

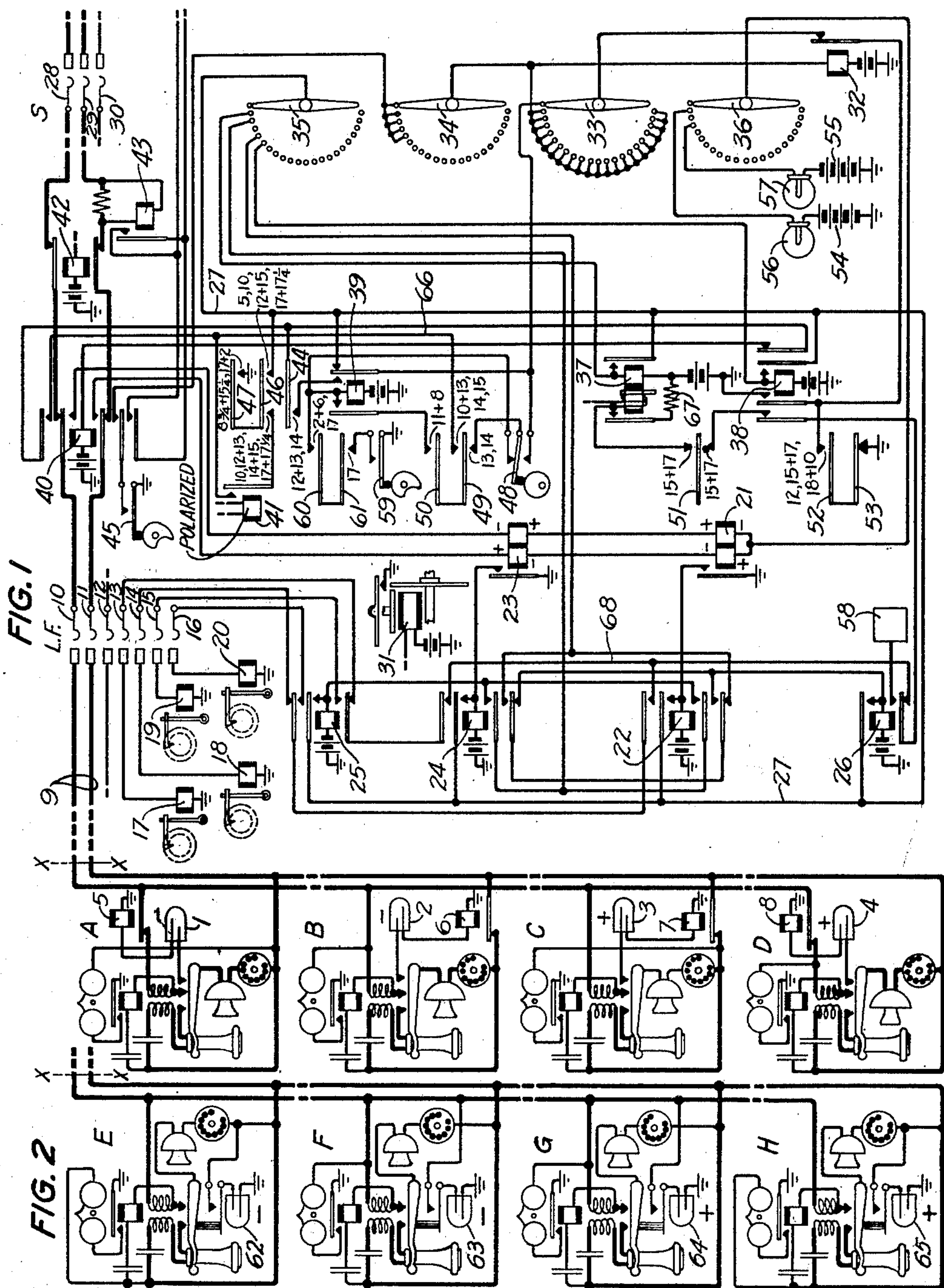
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TELEPHONE EXCHANGE SYSTEM.

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TELEPHONE-EXCHANGE SYSTEM

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

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

According to one feature of this invention uni-directional current-carrying devices are employed at the stations on a party line in combination with an unbalanced condition of the two sides of the line to serve as an identification of the calling line.

According to another feature of the invention polarized differential relays are employed in testing a calling line to determine which party has originated the call. By applying to the line sources of potential of different polarities the operation of the test relays indicates which station is the calling station and controls the selection of the corresponding message register.

The drawing shows the invention applied to a four-party line in an automatic telephone system.

Fig. 1 illustrates diagrammatically a four-party line 9 which is connected to a set of terminals in a line finder bank, a line finder LF which has access to this bank for finding the line when a call is originated by one of the stations, and a selector S which is associated with the line finder LF for extending the calling line.

The party line 9 is shown with four subscriber stations A, B, C and D. The station A is provided with a uni-directional current-carrying device 1 and a relay 5, connected in series between one of the switch hook contacts and ground. A current flows through the uni-directional current-carrying device 1 and through the winding of relay 5 only when an electromotive force of a certain polarity and magnitude is impressed upon the line. The station B is similarly equipped with a uni-directional current-carrying device 2 and a relay 6, so connected that a current flows through the relay 6 only when an electromotive force of the same magnitude but opposite polarity is impressed upon the line. The stations C and D are equipped with

devices 3 and 4 and with relays 7 and 8 connected similarly to the devices and relays at stations A and B, respectively. The operation of either of relays 5 and 8 opens the circuit over the tip side of the line 9 and the operation of either of relays 6 and 7 opens the circuit over the ring side of the line 9. The opening of either the tip or ring side of the line makes possible the identification of the calling station by the use of differentially-wound polarized testing relays at the central office.

In Fig. 2 is shown an alternative arrangement of the stations on a four-party line. Stations E, F, G, and H are equipped with uni-directional current-carrying devices 62, 63, 64 and 65 similar to those with which stations A, B, C and D are equipped, but the relays for opening either the tip or ring sides of the line, during the identification test of the line, are omitted. By the removal of the receiver at either of stations E and H the tip side of the line is connected through the transmitter and one winding of the induction coil to the device 62 or 65, but the ring side of the line is connected directly to the device 62 or 65; by the removal of the receiver at either of stations F and G, the ring side of the line is connected through the transmitter and one winding of the induction coil to the device 63 or 64 while the tip side is connected directly to the device 63 or 64. This arrangement secures sufficient unbalance between the two sides of the line to selectively operate the differentially wound polarized testing relays at the central office when the line is tested to determine which is the calling station. It is therefore not necessary to provide a relay at each station to accentuate the unbalance by opening one side of the line during the identification test, as is the case when the stations are connected as shown in Fig. 1.

The uni-directional current-carrying devices at stations A, B, C, and D and at stations E, F, G and H are shown as space discharge tubes and may be similar to the one illustrated in the application of F. Gray, Serial No. 98,658, filed March 31, 1926. Other types of uni-directional current-carrying de-

vices might be used instead of space discharge tubes.

At the central office the party line terminates in a bank which is accessible to the line finder switch LF. The line finder LF is illustrated diagrammatically by the brushes 10 to 16 inclusive and is connected directly to a selector switch S having brushes 28, 29 and 30. The line finder selector unit partially shown in Fig. 1 may be of substantially the same construction and operation as is shown and described in detail in the patent to Kopp, No. 1,589,402, issued June 22, 1926. Control and operating circuits for a selector switch of this character are also shown in the patent to Stearn et al, No. 1,395,977, issued November 1, 1921. The switches LF and S may be of the panel type and the sequence switch 31 which controls the circuit changes may be similar to that illustrated in the Kopp and Stearn patents mentioned above. The message registers 17, 18, 19 and 20 are respectively individual to stations A, B, C and D and are connected to terminals in the line finder bank which are companion to the line terminals. The means for determining which of the stations has originated a call includes the rotary stepping switch having a stepping magnet 32, the oppositely poled sources of testing potential 54 and 55, the testing control relay 40, and the differentially wound polarized testing relays 21 and 23.

The circuit is arranged to successively connect the sources of testing potential 54 and 55 through brush 36 of the rotary switch to both windings of the testing relay 21, thence respectively through both windings of the testing relay 23, and, with test control relay 40 operated, through the contacts of relay 40 and brushes 10 and 11 of the line finder LF to both sides of the line 9. The windings of testing relay 21 are differentially connected so that the relay will not operate when the current through one of its windings to one side of the line is equal to the current through the other of its windings to the other side of the line. The windings of testing relay 23 are also connected differentially in the testing circuit so that relay 23 will not operate when the current through one of its windings to one side of the line is equal to the current through the other of its windings to the other side of the line. Each of these testing relays is polarized so that it will not operate even though there is a sufficient difference in strength between the currents through its windings unless the winding through which the current is the stronger is poled in the same direction as the current. To illustrate, when the positive source of testing potential is connected through the windings of test relays 21 and 23 to the line 9, relay 21 operates if the current flowing through its left hand winding is stronger than the current through its right hand winding, the difference in strength being

sufficient to cause operation, and relay 23 operates if the current flowing through its right hand winding is stronger than the current through its left hand winding. And, when the negative source of testing potential is connected through the windings of test relays 21 and 23 to the line 9, relay 21 operates if the current flowing through its right hand winding is stronger than the current through its left hand winding, the difference in strength being sufficient to cause operation, and relay 23 operates if the current flowing through its left hand winding is stronger than the current through its right hand winding.

Assuming that the party at substation A has initiated a call, that by the operation of the line finder LF the line 9 has been extended to selector S, that the impulse transmitter at the calling station A has been manipulated to set up the designation of the called line in a register sender at the central office, and that the register sender has controlled the selector S and the succeeding switches to extend the connection to the called subscriber's line in the usual manner, as is fully described in the Stearn patent above mentioned, test of the line 9, to identify the calling station, is initiated after the called subscriber has answered and will be described in detail.

When the called subscriber answers the call the direction of current flow over the trunk, with whose terminals the brushes 28 and 29 of selector S are in contact, is reversed thereby causing the operation of the polarized supervisory relay 41. At this time the sequence switch 31 has advanced to some position, such as position 13, in which the switch remains during conversation. As soon, after the relay 41 operates, as the interrupter 48 closes its upper contact, a circuit is completed from battery through the winding of relay 39, upper contact of interrupter 48, contacts of sequence switch spring 49, lead 66, contacts of relay 41, and through the contacts of sequence switch springs 46 and 47, to ground. Relay 39 operates and locks through its left hand contacts and through the contacts of sequence switch springs 50 and 49, to ground on lead 66. As soon after relay 39 has operated as the interrupter 48 closes its lower contact, a circuit is closed from battery through the winding of relay 40, back contact of relay 38, contact of sequence switch spring 44, front contact and right hand armature of relay 39, lower contact of interrupter 48, contacts of sequence switch spring 49, to ground on lead 66. Relay 40 operates in this circuit and is locked through its outer upper armature and front contact to the ground on lead 66.

The brushes 33, 34, 35 and 36 of the rotary stepping switch are now advanced by the

alternate operation and release of the stepping magnet 32 to control the testing of the line 9. With the brushes in any one of positions 1 to 5 inclusive, position 1 being the normal position, a circuit is closed, after relay 40 has operated, through the winding of stepping magnet 32 each time the interrupter 45 closes its contacts. This circuit may be traced from battery, through the winding of magnet 32, brush 34 in any one of positions 1 to 5 inclusive, the front contact and middle lower armature of relay 40, and through the contacts of interrupter 45, to ground. The release of the magnet 32 each time this circuit is opened at the contacts of interrupter 45 advances the brushes one step at a time from position 1 to position 6. After the brushes are advanced beyond position 5 the magnet 32 is no longer under the control of interrupter 45.

With the stepping switch in position 2, a circuit is closed from battery, through the winding of relay 37, brush 35 in position 2, lead 27, and through the contacts of sequence switch springs 46 and 47, to ground. Relay 37 operates in this circuit and locks through its front contact and right hand armature to ground on lead 27. The operation of relay 37 prepares the circuit for operating the calling subscriber's message register after the calling subscriber has released the connection.

With the stepping switch in position 2, a circuit is closed from the positive source of testing potential 54, through resistance lamp 56, brush 36 in position 2, both windings of relay 21, both windings of relay 23, front contacts and inner armatures of relay 40, and through brushes 10 and 11, to the tip and ring sides respectively of the line 9. The device 1 at station A is so connected that there is no current in this circuit and neither test relay 21 nor test relay 23 operates.

No further operation takes place while the stepping switch is in position 3 but when the switch has advanced to position 4 the negative source of testing potential 55 is connected through resistance lamp 57 and brush 36 in position 4, through the windings of test relays 21 and 23 to the tip and ring sides of line 9. Current in this circuit, over both sides of the line through the uni-directional current-carrying device 1 and the winding of relay 5 to ground, operates relay 5. The operation of relay 5 opens the circuit over the tip side of the line 9 thereby creating an unbalanced condition between the two sides of the line so as to cause the operation of test relay 23. The operation of relay 23 closes an obvious circuit for operating relay 24. Relay 24 locks through its front contact and its upper inner armature to ground on lead 27.

No further operation takes place until the

brushes of the stepping switch are advanced to position 6 at which time a circuit is closed from battery, through the winding of relay 38, brush 35 in position 6, to ground on lead 27. Relay 38 operates in this circuit and locks through its front contact and inner right hand armature to ground on lead 27. The operation of relay 38 connects ground through its front contact and left hand inner armature, armature and back contact of stepping magnet 32, brush 33 in position 6, and through the winding of stepping magnet 32, to battery. The operation of magnet 32 opens its own operating circuit and its release advances the brushes to position 7. Since the terminals from 6 to 27 inclusive, with which brush 33 is associated, are all connected together, stepping magnet 32 continues to operate and release and thus advance the brushes until they have reached position 1, their normal position. The apparatus remains in this condition during conversation.

When the called subscriber replaces his receiver on the switchhook relay 41 releases and sequence switch 31 is advanced from the talking position to a subsequent position such as position 17 in which the message register 17 of the calling station A is to be operated. The release of relay 41 opens the holding circuit for relay 39 and this latter relay releases. Relays 37 and 38 are now held in a circuit through their windings and locking contacts over lead 27, through the back contact and right hand armature of relay 39, brush 33 in position 1, contact of stepping magnet 32, left hand inner armature and front contact of relay 38, to ground.

While the sequence switch 31 is advancing from position 15 to position 17, a circuit is closed from battery, through resistance 67, the left hand armature and front contact of relay 37, contacts of sequence switch spring 51, front contact and left hand outer armature of relay 38, lower armature and back contact of relay 26, lead 68, front contact and upper outer armature of relay 24, lower armature and back contact of relay 25, brush 13, and through the winding of message register 17, to ground. The message register 17 is operated in this circuit, thereby charging the subscriber at station A for the call. When the sequence switch reaches position 17 and as soon thereafter as interrupter 59 closes its contacts, a circuit is completed from battery, through the winding of relay 39, contacts of sequence switch springs 60 and 61, to ground at the interrupter 59. Relay 39 operates thereby releasing relays 24, 37 and 38. Relay 39 may be held energized in the manner shown in detail in the above-mentioned patent to Kopp, to permit the release of relays 24, 37 and 38 as the sequence switch 31 advances to subsequent positions. From this point the release of the line finder and district selector takes place in any well known

manner such as explained in the patent to Kopp mentioned above.

Assume next that the call is initiated by the subscriber at station B. In this case when the positive source of testing potential 54, is connected to the tip and ring sides of line 9, neither of test relays 21 or 23 is operated since there is no current through the uni-directional current-carrying device 2 and relay 6. When the stepping switch has advanced to position 4 the test circuit is closed from the negative source of potential 55, through the windings of the test relays 21 and 23, tip and ring sides of line 9, through the device 2 and relay 6, to ground. Relay 6 operates thereby opening the ring side of the line 9 to create an unbalance between the two sides of the line which causes the operation of test relay 21. The operation of relay 21 closes an obvious circuit for operating relay 22. Relay 22 locks through its front contact and upper inner armature, to ground on lead 27. Later when the sequence switch 31 is advancing from position 15 to position 17, the metering circuit is closed from battery through the resistance 67, as hereinbefore traced to lead 68, through the front contact and upper outer armature of relay 22, upper outer armature and back contact of relay 25, brush 14, and through the winding of message register 18, to ground. The message register 18 is operated in this circuit thereby charging the subscriber at station B for the call.

Assume next that the call is initiated by the subscriber at station C. In this case when the stepping switch has advanced to position 2 and the positive source of testing potential 54 is connected to the tip and ring sides of line 9, relay 7 is operated by the current over both sides of the line, through the unidirectional current-carrying device 3 and relay 7 to ground. The operation of relay 7 opens the circuit over the ring side of the line, thereby creating an unbalance between the two sides of the line to cause the operation of testing relay 23. The operation of relay 23 causes the operation of relay 24 which locks to ground on lead 27. When the stepping switch has advanced to position 3 a circuit is closed from battery, through the winding of relay 25, front contact and lower inner armature of relay 24, brush 35 in position 3, to ground on lead 27. Relay 25 locks through its front contact and upper inner armature, to ground on lead 27. When the negative source of testing potential 55 is connected through the windings of the test relays 21 and 23 to the line 9, the switch being in position 4, there is no current through the device 3 and relay 7 and neither of the test relays is operated. Later when the sequence switch 31 is advancing from position 15 to position 17, a metering circuit is closed from battery, through resistance 67 as hereinbefore traced to lead

68, through the front contact and upper outer armature of relay 24, lower armature and front contact of relay 25, brush 15, and through the winding of message register 19, to ground. The register 19 is operated in this circuit thereby charging the subscriber at station C for the call.

Assume, finally, that the call is initiated by the subscriber at station D. When the positive source of testing potential 54 is connected through the windings of the testing relays 21 and 23 to the tip and ring sides of the line 9, relay 8 operates thereby opening the circuit over the tip side of the line. The unbalance thus created between the two sides of the line causes the operation of test relay 21. The operation of relay 21 causes the operation of relay 22 which locks to ground on lead 27. When the stepping switch has advanced to position 3, relay 25 is operated in a circuit from battery, through its winding, front contact and lower inner armature of relay 22, and through brush 35 in position 3, to ground on lead 27. Relay 25 locks to this same ground and when the sequence switch 31 is advancing from position 15 to position 17 after the calling subscriber has released the connection, the metering circuit is closed from battery, through resistance 67, as hereinbefore traced to lead 68, through the front contact and upper outer armature of relay 22, upper outer armature and front contact of relay 25, brush 16, and through the winding of message register 20, to ground. The message register 20 is operated in this circuit thereby charging the subscriber at station D for the call.

In case subscribers at more than one of the stations attempt to originate a call at the same time both of the testing relays 21 and 23 will have been operated by current in the test circuit as hereinbefore described. Relays 22 and 24 will also have been operated and when the stepping switch has advanced to position 5 a circuit is closed from battery, through the winding of relay 26, front contact and lower outer armature of relay 22, lower outer armature and front contact of relay 24, brush 35 in position 5, to ground at lead 27. Relay 26 operates in this circuit and locks through its front contact and upper armature to the same ground. The operation of relay 26 connects battery, through resistance 67, left hand armature and front contact of relay 37, contacts of sequence switch spring 51, front contact and left hand outer armature of relay 38 and through the lower armature and front contact of relay 26, to the alarm circuit 58. This arrangement prevents the operation of any of the message registers and operates a suitable alarm device. If neither of test relays 21 and 23 has been operated during the tests made while the stepping switch is in position 2 or 4, the circuit for operating relay 26 is closed through the back contacts of relays

22 and 24 and through brush 35 in position 5 to ground on lead 27, and the consequent operation of relay 26 closes the alarm circuit as just described.

5 While the invention has been shown in connection with a telephone system employing panel switches, it is to be understood that it may be embodied in systems of other types.

What is claimed is:

10 1. In a telephone system, a line having a plurality of subscribers' stations, one of which is a calling station, means at each of said stations for creating an unbalanced condition of the two sides of the line, and means including differentially-wound polarized re-
15 lays for testing the line to determine the calling station.

2. In a telephone system, a line having a plurality of subscribers' stations, one of
20 which is a calling station, means including a uni-directional current-carrying device at each of said stations for creating an unbalanced condition of the two sides of the line, and means dependent upon said unbalanced
25 condition for testing the line to determine the calling station.

3. In a telephone system, a line having a plurality of subscribers' stations, one of
30 which is a calling station, means including a uni-directional current-carrying device at each of said stations for creating an unbalanced condition of the two sides of the line, and means including differentially-wound polarized relays for testing the line
35 to determine the calling station.

4. In a telephone system, a line, a plural-
40 ity of subscribers' stations permanently connected to said line, means at said stations for rendering each of them distinguishable from the others when a call is originated at one of said stations, and means including differentially-wound polarized testing relays for testing the line to determined which of
said stations is the calling station.

45 5. In a telephone system, a line, a plurality of subscribers' stations permanently connected to said line, one of said stations being a calling station, a receiver and a receiver hook at said calling station, a uni-
50 directional current-carrying device at said calling station for connecting ground to both sides of said line when said receiver is removed from said hook, and means including polarized differentially-wound testing re-
55 lays for determining which of said plurality of stations is said calling station.

6. In a telephone system, a line having a plurality of subscribers' stations, one of
60 which is a calling station, means at said calling station for rendering said calling station distinguishable from the other stations of said line, a positive source of testing potential, a negative source of testing potential, polarized differentially-wound re-
65 lays, and means for successively connecting

each of said sources of testing potential to the windings of said relays and through said windings to said line to determine which of said plurality of stations is the calling station.

7. In a telephone system, a line having a
70 plurality of subscribers' stations permanently connected thereto, a call originated at one of said stations, means for testing said line to determine which of said stations has orig-
75 inated the call, and a uni-directional current-carrying device at said calling station effective upon the initiation of said call to connect said line to ground, and means actuated
80 by current through said device to disconnect one side of said line from said device.

In witness whereof, I hereunto subscribe my name this 29th day of March, 1929.

ALFRED E. HAGUE.

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