

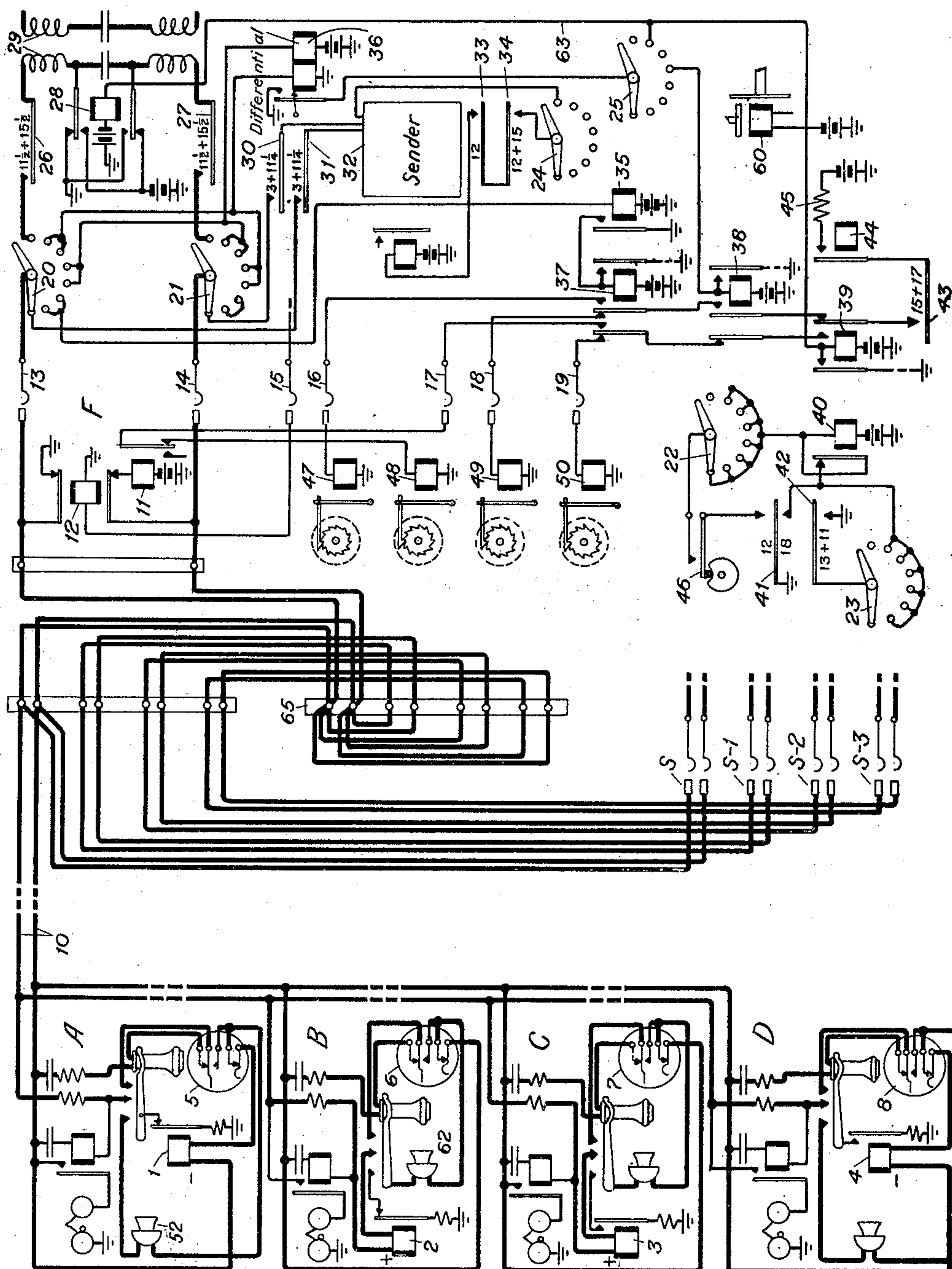
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H. M. BASCOM ET AL

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TELEPHONE EXCHANGE SYSTEM

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INVENTORS: HENRY M. BASCOM
WILLIAM T. HAINES

By *g v 708*
ATTORNEY

UNITED STATES PATENT OFFICE

HENRY M. BASCOM, OF BROOKLYN, NEW YORK, AND WILLIAM T. HAINES, OF MOUNTAIN LAKES, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

TELEPHONE-EXCHANGE SYSTEM

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This invention relates to telephone exchange systems and particularly to improvements in party line message registration.

Its object is to enable the performance of a more positive and reliable test of party lines to determine the station originating the call.

According to this invention the substations of a party line are equipped each with a test relay to enable a plurality of separate tests to be made from the central office to determine the calling station.

A feature of the invention is a system in which the source of talking current is applied to the line on either originating or terminating calls in such a direction as to operate or not operate the substation relay to insure the removal of ground connections from the talking circuit.

The drawing shows the invention applied to a four-party line in an automatic telephone system. The substations A, B, C and D of the party line 10 are equipped with polarized relays 1 to 4 respectively. Relays 1 and 4 are polarized in such a manner that they operate when the negative pole of the current source is connected to the ring conductor of the line and the positive pole is connected to the tip side. The relays 2 and 3 are polarized to respond to current flowing in the opposite direction. It will be noted that relay 1 when deenergized extends a ground connection through the switchhook contact directly to the tip side of the line 10. The relay 2 when deenergized extends a ground connection through the switchhook contact, the talking transmitter and contacts of the dial 6 to the ring side of the line 10. Relay 3 when operated extends a ground connection to the ring side of the line and relay 4 when operated connects ground to the tip side of the line.

At the central office the line terminates in a line finder switch F illustrated diagrammatically by the brushes 13 to 19 inclusive. The line finder F is connected to the left windings of a repeating coil 29, the right hand windings of which may be connected directly to the brushes of a selector switch. The line finder and selector unit may be of substantially the same construction and operation as illustrated and described in detail in the patent to Kopp No. 1,589,402, granted June 22, 1926.

The control and operating circuits for a selector switch of this character are also shown and described in the patent to Stearn et al., No. 1,395,977, granted November 1, 1921.

The sequence switch 60 controls the line finder and district circuits and is partly illustrated in the drawing. This switch may be of the well-known type described in the patent to Reynolds et al., 1,127,808, granted February 9, 1915.

A step-by-step single movement control switch having the brushes 20 to 25 inclusive and stepping magnet 40 is also provided for controlling the circuits. The line 10 is further provided with message registers 47 to 50 inclusive, one for each of the four stations on the line.

On calls extended to the party line 10, one of four final selector terminals may be used depending upon the party called. These four terminals S, S¹, S² and S³ are illustrated diagrammatically.

By means of the testing devices located at the central office and the polarized relays at the individual stations, a number of separate tests may be made to definitely determine which station on the party line has originated a call. First a test is made to determine whether the calling station is one of the two stations A and B or one of the stations C and D. Next a test is made by applying current to the line in such a direction as to operate one relay and not to operate the other relay of the pair already determined. After the relay operates it removes ground potential from one or the other sides of the line in one case. In another case if the relay operates it applies ground potential to the tip or to the ring side of the line. The third test is made by applying current to the line in the opposite direction such that if the relay at the calling station is operated on the second test to apply ground potential to the line or to remove it from the line the relay now remains unoperated to establish the opposite condition. Similarly if on the second test the relay remained inert to withhold ground potential from the line or to maintain ground potential on the line it operates on the third test to establish the opposite condition. By

means of these three tests a check is secured to insure that the condition found on one or another of the tests is a true identifying condition and not one which has been brought about either accidentally or due to an attempt on the part of the subscriber to defeat the charge.

A detailed description will now be given, assuming that the party at the substation A initiates the call. The initiation of the call causes the operation of the line finder F to seize the subscriber's line 10. The calling line is thus extended over the brushes 13 and 14 and the wipers 20 and 21 in the first position through contacts 30 and 31 of sequence switch 60 to the register sender 32. In the well-known manner, the sequence switch 60 in response to the initiation of the call advances the contacts 30 and 31 to the closing position. Also battery potential is applied to the brush 15 to operate the cut-off relay 12 which opens the usual circuit for the line relay 11. The calling subscriber manipulates his dial 5 and sets up a record of the wanted designation at the register sender 32. The register sender proceeds to control the selective switches to establish the connection.

During the processes of establishing the connection the sequence switch 60 arrives in some position such as position 12. As soon after the sequence switch reaches position 12 as the interrupter 46 closes, a circuit is established over the contact 41 for the stepping magnet 40. Magnet 40 energizes and, on the next opening of the interrupter, deenergizes to advance the brushes 20 to 25 inclusive to their second position.

In position 2 of the control switch, a test circuit is closed from the positive pole of battery, through the winding of test relay 35, wiper 20, thence through the brush 13 over the tip side of the line 10 through the switchhook contacts at station A, back contact of relay 1 to ground. The ring side of the line is open at this time and hence no circuit is completed for the polarized relay 1. The relay 35 operates in the circuit traced and closes an obvious circuit for relay 37. Relay 37 locks through its winding and contact to ground. The locking circuit of relay 37, and also of locking circuits of relays 38 and 39, extend through a sequence switch contact or a relay contact (not shown) which may be opened at some convenient time to permit the release of these relays.

The switch continues to step under the control of interrupter 46 and advances into position 3. The test circuit through the winding of relay 35 is maintained in both positions 2 and 3 giving the relay sufficient time in which to operate.

When the control switch reaches position 4, the relay 35 releases and a second test circuit is closed from the negative pole of battery, through the right winding of test re-

lay 36, wiper 20, over the tip side of the line, through the talking transmitter 52, normal contacts of the dial 5, winding of polarized relay 1, returning on the ring side of the line through the wiper 21, left winding of test relay 36 to ground. The flow of current in this circuit is in the opposite direction from that required to operate relay 1. Accordingly relay 1 remains inert. Relay 36 is differentially wound so that when current flows through both its windings the relay is balanced and does not attract its armatures. Since the relay 1 does not operate in this case it maintains a grounded connection through its back contact and through the switchhook contact to the tip side of the line 10. This results in a short-circuit of the left winding of relay 36. Accordingly, relay 36, which is slow to operate, attracts its armature after an interval.

On the next step of the control switch the test circuit through relay 36 is maintained and, the relay being operated, a circuit is completed from ground through its contact, wiper 25, in its fifth position, winding of relay 38 to battery. Relay 38 operates and locks.

On the next step of the control switch it moves into position 6, opening the previously traced circuits through the windings of relay 36. A third test is made at this time and the circuit therefore may be traced from ground through the left winding of relay 36, wiper 20, thence over the tip side of the line through switchhook contacts at station A, transmitter 52, contacts of the dial 5, winding of relay 1 and returning over the ring side of the line through the right winding of relay 36 to the negative pole of battery. The flow of current in this circuit is in the proper direction to operate the polarized relay 1. Relay 1 immediately removes the ground connection from the tip side of the line, preventing the left winding of relay 36 from being short-circuited. With current flowing through both windings of relay 36 it releases and maintains its armature in its normal position.

On the next step of the control switch the relay 36 remains inert to indicate that the ground potential has been removed from the tip side of the line at the calling station A.

Finally, the control switch advances into its last position where it remains. In this position the tip and ring conductors of the line are extended over wipers 20 and 21 through sequence switch contacts 26 and 27 and the left windings of repeating coil 29 to battery through the back contacts of reversing relay 28.

In the well-known manner, the sequence switch 60 advances into the talking position and conversation takes place. Following conversation, the subscribers replace their receivers on the switchhooks and the sequence

switch 60 is advanced from the talking position into position 18. While the sequence switch is moving through positions 15 to 17 inclusive a circuit is completed from battery through the resistance 45, contact of relay 44, contact 43, right back contact of relay 39, inner left front contacts of relays 38 and 37, and brush 16 through the winding of message register 47 to ground. The register 47 is operated to charge the call to the party at substation A. When the sequence switch reaches position 18 a circuit is closed from battery through the winding and contact of magnet 40 to ground at the contact 41. Magnet 40 interrupts its own circuit and steps the brushes of the control switch to their normal position. The energized relays are released in any suitable manner.

If the call is originated at substation B, the first test takes place in the same manner resulting in the operation of relays 35 and 37. In this case, the test circuit is traceable from the positive pole of battery through the winding of relay 35, thence over the tip side of the line, through the winding of relay 2, and the switch hook contacts, and the back contact of relay 2 to ground. The relay 35 operates, but the direction of current flow is such that the relay 2 does not operate.

The second test is made by completing a circuit from battery through the right winding of the differential relay 36, thence over the tip side of the line through the winding of relay 2, switchhook contacts and the back contact of relay 2 to ground. Current flows in the proper direction in this circuit to operate the relay 2. Relay 2 operates before relay 36 has an opportunity to attract its armature. Relay 2 in operating disconnects the ground potential from the ring conductor of the line so that the test circuit now leads through the winding of relay 2, thence through the switchhook contacts, talking transmitter 62, contacts of dial 6 and returning over the ring side of the line through the left winding of relay 36 to ground. With current flowing through both windings of relay 36 it does not attract its armature.

The third test of the substation B is performed by applying current over the test circuit in the opposite direction so that relay 2 will release to reestablish the connection from ground to the line. This circuit leads from battery through the right winding of relay 36, thence over the ring side of the line through contacts of the dial 6, transmitter 62, switchhook contacts, windings of relay 2, and returning over the tip side of the line through the left winding of relay 36 to the grounded positive pole of battery. Relay 2 releases in this circuit and short-circuits the left winding of relay 36. This causes relay 36 to operate and when the control switch steps into position 7 a circuit is closed from ground through the contact of relay 36, wiper 25, to

conductor 63. The application of ground potential to conductor 63 causes the operation of relays 28 and 39 and these relays lock through the left front contact of relay 39.

Later, when the sequence switch 60 is passing from position 15 to position 17 the metering circuit is completed over contact 43 through the right front contact of relay 39, outer left contact of relay 38, outer left front contact of relay 37, brush 17, back contact of the line relay 11, winding of the message register 48 to ground. The register 48 operates to charge the call against the party at substation B. The purpose of relay 28 will be explained hereinafter.

If the call originates at substation C the first test finds no ground potential on either side of the line since the relay 3 is normally deenergized. Accordingly, relay 35 remains inert.

On the second test current is applied to the line in such a direction as to operate the relay 3. Relay 3 in operating short-circuits the left winding of relay 36 causing the latter relay to energize. Relay 36 in operating completes a circuit from ground through its contact, wiper 25 in position 5, winding of relay 38 to battery. Relay 38 operates and locks.

On the third test, current is supplied in the opposite direction causing relay 3 to release to remove the short-circuit, whereby the relay 36 fails to operate.

The metering circuit when closed extends through the contact 43, right back contact of relay 39, inner left front contact of relay 38, inner left back contact of relay 37, brush 18 to ground through the winding of register 49. Thus the call is charged to the party at substation C.

If the call originates at substation D the first test is made by attempting to complete a circuit for relay 35. This circuit is held open, however, at the relay 4 and consequently relay 35 does not operate.

On the second test, negative potential is applied to the tip conductor of the line and positive potential to the ring conductor. In this case the relay 4 does not operate and accordingly the relay 36 remains neutralized and inert.

Lastly, when the third test is made, current is applied in the opposite direction resulting in the actuation of relay 4 which short-circuits the left winding of relay 36. Relay 36 in the manner explained applies a potential to conductor 63 resulting in the operation of relays 28 and 39.

The metering circuit in this case may be traced through the contact 43, right front contact of relay 39, outer left back contacts of relays 38 and 37, brush 19, through the winding of message register 50 to ground, charging the call to the substation D.

It will be noted that the relay 28 operates whenever a call is initiated by the subscriber

at station B and by the subscriber at station D, but does not operate when calls are initiated at substations A and C. The purpose of this is to apply the source of talking current to the line in such a manner that current flows in the direction necessary to insure the removal of ground connections at the substation. When the substation A initiates a call, the relay 1, having its back contact connected to ground, should be operated during the conversation to remove the ground connection. By observing the direction of current flow required to operate relay A it will be seen that this is secured by applying the talking current through the back contacts of the relay 28.

When the party at substation B originates the call the talking current should be applied in the opposite direction in order to operate the relay 2. This is accomplished as above explained by operating the relay 28.

When the call originates at station C current should be applied in such a direction as not to operate the relay 3. The same is true of substation D.

On calls extended to the line 10 as a called line, the talking current supplied from the switches through the brushes of the final selectors to the terminals S, S¹, S² and S³, also flows in such a direction as to insure the removal of ground connections from the line at the substations. If it is assumed that the negative pole of battery is connected to the ring side of the circuit in the selector switch it will be found on tracing the connections that the direction of current flow will be such in every case that the ground potential at the substation is removed. This is accomplished by reversing the connections leading from two of the selector switches at the frame 65.

While the invention has been applied to a system employing switches of a given type it is to be understood that the construction and operation of the switches are unimportant and that the invention is applicable to a variety of types of telephone systems.

What is claimed is:

1. In a telephone system, a line having a plurality of substations, means for establishing an identifying condition at each station, means for testing for the condition identifying a particular station, means for altering the condition at said station, and means for making a test to verify that such alteration has been made.

2. In a telephone system, a line having a plurality of substations, means for establishing an identifying condition at each station, means for making a test for the identifying condition at a particular station, means for changing the condition at said station, means for making another test to verify that the condition has been changed, registers, one for each station, and means controlled by said test means for selecting and operating said registers.

3. In combination, a line having a number of stations, means at each station for placing an identifying condition on said line, means for making a test for the identifying condition pertaining to any particular station, means at such station for removing said condition from the line, and means for testing the line to determine if it is free of said condition.

4. In combination, a line having a plurality of stations, relays, one at each station, means at each station for placing an identifying condition on the line, means for making a test for the condition pertaining to a particular station, means for operating the relay at such station to remove the condition from said line, means for testing the line to determine if it is free from said condition, registers, one for each station, and means controlled by said testing means to select and operate the register for said particular station.

5. In a telephone system, a line having a plurality of stations, a central office, means for establishing an identifying condition at each station, means at the central office to test for the condition at a calling station, means at the central office to change the identifying condition at such station, and means for making a further test to determine if the condition has been changed.

6. In combination, a telephone line having a plurality of stations, relays, one at each station, certain of said relays serving while inert to apply identifying conditions to said line, other of said relays serving while operated to apply identifying conditions thereto, and means for making separate tests of any station, one of which operates and another of which does not operate the corresponding relay.

7. In a telephone system, a line having a number of stations, means at each station for applying an identifying condition to said line, a source of talking current for supplying the line, and means for connecting said source to the line in such a manner as to insure the removal of the identifying condition from the line at the calling substation.

8. In a telephone system, a line having a number of stations, means at each station for applying an identifying condition to said line, a source of talking current for supplying the line, and means dependent on which station is calling for varying the connection of said source to the line to insure the removal of said condition during conversation.

9. In combination, a party line, means at each substation on the line for applying an identifying condition to said line, means for testing the line for an identifying condition, registers controlled by said testing means, a source of talking current, and means for variably connecting said source to the line to

cause the removal of the identifying condition during conversation.

10. In combination, a party line, polarized relays, one at each substation, means controlled by one relay in its operated condition and by another relay in its unoperated condition for applying an identifying potential to said line, a source of talking current, and means for connecting said source to the line in such a direction as to operate or not to operate said relays.

In testimony whereof, we have signed our names to this specification this 16th day of September, 1927.

HENRY M. BASCOM.
WILLIAM T. HAINES.