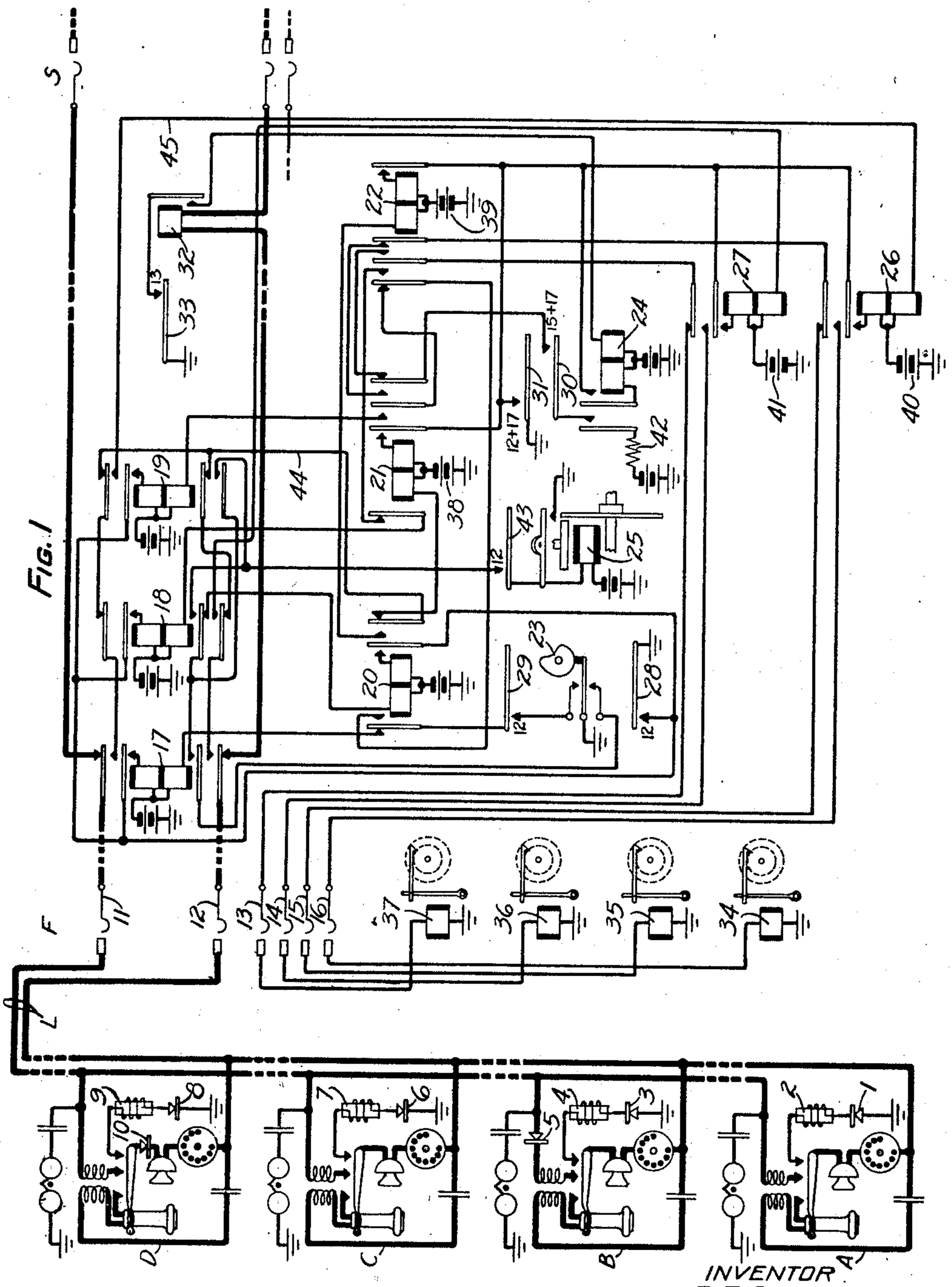
Oct. 29, 1929. R. E. COLLIS 1,733,580

TELEPHONE SYSTEM

Filed Sept. 19, 1928 2 Sheets-Sheet 1

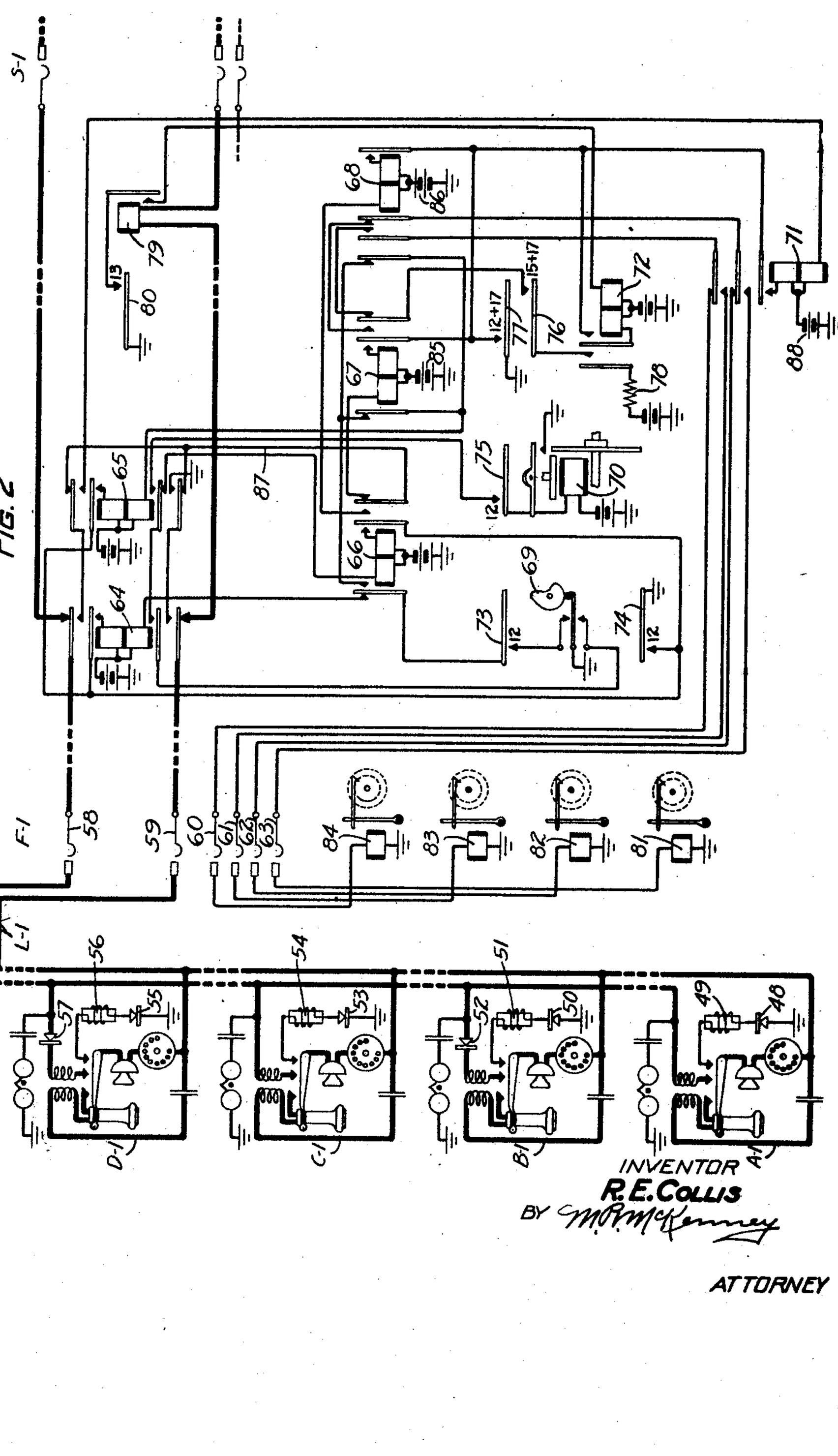


Oct. 29, 1929. R. E. COLLIS 1,733,580

TELEPHONE SYSTEM

Filed Sept. 19. 1928 2 Sheets-Sheet 2

FIG. 2



Patented Oct. 29, 1929 1,733,580

UNITED STATES PATENT OFFICE

RAYMOND E. COLLIS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE SYSTEM

Application filed September 19, 1928. Serial No. 306,811.

This invention relates to telephone systems and 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.

A feature of the invention is a system in which the substations on a party line are equipped with devices which permit the flow of current in one direction, but offer substantial resistance to flow in the opposite direction, the devices at a plurality of said substations being connected in series with the talking circuit.

Another feature is a testing arrangement at the central office by means of which a number of preliminary tests are made to partially establish the identity of the calling station, following which one of a number of final tests is made, dependent on the results of the preliminary tests, to completely identify said calling station.

In the drawing, Fig. 1 illustrates a party line in an automatic telephone system arranged for testing and message registration in accordance with the features of this invention. Fig. 2 is a modification of the system shown in Fig. 1.

The subscriber's line L, shown in Fig. 1, is provided with four substations A, B, C and D. All four of these substations are equipped with unidirectional current carrying devices connected in different ways to enable a distinctive test to determine the calling substation. These devices, being unidirectional or asymmetrical, permit current to flow in one direction, but resist the flow of current in the opposite direction. At stations A and B the unidirectional devices 1 and 3 are connected in series with impedance coils 2 and 4, respectively, to a contact of the receiver switchhook in such a manner that current of negative polarity is permitted to flow from the line through the coils 2 and 4 and the devices 1 and 3 to ground. At stations C and D the devices 6 and 8, included in series, respectively, with coils 7 and 9, are connected in the opposite direction so that current of positive polarity is permitted to flow from the line to ground. At station B the device 5 is connected in the tip side of the talking circuit to permit current of positive polarity to flow from the tip side of the line through the telephone set, but to resist the flow of negative current. At the substation D the device 10 is connected as shown in the talking circuit so that current of negative polarity is permitted to flow from the ring side of the line through said device, but current of opposite polarity is prevented from flowing. The uni-directional current devices may be of any suitable type such as described in the Journal of the American Institute of Electrical Engineers for March 1927, page 215.

The line L extends to the central office and terminates in the contact bank of a line finder switch F, which is illustrated schematically by the brushes 11 to 16 inclusive. The line finder F extends the line to the brushes of a selector switch S also shown schematically. The line finder F and selector S may be of any suitable type such as the power driven panel type switches described in the patent to McQuarrie, No. 1,177,044, granted March 28, 1916, and in the patent to Craft et al, No. 1,123,696, granted Jan. 5, 1915. The selector S and succeeding selector switches may be controlled by central office register senders, such as described in detail in the patent to Kopp, No. 1,589,402, granted June 22, 1926 and the patent to Stearn et al, No. 1,395,977, granted Nov. 1, 1921.

Since each of the four substations is provided with an individual message register at the central office, (registers 34 to 37) it is necessary to make a test of the line at some convenient time to determine which substation has initiated the call. By using a unilateral device of the character described, a more dependable and accurate test is possible for the reason that these devices are included directly in series with the talking circuit at a plurality of different substations without interfering with the talking characteristics of the line.

The testing equipment at the central office comprises two relays 21 and 22 and oppositely poled sources of current 38 and 39 together with relays 26 and 27 and oppositely poled

sources 40 and 41. The test is divided into two parts, the first or preliminary test serving to determine which pair of stations is responsible for the call The second or final test is made by the relays 26 and 27 and depends upon the outcome of the first test and serves to accurately determine which one of the pair of substations initiated the call.

Taking up the detailed description, it will first be assumed that a call is originated at the substation A. The initiation of the call sets the line finder F in operation to find the calling subscriber's line. Following this the called line designation is sent by the impulse transmitter and recorded at the central office for the purpose of operating the switch S and succeeding switches to complete the extension of the connection to the called line At some convenient point in the extension of the connection the controlling sequence switch 25, associated with the switch S and finder F, reaches some position such as position 12. As soon, after the sequence switch reaches position 12, as the power driven interrupter 23 closes its upper contact, a circuit is completed from ground through the contact of said interrupter, sequence switch spring 29, left back contact of relay 20, lower winding or relay 17 to battery. Relay 17 operates and locks through its upper winding and contact to ground at the contact of spring 28. With relay 17 actuated, the tip and ring conductors of the line L are extended through the brushes 11 and 12, front contacts of relay 17, back contacts of relays 18 and 19, conductor 44, outer right back contact of relay 20, left winding of test relay 21, to the negative pole of battery 38. This test circuit, it will be noted, includes both the tip and ring conductors of the line L. At the substation A the tip conductor extends through the winding of the induction coil, the switchhook contacts, the coil 2 to the device 1. Since the polarity of the source 38, applied to the tip conductor, is negative, current is permitted to flow through the device 1 to ground and thence to the opposite pole of battery 38. In like manner a circuit may be traced over the ring side of the line through the impulse transmitter and talking transmitter and thence through the coil 2 and device 1 to ground. With current flowing in the test circuit relay 21 operates, and it locks through its right winding and contact to ground at the sequence switch spring 31.

When interrupter 23 shifts its contacts, a circuit is completed from ground through the lower contact of the interrupter, lower front contact of relay 17, lower back contact of relay 18, left winding of relay 20 to battery. Relay 20 operates and it locks through its right winding and contact to the sequence switch spring 28. Relay 20 disconnects the test conductor 44 from the relay 21 and connects it to the test relay 22. The test circuit now extends from the positive pole of battery 39 through the left winding of the test relay 22 and thence to the tip and ring conductors of the line L Due to the polarity of the device 1, however, current does not flow in the test circuit and accordingly the test relay 22 does not operate.

On the next shift of the interrupter 23, a circuit is closed from ground through the upper contacts of the interrupter, spring 29, left front contact of relay 20, outer left back contact of relay 22, middle right contact of relay 21, lower winding of relay 19 to battery. Relay 19 operates and locks through its upper winding and contact to the sequence switch spring 28. Relay 19 opens the preliminary test circuit above described and closes the tip side of the line to the conductor 45, thus establishing a second test circuit. This second test circuit may be traced from the negative pole of battery 40, through the lower winding of test relay 26, conductor 45, upper front contact of relay 19, upper back contact of relay 18, upper front contact of relay 17, thence over the tip side of the line through the coil 2 and the device 1 to ground. The potential being of the proper polarity, current flows in this circuit and operates the relay 26. Relay 26 locks through its upper winding and contact to ground at the sequence switch spring 31.

Later, the interrupter 23 shifts its contacts and a circuit is completed from ground through the lower contacts of the interrupter, inner lower contact of relay 17, lower front contact or relay 19, through the spring 43 to the sequence switch magnet 25. Thus, the sequence switch advances into some subsequent position indicating that the test has been completed. As the sequence switch moves out of position 12, the holding circuits of relays 17, 19 and 20 are opened and these relays release.

If the call is successful and the called subscriber answers, a supervisory relay such as the relay 32 operates and completes a circuit from ground through the spring 33, contact of relay 32, right winding of relay 24 to battery. Relay 24 operates and locks through its left winding and contact to ground through the spring 31. Subsequently, when conversation is completed and release is taking place, the sequence switch 25 moves through successive positions, such as positions 15 to 17. While the sequence switch is moving through these positions, a circuit is completed for operating the register 34 individual to the calling station A. The circuit may be traced from battery through the resistance 42, contact of relay 24, spring 30, outer right front contact of relay 21, inner left contact of relay 22, upper front contact of relay 26, brush 16, through the winding of the register 34 to ground. The register 34 operates and charges the call against the substation A. As the sequence switch 25 leaves position 17, the test relays 21 and 26 are deenergized.

If the call is initiated at the substation B instead of substation A, the relay 21 operates on the preliminary test the same as it did in the instance above described. The operating circuit of relay 21 extends over the ring side of the line through the transmitters and switchhook at the station B, through the coil 4 and the device 3 to ground. The polarity of the source 38 being negative, current flows and relay 21 operates. Subsequently, when relay 26 is connected to the line as above described, the potential of source 40 being negative, current will not flow through the tip side of the line due to the device 5, nor through the ring side due to the device 3. Accordingly, no current flows in the test circuit and relay 26 remains inert. The metering circuit may now be traced from battery through the resistance 42, spring 30, outer right front contact of relay 21, inner left back contact of relay 22, upper back contact of relay 26, brush 15, through the register 35 to ground.

Assume next that the call is initiated at the substation C. The first test is made by connecting the left winding of relay 21 to the tip and ring conductors, as explained. Since the polarity of the source 38 is negative, current does not flow through the device 6 to ground. Accordingly, relay 21 does not operate. The next test is made by connecting the left winding of relay 22 to the tip and ring conductors, as above described. Since the polarity of source 39 is positive, current flows through both tip and ring conductors through the coil 7 and the device 6 to ground. Relay 22 operates in this circuit and locks through its right winding and contact to the sequence switch spring 31. It will be recalled that when relay 21 operated during the first test a circuit was completed for relay 19 to bring about the second portion of the test, using relay 26. In the present instance, however, since relay 21 is deenergized and relay 22 is operated, a circuit is completed for the relay 18 which may be traced from battery, through the lower winding of said relay, left back contact of relay 21, outer left front contact of relay 22 and thence to ground, as above traced. Relay 18 operates and locks through its upper winding and contact to the spring 28. Under these conditions the second portion of the test, namely, to distinguish whether substation C or substation D is calling, is made by connecting the test relay 27 to the ring side of the line L. The circuit may be traced from the positive pole of battery 41, lower winding of relay 27, lower front contact of relay 18, lower front contact of relay 17, thence over the ring side of the line to the transmitters at the substation C, switchhook contact, coil 7, device 6 to ground. Current flowing in this circuit operates the relay 27 which locks through its upper winding and contact to the spring 31.

At the end of conversation, the metering circuit is closed from battery through the resistance 42, contact of relay 24, spring 30, outer right back contact of relay 21, middle contact of relay 22, upper front contact of relay 27, brush 14, register 36 to ground. The register 36 charges the call to the substation C.

Should the substation D initiate a call, the test relay 21, on being connected to the tip and ring conductors of the line, does not operate for the reason that current of negative polarity cannot flow over either the tip side or the ring side of the line due to the devices 8 and 10. Relay 22 on being connected to the line, however, operates since current of positive polarity is permitted to flow over the tip side of the line through the coil 9 and device 8 to ground.

Later, when the relay 27 is connected to the ring side of the line, current does not flow from the source 41 due to the device 10. Accordingly, the metering circuit may be traced from battery through the resistance 42, contact of relay 24, spring 30, contacts of relays 21 and 22, upper back contact of relay 27, brush 13, winding of the register 37 to ground.

From the foregoing description, it will be seen that the test is divided into two parts. The first test, made by the relays 21 and 22, is to determine whether the call is made by station A or B or by station C or D. According to which pair of stations contains the calling station, a subsequent test is made using either the relay 26 or the relay 27. If the calling station is either station A or B, then relay 26 is used for the second part of the test and operates or not according to which one of the two stations initiates the call. On the other hand, if either station C or D is calling, relay 27 is used and operates or not according to the calling station.

In Fig. 2 the calling line L—1 has four substations A—1, B—1, C—1 and D—1 provided with unilateral devices the same as those shown in Fig. 1. Devices 48, 50, 53 and 55 are connected in series with coils 49, 51, 54 and 56, respectively, to the switchhook contacts and with the poles arranged the same as shown in Fig. 1. Likewise the device 52 at substation B—1 is connected in the tip side the same as device 5 in Fig. 1. At substation D—1, however, the device 57 is connected in the tip side of the line in the talking circuit instead of in the ring side as shown at the corresponding station in Fig. 1.

The line L—1 terminates in the contacts of the finder F—1 having brushes 58 to 63, inclusive. The finder F—1 is associated with selector switch S—1, which selector and succeeding selectors are controlled in the same manner as explained in connection with Fig. 1.

During the establishment of the connection the sequence switch 70 reaches some position, such as position 12. As soon, after the sequence switch reaches position 12, as the in-

terrupter 69 closes its upper contacts, a circuit is closed from ground through the interrupter, spring 73, left back contact of relay 66, lower winding of relay 64 to battery. Relay 64 operates and locks through its upper winding and contact to ground at the spring 74. Relay 64 connects the tip and ring conductors of the line through the back contacts of relay 65, conductor 87, outer right back contact of relay 66, left winding of relay 67 to the negative pole of battery 85. Assuming the call was initiated at the substation A—1, the test circuit extends over the tip and ring conductors through the substation elements, coil 49 to the device 48. The polarity of the device 48 is such that current flows therethrough and accordingly the relay 67 operates. Relay 67 locks through its right winding and contact to ground at the sequence switch spring 77.

When the interrupter 69 shifts its contacts, a circuit is closed from ground through the lower contacts of said interrupter, lower contact of relay 64, lower back contact of relay 65, left winding of relay 66 to battery. Relay 66 locks through its right winding and contact to the spring 74. Relay 66 disconnects the test circuit from the relay 67 and connects it to the left winding of relay 68. Since the polarity of the battery 86 is opposite to the battery 85 current does not flow in the test circuit and accordingly relay 68 remains inert.

On the next shift of the interrupter 69, a circuit is completed from ground through the upper contacts of said interrupter, spring 73, left front contact of relay 66, outer left contact of relay 68, lower winding of relay 65 to battery. Relay 65 operates and locks through its upper winding and contact to the spring 74. Relay 65 disconnects the tip and ring conductors from the conductor 87 and prepares a second test circuit including the relay 71. This test circuit may be traced from the negative pole of battery 88, through the lower winding of relay 71, upper front contacts of relays 65 and 64, thence to the tip side of the line L—1. Due to the polarity of the device 48 current flows in this circuit and causes the operation of relay 71. Relay 71 locks through its upper winding and contact to the spring 77.

On the next shifting of the interrupter 69, a circuit is closed from ground through the lower contacts thereof, lower contacts of relays 64 and 65, spring 75 to the sequence switch magnet 70, thus driving the sequence switch out of position 12 and into some subsequent position, indicating that the test has been completed. As the sequence switch leaves position 12, it opens the spring 74 and causes the release of relays 64, 65 and 66.

When the called subscriber answers the relay 79 operates and a circuit is closed from ground through the spring 80, contact of relay 79, right winding of relay 72 to battery. Relay 72 locks through its left winding and contact to the spring 77.

After conversation and while the sequence switch 70 is passing from positions 15 to 17, a metering circuit is completed from battery through the resistance 78, outer contact of relay 72, spring 76, outer right front contact of relay 67, inner left contact of relay 68, middle front contact of relay 71, brush 63, through the winding of the register 81 to ground. Register 81 operates and charges the call to the substation A—1.

By inspetcing the circuits it will be seen that when substation B—1 initiates a call the relay 67 operates the same as in the case of substation A—1, whereas relay 68 remains deenergized. When relay 71 is connected to the tip side of the line, current does not flow from the source 88 due to the device 52 at the substation B—1. Accordingly, relay 71 remains deenergized and the metering circuit extends as above traced through the middle back contact of relay 71, brush 62 and the register 82 to ground.

If substation C—1 initiates a call relay 67 does not operate, since negative current cannot flow through the device 53. Relay 68 does, however, operate due to the polarity of battery 86. With relay 67 deenergized and relay 68 operated, relay 65 operates in a circuit from battery through its lower winding, outer left contact of relay 67 and thence to ground through the interrupter 69, as above traced. Relay 65 connects the relay 71 to the tip side of the line. In this instance the test circuit may be traced from the battery 88 to the lower winding of relay 71, thence over the tip side of the line through the right winding of the induction coil to the switchhook contacts through the talking transmitter and impulse sender and thence returning over the ring side of the line to the lower front contacts of relays 64 and 65 to ground. Relay 71 operates in this circuit and locks and subsequently the metering circuit may be traced from battery through resistance 78, contact of relay 72, spring 76, outer right back contact of relay 67, middle contact of relay 68, upper front contact of relay 71, brush 61, winding of the register 83 to ground.

When the substation D—1 initiates the call, relay 67 remains deenergized and relay 68 operates on the first test. On the second test, however, relay 71 does not operate since negative current cannot flow through the device 57. Accordingly the metering circuit extends as above traced through the upper contact of relay 71, brush 60, to the winding of the meter 84 to ground.

While the invention has been illustrated in connection with systems of a certain type, it will be understood that it is not so limited, but is applicable to various types of systems.

What is claimed is:

1. In a telephone system, a line having a plurality of substations, devices, one at each substation connected in series with the talking circuit and arranged to permit the flow of current in one direction but to resist the flow of current in the opposite direction, and a test circuit including the conductors of said line.

2. In a telephone system, a line having a plurality of substations, rectifying devices, one connected in series with the talking circuit at each substation and arranged to allow the flow of current in one direction and to resist the flow of current in the opposite direction, and a test circuit including one side of the line and one of said devices.

3. The combination in a telephone system of a line having a plurality of substations, devices, one at each of said substations connected in series with the talking circuit for permitting the flow of current in one direction and resisting its flow in the opposite direction, and test circuits, each including opposite sides of said line and one of said devices.

4. The combination in a telephone system of a line having a plurality of substations, each substation being equipped with a device connected in series with the talking circuit and serving to permit the flow of current in one direction and to resist the flow of current in the opposite direction, and a test circuit including both sides of the line in parallel.

5. In a telephone system, a line having a plurality of substations, devices, one at each substation connected in series with the talking circuit and arranged to permit the flow of test current in one direction but to resist the flow of such current in the opposite direction, and a test circuit having one branch including one side of the line and a parallel branch including the other side of the line and one of said devices.

6. The combination in a telephone system of a party line, devices at the substations for permitting current to flow in one direction and for resisting flow in the opposite direction, certain of said devices being connected in parallel relation to the line conductors, other of said devices at a plurality of said stations being connected in series with the line conductors, and a test circuit including the conductors of said line.

7. In a telephone system, a line having a plurality of substations, each substation having a device connected in series with the talking circuit for permitting the flow of current in one direction and resisting its flow in the opposite direction, a test circuit including the conductors of said line, a register, and means responsive to the flow of current in said test circuit for controlling the operation of said register.

8. In a telephone system, a line having a plurality of substations, each substation having a device connected in series with the talking circuit for permitting the flow of current in one direction and resisting its flow in the opposite direction, a test circuit including the conductors of said line, registers, one for each substation, and means responsive to the flow of current in said test circuit for selecting and operating one of said registers.

9. In a telephone system, a party line, each of a plurality of stations on said line having a device in series with the talking circuit for permitting the flow of current in one direction and resisting the flow of current in the opposite direction, means for making a number of preliminary tests on said line to partially identify a calling station, and means dependent on said preliminary tests for making a further test to determine the calling station.

10. In a telephone system, a party line, each of a plurality of stations on said line having a device in series with the talking circuit for permiting the flow of current in one direction and resisting the flow of current in the opposite direction, means for making preliminary tests on said line by applying to the line sources of current of opposite polarity to partly identify a calling substation, and means dependent upon the result of said preliminary test for making a further test to completely identify the calling substation.

11. In a telephone system, a party line, each of a plurality of stations on said line having a device in series with the talking circuit for permitting the flow of current in one direction and resisting the flow of current in the opposite direction, means for making a preliminary test over a circuit including both sides of said line, and means dependent upon the result of the preliminary test for making a final test over one side of said line to identify a calling substation.

12. In a telephone system, a party line, each of a plurality of stations on said line having a device in series with the talking circuit for permitting the flow of current in one direction and resisting the flow of current in the opposite direction, means for making two preliminary tests of the line over a test circuit including both sides of said line, and means for making a final test over either one side of the line or the other dependent upon the result of the preliminary test to identify the calling substation.

In witness whereof, I hereunto subscribe my name this 12th day of September, 1928.

RAYMOND E. COLLIS.