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1,753,321

TELEPHONE EXCHANGE SYSTEM

Filed Aug. 4, 1927

2 Sheets-Sheet 1

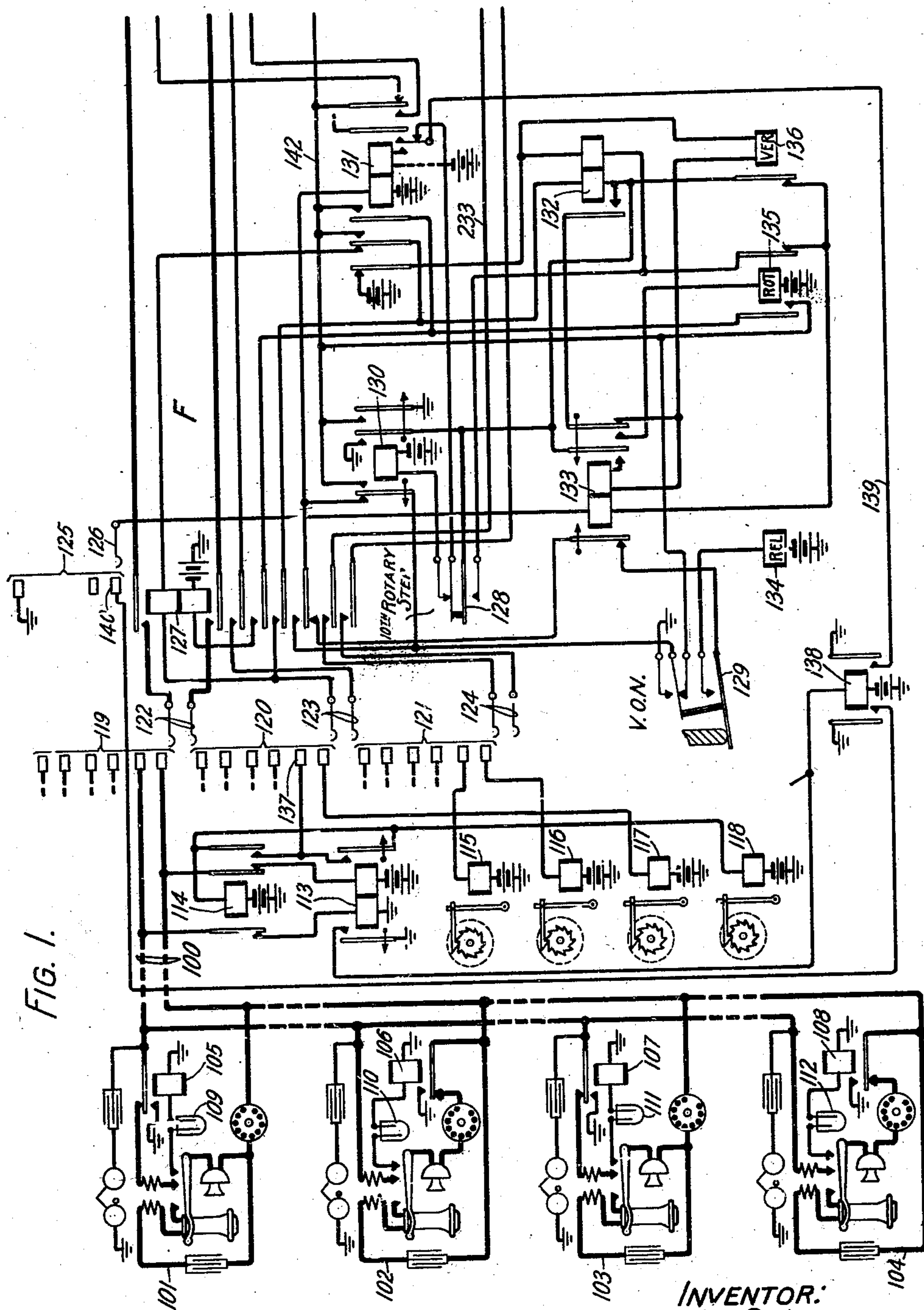


FIG. 1.

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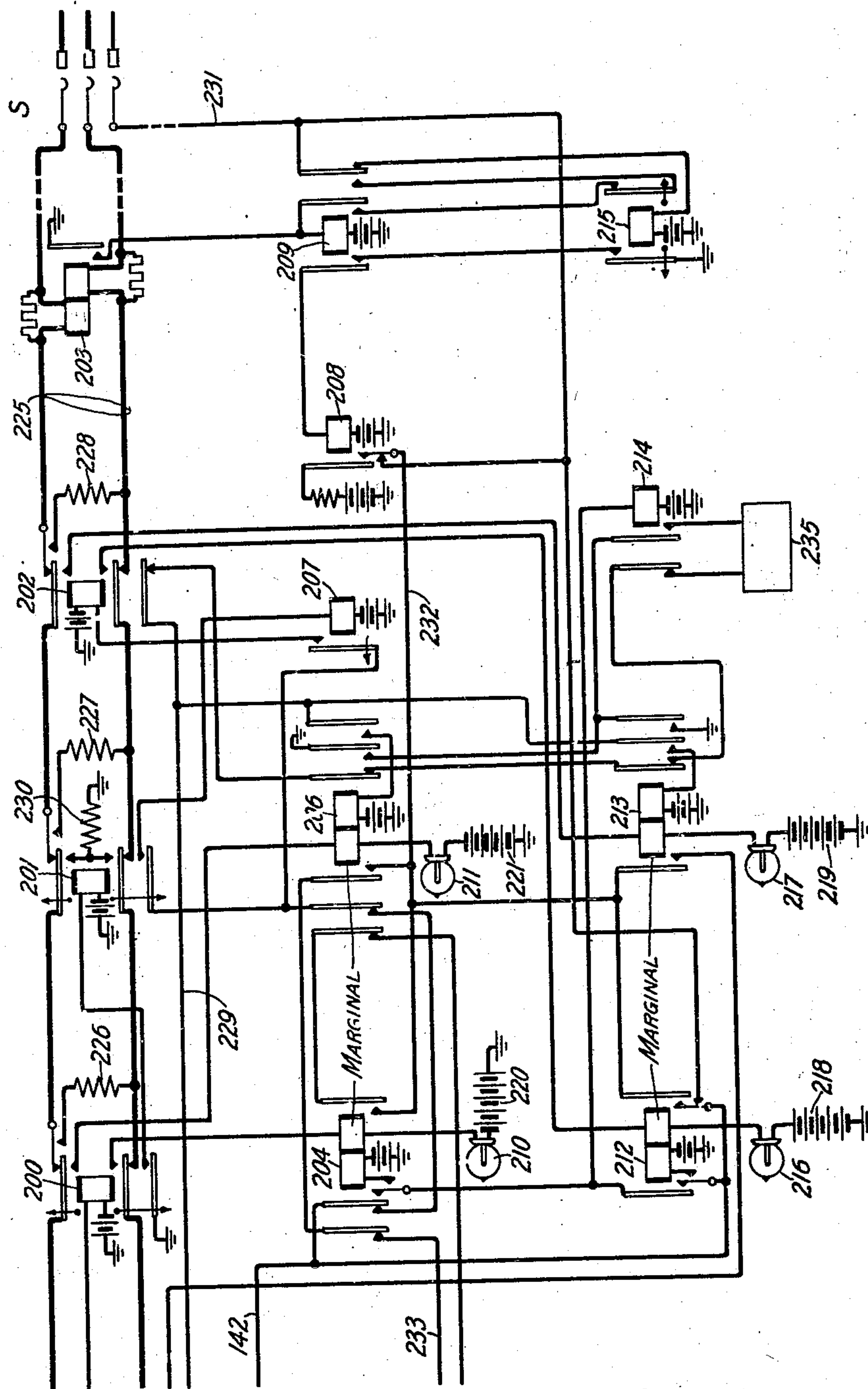
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2 Sheets-Sheet 2

FIG. 2.



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TELEPHONE-EXCHANGE SYSTEM

Application filed August 4, 1927. Serial No. 210,535.

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

5 In accordance with the invention each station on a four-party line is equipped with a relay, two of these relays being connected to opposite sides of the line and designed to respond to high potential current of one polarity
10 ity applied from the central office, the other two also being connected to opposite sides and responsive to high potential current of the other polarity. Any relay in operating applies direct ground to the side opposite to
15 which its winding is connected to operate a marginal test relay at the central office.

The drawing, comprising Figs. 1 and 2, illustrates the operation of an automatic telephone system embodying the invention. Fig.
20 1 shows a four-party line terminating in a line finder. Fig. 2 shows a selector switch schematically and a trunk leading from the line finder switch including the message register control circuits.

25 The line finder F is of the 200-point step by step type having a vertical and rotary magnet and may be in general the same as that disclosed in the patent to Carpenter, 1,567,240, granted December 29, 1925. The
30 selector switch S is also of the two movement step by step type.

The substations are equipped respectively with relays 105, 106, 107 and 108 and space discharge tubes 109, 110, 111 and 112. The
35 relay 105 and discharge device 109 are connected in series to a contact of the switchhook. When the switchhook is shifted a circuit is closed for relay 105 through the transmitter to the ring conductor of the line 100. A parallel path extends through the back contact
40 of relay 105 to the tip conductor. The discharge tube 109 consists of two elements so arranged that when potential of sufficient
45 value is applied in the proper direction current will flow, whereas if the potential is applied in the opposite direction substantially no current will flow. It will be assumed that the device 109 is so arranged that when cur-
50 rent of negative polarity is applied to the

line 100 current flows and the relay 105 operates.

The relay 106 and the discharge device 110 at the substation 102 are similarly connected to the switchhook, but in this case the switch-
55 hook when shifted connects the relay and device directly to the tip side of the line, the path through the back contact of the relay leading to the ring side. The device 110 also permits current to flow when potential of
60 negative polarity is applied to the line.

In like manner the other substations 103 and 104 are equipped each with a relay and discharge device. The device 111, however, permits current to pass when a source of posi-
65 tive polarity is applied to the line and the same is true of the device 112.

For the purpose of a detailed description assume that the subscriber at substation 101 initiates a call. The initiation of the call
70 causes the operation of line relay 113 in circuit from battery, through the right winding of said relay, back contact of relay 114, ring conductor of line 100, through the talking transmitter and switchhook contacts, back
75 contact of relay 105, tip conductor of the line, contact of relay 114 to ground through the left winding of relay 113. The potential of the operating battery at the central office is not sufficient to cause current to flow through
80 the space discharge devices of the substations. Relay 113 operates and applies battery potential through the winding of relay 114 and message register 118 in parallel contact of relay 113 to test terminal 137 in the
85 bank of terminals 120. The register 118 does not operate in this circuit. Relay 113 also closes an obvious operating circuit for the group relay 138. Relay 138 closes the start wire 139 from ground through the contact
90 of the relay, thence over conductor 139, normal contacts of relay 131, normal contacts of the spring combination 128, winding of slow release relay 130 to battery.

Relay 130 closes a circuit from battery
95 through the outer left contact of relay 131, right winding of relay 132, contact of the rotary magnet 135, contact of the vertical magnet 136 to ground at the contact of relay 130. Relay 132 operates and closes a circuit
100

from battery through the contact of relay 131, winding of the vertical magnet 136, outer right contact of relay 133, contact of relay 132 to ground at the contact of relay 130. The magnet 136 operates, stepping the brushes 122, 123 and 124 up one step and opening the circuit of relay 132. Relay 132 releases, in turn opening the circuit of the magnet which on releasing recloses the circuit of the relay. The switch continues to step in a vertical direction until the group commutator brush 126 reaches the commutator segment representing the level containing the calling line. Assuming the line 100 to appear in the level represented by the segment 140, when the brush 126 reaches this segment a circuit is closed from ground through the contact of relay 138, segment 140, brush 126, left winding of relay 133, contact of magnet 135, right winding of relay 132 to battery at the contact of relay 131. Relay 132 remains energized to prevent further stepping of the switch and relay 133 operates. Relay 133 locks in a circuit from battery through the contact of relay 131, winding of the magnet 136, right winding and contact of relay 133 to ground at the contact of relay 130.

When relay 133 operates, a circuit is closed from battery through the winding of the rotary magnet 135, contact of relay 133, contact of relay 132 to ground at the contact of relay 130. The magnet 135 rotates the brushes onto the first set of terminals in the selected level. Magnet 135 opens the circuit of relay 132, which releases, in turn opening the circuit of the magnet 135. The magnet 135 continues to step the brushes until the calling line 100 is reached. When the brushes reach the terminals of the calling line a circuit is completed from battery over the test terminal 137, as above explained, upper brush 123, upper winding of relay 127, back contact of relay 131, left winding of relay 132 to ground at the contact of relay 130. Relay 132 remains energized to prevent further stepping by the magnet 135. Relay 127 also operates, closing a locking circuit from battery through its lower winding and contact, contact of magnet 135 to ground through the contact of relay 130.

Relay 127 in operating closes a circuit from battery through the left winding of relay 131, front contact of relay 127 to ground at the closed contacts of the vertical off-normal spring combination 129. Relay 131 in operating closes a new holding circuit for relay 127, traceable from battery through the lower winding and contact of the latter relay, front contact of relay 131 to the grounded sleeve conductor 142. Relay 131 also opens the energizing circuit of relays 132 and 133, and opens the holding circuit of relay 133. Relay 131 also opens the circuit of slow-release relay 130. Before relay 130 can release to re-

move ground from conductor 142, a substitute ground is placed upon said conductor from the selector switch S in the well-known manner. Relay 127 in operating also extends the tip and ring conductors of the subscriber's line 100 through to the circuits shown in Fig. 2.

During the time the line finder F is finding the calling line, the circuits shown in Fig. 2 are functioning preparatory to making a test to determine which one of the four substations initiated the call. At the time ground potential is applied to the sleeve conductor 142, slow-release relay 200 operates. The circuit for relay 200 may be traced from battery through its winding, outer right back contact of relay 131 to the grounded conductor 142. Relay 200 closes a bridge across the tip and ring conductors of the trunk 225 to prepare the selector switch S for operation. This bridge includes the resistance 226. Relay 200 also closes an obvious circuit for slow-release relay 201. Relay 201 in turn completes a circuit from battery through the winding of slow-release relay 207, contact of relay 201, back contacts of relays 206 and 204, to the grounded conductor 142. Relay 207 energizes and operates the relay 202 in a circuit from battery through the winding of the latter relay, contact of relay 207, thence through contacts of the relays 206 and 204 to the grounded conductor 142. Relay 201 in operating opens the bridge 226, but closes a substitute bridge through the resistance 227. Relay 202 in operating subsequently closes a substitute bridge 228. Thus the impulse relay at the selector S is held operated.

The relay 200 extends the tip and ring conductors of the connection leading from the line finder F to the marginal test relays 204 and 206, the windings of which are connected to the sources of high potential negative current 220 and 221. As soon as the line finder F finds the line 100 and relay 127 operates, a test circuit is completed from negative battery 221 to the lamp 211, left winding of relay 206, front contact of relay 200, thence over the tip side of the line, back contact of relay 105 through the switchhook contacts to the device 109 and relay 105 to ground. Another circuit is closed from negative battery 220, lamp 210, right winding of relay 204, front contact of relay 200, over the ring side of the line through the transmitter and switchhook contact to device 109, relay 105 and ground. The polarity of the device 109 is such that current is permitted to flow through both of these test circuits. The resistance of the test circuits, however, is such that neither of the marginal relays 206 and 204 operates. Since current flows in the test circuits relay 105 operates and in operating opens the test circuit leading over the tip side of the line. The relay 105 at its front

contact places a direct ground potential on the tip side of the line permitting the marginal relay 206 to operate. Relay 206 immediately locks in a circuit from battery through its right winding and front contact, conductor 229, front contact of relay 131, to ground on conductor 142. Relay 206 opens the circuit of relay 207 which after an interval releases, releasing the relay 202.

This test has taken place during the releasing time of the slow relay 200. Relay 200 releases presently and opens the circuit of relay 201. Before relay 201 releases, however, the tip and ring conductors of the line are connected to ground through the resistance 230. This is for the purpose of discharging the line before a high potential of opposite polarity is applied thereto. As soon as relay 201 releases the tip and ring conductors of the calling line are extended through the windings of the polarized relay 203 to the selector switch S.

At the time the switch S is first seized it places a ground potential on the sleeve conductor 231 in the well-known manner. The conductor 231 extends through the normal contact of relay 212 to the sleeve conductor 142. This ground potential is applied to the conductor 142 to hold the finder F after the relay 130 releases. The slow-release relay 215 also operates in a circuit from battery through its winding and back contact of relay 209 to the grounded conductor 231. The cut-off relay 114 is also energized at this time in a circuit from battery through its winding, contact of the line relay 113, upper brush 123, contact of relay 127, front contact of relay 131 to the grounded conductor 142. Relay 114 operates and locks through its outer right contact and releases the line relay 113.

As above explained the relay 105 at the substation 101 in operating opens the test circuit leading through its back contact to the tip side of the line. The relay 105 remains energized over the ring side of the line as long as relay 200 is operated. As soon as relay 200 releases, however, the circuit of relay 105 is opened and the latter relay deenergizes completing the talking circuit.

As soon as the called subscriber answers polarized relay 203 is operated in the usual manner and closes an obvious circuit for relay 209. Relay 209 completes a circuit from ground through the left contact of relay 215, left contact of relay 209, winding of relay 208 to battery. Relay 208 operates and connects the positive pole of booster battery through its front contact, thence over conductor 232, inner left contact of relay 206, outer left contact of relay 204, conductor 233, contact of relay 127, upper brush 124, through the message register 115 to the opposite pole of battery and ground. The register 115 operates to charge the call to the substation 101.

Relay 209 in operating opens the circuit of relay 215 which after an interval releases. Relay 215 opens the circuit of relay 208 which opens the circuit to the message register. Relay 215 on releasing closes a locking circuit for relay 209, including the inner right front contact of relay 209, back contact of relay 215, outer front contact of relay 209 to the grounded conductor 231. Relay 209 remains energized to prevent the reoperation of relay 215.

If the call originates at substation 102, then the relay 106 in operating places a direct ground potential on the ring side of the line which causes the operation of the marginal relay 204. Relay 204 locks directly to the sleeve conductor 142 and prepares an operating circuit for the individual message register 116.

If the call originates at the substation 103, then neither of the relays 204 and 206 operates on the first test and consequently relay 207 remains energized until after relay 200 releases. After relay 200 releases the relay 201 retracts its armatures and extends the tip and ring conductors of the line through the front contacts of relay 202 to the windings of relays 212 and 213 connected to the positive pole of high potential batteries 218 and 219. Since the call originated at substation 103 the relay 107 operates and places a ground potential on the tip side of the line causing the operation of the marginal relay 213. Relay 213 locks to the conductor 229 and prepares a circuit for the operation of message register 117.

Should the call originate at substation 104 the relay 108 would place ground potential on the ring side of the line operating the relay 212. Relay 212 prepares an operating circuit for the message register 118. This circuit leads over the sleeve conductor 142. When relay 208 operates it opens the sleeve connection extending from conductor 231 through the normal contact of relay 208, right front contact of relay 212 to conductor 142. However, it substitutes the booster battery for the normal ground connection on conductor 231. This prevents the release of the finder F.

When conversation is finished ground potential is removed from conductor 231 causing the release of relay 127 and the cut-off relay 114. Relay 127 completes a circuit from battery through the winding of release magnet 134, closed contacts 129, left contact of relay 133, back contact of relay 127, back contact of relay 130 to ground at the contacts 129. Magnet 134 releases the finder F to its normal position.

In case a call is originated by the presence of an accidental ground connection on one or the other of the line conductors or in case the subscriber attempts to simulate a calling condition at another substation in or-

der to avoid the charge the relays 204, 206, 212 and 213 operate in combinations other than those in which they would normally function. Suppose the subscriber at substation 101 places a ground connection on the ring conductor of the line. When the receiver is removed the test circuits are closed as above explained but since a ground potential exists on the ring side of the line the relay 105 is short-circuited. Since the relay 105 does not operate the ground connection is extended through the switch contacts and the back contact of said relay to the tip side of the line. This causes the operation of both relays 204 and 206 at the central office. Relay 204 in operating completes a circuit from battery through the winding of relay 214, contact of relay 204 to the grounded conductor 142. A circuit is now closed from ground through the contact of relay 206, front contact of relay 214 to the alarm device 235. The alarm 235 indicates that an unstandard condition exists on the subscriber's line. With both relays 204 and 206 operated no circuit is closed for the operation of the message register.

Suppose that one of the subscribers disconnects the front contact of the relay at his substation. This will prevent any one of the test relays 204, 206, 212 and 213 from operating. Accordingly a circuit is closed from the grounded conductor 229 through the lower back contact of relay 202, back contacts of relays 206 and 213, back contact of relay 214 to the alarm device 235. Since none of the test relays is operated the message register circuit is not closed.

What is claimed is:

1. In a telephone system, a party line, relays, one at each of two substations, said relays being responsive to current of opposite polarity, operating circuits for said relays, the operating circuit of one relay including one side of the line and the operating circuit of the other relay including the other side of the line, and circuits closed by said relays in operating for applying potential to the side of the line opposite the side over which the relay is operated.

2. In combination, a line having a plurality of subscribers' stations, a relay at one substation responsive to test current of a given polarity, means controlled by the switchhook for connecting the winding of said relay to one side of the line, a relay at a second substation responsive to test current of the other polarity, means controlled by the substation switchhook for connecting said latter relay to the opposite side of the line, and circuits closed by said relays in operating for applying potential to the opposite side of the line to which the relay winding is connectible.

3. In combination, a line having a plurality of subscribers' stations, relays, one at each substation, a plurality of said relays respon-

sive to current of a given polarity, another plurality of the relays responsive to current of the opposite polarity, means controlled by the switchhooks at certain substations for connecting the windings of the corresponding relays to one side of the line, means controlled by the switchhooks at other substations for connecting the relay windings to the opposite side of the line, and a circuit closed through contacts of any relay for connecting ground to the side of the line opposite the side to which the relay winding is connectible.

4. In a telephone system, a line having a plurality of subscribers' substations, relays, one at each substation, means controlled by the switchhook at each of two substations for connecting the relay windings to both tip and ring conductors of the line, means controlled by said relays for disconnecting their windings, one from the tip and the other from the ring conductors, and means controlled by either relay for applying potential to the line conductor opposite the one to which the relay winding remains connected.

5. In a telephone system, a central office, a line having two substations, relays, one at each substation, means controlled by the switchhook at each substation for connecting the winding of the associated relay over two paths, one leading to the tip and the other to the ring conductors of said line, means for operating one relay to open the path to the tip conductor and for operating the other relay to open the path to the ring conductor, means controlled by each relay for closing a circuit to the side of the line opposite the side to which the relay winding remains connected, and message registers at the central office controlled by said circuits.

6. In a telephone system, a central office, a line having two substations thereon, relays, one at each substation, an operating circuit for one relay including the tip conductor of the line, an operating circuit for the other relay including the ring conductor of the line, sources of potential of opposite polarity and test relays at the central office, means for connecting said sources and said test relays to the tip and ring conductors of the line, said relays at the substations responsive to current of opposite polarity, means controlled by the relays at the substations in operating for closing operating circuits for said test relays, said last mentioned circuits each including the line conductor opposite that to which the substation relay is connected, and message registers controlled by said test relays.

7. In a telephone system, a party line, a central office, a relay at one substation of said line connectible to the tip conductor and operating to close a test circuit including the ring conductor, a relay at another substation connectible to the ring conductor and operable to close a test circuit including the tip

conductor, marginal test relays at the central office, means for including said marginal relays both in the operating circuits of the substation relays and in said test circuits, and message registers selectively operated by said marginal relays.

8. In a telephone system, a party line, relays, one at each of two substations on said line, unidirectional devices, one associated with each relay, the device at one of said substations permitting current of one polarity to flow through the relay and the device at the other substation permitting current of opposite polarity to flow through the associated relay, operating circuits for said relays including sources of potential and the conductors of said line, and means controlled by the relays for discriminating one substation from another.

9. In a telephone system, a party line, relays, one at each of two substations on said line, unidirectional space discharge devices, one connected in series with each of said relays, the device at one of said substations permitting current of one polarity to flow through the relay and the device at the other substation permitting current of the opposite polarity to flow through the associated relay, operating circuits for said relays including the conductors of said line, sources of potential of different polarity for connection in said circuits, circuits closed by said relays in operating including the line conductors, and relays responsive to the closure of said last mentioned circuits for discriminating one substation from another.

10. In combination, a line having two substations thereon, relays, one at each substation, an operating circuit for one relay including one conductor of the line, an operating circuit for the other relay including the other conductor of the line, sources of potential of opposite polarity, test relays, means for connecting said sources and test relays to the conductors of said line, said relays at the substations responsive to current of opposite polarity, operating circuits for said test relays closed either by the relays at the said substations or in response to unstandard conditions on the line, message registers, an alarm device, circuits closed by said test relays when actuated in response to the substation relays for operating said registers, and circuits closed by the test relays when operated in response to an unstandard condition on the line for actuating said alarm device.

In witness whereof, I hereunto subscribe my name this 1 day of August, A. D. 1927.

RAY L. STOKELY.