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TELEPHONE SYSTEM

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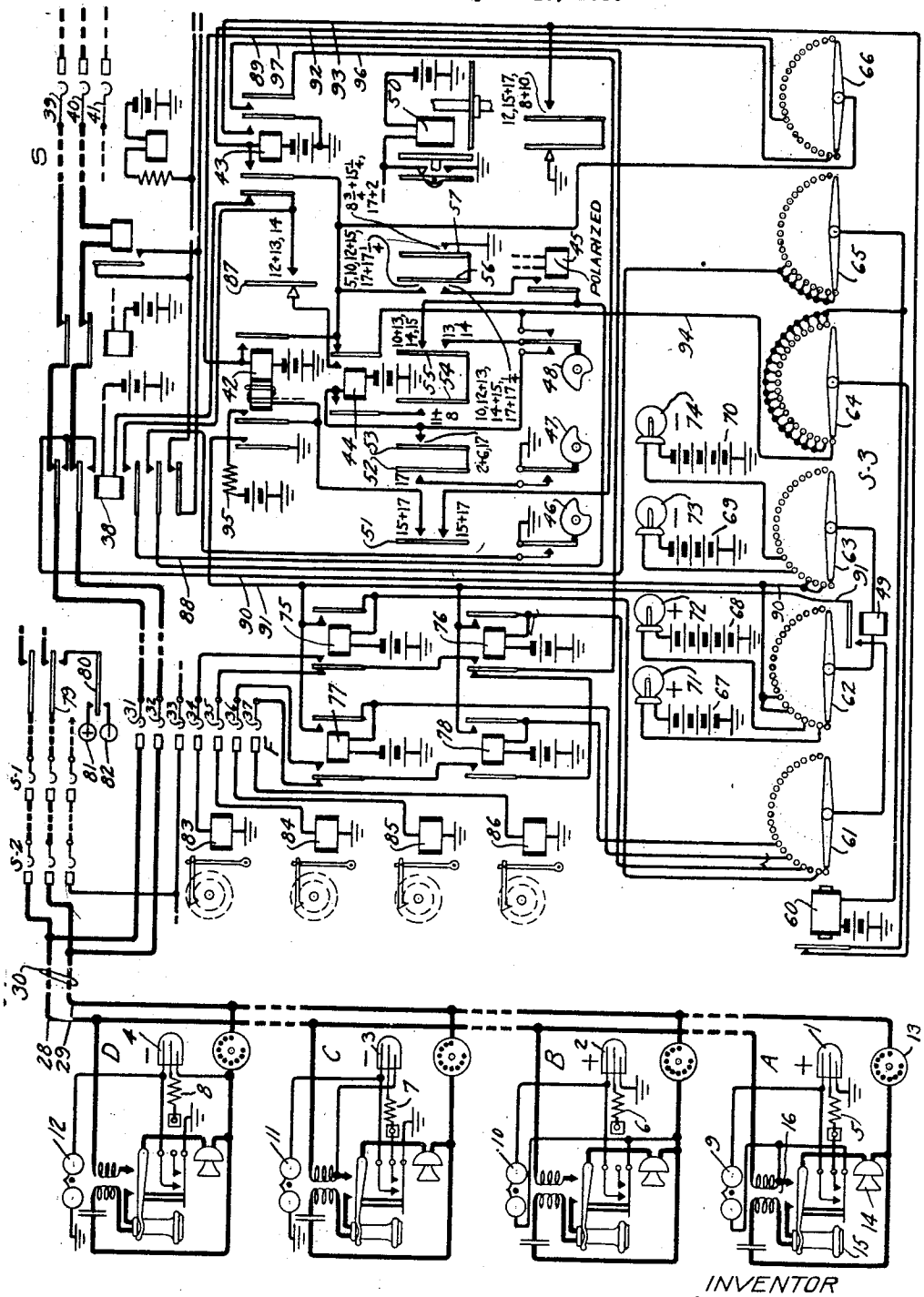

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to the identification of calling stations on a party line.

The objects are to secure a positive and accurate test of a party line to identify calling stations, to simplify the equipment used for this purpose at the substation, to enable the test in a system employing full-selective ringing, to obviate the use of connections which interfere with conversation, and to otherwise improve systems of this character.

According to this invention, the stations on a four-party line are equipped with directional current-discharge devices so connected in circuit with the signal bells that full-selective ringing is secured by applying either positive or negative signaling current either to the tip or to the ring conductor of the line. Furthermore, an identification of any of the four stations may be performed by applying to the line a series of tests, two at low potential and of opposite polarities and two at high potential and of opposite polarities. Two of the discharge devices are arranged to permit test current to flow when subjected to low potential, one of positive and the other of negative polarity. The other two devices permit test current to flow only when subjected to high potential, one positive and the other negative. An advantage of this arrangement is that both identification and full selective ringing are possible on a four-party line without the use of relays at the substations and without the presence of any interfering connections on the line during conversation.

A feature of the invention is a system of the character described in which the current-discharge devices, that serve to control both signaling and testing currents, are provided with positive and negative electrodes and also auxiliary electrodes which are so controlled by the switchhook contacts that the devices at certain stations respond to lower potentials than do those at other stations.

Another feature is an arrangement in which the signal bells, which are included in circuit with the discharge devices when the stations are in a non-calling condition, are shunted at a calling station so that test current may flow directly to the discharge device without traversing the signal bell.

The invention is illustrated in the accompanying drawing, which shows a party line terminating in a line finder switch together with means at the central office for performing the identification tests and for selectively operating message registers.

The subscriber's line 30 has four substations, A, B, C, and D. These stations are equipped respectively with individual call signal bells 9, 10, 11, and 12. These stations are also equipped with individual unidirectional current-discharge devices 1, 2, 3, and 4. These devices are arranged to permit the flow of current only in one direction when potential of a sufficient value is applied thereto. The discharge device 1 at substation A is connected from ground through the windings of bell 9 and the right winding of the induction coil 16 to the tip side of the line. This device 1 is so polarized that it will permit only current of positive polarity to flow from the line through the bell to ground. The device 2 at substation B is connected in series with the bell 10 to the ring conductor of the line. The discharge device 2 is also polarized to permit only current of positive polarity to flow. The devices 3 and 4 at substations C and D are likewise connected in circuits from ground through the windings of the respective bells 11 and 12, one to the tip side of the line and the other to the ring side. These devices are polarized such that they permit only current of negative polarity to flow to the bells from the line. In this manner, full-selective ringing of the substation bells is attained.

The discharge devices 1, 2, 3, and 4 are also used for the purpose of making identifying tests to determine the calling substation. The electrode of the device 1, for instance, which is connected to the bell 9 is also connected to the normally open switchhook contacts. When the receiver is off the hook, these contacts are closed to extend connections from said electrode to both the tip and ring conductors of the line. The same is true of each of the remaining devices 2, 3, and 4. The discharge devices are equipped with third elec-

trodes which are illustrated as being positioned between the primary and secondary electrodes. The third electrodes are connected to the respective resistances 5, 6, 7, and 8. At two of the substations, stations A and C, the third electrodes are connected in circuit with the switchhook contacts, whereas at the other two stations, B and D, the third electrodes are disconnected. Therefore, when the receiver is removed at either of the stations A and C, the third electrodes are connected to the line and are rendered effective by the presence of test potentials on the line. On the other hand, the removal of the receiver from the switchhook at either of stations B and D does not render the third electrodes effective. The third electrode serves in the well-known manner to enhance the sensitivity of the discharge device, permitting it to break down and allow current to flow between the primary and secondary electrodes at lower potentials. Thus the devices 1 and 3 are more sensitive than devices 2 and 4 and will permit the flow of current at lower potentials.

The devices 1, 2, 3, and 4 may be of any suitable type such as the well-known discharge tubes comprising electrodes within a glass tube or container which may be filled with any suitable gas. As an illustration of a current-discharge device of the same general type as those employed in this system, reference is made to the application of F. Gray, Serial No. 98,658, filed March 31, 1926. Another discharge tube is also shown in the patent to Schroter No. 1,605,001, granted November 2, 1926.

At the central office, the subscriber's line terminates in the bank of the line finder switch F, which is diagrammatically illustrated by the brushes 31 to 37 inclusive and also terminates in the contact bank of a final selector switch S—2. The line finder F is directly connected to a selector switch S having the brushes 39, 40, and 41, which is also diagrammatically illustrated.

The subscriber's line 30 may be seized as a called line over a connection extending through selector switches S—1 and S—2.

The line finder and selector unit may be similar in construction and operation to the one shown and described in detail in the patent to Kopp No. 1,589,402 granted June 22, 1926. Control and operating circuits for a selector switch of this character are also shown in the patent to Stern et al. No. 1,395,977, granted November 1, 1921. The construction of these switches is illustrated and described in the patent to Craft et al. No. 1,123,696 granted January 5, 1915.

Stations A, B, C, and D are provided at the central office with individual message registers 83, 84, 85, and 86, which are selectively operated to charge the calls against the corresponding stations. The registers are selected as a result of the identification test performed at some convenient time after the subscriber initiates the call. The test is made and the result registered by means of the sources of potential 67, 68, 69, and 70 and relays 49, 75, 76, 77, and 78. The positive poles of sources 67 and 68 are connected in succession to the line by the rotary stepping switch S—3, following which the negative poles of sources 69 and 70 are connected in succession to the line. Sources 67 and 69 are of relatively low potential, whereas sources 68 and 70 are of relatively high potential. The discharge devices 1 and 3 being sensitive will permit current to flow when either of the low or high potential sources is applied to the line, provided the polarity is in the proper direction. The devices 2 and 4, however, being less sensitive, will only permit current to flow when the high potential sources are applied. By this arrangement, one or more of the relays 75 to 78 inclusive are operated to record the result of the test. These relays subsequently determine the selection and operation of the message register.

A detailed description will now be given, and it will be assumed for this purpose that the subscriber at station A initiates a call. In response to the initiation of the call, the line finder F operates to seize the calling line 30. Thereupon the subscriber manipulates his impulse transmitter 13 to set up the called designation in a register sender, not shown, at the central office. The register sender proceeds to control the selector S and succeeding selector switches to extend the connection to the called subscriber's line as is fully described in the above-mentioned patents to Kopp and Stern et. al.

When the called subscriber answers, the direction of current flow over the trunk, with the terminal of which brushes 39, 40 and 41 of the selector switch S are in contact, is reversed, thereby causing the operation of the polarized supervisory relay 45. The sequence switch 50 has at this time advanced to some position such as position 13 in which it remains during conversation. As soon after the relay 45 operates as the interrupter 48 closes its left contacts, a circuit is completed from battery through winding of relay 44, left contacts of said interrupter, contacts of sequence switch spring 55, contacts of relay 45, lower contact of spring 56 to ground on sequence switch spring 57. Relay 44 operates and locks through its left contact, contact of spring 54, thence to ground as above traced. As soon after relay 44 operates as the interrupter 48 closes its right contacts, a circuit is completed from battery through the winding of relay 38, outer left contact of relay 43, contacts of sequence switch spring 87, right front contact of relay 44, right contacts of interrupter 48, thence to ground as above traced at sequence switch

spring 57. Relay 38 operates and locks in a circuit from battery through its winding, left contacts of relay 43, inner lower contact of relay 38, conductor 88, contact of relay 45 to ground at springs 56 and 57.

The brushes 61 to 66 of the stepping switch S—3 are now advanced by the successive operation and release of stepping magnet 60 to control the testing of the subscriber's line. With the brushes in any one of positions 1 to 8 inclusive, position 1 being the normal position, and with relay 38 operated, a circuit is closed through the winding of magnet 60 each time the continuously driven interrupter 46 completes its contacts. This circuit may be traced from battery through the winding of magnet 60, brush 65, middle lower contact of relay 38 to ground at the contacts of interrupter 46. After the brushes have advanced beyond position 8, magnet 60 is no longer under the control of the interrupter 46.

A circuit is closed with the stepping switch in position 2 from battery through the right winding of relay 42, conductor 89, brush 66, upper and lower contacts of spring 56 to ground at spring 57. Relay 42 operates and locks through its right winding and contact to ground through springs 56 and 57. Relay 42 prepares a circuit for operating the calling subscriber's message register after conversation has been completed.

With the stepping switch S—3 in position 2, a test circuit is closed from the positive pole of the source 67 through the resistance lamp 71, brush 62, winding of relay 49, brush 63, conductor 90, through the upper front contacts of relay 38, over brushes 31 and 32 to the tip and ring conductors 28 and 29 of the subscriber's line 30. The circuit over the tip conductor 28 may be further traced to the right winding of induction coil 16, contacts of the switchhook to the upper electrode of the discharge device 1. A parallel circuit extends through the contacts of the switchhook and resistance 5 to the third or middle electrode of the device 1. A circuit may be traced over the ring conductor 29 through the impulse transmitter 13, talking transmitter 14, thence through the contacts of the switchhook to the upper and middle electrodes of discharge device 1. Since the device 1 is relatively sensitive due to the energization of its auxiliary electrode, it permits current to flow over the test circuit above traced from the source 67, the polarity of said device being such as to permit current to flow when a positive potential is applied to the line. Current flowing through the relay 49 causes it to operate, and a circuit is completed from ground through the outer left contact of relay 42, conductor 91, contacts of relay 49, brush 61, winding of relay 75 to battery. Relay 75 operates and locks through its right contact to the grounded conductor 91. When the stepping switch moves out of position 2 and into position 3, the above traced test circuit is opened, and current ceases to flow through the relay 49 and the discharge tube 1, whereupon said relay retracts its armature.

In position 4 of the stepping switch, the high potential source 68 is applied to the line 30. The circuit for this purpose may be traced from the positive pole of source 68, resistance lamp 72, brush 62, winding of relay 49, brush 63 and conductor 90. Since the polarity of the source 68 is positive and since it is of high potential, the device 1 permits flow of current and relay 49 energizes. With relay 49 operated, a circuit is closed over the grounded conductor 91, contact of relay 49, brush 61 in position 4, winding of relay 76 to battery. Relay 76 operates and locks through its right contact to the grounded conductor 91. As the switch S—3 moves out of position 4 and into position 5, the test circuit is opened and relay 49 releases.

In position 6 of the stepping switch, a circuit is completed from the negative pole of the relatively low potential source 69, resistance lamp 73, brush 63, relay 49, brush 62, conductor 90 and thence to the tip and ring conductors of the subscriber's line. Due to the polarity of source 69, no current flows through the discharge device 1. Accordingly, relay 49 does not operate.

Finally the stepping switch passes into position 8 where a circuit is closed from the negative pole of the relatively high potential source 70, resistance lamp 74, brush 63, winding of relay 49, brush 62, to the conductor 90. The source 70 being negative, no current passes through the device 1; accordingly relay 49 does not energize to attract its armature.

The stepping switch advances into position 9 where a circuit is closed from battery through the winding of relay 43, conductor 92, and brush 66 through the sequence switch springs 56 and 57 to ground. Relay 43 operates and locks through its winding and inner left contact to ground at springs 56 and 57. Relay 43 at its outer left contact opens the circuit of relay 38, and the latter relay releases. Relay 43 in operating closes a circuit from ground through its inner right contact, conductor 93, contact of stepping magnet 60, brush 64 through the winding of magnet 60 to battery. The magnet 60 advances its brushes out of position 9 and also continues to advance them into the normal position since the terminals with which brush 64 cooperates are connected together. The apparatus remains in this condition during conversation.

When the conversation is over and the called subscriber replaces his receiver on the switchhook, relay 45 releases, and the sequence switch 50 is advanced from talking

position to some subsequent position such as position 17 to operate the message register of the calling party. The release of relay 45 causes the opening of the holding circuit of relay 44, and the latter relay releases. Relays 42 and 43 are now held in a circuit from battery through their locking contacts, back contact and right armature of relay 44, conductor 94, brush 64 in position 1, back contact of magnet 60, conductor 93 to ground through the contact of relay 43. While the sequence switch 50 is advancing from position 15 to position 17, a meter circuit is closed from battery through the resistance 95, inner left contact of relay 42, contacts of spring 51, conductor 96, outer right contact of relay 43, conductor 97, left front contacts of relays 76 and 75, brush 34, winding of message register 83 to ground. Register 83 operates and charges the call against substation A. When sequence switch 50 reaches position 17 and as soon thereafter as interrupter 47 closes its contacts, a circuit is completed from battery through the winding of relay 44, springs 53 and 52 to ground through the contacts of said interrupter. Relay 44 operates and opens the holding circuit of relays 42 and 43. Relay 44 may be held energized in a manner shown in detail in the above-mentioned patent to Kopp to permit the release of relays 42 and 43 as the sequence switch 50 advances to subsequent positions. The release of relay 42 opens the holding circuit of relays 75 and 76. From this point, the release of the line finder and selector switches takes place in any well-known manner such as explained in the above-noted patents to Kopp and Stern et al.

Assume next that the call is initiated at the substation B. In this case the polarity of the discharge tube 2 is the same as the one at substation A, but since the tube 2 is not as sensitive it will not permit current to flow when the relatively low potential source 67 is applied to the line. Therefore, relay 49 does not energize in position 2 of the stepping switch. In position 4 of the stepping switch the high potential source 68 is applied to the line, and, being of positive polarity, current flows through the discharge tube 2 operating the relay 49. A circuit is thereupon completed from the grounded conductor 91, contact of relay 49, brush 61, winding of relay 76 to battery. Relay 76 operates and locks to conductor 91. In positions 6 and 8 of the stepping switch, the negative sources 69 and 70 are applied to the line as above described, but due to the polarity of the tube 2 no current flows, and relay 49 remains inert. Subsequently, when the sequence switch passes from position 15 to position 17, the metering circuit is closed from battery through resistance 95, contact of relay 42, spring 51, thence over conductors 96 and 97, through the left front contact of relay 76, left back contact of relay 75, brush 35, winding of message register 84 to ground. Register 84 operates and charges the call to substation B.

Assume next that a call is initiated at substation C. The device 3 at substation C being negative will not respond to current from either of the sources 67 and 68. When the stepping switch S—3 reaches position 6, the negative source 69 is applied to the line, and, since device 3 is relatively sensitive, current flows over the test circuit causing the operation of relay 49. The grounded conductor 91 is thereupon extended through the contact of relay 49, brush 61, winding of relay 77 to battery. Relay 77 operates and locks to the grounded conductor 91. With the stepping switch in position 8, the high potential negative source 70 is applied to the line, and current flows thereover, causing the reoperation of relay 49. Relay 49 extends the grounded conductor 91 through its contact and brush 61 through the winding of relay 78 to battery. Relay 78 operates and locks to the grounded conductor 91. When the sequence switch 50 subsequently moves through position 15 to 17, the metering circuit is completed over conductor 97, left back contact of relay 76, left front contacts of relays 78 and 77, brush 36, winding of message register 85 to ground. Register 85 operates and charges the call to substation C.

Finally, assume that the call is initiated at substation D. Due to the polarity of the discharge device 4, no current flows in response to the application of the positive sources 67 and 68. Also, when the negative source 69 is applied to the line in position 6 of the stepping switch, no current flows due to the fact that device 4 is not sufficiently sensitive. However, in position 8 of the stepping switch, the negative source 70 is applied to the line, and, being of high potential, it causes current to flow through the device 4, and relay 49 operates. Relay 49 extends the grounded conductor 91 over brush 61 through the winding of relay 78 to battery. Relay 78 operates and locks to conductor 91. As the sequence switch 50 passes through position 15 to 17, the metering circuit is completed over conductor 97, left back contact of relay 76, left front contact of relay 78, left back contact of relay 77, brushes 37, winding of message register 86 to ground. The register 86 operates and charges the call to station D.

It will be noted that the signal bell of a non-calling station is connected directly in series with the discharge tube thereat. When the station is calling, however, the signal bell is shunted by the receiver switchhook contacts. This permits the test current to flow directly from the line to the discharge device without traversing the windings of the bell.

When the subscriber's line 30 is called by a calling subscriber, the connection is extended in any suitable manner over selector switches S—1 and S—2. Ringing current is supplied from either of the sources 81 and 82 through contacts 80 and 79 to cause the selective ringing of the substation bells. The potential of sources 81 and 82 is such as to cause the flow of ringing current through the devices 1, 2, 3, and 4, provided the proper polarity is applied. For a detailed disclosure of one manner in which ringing current may be applied to the line, reference is made to the patent to Reeves No. 1,218,804, granted March 13, 1917.

While the invention has been illustrated in connection with a particular type of system, it is to be understood that it is not so limited but may be embodied in various other kinds of systems.

What is claimed is:

1. In a telephone system, a line having two stations thereon, means for applying a source of test potential to the line, a current-controlling device at one station arranged to permit the flow of test current when subjected to low potential, a current-controlling device at the other station arranged to permit the flow of test current when subjected to high potential, and means controlled by the flow of said test current for identifying said stations.

2. In a telephone system, a line having two stations thereon, means for applying to said line test sources of different potential, a directional device at one of said stations for permitting the flow of current when subjected to a given potential, a directional device at the other station for permitting the flow of current when subjected to a potential lower than that necessary to cause the flow of current through said first device, and means controlled by the flow of current in said devices for identifying said stations.

3. The combination in a telephone system of a line having two stations thereon, individual signal devices for said stations, a current-controlling device connected in circuit with the signal device at one of said stations and arranged to permit the flow of signaling current of a given polarity, a current-controlling device in circuit with the signal device at the other station arranged to permit the flow of signaling current of opposite polarity, and means for applying test potential to said line, one of said controlling devices arranged to permit the flow of test current when subjected to a given potential and the other of said devices arranged to permit the flow of test current when subjected to a potential lower than that necessary to cause the flow of current in said first mentioned current controlling device.

4. The combination in a telephone system of a line having two stations thereon, means for applying to said line sources of test potential of different polarities, a directional discharge device at one of said stations arranged to permit the flow of current of a given polarity when subjected to a given potential, a directional discharge device at the other station arranged to permit the flow of current of opposite polarity when subjected to a lower potential than that necessary to cause the flow of current at said first station, and means controlled by the flow of current in said devices for identifying said stations.

5. In a telephone system, a line having two stations thereon, a discharge device having cooperating electrodes, one device at each of said stations, means for applying sources of potential of different values to said line, the discharge device at one of said stations arranged to permit the flow of current when its electrodes are subjected to a given potential, the discharge device at the other station having an auxiliary electrode effective to cause the flow of current when subjected to a lower potential than that necessary to cause the flow of current at the first device, and means responsive to the flow of current in said devices for identifying said stations.

6. In a telephone system, a line having a number of stations thereon, individual discharge devices for said stations having cooperating electrodes, certain of said devices having auxiliary electrodes, means controlled by the switchhooks at the corresponding stations for rendering effective said auxiliary electrodes, means for applying to the line sources of potential of different values, said discharge devices having auxiliary electrodes arranged to permit flow of current when subjected to a potential lower than that required to cause the flow of current in the devices not provided with auxiliary electrodes, and means controlled by the flow of current in said devices for distinguishing said stations.

7. The combination in a telephone system of a line having a plurality of stations thereon, signal bells, one for each of said stations, individual current-controlling devices for said stations, certain of said devices arranged to permit flow of positive ringing current to the corresponding bells, the other of said devices arranged to permit flow of negative ringing current to the corresponding bells, means for applying test potentials of different values to said line, certain of said controlling devices arranged to permit the flow of test current when subjected to a given potential, other of said controlling devices arranged to permit the flow of test current when subjected to a potential lower than said given potential, and means controlled by the flow of test current in the said line for identifying the stations thereon.

8. In a telephone system, a line having a

number of stations, space-discharge devices, one for each of said stations, sources of potential of different polarities, each of said devices having a terminal connected to one pole of said sources, means for connecting the other pole of said sources to the line, certain of said devices arranged to permit the flow of current when subjected to given potentials of different polarities, other of said devices arranged to prevent the flow of current when subjected to said given potentials, and means controlled according to the flow of current in said devices for identifying said stations.

9. In a telephone system, a line having a plurality of stations, a central office in which said line terminates, individual registers for said stations at the central office, current-controlling devices, one for each of said stations, certain of said devices arranged to permit the flow of current only when subjected to a given potential, other of said devices arranged to permit the flow of current when subjected to a potential lower than said given potential, means at the central office for applying different test potentials to said line, and testing means at the central office operated according to the flow of test current in the line for causing the selective actuation of said registers.

10. The combination in a telephone system of a party line, individual ringers for the stations of said lines, current-controlling devices, one for each station, connected in circuit with said ringers, certain of said devices arranged to permit the flow of test current of a given potential, the other of said devices arranged to permit the flow of test current of a potential lower than said given potential, means for applying a source of test current to said line, means for applying a source of ringing current to said line, and means for closing a shunt path around said ringers when test current is being applied to the line.

11. In a telephone system, a line having a plurality of stations, a central office in which said line terminates, individual registers for said stations at the central office, current controlling devices, one for each of said stations, certain of said devices arranged to permit the flow of current only when subjected to a given potential, other of said devices arranged to permit the flow of current when subjected to a potential lower than said given potential, means at the central office for applying different test potentials to said line, relays at the central office operative according to the flow of test current in the line and means controlled by said relays for causing corresponding selective actuation of said registers.

In witness whereof, I hereunto subscribe my name this fourteenth day of April, 1930.

HERBERT E. BRAGG.