

June 1, 1926.

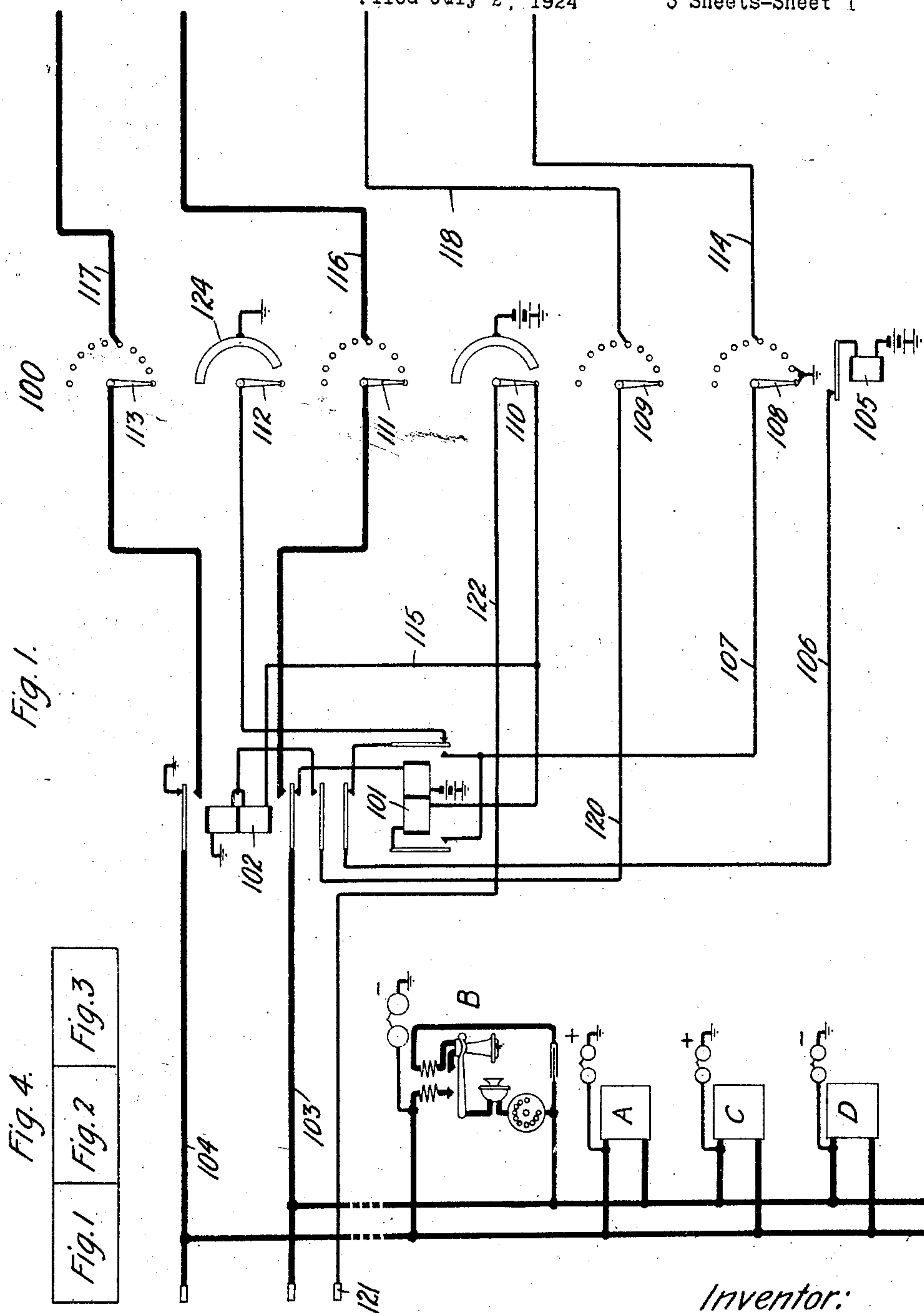
C. V. TAPLIN

1,586,587

TESTING SYSTEM FOR TESTING SUBSCRIBERS' STATION APPARATUS

Filed July 2, 1924

3 Sheets-Sheet 1



Inventor:
Carleton V. Taplin

by

getz

Att'y.

June 1, 1926.

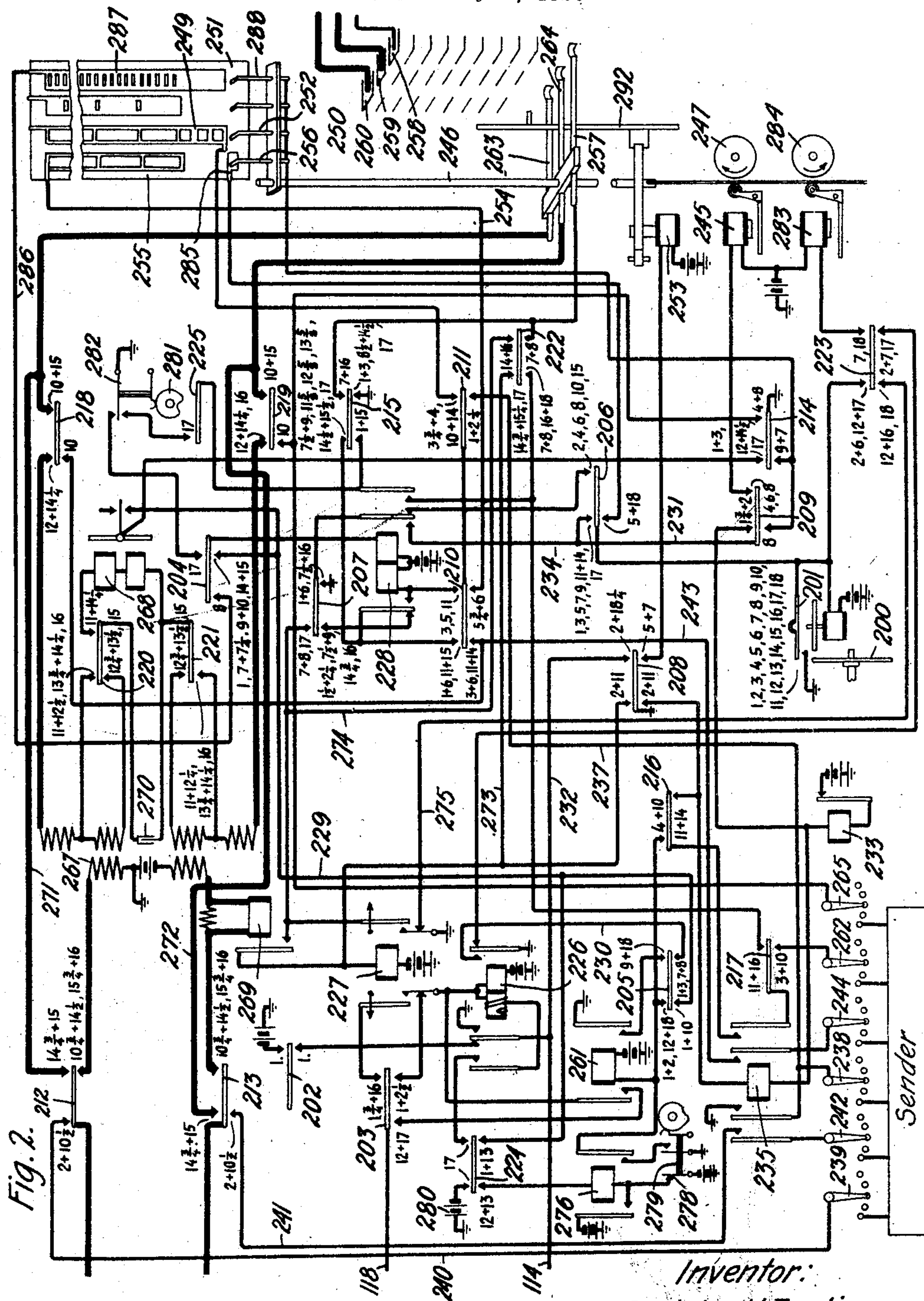
1,586,587

C. V. TAPLIN

TESTING SYSTEM FOR TESTING SUBSCRIBERS' STATION APPARATUS

Filed July 2, 1924

3 Sheets-Sheet 2



Inventor:
Carleton V. Taplin

by

g. w. 402

Att'y

June 1, 1926.

C. V. TAPLIN

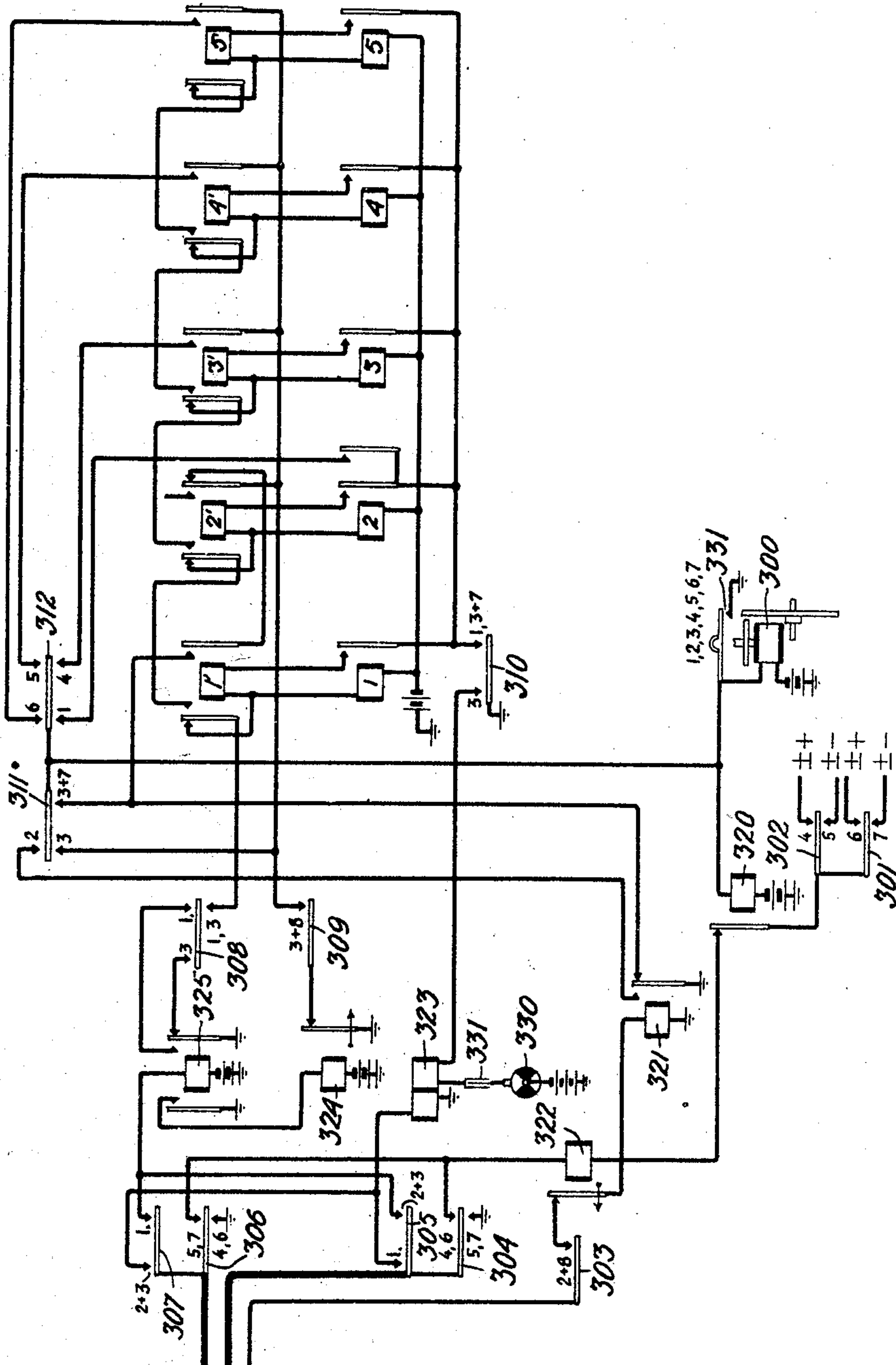
1,586,587

TESTING SYSTEM FOR TESTING SUBSCRIBERS' STATION APPARATUS

Filed July 2, 1924

3 Sheets-Sheet 3

Fig. 3.



Inventor:
Carleton V. Taplin

by

gustor

Att'y.

UNITED STATES PATENT OFFICE.

CARLETON V. TAPLIN, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TESTING SYSTEM FOR TESTING SUBSCRIBERS' STATION APPARATUS.

Application filed July 2, 1924. Serial No. 723,804.

This invention relates to an automatic telephone exchange system and more particularly to a testing system for testing subscribers' station apparatus.

It is the object of this invention to provide an improved testing system.

This invention is especially directed toward the provision of testing equipment in an automatic central office for use by a man repairing an unstandard subscriber's station associated with a line extending from that central office.

Heretofore it has been the practice for a man who has made adjustments at a subscriber's station to dial or call a special operator at the central office and request that a call be directed to said subscriber's station. This method of testing requires manual assistance at the central office, also the usual period of time consumed in making the manual test is greater than in a test that is automatically responsive.

It is therefore the purpose of this invention to provide improved automatic testing equipment at the central office that may be selected by ordinary means from a subscriber's station. In response to the selection of this testing equipment, a test is made of the subscribers' station apparatus.

A feature of this invention is in the use of an automatically operable testing device to test subscribers' station apparatus in response to a call from that subscriber's station.

A further feature of the invention relates to progressive means for the control of the application of ringing current to variously adjusted subscribers' station apparatus in response to a call from said subscriber's station.

These and other features of the invention will be apparent from the following description taken in connection with the accompanying drawings.

While the invention has been disclosed as particularly adaptable for use with panel type machine switching systems, it will be apparent, however, from the following description that the invention has a wider utility and that by slight modification it could be adapted for other types of automatic apparatus.

Figure 1 illustrates a subscriber's line with the associated stations, also the line switch circuit at the automatic central office.

Fig. 2 illustrates a district selector switch used to associate the subscriber's line with the automatic testing circuit shown in Fig. 3. Fig. 2 also illustrates a sender in diagram form associated with the district selector switch.

Fig. 3 illustrates the testing device arranged to hold the district selector in a given position so that tests may be applied to a calling subscriber's station.

Fig. 4 illustrates the manner in which the drawings of Figs. 1, 2 and 3 should be associated.

Description of apparatus.

The subscribers' station apparatus is of a well known type equipped with a dial for operating apparatus at an automatic telephone exchange. The apparatus of stations A, C and D is the same as that shown for B excepting the connections and adjustment of the apparatus operated by ringing potential. The line switch, Fig. 1, the district selector switch and sender, Fig. 2, are of the type fully described in Patent No. 1,395,977 to Franklin A. Stearn and Frederick J. Scudder, issued November 1, 1921. The apparatus shown in Fig. 3 comprises a sequence switch and relays of well known types.

General description.

Let it be assumed that a repair man is making adjustments or repairs upon the apparatus of a subscriber's station associated with a line extending from an automatic central office. After the completion of adjustments or repairs, it is the usual practice to test the subscribers' station apparatus by requesting a call from a desk operator at the central office. According to this invention, the testing apparatus at the central office is automatically responsive to test subscribers' station apparatus from which a call is initiated, independent of manual assistance at said central office.

The man at the subscriber's station dials a code specified for bell testing, in the normal manner of initiating a call, with the exception that the numbers are omitted that are ordinarily used for associating selector switches with a distant line. The code registers of the sender are set to direct the district selector shown in Fig. 2 to a trunk associated with the automatic testing device shown in Fig. 3. When the district selec-

tor is advanced to a particular position known as an operator's talking position, a suitable tone is connected to the line by the testing device. The purpose of the tone is to signal the man at the subscriber's station to dial a number 1, 2, 3 or 4 to indicate the type of ringing current to be used for ringing the bell. When this number has been dialed, the receiver is restored to the switchhook, which action causes the testing device to automatically position itself to associate ringing current of the correct potential and polarity with the line. If the bell rings in the proper manner, the test is concluded by the removal of the receiver from the switchhook to trip the ringing control apparatus of the testing device. When the receiver is again restored to the switchhook, the testing device and district selector are released and automatically restore themselves to normal.

Detailed description.

Let it be assumed that a repair man, located at subscriber's station B to make repairs or adjustments, wishes to test the subscribers' station apparatus. The receiver is removed from the switchhook to initiate a call to the central office and a circuit is thus established to operate line relay 101 of the switch 100. This circuit may be traced from grounded battery, through the right winding of relay 101, the innermost lower contacts of cut-off relay 102, over the line conductor 103 through the substation apparatus of subscriber's station B and thence over line conductor 104 to ground at the upper contacts of cut-off relay 102. The operation of line relay 101 establishes a circuit to operate the stepping magnet 105 from grounded battery, through the winding and contacts of magnet 105, conductor 106, the lowermost contacts of relay 102, right front contacts of relay 101, conductor 107, and thence to ground through brush 108 and its associated contact. The magnet 105 upon energizing in this circuit, advances brushes 108 to 113 inclusive of switch 100 to the second contacts to which they have access. As the second contact associated with brush 108 is permanently connected to ground, the magnet 105 continues to step the brushes to the third set of contacts leading to the first of a group of trunks to which the switch 100 has access.

If the first trunk of the group is busy, there will be a ground potential on the test terminal thereof, appearing in the lowermost bank of the switch and the switch will, therefore, continue stepping until an idle trunk is found. An idle trunk is characterized by grounded battery. When this battery is encountered, a circuit is established through the right contacts of sequence switch cam 202, of the district selector to

which the first idle trunk extends, through the inner left normal contacts of relay 226, test conductor 114, brush 108 and its associated contact, conductor 107, left contacts and left winding of relay 101, conductor 115 and thence to ground through both windings of the cut-off relay 102. The energization of the cut-off relay 102 in the circuit traced opens the energizing circuit for the stepping magnet 105 to arrest the rotary movement of the line switch. Line conductors 103 and 104 are now extended from the subscriber's station B through brushes 111 and 113 to the trunk conductors 116 and 117 leading to the selected district selector. The operation of relay 102 further establishes a circuit to operate relay 226. This circuit may be traced from grounded battery, through the right winding of relay 226, left normal contacts of relay 227, right lower contact of cam 203, sleeve conductor 118, brush 109 and its associated contact, conductor 120 and thence to ground through the lower intermediate contacts and upper winding of cut-off relay 102.

The calling subscriber's line is made busy to calls incoming thereto by the connection of battery potential to terminal 121 of the calling line appearing in the banks of all final selector switches having access to this line over brush 110.

Upon the operation of sleeve relay 226 a circuit is established to operate relay 228 of the district selector. This circuit may be traced from grounded battery through the right winding of relay 228, lower right contact of cam 204, conductor 229, lower contacts of cam 205, conductor 230 to ground through the right alternate contacts of relay 226. The operation of relay 226 further associates ground over its inner left front contacts with the test conductor 114 of the selected trunk to mark the trunk busy to other line switches and at the back contact of this same set of relay contacts disconnects the source of battery potential which up to this time marked the selector switch as idle. Line relay 101 is now deenergized.

Relay 228 upon energizing establishes a circuit for rotating sequence switch 200 from its normal position 1 to position 2. This circuit extends from grounded battery through the winding of magnet 200, conductor 231, left upper contact of cam 206, right inner contacts of relay 223 and thence to ground at the right lower contact of cam 207. In sequence switch position 2, a circuit is established to operate relay 227 from grounded battery through its winding, left upper contact of cam 208 to ground. The operation of relay 227 establishes a locking circuit for the sleeve relay 226 and cut off relay 102 extending from grounded battery through the right winding of relay 226, left contacts of relay 227 and thence to the

sleeve conductor 118 over the right upper contact of cam 203 to ground through the contacts and upper winding of relay 102. This circuit is maintained through position 16 of the sequence switch or until relay 227 becomes deenergized. In sequence switch position 2 a further circuit is established to associate a new holding ground with test conductor 114 extending over conductor 232 and through the right upper contact of cam 208 which is maintained through position 18 $\frac{1}{4}$ of the sequence switch.

As soon as the sequence switch reaches position 13 $\frac{1}{4}$, during its rotation from position 1 to position 2, a circuit is established for energizing stepping magnet 233 of the sender finder switch. This circuit may be traced from grounded battery through the contacts and winding of magnet 233, left upper contact of cam 209, conductor 234, to ground through the right inner contacts of relay 228 and right lower contact of cam 207. A circuit is further established from grounded battery through the contact and winding of magnet 233, winding of cut-in relay 235 to ground at the left lower contact of cam 208. Relay 235 does not energize at this time since its winding is shunted by ground connected to the armature of relay 228.

Upon the rotation of sequence switch 200 out of position 1 the initial energizing circuit for relay 228 is opened at the right lower contact of cam 204. A holding circuit is, however, established over a circuit extending from grounded battery through its left winding and left contacts, left upper contact of cam 210, right lower contact of cam 211, conductor 237, brush 238 of the sender finder switch and to ground upon the busy contacts associated with brush 238 assuming that the first contacts encountered by brush 238 are busy. When an idle sender is associated with brush 238 the terminal is not characterized by a ground thus opening the holding circuit for relay 228 to cause its release. The release of relay 228 opens the energizing circuit for the stepping magnet 233 and establishes at its right inner contacts a circuit to rotate sequence switch 200 from position 2 to position 3. The circuit for rotating the sequence switch may be traced from grounded battery through the magnet 200, conductor 231, right upper contact of cam 206, right inner contacts of relay 228 to ground at the right lower contact of cam 207.

The deenergization of relay 228 removes the shunt around the winding of relay 235. Relay 235 thereupon energizes in series with stepping magnet 233 over the circuit previously traced. The current flow through the winding of magnet 233 is not sufficient to cause its energization. The operation of relay 235 establishes a circuit from ground

through its left inner contacts, brush 238 and associated contact to operate certain apparatus of the sender as described in Patent No. 1,395,977 to Franklin A. Stearn and Frederick J. Scudder.

Upon the operation of certain of the sender apparatus the dial tone is associated with the calling subscriber's line B to indicate to the calling repair man that the apparatus of the central office is prepared to receive the dial interruptions. To control the sender in such manner that the district selector switch is associated with a trunk connected to the testing device, Fig. 3, the repair man dials a particular code that will set the A and B code registers of the sender in a particular manner, to set the translator for driving the district selector switch to terminals 260, 259 and 258 associated with the testing device. The numerical registers of the sender are not set since the district selector switch alone is to be controlled.

Upon the association of the sender apparatus including the A and B code registers and the translator, a fundamental circuit is established from grounded battery through the left winding of relay 228, right upper and left lower contacts of cam 210, conductor 243, right inner contacts of relay 235, brush 244 and associated contact, and thence over the fundamental circuit of the sender to ground, to operate relay 228 in series with the stepping relay of the sender. The operation of relay 228 establishes a circuit to rotate the sequence switch, Fig. 2, from position 3 to position 4. This circuit may be traced from grounded battery through the winding of magnet 200, left upper contact of cam 206, right inner contacts of relay 228 to ground through the right lower contact of cam 207.

With the sequence switch, Fig. 2, in position 4, brush selection is made by the establishment of a circuit for updrive magnet 245 from grounded battery through the winding of magnet 245, right upper contact of cam 209, conductor 234 to ground through the right inner contacts of relay 228 and right lower contact of cam 207. Updrive magnet 245 upon energizing causes the upward movement of the switch shaft, whereupon brush 252 engages commutator 249 and intermittently establishes a shunt circuit to intermittently release the stepping relay of the sender. Relay 228 remains operated during the upward movement of the selector switch shaft from grounded battery through its left winding and contacts, left upper contacts of cam 210, inner right contacts of relay 235, brush 244 to ground through the sender stepping relay.

When the counting relays in the sender have been operated in accordance with the setting of the translator switch, the fundamental circuit is opened to open the operat-

ing circuit for relay 228 and the stepping relay of the sender. Relay 228 opens the energizing circuit for updrive magnet 245 and thus arrests the upward movement of the selector switch shaft. The release of relay 228 further establishes a circuit to rotate the sequence switch, Fig. 2, from position 4 to position 5. This circuit extends from grounded battery, through the winding of magnet 200, right upper contact of cam 206, right inner contacts of relay 228 to ground at the right lower contact of cam 207. The sequence switch, Fig. 2, now in position 5, again establishes the fundamental circuit previously traced to operate relay 228 in series with the stepping relay of the sender. The operation of relay 228 establishes a circuit to rotate the sequence switch, Fig. 2, from position 5 to position 6. When the sequence switch rotates out of position 5 the initial energizing circuit for relay 228 is replaced by a holding circuit through its left winding and contacts as previously traced.

Upon reaching position 6 district group selection is made by the establishment of a circuit as previously traced to energize the updrive magnet 245. In positions 5 and 6 of the sequence switch an obvious circuit is established to energize trip magnet 253. Upon the energization of the updrive magnet the tripping spindle 292 has therefore been rotated to a position to trip the brushes 263, 264 and 257 upon the upward movement of the selector switch shaft and during the continued upward movement of the switch shaft the brushes travel over the contacts of the banks with which they are associated. During the upward movement of the switch shaft, brush 256 intermittently engages the conducting and non-conducting portions of commutator 255 and thus intermittently establishes a shunt for the stepping relay in the sender in the same manner as for district brush selection. In this manner when the stepping relay has been released and operated a sufficient number of times to operate the counting relays of the sender, the fundamental circuit is again opened, to release relay 228 and release the stepping relay of the sender. The release of relay 228 opens the energizing circuit for updrive magnet 245 and thus arrests the upward movement of the district selector switch shaft. The release of relay 228 further establishes a circuit to rotate the sequence switch, Fig. 2, from position 6 to position 7. In sequence switch position 7, a circuit is again established to energize relay 228 from grounded battery through its right winding, right lower contact of sequence switch spring 204, conductor 229, lower contacts of cam 205 to ground at the right contacts of sleeve relay 226. Relay 228 upon energizing establishes a circuit to rotate the

sequence switch, Fig. 2, from position 7 to position 8. This circuit may be traced from grounded battery through the winding of magnet 200, conductor 231, left upper contact of cam 206, right inner contacts of relay 228, left upper contact of cam 207 to ground through the right contacts of relay 227.

The sequence switch, Fig. 2, upon rotating out of position 7, opens the initial energizing circuit for relay 228, but this relay, however, remains energized over a locking circuit which may be traced from grounded battery through its left winding and left contacts through the left upper and lower contacts of cam 215, right outer contacts of relay 228, lower contacts of cam 222, test brush 257 to a ground if a busy testing device is encountered. A plurality of these testing devices are associated with adjacent terminals and it may be necessary for the district selector switch, Fig. 2, to hunt for an idle one. A busy trunk to a testing device is characterized by a ground through the winding of relay 321, contacts of relay 322, contact of cam 303 to terminal 258. Upon reaching position 8 with relay 228 energized, a circuit is established for the updrive magnet 245 which may be traced from grounded battery through the magnet 245, right upper contact of cam 209, right inner contacts of relay 228 to ground through the right lower contact of cam 207. The updrive magnet 245 upon energizing drives the switch shaft upward in search of an idle trunk extending to a testing device. The selector switch shaft continues in its upward movement until the terminals of an idle testing device are encountered. When an idle trunk is encountered which it will be assumed is the trunk terminating in terminals 258, 259 and 260, the locking circuit for relay 228 is opened to cause its release. Upon the release of relay 228 the energizing circuit for updrive magnet 245 is opened to arrest the upward movement of the district selector switch shaft and a circuit is established to rotate the sequence switch, Fig. 2, from position 8 to position 9. Upon reaching position 8½ a busy ground is connected to the multiple testing terminals of the selected trunk over brush 257 and the right contacts of cam 215.

An energizing circuit is again established for relay 228 upon the rotation of the sequence switch, Fig. 2, to position 9, from grounded battery through its right winding, right lower contact of cam 204, conductor 229, left lower and right upper contacts of cam 205 to ground at the right contacts of relay 261. Relay 261 is at this time energized over a circuit extending from grounded battery through its winding, left upper contact of cam 216, right outer contacts of relay 235, right lower contact of cam 217, brush 262 and its associated contact to

ground at the sender. Relay 228 upon energizing in the circuit traced establishes a circuit to rotate the sequence switch, Fig. 2, from position 9 to position 10.

During the control of other switches for an ordinary service connection, the district selector switch remains in position 10 and the office selector switch, incoming selector switch and final selector switch are positioned in accordance with the setting of the numerical registers of the office sender. Upon the completion of the setting of these selector switches a reversal of current flow is made in the incoming selector switch to advance the district selector switch, Fig. 2, and the office sender. Since in selecting this testing device it is not necessary to control other selector switches the reversal of current flow is controlled by the testing device as soon as the district selector switch, Fig. 2, rotates its sequence switch to position 10. This circuit may be traced from grounded battery through the winding of relay 325, right contact of cam 307, terminals 260, brush 263, right upper and left lower contacts of cam 218, right inner contacts of relay 235, brush 244 and its associated contact and thence over the fundamental circuit of the office sender through the stepping and overflow relays of the sender to brush 265 and its associated contact, left lower and right upper contacts of cam 219, brush 264, terminal 259, left contact of cam 305 to ground through the left winding of balance coil 323. The operation of the office sender under this condition is fully described in Patent 1,395,977 to Franklin A. Stearn and Frederick J. Scudder under talking selection and therefore will not be covered in detail herein.

The operation of the sender apparatus opens the actuating circuit for relay 261 to cause its release. The release of relay 261 opens the actuating circuit for relay 228 which releases and establishes a circuit to rotate the sequence switch, Fig. 2, from position 10 to position 11. This circuit may be traced from grounded battery, through the winding of magnet 200, right upper contact of cam 206, right inner normal contacts of relay 228 to ground through the right lower contact of cam 207. In sequence switch position 11 a circuit is established through the apparatus of the office sender to again operate relay 228. This circuit may be traced from grounded battery, through the left winding of relay 228, right upper and left lower contacts of cam 210, right inner contacts of relay 235, brush 244 and its associated contact to ground through the sender apparatus. The operation of relay 228 establishes an energizing circuit for sequence switch magnet 200 from grounded battery through the winding of this magnet, left upper contact of cam 206, right inner

contacts of relay 228 to ground through the right lower contact of cam 207. The sequence switch, Fig. 2, is now rotated from position 11 to position 14 under the control of the office sender. When the sequence switch, Fig. 2, has rotated through position 13 $\frac{5}{8}$ the holding circuit for relay 228 is opened by the sender apparatus. The release of relay 228 opens the actuating circuit for sequence switch magnet 200 to arrest the sequence switch in position 14. It will be noted that when the sequence switch, Fig. 2, rotated out of position 11, the original energizing circuit for relay 228 was opened at the right upper contact of cam 210. Relay 228 is, however, held operated over a locking circuit extending from grounded battery through its left winding and left contacts, through the left contacts of cam 210, right inner contacts of relay 235, brush 244 and its associated contacts to ground through the associated sender apparatus.

It will be remembered that relay 325 was operated in position 10 of the sequence switch, Fig. 2. The operation of relay 325 establishes an obvious circuit to operate slow-releasing relay 324. Also a circuit is established to operate counting relay 1. This circuit may be traced from grounded battery through the winding of counting relay 1, left normal contacts of counting relay 1', right contacts of cam 308 to ground through the right contacts of relay 325. The operation of counting relay 1 establishes a holding circuit for itself through the winding of counting relay 1' to ground through the right contact of cam 310. An operating circuit for relay 1' is also established which is not effective until the release of relay 325 which removes the shunt ground. Upon the rotation of sequence switch, Fig. 2, out of position 10, relay 325 is released and counting relay 1' is thus operated. Upon further rotation of the sequence switch, Fig. 2, a circuit is again established to operate relay 325 which may be traced from grounded battery, through its winding, right contact of cam 307, terminal 260, brush 263, upper contacts of cam 218, right upper winding of repeating coil 267, upper contacts of cam 220, winding of relay 268, lower contact of cam 221, right lowermost winding of repeating coil 267, upper contacts of cam 219, brush 264, terminal 259, left contact of cam 305 to ground through the left winding of balancing coil 323. The operation of relay 325 over the circuit traced establishes an actuating circuit for counting relay 2 from ground through the right contacts of relay 325, right contacts of cam 308, contacts of counting relay 1', left normal contacts of counting relay 2', winding of counting relay 2 to grounded battery. Counting relay

2 operates in the circuit traced to establish an actuating circuit for sequence switch magnet 300 to rotate the sequence switch from position 1 to position 2. This energizing circuit may be traced from grounded battery through the winding of magnet 300, left lower contact of cam 312, right outer contacts of counting relay 2 to ground through the right contact of cam 310. The sequence switch in rotating from position 1 to position 2 opens the holding circuit for the counting relays to cause their release and opens the circuit path extending from the winding of relay 325 to the district selector switch. The current which was flowing in the circuit as traced through the winding of polarized relay 268 was in such direction that the relay was not actuated.

Upon the rotation of the sequence switch, Fig. 3, from position 1 to position 2, a circuit is established through the windings of relays 325 and 268 over which both relays are operated. This circuit may be traced from grounded battery through the winding of relay 325, right contact of cam 305, terminal 259, brush 264, upper contacts of cam 219, right lowermost winding of repeating coil 267, lower contact of cam 221, winding of relay 268, upper contacts of cam 220, right upper winding of repeating coil 267, upper contacts of cam 218, brush 263, terminal 260, left contact of cam 307 to ground through the left winding of balancing coil 323. The operation of relay 268 establishes a circuit to operate relay 228. This circuit may be traced from grounded battery through the right winding of relay 228, right lower contact of cam 204, contacts of relay 268 to ground through the left upper contact of cam 214. The operation of relay 228 establishes a circuit to rotate the sequence switch, Fig. 2, from position 14 to position 15. The circuit for energizing magnet 200 may be traced from grounded battery through its winding, left upper contact of cam 206, right inner contacts of relay 228 to ground through the right lower contact of cam 207.

During the rotation of the sequence switch, Fig. 2, from position 14 to position 15, the energizing circuit for relay 268 is opened, thus opening the energizing circuit for relay 228. A locking circuit is, however, established to maintain relay 228 in an operated position. This circuit may be traced from grounded battery through the left winding and left contacts of relay 228, upper contacts of cam 215, brush 257, terminal 258, contact of cam 303, normal contacts of relay 322, winding of relay 231 to ground. Relay 321 is operated in the holding circuit traced for relay 228. The operation of relay 321 establishes a circuit to rotate the sequence switch, Fig. 3, from position 2 to position 3. This circuit may be traced from

grounded battery through the winding of magnet 300, upper contact of cam 311 to ground through the contacts of relay 321.

A source of tone current is now associated with the calling subscriber's station through balancing coil 323. The primary tone circuit may be traced from grounded battery through tone interrupter 330, condenser 331, right winding of balancing coil 323 to ground through left contact of cam 310. The tone current is induced from the right to the left winding of balancing coil 323 and is carried over the district and line conductors to the subscriber's station so that it is audible to the repairman controlling the testing device. The secondary tone circuit may be traced from ground through the left winding of balancing coil 323, left contact of cam 307, terminal 260, brush 263, conductor 271, right upper contact of cam 212, conductor 117, brush 113 and its associated contact, upper contacts of relay 102, conductor 104, through the apparatus of the subscriber's station B, returning over conductor 103, lower innermost contacts of relay 102, brush 111 and its associated contact, conductor 116, left upper contact of cam 213, conductor 272, brush 264, terminal 259, right contact of cam 305, winding of relay 325 to grounded battery.

The tone current transmitted through the subscriber's station serves as a signal to the repairman that the testing device is associated with the line. It is now the duty of the repairman to dial the proper digit to select the character of ringing current to be associated with the subscriber's station for actuating the ringer magnet. If a "2" is dialed, the interruptions of the dial cause relay 325 to release and operate twice. The initial release of relay 325 establishes a circuit to operate counting relay 1. This circuit may be traced from grounded battery through the winding of counting relay 1, left normal contacts of counting relay 1', right lower and left upper contacts of cam 308 to ground through the left contacts of relay 325. The operation of counting relay 1 establishes a locking circuit for itself and an operating circuit for counting relay 1' which is effective as soon as the shunt ground is removed by the succeeding operation of relay 325. Relay 325 again operates as the dial rotates to close the circuit of the subscriber's station and removes the shunt from counting relay 1'. Upon the next subsequent release of relay 325, a circuit is established to energize counting relay 2 from grounded battery through its winding, left normal contacts of counting relay 2', left alternate contacts of counting relay 1', right lower and left upper contacts of cam 308 to ground through the right back contacts of relay 325. Counting relay 2 establishes a locking circuit for itself and an operating

circuit for relay 2' which is effective upon the subsequent and last operation of relay 325. The repairman now restores the receiver to the switchhook, thus causing the release of relays 325 and 324. The release of relay 325 now establishes a circuit to operate counting relay 3, from grounded battery through its winding, left normal contacts of counting relay 3', left contacts of relay 2', left contacts of relay 1', right lower and left upper contacts of cam 308 to ground through the right normal contacts of relay 325. The release of relay 324 establishes a circuit to rotate the sequence switch, Fig. 3, out of position 3. This circuit may be traced from grounded battery through the winding of magnet 300, lower left contact of cam 311, contact of cam 309 to ground through the normal contacts of relay 324. Upon the rotation of the sequence switch out of position 3 a shunt is removed from the winding of counting relay 3' and a circuit for its operation is effective through the winding and contacts of counting relay 3. Upon the rotation of the sequence switch into position 4 a circuit is established to further rotate the sequence switch to position 5. This circuit may be traced from grounded battery through the winding of magnet 300, right lower contact of cam 312, right contacts of counting relay 3', contact of cam 309 to ground through the normal contacts of relay 324.

During the rotation of the sequence switch, Fig. 3, from position 3 to position 5, relay 320 is operated so that ringing potential is not impressed upon the line until the sequence switch is properly positioned. The initial actuating circuit for relay 320 may be traced from grounded battery through its winding, lower left contact of cam 311, contact of cam 309 to ground through the normal contacts of relay 324. During the rotation of the sequence switch from position 3 to position 4, a circuit is established to ground through the contact of magnet 300 to hold relay 320 actuated. Upon reaching position 4, the energizing circuit for relay 320 is again changed and may be traced through the right lower contact of cam 312, right contacts of counting relay 3', contact of cam 309 to ground through the normal contacts of relay 324. When the sequence switch has rotated to position 5, the actuating circuit for relay 320 is opened to cause its release. Negative ringing current is now associated with the tip conductor of the line and ringing ground is associated with the ring conductor to ring the bell at subscriber's station B. This circuit may be traced from the negative ringing current source through the lower contact of cam 302, normal contact of relay 320, winding of relay 322, upper contact of cam 306, terminal 260, brush 263, conductor

271, right upper contact of cam 212, conductor 117, brush 113 and its associated contact, upper contacts of relay 102, conductor 104, the bell magnets of subscribers' stations A and B to ground. The bell magnets of stations C and D are at this time shunted by a circuit over the lower innermost contacts of relay 102, brush 112 and its associated contact, conductor 116, left upper contact of cam 213, brush 264, terminal 259 to ground through the lower contact of cam 304.

The ringer magnet and its associated armature of subscriber's station B is adjusted to operate from negative ringing current applied to the tip conductor of the line and when properly adjusted respond to the ringing current imposed upon the line by the testing device, Fig. 3.

When the bell is sounded it is the duty of the repairman to remove the receiver from the switchhook to establish a low resistance circuit in the subscriber's station. It will be noted that the ringing current is transmitted through the winding relay 322 which is adjusted in such manner that it will not operate during the period when the ringing current is transmitted through the ringer winding. However, when the receiver is removed from the switchhook to establish a low resistance line loop, the current then transmitted through the winding of relay 322 is sufficient to cause its energization. The energization of relay 322 opens the holding circuit for relay 228, Fig. 2, and opens the actuating circuit for relay 321 of Fig. 3. The release of relay 321 establishes a circuit to rotate the sequence switch, Fig. 3, from position 5 to position 8. This circuit may be traced from grounded battery through the winding of magnet 300, right contact of cam 311 to ground through the normal contacts of relay 321. The sequence switch is now rotated from position 8 to its normal position 1 under the control of the master contact 331. The release of relay 228 establishes circuits to rotate the district selector sequence switch out of position 15. The district selector then restored to normal in the manner described in Patent No. 1,395,977, previously referred to.

In a similar manner a repairman at station A, upon receiving the tone impressed upon the line conductors by tone interrupter 330, will dial "1", instead of "2" as described for station B or if at station C or D will dial "3" and "4", respectively. The number of counting relays operated in Fig. 3 corresponds with the number of interruptions from the dial at the subscriber's station.

This circuit may be used in conjunction with single party lines; and for such lines the usual practice is to associate alternating current with the subscriber's station to energize the ringer magnet, since for single party

lines it is not necessary to adjust the ringer to operate from a particularly poled source of current.

The testing device, Fig. 3, may be used in conjunction with any of the various methods of ringing subscribers' stations, by associating ringing current sources with the contacts of cams 301 and 302 such as is required to operate the subscriber's station to make a service connection.

Should the testman at a subscribers' station dial the code to associate the test set in operative relation with the line, and, upon receiving the tone from tone source 330, decide that he does not desire to ring the bells, the receiver may be restored upon the switch hook to cause the test set to restore to normal. It will be remembered that the tone is transmitted in sequence switch position 3. The restoration of the receiver releases relay 325 which, in turn, releases relay 324. The release of relay 325 operates counting relay 1 over an obvious circuit. The release of relay 324 establishes a circuit to energize sequence switch magnet 300 to rotate the sequence switch from position 3 to 4. When the sequence switch rotates out of position 3, a shunt is removed from the winding of counting relay 1' to cause its operation. The operation of counting relay 1' establishes a circuit to energize magnet 300 to restore the sequence switch to normal and release the counting relays. This circuit may be traced from grounded battery through the winding of magnet 300, right lower contact of cam 311, right contact of counting relay 1', right normal contact of counting relay 2', contact of cam 309, to ground through the normal contact of relay 324.

What is claimed is:

1. In a testing system for testing subscribers' station apparatus associated with single or party lines of a central office, a testing device located in said central office, means for directing a call from a subscribers' station to said testing device, and means for testing only the subscriber's station from which said call is initiated independent of manual assistance at said central office.

2. In a testing system for testing subscribers' station apparatus associated with single or party lines of a central office, a testing device located in said central office, means for directing a call from a subscriber's station to said testing device, a source of ringing current and automatic means in said testing device responsive to said call for associating said ringing current source only with the subscriber's station from which said call is initiated.

3. In a testing system for testing subscribers' station apparatus associated with single or party lines of a central office, a testing device located in said central office,

means for directing a call from a subscriber's station associated with a party line to said testing device, sources of ringing current of different polarities, and automatic means in said testing device responsive to said call for associating a ringing current source only with the subscriber's station initiating the call, said ringing current being of the polarity to properly actuate the apparatus of said subscriber's station.

4. In a testing system for testing subscribers' station apparatus associated with single or party lines of a central office, a testing device located in said central office, means for directing a call from a subscriber's station to said testing device, sources of ringing current of different characteristics, and means to control said testing device from a subscriber's station to associate ringing current only with said subscriber's station, said ringing current having the characteristics ordinarily used in service to actuate the apparatus of said subscriber's station.

5. In a testing system for testing subscribers' station apparatus associated with single or party lines of a central office, a testing device located in said central office, sources of ringing current of different characteristics associated with said testing device, and means to control said testing device from a subscriber's station to associate ringing current only with said subscriber's station, said ringing current having the proper characteristics to actuate the apparatus of said subscriber's station in accordance with its adjustment.

6. In a testing system for testing subscribers' station apparatus associated with a central office, a testing device located in said central office, means under the control of a subscriber's station for associating said subscriber's station with said testing device, sources of ringing current associated with said testing device, means under the control of said subscriber's station to select one of said sources of ringing current, means to connect said selected source of ringing current for actuating the apparatus of said subscriber's station, and means under the control of said subscriber's station to disconnect said ringing source.

7. In a testing system for testing subscribers' stations equipped with dials and associated with a central office, a testing device located in said central office, means for directing a call to said testing device by a particular manipulation of a dial at a subscriber's station, means for associating a tone source with said subscriber's station to indicate that a testing device has been selected, sources of ringing current, and means to control said testing device by further manipulation of said dial to associate ringing current with said subscriber's station of a potential and polarity to actuate the ap-

paratus of said subscriber's station in accordance with its adjustment.

8. A method of testing subscribers' station apparatus consisting in transmitting a set of signals from a station to a central office, receiving an audible tone in response thereto, transmitting a second set of signals to said central office and receiving ringing current

of a particular polarity to properly test said station, the ringing current of said particular polarity being selected in response to said second signals. 10

In testimony whereof, I have signed my name to this specification this 26th day of June, 1924.

CARLETON V. TAPLIN.