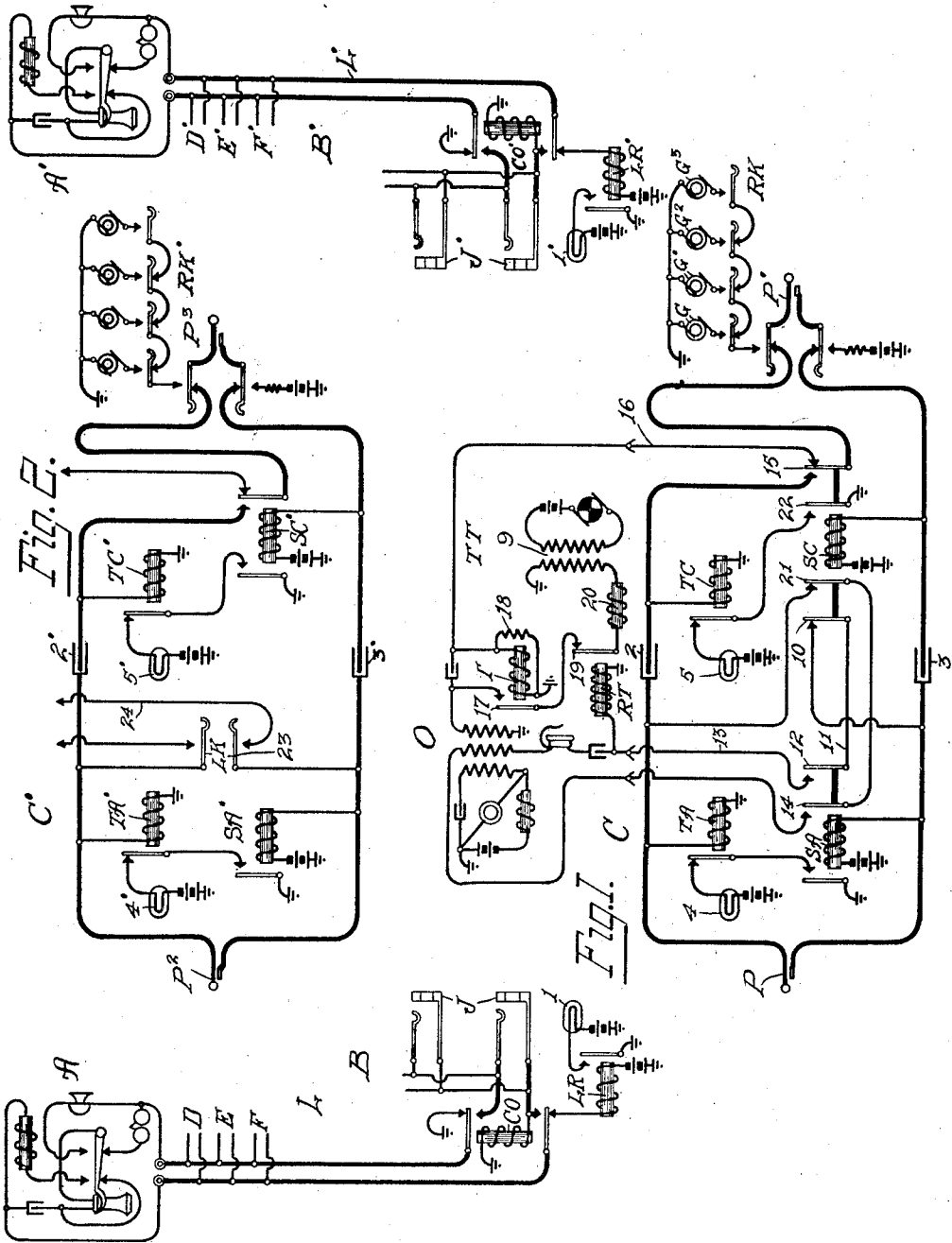


M. B. STAZAK.
 REVERTING TEST CIRCUIT FOR TELEPHONE SYSTEMS.
 APPLICATION FILED APR. 27, 1914.

1,357,303.

Patented Nov. 2, 1920.



Witnesses:
 Wm. Bergahn
 B. Brien.

Inventor:
 Michael B. Stazak.
 By Curtis B. Lamp.
 Attorney.

UNITED STATES PATENT OFFICE.

MICHAEL B. STAZAK, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

REVERTING-TEST CIRCUIT FOR TELEPHONE SYSTEMS.

1,357,303.

Specification of Letters Patent.

Patented Nov. 2, 1920.

Application filed April 27, 1914. Serial No. 834,633.

To all whom it may concern:

Be it known that I, MICHAEL B. STAZAK, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Reverting-Test Circuits for Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with a reverting busy test by which the operator receives a distinctive busy signal when a test is being made at a jack multiply connected with the jack in which the answering plug has been inserted, an object being to provide an improved and simplified circuit arrangement which is positive in operation.

My invention is illustrated in connection with an operator's cord circuit which is arranged for automatically cutting in the operator's telephone with the cord circuit when an answering plug is inserted into a jack of a calling line, and for automatically disconnecting said operator's telephone when the connection is completed by the insertion of the calling plug into a multiple jack of the called line. My invention may also be used with an operator's cord circuit which is arranged for manually connecting the operator's telephone with the cord circuit by the actuation of a listening key, the reverting tone test operating as when used in connection with a cord circuit as described above, but I do not wish to be limited to the specific circuit arrangements illustrated as I contemplate using said test in connection with other cord circuits.

For a more complete understanding of my invention reference may be had to the accompanying drawing in which—

Figure 1 illustrates the reverting busy test used in connection with a cord circuit which is provided with automatic listening.

Fig. 2 illustrates a cord circuit similar to Fig. 1 but with a listening key bridged across the cord conductors for manually connecting the operator's telephone.

Referring now more in detail to the system which embodies my invention as illustrated in Fig. 1, it comprises a calling substation A connected by the line limbs L with a line circuit B comprising a line relay LR, a cutoff relay CO, line signal 1 and multiple jacks J. I have shown party line terminals D, E and F connected to the line L for party

line service. The cord circuit C comprises an answering plug P and a calling plug P¹, condensers 2 and 3 being interposed in the tip and sleeve conductors connecting the plugs P and P¹. The answering end of the cord circuit comprises a tip answering supervisory relay TA and a sleeve answering supervisory relay SA, the two relays controlling the answering supervisory signal 4. The sleeve supervisory relay SA has contacts 12, 14 actuated upon insertion of the answering plug into the answering jack for connecting the operator's telephone with the cord circuit. The calling end of the cord circuit C comprises a tip calling supervisory relay TC and a sleeve calling supervisory relay SC, the two relays controlling the supervisory signal 5. The sleeve calling supervisory relay SC has contacts 10, 21 actuated upon the insertion of the calling plug P¹ into a jack of the called line for automatically disconnecting the operator's set from the cord circuit. A party line key RK is provided which, when any one of the four key plungers is depressed, connects any one of the four ringing generators G, G¹, G² or G³ which is associated with the called substation, for signaling the said substation.

To the right of the drawing I illustrate a substation A¹ similar to that illustrated at substation A, and being connected by line limbs L¹ to a line circuit B¹ similar to the line circuit B and bearing the same reference numerals but having the suffix prime. I also show party line terminals D¹, E¹ and F¹.

The reverting busy test circuit TT comprises a comparatively high resistance reverting test relay RT, common to an operator's position, which is actuated whenever the operator inserts an answering plug into an answering jack. A test relay T is also provided which is actuated when the operator tests a multiple jack of any busy line but which is effective only when testing a jack of a calling line.

When a party calls for another party on the same line and the operator tests, relay T energizes and due to the shunting effect of the comparatively low resistance of the circuit including its winding and resistance 18, relay RT deenergizes, and therefore relay RT being deenergized and relay T energized, the special tone is connected in circuit with the third winding of the induc-

tion coil and thus through the operator's receiver. The high resistance of relay RT also prevents relays RT and SA from locking up in series through contacts 10, 12.

5 When a busy line different than the calling line is tested, although relay T is energized, it is not effective because relay RT remains energized and only the ordinary busy click is received by the operator.

10 In practice I have found that when operating on twenty-four volts the following resistances give a successful operation. Relays TA, SA, TC and SC, 100 ohms. Relay RT, 3100 ohms, relay T, 300 ohms and coils 15 18 and 20, 50 and 300 ohms respectively. Relay LR, 1000 ohms and relay CO, 500 ohms. These values are given for purpose of illustration and it is to be understood that they may be varied and still give satisfactory results.

20 Assuming now that a subscriber at substation A wishes to converse with another subscriber, say at substation E for instance located on the same party line with A, the subscriber at A removes his receiver from the switch-hook causing the energization of the relay LR of the line circuit B which attracts its armature to close its alternate contact to light the line lamp 1. The operator 25 in response to signal 1, inserts an answering plug P into the jack J of the called line. Relay SA of cord circuit C and relay CO of line circuit B are energized in series from battery through relay SA, the sleeve contacts of the plug P and jack J through the winding of relay CO to ground. The relay CO operates and opens the circuit of the line relay LR, deenergizing the said relay LR and effacing the signal 1. The relay TA 30 of cord circuit C also operates from battery through the relay SA, sleeve contacts of the plug P and jack J, one line conductor of the line L, through substation A, the other line conductor of the line limbs L, tip contacts of jack J and plug P through relay TA to ground. Relay TA energizes opening its normal contact to prevent the signal 4 from lighting.

35 The high resistance reverting test relay RT of the tone test circuit TT is also operated from battery through the relay SA, normal contact 10, conductor 11, alternate contact 12, conductor 13, through relay RT to ground, the said relay RT energizing. The relay SA was energized, as will be remembered, when the answering plug P was inserted into the jack J and said relay closed its alternate contacts 12 and 14 to connect the operator's telephone O.

40 The operator having received the number from the calling subscriber, tests a multiple jack of the called line to determine its idle or busy condition, perhaps not knowing that the called subscriber E is located on the same party line with calling subscriber A.

The operator in testing places the tip of the plug P¹ against the sleeve of a multiple jack of the wanted substation E in the usual manner. The sleeve of the jack being at a battery potential above ground 70 which is extended from battery through relay SA of said circuit C over the sleeve conductor of the cord circuit, the relay T is energized from battery at the sleeve of the tested jack, the tip of the plug P¹, normal contact 15, test conductor 16, winding of relay T to ground, said relay closing its alternate contact 17. The high resistance relay RT thus is shunted by the low resistance circuit including resistance 18 and relay T, 75 80 which shunt can be traced from ground at relay T through low resistance 18 and winding of relay T, test conductor 16, normal contact 15, tip of plug P¹, sleeve of the multiple jack, sleeve conductor of the cord circuit C, normal contact 10, alternate contact 12, conductor 13, to relay RT. The relay RT therefore deenergizes and closes its normal contact 19 to connect the reverting test tone which may be traced from ground through 90 the secondary winding of coil 9, impedance 20, normal contact 19, alternate contact 17, through the third winding of operator's induction coil to ground, the tone being induced into the secondary of the operator's 95 induction coil and through the circuit including her head receiver. I place the impedance 20 in circuit with the reverting tone test to reduce the tone so that the operator will not receive a harsh tone in her head 100 receiver.

This special tone indicates to the operator that she has tested a multiple jack which is associated with the jack in which the answering plug is inserted. The operator then 105 notifies the calling subscriber at substation A to replace his receiver upon its switch-hook so that she may ring the called for subscriber E. The operator will then insert the calling plug P¹ into a jack of the said line which in this 110 case would be the jack J, after having removed the answering plug P. The relay SC is therefore energized closing a circuit for lamp 5. The operator will then signal the called-for subscriber on the party line 115 by depressing the proper ringing key. Upon both subscribers removing their receivers the substations A and E are ready for conversation. Upon replacing their receivers the usual disconnect signal is given and the operator 120 withdraws the plug.

Assuming now that the subscriber at substation A wishes to converse with a subscriber at substation A¹ the operation of this circuit is the same as previously described, 125 the relay CO of the line circuit B, the relays SA and TA of the cord circuit C and the high resistance relay RT of the tone test circuit TT operate as before described, the operator's set O being automatically con- 130

nected to the cord circuit so that the oper-
 ator may ascertain the wants of the calling
 subscriber. She then takes the plug P^1 ,
 tests the multiple jack J^1 of the called line
 5 as to its idle or busy condition. If the line
 is busy there will be a battery potential
 upon the sleeve of the multiple jack J^1 from
 another cord circuit, said battery energizing
 the test relay T of the tone test circuit TT ,
 10 but as the high resistance reverting test re-
 lay RT energizes in every case when the
 operator plugs into a calling line, the tone
 test is not put in circuit by reason of the
 contact of relay RT moving to its alternate
 15 position but the operator receives the cus-
 tomary click in her head receiver notifying
 her that substation A^1 is in use. If idle, she
 inserts the plug P^1 into the multiple jack
 J^1 . The cut-off relay CO' and relay SC of
 20 the cord circuit C operate in series. The
 contacts 10 and 21 of the relay SC assume
 their alternate position automatically dis-
 connecting the operator's set O from the
 cord circuit C . This interrupts the circuit
 25 for the high resistance relay RT of the tone
 test circuit TT the said relay deenergizing.
 The contact 15 of the relay SC opens its
 normal contact interrupting the circuit of
 the relay T , the said relay SC closing its
 30 alternate contact 22 and completing the con-
 tinuity of the tip conductor of the cord cir-
 cuit C . The operator then depresses the
 proper ringing plunger connecting the
 proper generator to the tip side of the line
 35 to ring the called for subscriber. The super-
 visory signal 5 is lighted upon the closing
 of the alternate contact 22, the signal 5 re-
 maining lighted until the called-for sub-
 scriber answers when the relay TC oper-
 40 ates to open the circuit of the signal 5.

Upon termination of conversation the
 subscribers at substations A and A^1 replace
 their receivers upon their respective switch-
 hooks which act causes the deenergization
 45 of relays TA and TC and closes circuit for
 the signals 4 and 5, the said supervisory
 lamps 4 and 5 lighting and notifying the
 operator that the subscribers at substations
 A and A^1 have replaced their receivers. The
 50 operator then takes down the connection de-
 energizing the relays SA and SC and effac-
 ing the signals 4 and 5.

In Fig. 2 I have illustrated an operator's
 cord circuit C^1 similar to the one illustrated
 55 in Fig. 1 with apparatus similar and bear-
 ing the same reference numerals but with
 suffixes added. The answering end of the
 cord circuit C^1 comprises the relays TA^1 and
 SA^1 , the relay SA^1 being without contacts
 60 for automatically connecting the operator's
 set. The calling end of the cord circuit C
 comprises the relays TC^1 and SC^1 the relay
 SC^1 being without contacts for automati-
 cally disconnecting the operator's set. In
 65 Fig. 2 I show a listening key IK bridged

across the conductors of the cord circuit C^1
 which, when actuated, connects the oper-
 ator's set with the cord circuit C^1 .

The tone test circuit TT as illustrated in
 Fig. 1 performs the same function when 70
 operating in connection with Fig. 2 as in
 connection with Fig. 1. I show the con-
 ductors which connect the operator's tele-
 phone extending from the listening key LK
 and also the test conductor from the test 75
 contact of relay SC^1 . The high resistance
 relay RT is operated, when the operator
 throws her listening key after an answer-
 ing plug has been inserted into an answer-
 80 ing jack, from battery through the wind-
 ing of the relay SA^1 , the alternate contact
 23 of the listening key LK , conductor 24,
 through the winding of the relay RT to
 ground. The reverting tone test circuit
 operates the same when used in connection 85
 with cord circuit C^1 illustrated in Fig. 2 as
 when used in connection with cord circuit
 of Fig. 1, the only material difference be-
 ing that in Fig. 1 the operator's set is con-
 90 nected automatically and in Fig. 2 it is con-
 nected manually by the use of the operator's
 key.

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

1. A telephone system comprising a call-
 ing telephone line, multiple jacks therefor,
 a cord circuit having an answering termi-
 nal connected to one of said jacks, an op-
 erator's telephone, a reverting test relay for 100
 said cord energized responsive to connec-
 tion of said operator's telephone to the cord,
 a test relay connected to the calling termi-
 nal of the cord energized responsive to the
 connection of the calling terminal to another 105
 one of said jacks, such connection being also
 effective to deenergize said first relay, and a
 test tone connected to said operator's tele-
 phone responsive to deenergization of the
 reverting test relay and energization of the 110
 test relay.

2. A telephone system comprising a call-
 ing telephone line, multiple jacks therefor,
 a cord circuit having an answering termi-
 nal connected to one of said jacks and tip and 115
 sleeve conductors connecting the answering
 and calling terminals thereof, a reverting
 test relay, circuit connections for energizing
 and connecting said relay to the answering
 sleeve conductor, a test relay energized re- 120
 sponsive to the application of the calling
 terminal of the cord to another one of said
 jacks, such application also being effective to
 cause deenergization of the reverting test
 relay, and a test tone connected to said op- 125
 erator's telephone responsive to the last said
 operations of the relays.

3. A telephone system comprising a tele-
 phone line, multiple jacks therefor, a cord
 circuit, reverting test and test relays for the 130

cord, an operator's telephone, means controlled by the operator when connecting her telephone in answering a call from said line for energizing the reverting test relay, means responsive to a test of said line for de-energizing said reverting test relay and energizing said test relay, and a test tone connected to said operator's telephone responsive to the last said operation of said relays.

4. A telephone system comprising a calling line, multiple jacks therefor, a cord circuit having its answering end connected to one of said jacks, an operator's telephone a reverting test relay, means for energizing said relay and connecting it to the answering terminal of the cord, a test relay connected to the calling terminal of the cord, means whereby when the calling terminal is applied to another of said jacks in testing said line said test relay is energized and the reverting test relay deenergized, and circuit connections controlled through normal contacts of the reverting test relay and alternate contacts of the test relay for applying a test tone to said operator's telephone.

5. A telephone system comprising telephone lines, multiple jacks therefor, a cord circuit, an operator's telephone, a reverting test relay operated each time a call is answered, a test relay operated each time a busy called line is tested, means whereby when a calling line is tested as a called line the reverting test relay is deenergized, and a test tone connected to the operator's telephone responsive to such deenergization of the reverting test relay and a testing energization of the test relay.

6. A telephone system comprising a telephone line, multiple jacks therefor, a cord circuit, an operator's telephone, a high resistance reverting test relay, means for energizing said relay and connecting it to the answering terminal of the cord in answering a call from said line, a test relay connected to the calling terminal of the cord, means for energizing said test relay when testing said calling line as a called line, a low resistance path including the winding of said test relay for shunting said reverting test relay to cause its deenergization responsive to said test, and a test tone applied to said operator's telephone responsive to said energization of the test relay and deenergization of the reverting test relay.

7. A telephone system comprising a telephone line, multiple jacks therefor, a cord circuit provided with a pair of two-conductor terminals, an operator's telephone adapted to be automatically connected to and disconnected from said cord circuit, a reverting tone test relay, manual means for connecting one terminal of said cord circuit to said telephone line whereby said operator's telephone and said reverting tone test

relay are connected to said cord circuit, and means responsive to the application of the other of said terminals to one of said multiple jacks for causing said relay to apply a test tone to said operator's telephone.

8. A telephone system comprising a telephone line, multiple jacks therefor, a link circuit provided with a reverting tone test relay, means responsive to the connection of the answering terminal of said link circuit to one of said jacks for energizing said relay, means whereby when the calling terminal of said link circuit is applied to another of said multiple jacks said relay is deenergized and operates to connect a test tone to said operator's telephone.

9. A telephone system including a calling telephone line provided with multiple jacks, a link circuit provided with terminals, a reverting tone test relay for said circuit, automatic means responsive to the connection of one of said terminals to one of said jacks for energizing said relay, manual means for testing said line as a called line by applying the other of said terminals to another of said jacks whereby said relay is deenergized to connect a test tone to said operator's telephone.

10. A telephone system comprising a telephone line, multiple jacks therefor, a cord circuit, a pair of relays for the cord circuit, an operator's telephone, means controlled by the operator when connecting her telephone in answering a call from said line for energizing one of said relays, means responsive to a test of said line for deenergizing said relay and for energizing the second of said relays, and a test tone connected to said operator's telephone responsive to the last said operation of said relays.

11. A telephone system comprising telephone lines, multiple jacks therefor, a cord circuit, an operator's telephone, a reverting test relay operated when a call is answered, a test relay operated when a busy called line is tested, means whereby when a calling line is tested as a called line the reverting test relay is deenergized, and a test tone connected to the operator's telephone responsive to such deenergization of said reverting test relay and a testing energization of the test relay.

12. A telephone system comprising a telephone line, multiple jacks therefor, a cord circuit provided with a pair of two-conductor terminals, an operator's telephone, a reverting tone test circuit having a normally open and a normally closed contact, means responsive to the connection of one of said terminals to said line for opening the normally closed contact, and means responsive to a test by the other of said terminals of one of said multiple jacks for closing the normally open contact and for causing the

said first means to return to normal whereby the test tone is operatively connected to said operator's telephone.

13. A telephone system comprising a telephone line, multiple jacks therefor, a cord circuit provided with a pair of terminals, an operator's telephone associated with said cord circuit, a reverting tone test circuit provided with a normally open and a normally closed contact, means responsive to the connection of one of said terminals to one of said multiple jacks for opening the normally closed contact, and means responsive to a test by the other of said terminals of another of said jacks for causing the said normally open contacts to be closed and the said normally closed contacts to be returned to normal whereby a tone test is connected to said operator's telephone.

14. A telephone system including a telephone line provided with multiple jacks, a link circuit provided with a pair of terminals, an operator's telephone, a reverting tone test relay for said link circuit, means responsive to a connection of one of said terminals to one of said jacks for energizing said relay, means responsive to a connection of the other of said terminals to another of said jacks for deenergizing said relay, and a busy tone generator for applying a tone to said operator's telephone responsive to said deenergization of said relay.

15. A telephone system including subscribers' telephone lines, a plurality of link circuits for interconnecting said lines, an operator's telephone common to said link circuits, a pair of relays associated with said operator's telephone, a tone test device, a circuit for one of said relays adapted to be closed when the answering terminal of one of said link circuits is connected to a calling one of said lines, a circuit for the other of said relays adapted to be closed when the calling terminal of said link circuit is connected to another terminal of said line, and contacts controlled by said relays for connecting said tone test device to said operator's telephone.

16. A telephone system including telephone lines, a plurality of link circuits for interconnecting said lines, an operator's telephone common to said link circuits, a pair of relays associated with said operator's telephone, a tone generator, and means controlled by said relays for connecting said tone generator to said operator's telephone when the answering terminal of one of said link circuits is connected to one of said lines and the calling terminal of said link circuit is used to test the said line.

17. A telephone system including a subscriber's telephone line, a plurality of operators' link circuits, an operator's telephone and a plurality of relays common to said link circuits, a tone test device, means for

connecting one terminal of one of said link circuits to said line, and means controlled by said relays for operatively connecting said tone test device to said operator's telephone when the other terminal of said link circuit is used to test said line as a called line.

18. A telephone system including telephone lines, a plurality of link circuits for interconnecting said lines, an operator's telephone and a pair of relays common to said link circuits, a tone test device, and means controlled by said relays for operatively connecting said tone test device to said operator's telephone when the called line tested is also the calling line.

19. A telephone system including a poly-station subscriber's telephone line, an operator's link circuit provided with only four relays for use in extending a call from said telephone line, an operator's telephone, contacts controlled by two of said relays for automatically connecting and disconnecting said link circuit and said operator's telephone, a tone test device, and means individual to said operator's telephone for use in operatively connecting said tone test device to said operator's telephone when the operator tests a multiple jack of said telephone line as the called line, said means including a relay normally connected to said operator's telephone.

20. A telephone system including telephone lines, a plurality of link circuits for interconnecting said lines, each of said link circuits being provided with only four relays, an operator's telephone, mechanism including part of said relays for automatically connecting and disconnecting said operator's telephone and said link circuits, a tone test device, and means common to said link circuits and individual to said operator's telephone for operatively connecting said tone test device to said operator's telephone when the called line tested is also the calling line, said means including a relay normally connected to said operator's telephone.

21. In a telephone system, the combination of a multi-party line having a plurality of jacks, multiple conductors connecting said jacks, supervisory signals associated with said conductors, reverting testing means, controlling means therefor and a shunt of said controlling means maintained closed during the operation of the reverting testing means, said shunt including one of said multiple conductors.

22. In a telephone system, the combination of a multi-party telephone line having a plurality of terminals, a cord circuit, supervisory signals in said cord circuit, means for connecting the cord to the terminals, reverting testing means associated with said cord circuit, controlling means for said reverting testing means and a shunt of said

controlling means controlled through the terminals of the multi-party line, maintained closed during the sending of the reverting busy test signals.

- 5 23. In a telephone system, the combination of a multi-party telephone line terminating in multiple jacks, a cord circuit including talking strands and means for connecting said strands to telephone jacks, su-
10 pervisory signals associated with said cord, reverting testing apparatus associated with

the cord circuit, controlling means therefor, and a shunt for said controlling means, including a portion of one of the talking strands of the cord circuit.

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

MICHAEL B. STAZAK.

Witnesses:

B. O'BRIEN,
M. R. ROCHFORD.