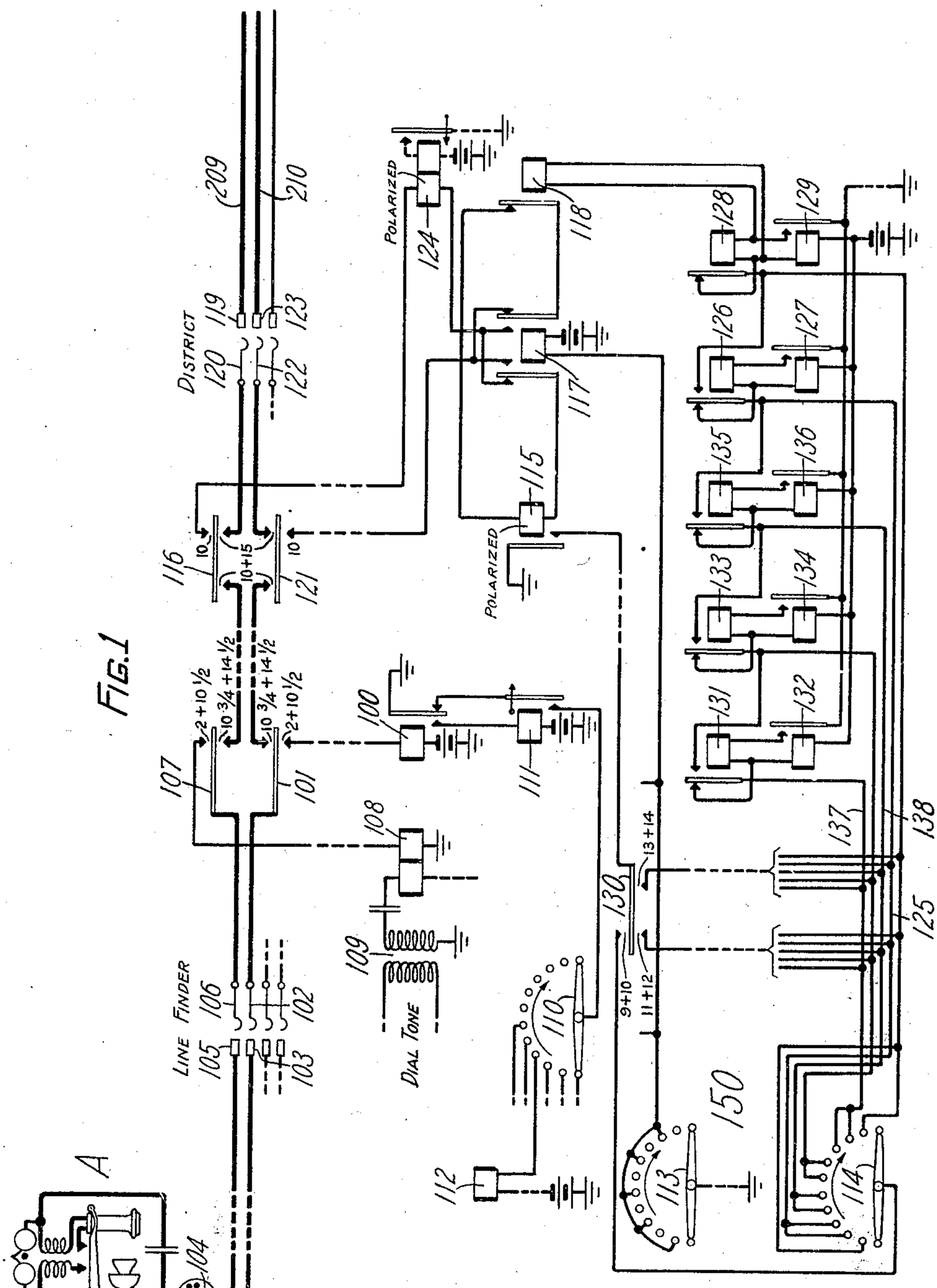
July 23, 1929. F. A. STEARN ET AL 1,722,064

TELEPHONE EXCHANGE SYSTEM

Filed March 7, 1928 3 Sheets-Sheet 1

FIG. 1



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TELEPHONE EXCHANGE SYSTEM

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FIG. 2

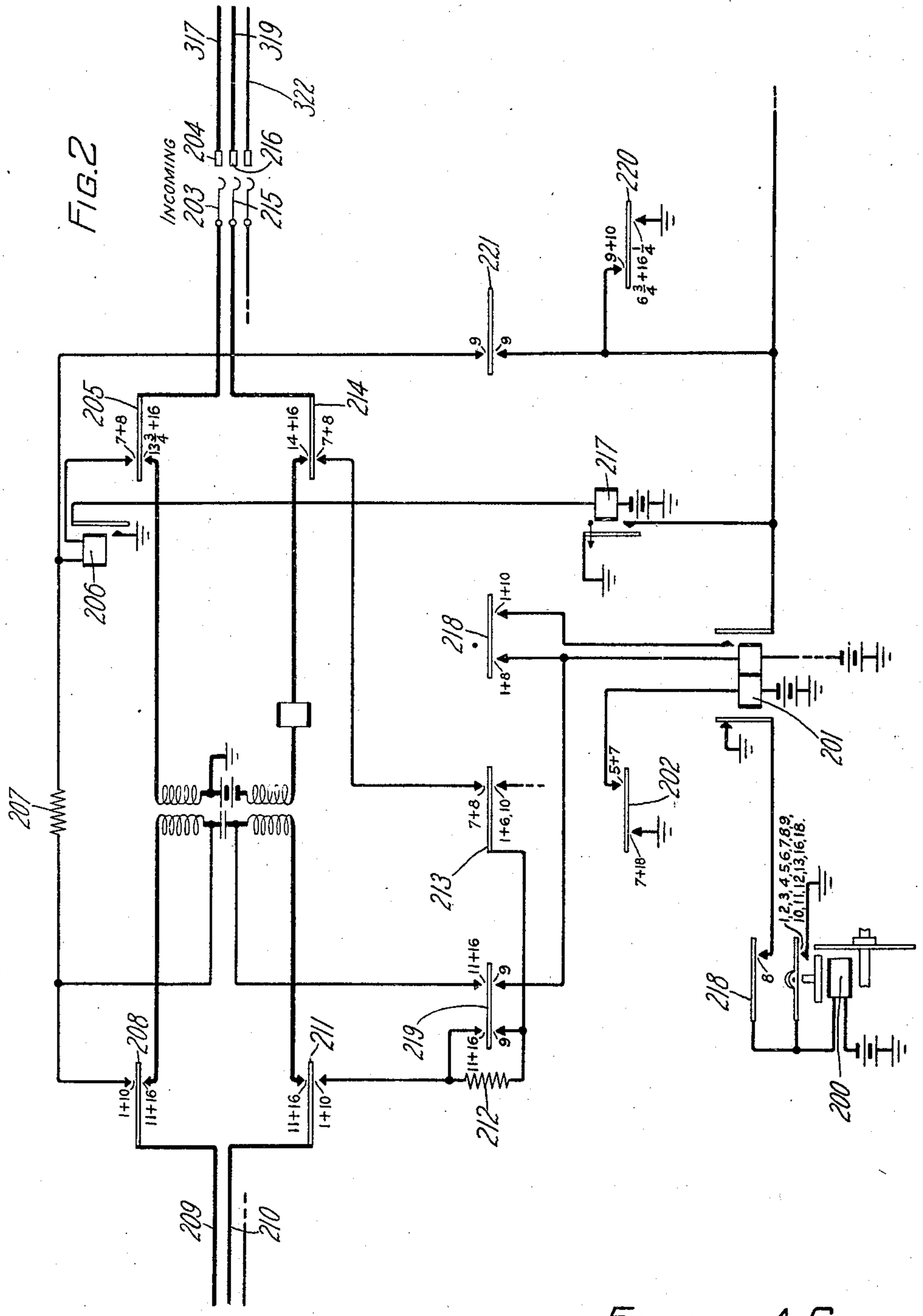

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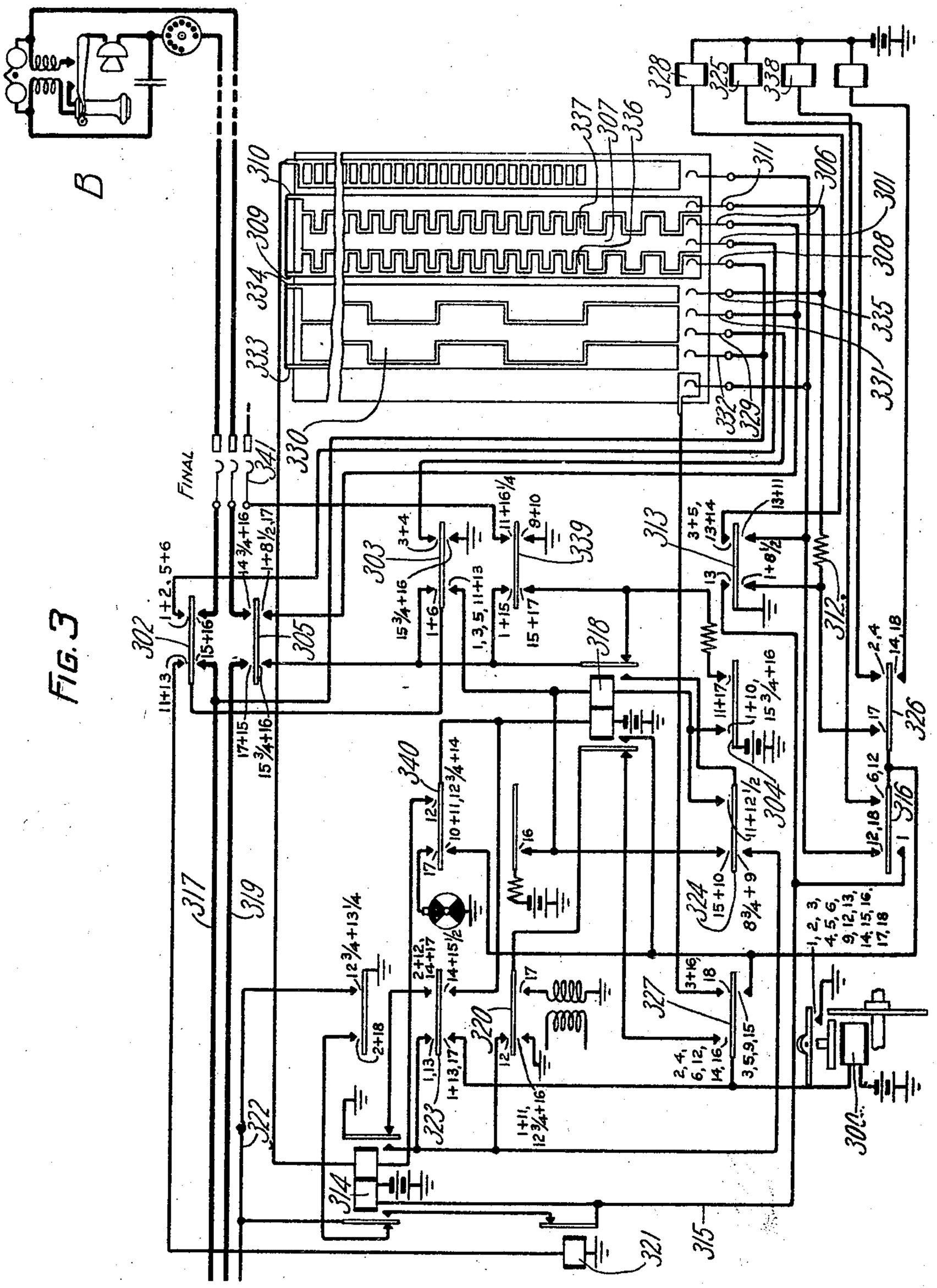
FIG. 3



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Patented July 23, 1929. 1,722,064

UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

Application filed March 7, 1928. Serial No. 259,634.

This invention relates to a telephone exchange system and more particularly to a system employing automatic selector switches which are revertively controlled from a common central office sender, and has for its object to simplify the apparatus in the sender which is responsive to the revertive impulses transmitted thereto by the selector switches and to increase the speed of operation of the switches.

Heretofore as shown for example in the patent to F. A. Stearn No. 1,505,171 issued August 19, 1924, impulses of one polarity have been transmitted to the stepping relay of the sender due to the shunting thereof by a commutator brush of a selector passing over segments of a commutator plate which plate had a segment for each selective position of the selector. The operation of the stepping relay controlled the successive energization of a plurality of counting relays there being ten pairs of such relays. Thus, for example, in setting a final selector in its units selection for the digit 9 the commutator brush of such selector caused the stepping relay of the sender to be shunted down ten times and thereby caused the successive energization of all ten pairs of counting relays.

In accordance with the present invention the circuits of the selector switches are modified by providing commutators which instead of sending shunting impulses of one polarity send impulses of first positive and then negative polarity. At the sender a group of five pairs of counting relays is provided and a switching relay which is controlled from the sender registers in accordance with whether the digits registered for controlling the selectors are of odd or even value. This relay is instrumental in connecting the stepping relay of the sender to the fundamental switch controlling circuit in such a manner that the stepping relay will either respond only to positive impulses transmitted from the selectors or only to negative impulses. Thus by the addition of one relay to the sender and a slight change in the commutator of each selector it is possible to eliminate ten counting relays from each sender thereby effecting a considerable economy. Furthermore, since only alternate impulses are effective for controlling the sender, that is, positive impulses if an even number of selective steps is to be counted and negative impulses if an odd number of steps is to be counted, the speed of switch travel may be materially increased.

One embodiment of the invention shown by way of illustration is disclosed in the accompanying drawings, in which:

Fig. 1 shows diagrammatically a calling line, a line finder, district selector, and as much of a central office sender as is necessary for an understanding of the invention;

Fig. 2 shows diagrammatically an incoming selector; and

Fig. 3 shows a called line and a final selector switch.

The line finder, district selector and sender of Fig. 1 may be of the type fully disclosed in Patent 1,589,402, issued June 22, 1926 to O. H. Kopp and the incoming selector of Fig. 2 and final selector of Fig. 3 may be of the type disclosed in the hereinbefore cited patent to F. A. Stearn, 1,505,171. It is, of course, understood that all the selector switches with the exception of the line finder are modified in a manner similar to the final selector of Fig. 3 and that the sender is also modified in accordance with the present invention. Since however, the invention may be understood from a detailed consideration of Fig. 3, the remaining selector switches have not been shown in detail in order that the disclosure may be simplified.

It is believed that the invention will be best understood from a consideration of the manner in which an actual connection is established between subscribers' lines. For this purpose, it will be assumed that the subscriber A of Fig. 1 desires to establish a connection with subscriber B of Fig. 3 and for that purpose he removes his receiver from the switchhook and dials the desired subscriber's directory No. MA–2294.

Upon the removal of his receiver a connection becomes extended over the brushes of the line finder to the district selector trunk and thence to the sender, the sequence switch of the district selector advancing into position 2. An impulsing circuit is thereby established in the well known manner from battery through the winding of impulse relay 100, the lower contact of cam 101, line finder brush 102 and terminal 103, thence over the subscriber's line loop through the calling dial 104, line-finder terminal 105 and brush 106, the upper contact of cam 107 to ground through the right winding of coil 108. As

soon as the calling subscriber receives a dial tone inductively transmitted from the tone coil 109 through left winding of coil 108, he proceeds to dial the office code and numerical designation of the wanted line.

With the register steering switch, one brush and terminal arc of which is shown at 110 in position 1, a stepping circuit is established upon each deenergization of pulsing relay 100 in response to the dialing of the first code letter M, which may be traced from ground at the back contact of relay 100 over the front contact of relay 111, which energized upon the initial energization of relay 100, over the brush 110 to the stepping magnet of the first office code register (not shown). When the first code digit is completely registered the steering switch advances in the well known manner to position 2, in which the second office code register is set in response to the dialing of the second code letter A. Similarly, the numerical registers are set in response to successive digit series. To simplify the disclosure, only a portion of the hundreds register has been selected for the purpose of illustration, the stepping magnet 112 and brushes 113 and 114 and their associated terminal arcs being illustrated.

When the office code of the desired number has been registered on the code registers of the sender, the sender proceeds to set the district selector to select a trunk outgoing to the office in which the desired line terminates and thereafter the district sequence switch advances into position 10 for extending a control circuit to the incoming selector. The setting of the district selector proceeds in substantially the same manner as described in the aforementioned patents, except that the revertive control of the sender is controlled in the manner hereinafter described in connection with the setting of the final selector switch. The incoming selector is thereupon set in its brush and group selections in accordance with the thousands and hundreds registrations and then hunts for a trunk extending to an idle final selector in which the desired line terminates. The incoming selector also controls the sender revertively in the manner hereinafter described in connection with the final selector.

It will be assumed that the final selector of Fig. 3 is selected by the incoming selector. As soon as the idle final selector has been found the sequence switch 200 of the incoming selector advances into position 7 and thence into position 8 in the manner disclosed in the aforementioned patent to Stearn. When the sequence switch 200 reaches position 7 the control relay 201 energizes in the circuit extending from battery through the left winding thereof to ground over contacts of cam 202 and the fundamental control circuit is extended from the sender to the final selector. This circuit may be traced from battery through the left contact of cam 304, the right winding of relay 318, the lower left contact of cam 303, the upper right contact of cam 302, commutator brush 301, a segment of commutator strip 307, brush 306, the lower right and upper left contacts of cam 305, conductor 319, terminal 216 and brush 215 of the incoming selector, lower contact of cam 214, upper contact of cam 213, resistance 212, lower contact of cam 211, conductor 210, terminal 123 and brush 122 of the district selector, right contacts of cam 121, right back contact of relay 117, back contact of relay 118, winding of stepping relay 115, left back contact of relay 117, left winding of polarized overflow relay 124, right contacts of cam 116, brush 120 and terminal 119, conductor 209, the upper contact of cam 208, resistance 207, winding of relay 206, the upper contact of cam 205, brush 203 and terminal 204, conductor 317, the commutator brush 308, segments of commutator strips 309 and 310, brush 311, resistance 312 to ground at the lower left contact of cam 313. Relays 115, 206 and 318 are energized in this circuit but relay 124, being polarized in a particular direction does not operate.

Relay 206 upon energizing closes an obvious circuit for slow releasing relay 217, which in turn closes a holding circuit extending from battery through the right winding of relay 201, the contact of cams 218, the right front contact of relay 201 to ground at the contact of relay 217 for holding relay 201 energized after the sequence switch 200 advances into position 8. When subsequently current is reversed by reason of the selective movements of the final selector relay 206 will upon each reversal momentarily open its contacts but relay 217 will not release due to its slow releasing characteristics and therefore relay 201 will be maintained energized until the final selector has been set upon the terminals of the called line and the sequence switch of such final selector has advanced beyond position 8½.

Relay 318 closes a circuit for relay 314 which may be traced from battery through the left winding of this relay, conductor 315, the lower contact of cam 316, the left front contact of relay 318 to ground at the lower left contact of cam 320. Relay 314 energizes in this circuit and at its left front contact closes a locking circuit for itself extending from battery through its left winding, the back contact of relay 321, the left front contact of relay 314 at the incoming selector, to ground over the sleeve conductor 322, and at its right front contact closes a circuit for advancing sequence switch 300 into position 2. This circuit may be traced from battery through the magnet winding of the sequence switch, the left contacts of cam 323 to ground at the right front contact of relay 314. When the sequence switch 300 moves out of position

1, the initial energizing circuit of relay 318 is opened at the lower left contact of cam 303 but the relay 318 remains energized over the fundamental circuit by reason of a locking circuit extending from battery through the upper left contact of cam 304, the right winding of relay 318, the upper left contact of cam 324, the right front contact of relay 318, the upper left contact of cam 303, and thence as traced.

Relay 318 upon energizing with sequence switch 300 in position 2 closes a circuit for the high speed up-drive magnet 325, which may be traced from battery through the winding of magnet 325, the upper right contact of cam 326, the left front contact of relay 318, and thence to ground at the lower left contact of cam 320. Magnet 325 upon energizing causes the switch-shaft to be moved upwardly in its brush selection movement. As the switch-shaft approaches its first brush selection position the bridging brushes 306 and 308 leave the first or lowermost segments of commutator strips 307 and 309 and engage the second segments of commutator strips 307 and 310. The current flowing over the fundamental circuit above traced is thus reversed, battery being now connected over the left contact of cam 304 through the right winding of relay 318, thence as traced to brush 301, segment of commutator strip 307, brush 308, trunk conductor 317, thence as traced through the winding of stepping relay 115, returning over trunk conductor 319, the upper left and lower right contacts of cam 305, brush 306, segment of commutator strip 310, brush 311, resistance 312 to ground at the lower left contact of cam 313. Since the commutator brushes are of a bridging type there is no break in the current flowing through relay 318 while the direction of the current is being reversed in the fundamental circuit, but since the stepping relay 115 is polarized in such a manner as not to be responsive to current as now reversed in the fundamental circuit it releases. As the switch-shaft continues in its upward movement the successive engagement of brushes 306 and 308 with segments of commutator strips 307, 309 and 310 causes further reversals of current.

On the initial closure of the fundamental circuit through the windings of the sender stepping relay 115 and overflow relay 124, with relay 117 deenergized, relay 115 energized, closing a circuit from ground through its contact, the upper contact of sequence switch cam 130, brush 114 of the hundreds register 150, standing on terminal No. 2 since the hundreds digit dialed was assumed to be 2, conductor 125 the back contact of counting relay 126, thence to battery through the winding of counting relay 127. Relay 127 energized closing a locking circuit for itself through the winding of counting relay 126, the front contact of relay 127 to ground. Relay 126 does not, however, energize in this locking circuit since its winding is shunted by ground at the front contact of stepping relay 115. Upon the first reversal of current in the fundamental circuit, relay 115 being polarized, releases, permitting the counting relay 126 to energize. Since the current reversal is of relatively short duration relay 124 does not energize due to its slow operating characteristic, this relay operating only when a selector switch advances to an overflow contact or when current is reversed for an appreciable time from the incoming selector following the completion of all selections.

On the next reversal of current in the fundamental circuit relay 115 again energizes and since at this time counting relay 126 is energized, a circuit is extended from conductor 125 over the front contact of relay 126, the back contact of relay 128 to battery through the winding of the counting relay 129, causing its energization. Relay 129 thereupon locks through its own winding, the winding of relay 128 and the front contact of relay 129 to ground. On the next reversal of current relay 115 again deenergizes, permitting relay 128 and relay 118 in parallel therewith to operate in the locking circuit of relay 129. In the well known manner relay 128 causes the sender sequence switch to be advanced preparatory to the control of the tens selection at the final selector and releases the operated counting relays.

Relay 118 upon energizing opens the fundamental circuit, thereby releasing relay 318 of the final selector to open the circuit of the up-drive magnet 325, thereby arresting the upward movement of the switch-shaft. At its left back contact relay 318 closes a circuit extending from battery through the winding of sequence switch magnet 300, upper left contact of cam 327, left back contact of relay 318 to ground at the lower left contact of cam 320, driving the sequence switch out of position 2 into position 3. The third set of brushes has now been positioned in relation to the tripping finger of the tripping spindle, so that upon a second upward movement of the switch-shaft this set of brushes will be tripped for engagement with the bank of one hundred terminals with which this brush set is associated. With sequence switch 300 in position 3 a circuit is closed for the tripping magnet 328, extending from battery through the winding of this magnet and thence to ground at the upper right contact of cam 313.

When the sequence switch 300 reaches position 3 the fundamental circuit is again closed and since the tens digit registered was assumed to be 9 or odd in value, relay 117 at the sender will be energized over a bank of the tens register (not shown) in the same manner

as may be traced from the brush 113 of the hundreds register 150. The fundamental circuit may now be traced from battery, left contact of cam 304, right winding of relay 318, the lower left contact of cam 303, the upper right contact of cam 303, brush 329, segment of commutator strip 330, brush 331, the lower right and upper left contacts of cam 305, trunk conductor 319, thence as traced through the right contacts of cam 121, the left front contact of relay 117, winding of stepping relay 115, the back contact of relay 118, the right front contact of relay 117, the left winding of overflow relay 124, thence as traced to trunk conductor 317, brush 332, segments of commutator strips 333 and 334, brush 335, resistance 312 to ground at the lower left contact of cam 313. Relays 318 and 206 energize in this circuit, but the stepping relay 115 and the overflow relay 124 are so polarized as not to be energized by the current now flowing over the fundamental circuit.

Relay 318 upon energizing again closes the previously traced circuit for driving sequence switch 300 out of position 3 and into position 4. With the sequence switch in position 4 relay 318 locks over its right front contact and the upper contact of cam 303, as previously described and closes the previously traced circuit for the up-drive magnet 325. The switch-shaft is now driven upwardly in its group selection movement, during the initial portion of which the third set of brushes is tripped in the well known manner. As the switch-shaft approaches its first group selection position the brush 331 leaves the lowermost segment of the commutator strip 330 and engages a segment of strip 334 and the brush 332 leaves a segment of strip 333 and engages a segment of strip 330, whereupon the direction of current flowing in the fundamental circuit becomes reversed. At this time battery through the winding of relay 318 becomes connected over brushes 329 and 332 and commutator strip 330 to trunk conductor 317 and ground becomes connected over brushes 335 and 331 and commutator strip 334 to trunk conductor 319. Upon this current reversal relay 318 does not deenergize, but current now flows through the winding of stepping relay 115 in such a direction as to cause its energization.

As the switch-shaft advances the current flowing in the foundamental circuit is again reversed each time that the brush set 329, 331, 332 and 335 passes over segments of the commutator strips 330, 333 and 334. When the stepping relay 115 at the sender energized as the selector brushes approached the bottom of the first bank group, it closed a circuit for the counting relay 132, which may be traced in part from ground at the contact of relay 115, the lower left contact of cam 130, thence through a brush of the tens register (not shown) which was assumed to be set in position 9, conductor 137, the back contact of relay 131, the winding of relay 132 to battery. Relay 132 energizes and locks through the winding of relay 131. As the selector brushes approach the bottom of the second bank group, again reversing the current over the foundamental circuit, relay 115 deenergizes, permitting relay 131 to energize to extend the operating circuit from the contact of relay 115 to the next pair of counting relays 133, 134.

Thus upon each energization and deenergization of relay 115 a pair of counting relays is operated until upon the deenergization of relay 115 at the time the selector brushes are positioned beneath the tenth bank group relays 128 and 118 energize. Relay 128 advances the sender sequence switch in the well known manner, preparatory to controlling units selection and restores all operated counting relays. Relay 118 opens the fundamental circuit, thereby releasing relay 318 at the final selector, which in turn opens the circuit of the up-drive magnet 325 and closes the previously traced circuit for advancing sequence switch 300 out of position 4 into position 5.

In position 5 the fundamental circuit is again established and since the units digit was assumed to be 4, or of even value and therefore relay 117 being deenergized, the fundamental circuit may be traced from battery over the left contact of cam 304, right winding of relay 318, the lower contact of cam 303, the upper right contact of cam 302, brush 301, commuator strip 307, brush 306, the lower right and upper left contacts of cam 305, trunk conductor 319, thence as traced through the winding of stepping relay 115 and the back contacts of relay 117, returning over trunk conductor 317, brush 308, segments of commutator strips 309 and 310, brush 311, resistance 312 to ground at the lower left contact of cam 313. The commutator brushes 306 and 308 are at this time standing on segments of strips 307 and 309, similar to the segments 336 and 337 immediately beneath the selected uppermost group of ten line terminals. Relays 115 and 318 energize in this circuit, relay 318 closing a holding circuit for itself over the fundamental circuit in the manner previously described, whereby it remains operated when the sequence switch 300 reaches position 6, and closes a circuit for the slow speed up-drive magnet 338. This circuit may be traced from battery, winding of magnet 338, the right contact of cam 316, the left front contact of relay 318 to ground at the lower left contact of cam 320. Upon the operation of the magnet 338 the brush shaft is driven upwardly, advancing the tripped switch brushes over the line terminals in the uppermost group of terminals in the bank associated therewith.

During this movement of the switch-shaft the engagement of brushes 308, 301, 306 and

311 with segments of the commutator strips 307, 309 and 310 causes successive reversals of current in the fundamental circuit. During these reversals relay 318 does not become deenergized. Upon the first energization of relay 115 a circuit is closed from ground at the front contact of relay 115, over the right contact of cam 130, through a brush on the units register (not shown) corresponding to brush 114 of the hundreds register 150, conductor 138, the back contact of counting relay 135 to battery through the winding of relay 136. Relay 136 operates locking itself over its front contact through the winding of relay 135. Upon the first deenergization of relay 115, relay 135 energizes extending conductor 138 over the front contact of relay 135 and the back contact of relay 126 to the winding of relay 127. Upon the second energization and deenergization of relay 115, the pair of counting relays 126 and 127 operate and upon the third energization and deenergization relays 128, 129 and 118 operate.

Relay 128 upon operating advances the sender sequence switch and releases the operated counting relays in the well known manner and relay 118 opens the fundamental circuit, thereby releasing relay 318. The release of relay 318 opens the circuit of the up-drive magnet 338 and closes the previously traced circuit for advancing the sequence switch 300 out of position 6 into position 9. The brushes of the final selector have now been positioned upon the terminals of the desired line. Upon the advance of the sequence switch 300 through position 8½ into position 9 the fundamental circuit previously traced through the winding of relay 206 is opened at the final selector for a sufficient time to permit relay 206 to release and in turn release relays 217 and 201, whereupon a circuit is closed over the left back contact of relay 201 and the contact of cam 218 for advancing the incoming selector sequence switch 200 out of position 8 and into position 9. With the sequence switch of the incoming selector in position 9 battery is connected through the right winding of relay 201, the lower contacts of cam 219, resistance 212, the lower contact of cam 211 to trunk conductor 210, and ground is connected over contacts of cams 220 and 221, resistance 207, the upper contact of cam 208 to trunk conductor 209, whereby current is caused to flow through the winding of overflow relay 124 in such a direction and for a sufficient time to permit the overflow relay 124 of the sender to operate, advancing the sender into the talking selection position. The sender thereupon functions in the well known manner to control talking selection at the district selector and to advance the district selector into such a position that the talking conductors are extended therethrough from the calling line to the incoming selector.

Upon reaching position 9 the sequence switch 300 closes a circuit for energizing relay 318, which may be traced from battery through the left contact of cam 304, the right winding of relay 318, the left contacts of cam 324 to ground at the right front contact of relay 314. Relay 318 upon energizing closes a locking circuit for itself, extending from battery through its right winding and the upper left contact of cam 324, the right front contact of relay 318, the upper left and lower right contacts of cam 339 to ground. This locking circuit is maintained through position 10 of sequence switch 300. Relay 318 upon energizing also closes a circuit as previously traced for driving sequence switch 300 into position 12. Upon reaching position 10 a new holding circuit is established for relay 318 extending from battery through the left winding of this relay, the lower left contact of cam 340, the left front contact of relay 318 to ground at the lower left contact of cam 320. Upon reaching position 11 sequence switch 300 establishes a new holding circuit for relay 318, extending from ground through the winding of test relay 321, the upper left contact of cam 302, the lower left contact of cam 303, the right winding of relay 318, the upper right contact of cam 324, the right front contact of relay 318, the upper contacts of cam 339 to the test brush 341.

If the called line B is idle, as is assumed, ground potential will be encountered by the brush 341. Therefore, relay 318 and relay 321 will be without current and relay 318 will deenergize as soon as sequence switch 300 leaves position 11. When therefore relay 318 becomes deenergized it closes a circuit for driving sequence switch 300 out of position 12 into position 13; this circuit extending from battery through the upper left contact of cam 327, the left back contact of relay 318, the upper contact of cam 320 to ground at the right front contact of relay 314. Upon reaching position 13 a circuit is established over the left contacts of cam 323 and the right front contact of relay 314 for advancing the sequence switch 300 into position 14. In position 14 a circuit is established through the magnet winding of sequence switch 300, the upper left contact of cam 327, the left back contact of relay 318 to ground at the lower left contact of cam 320 for driving sequence switch 300 into the talking position 15. In this position the trunk conductors 317 and 319 are cut through over contacts of cams 302 and 305 to the conductors of the called line. The called subscriber is then rung from ringing current applied at the incoming selector and following the response of the called subscriber the talking circuit is completed over the trunk conductors of the incoming selector in the well known manner. Following the termination of the conversa-

tion the connection becomes released as fully set forth in the aforementioned patent to F. A. Stearn.

While the invention has been described only in connection with the operation of the final selector, it will be apparent that by equipping the selector switches of the several selective stages of the exchange with commutators and control circuits similar in character to that disclosed for the final selector, it is possible to revertively control switches in a very simple manner, employing but half the usual number of counting relays at the sender. Furthermore, since the sender stepping relay 115 is required to operate only on alternate current reversals, that is, either on impulses of one polarity if the digit selection is even, or on impulses of the opposite polarity if the digit selection is odd, the speed of operation of selector switches may be increased and still permit the relay 115 to function accurately.

What is claimed is:

1. In a telephone exchange system, an electro-responsive device, a sending device for controlling the operation of said responsive device, said sending device including a counting device and a stepping relay to control the operation of said counting device, means operative during the operation of said responsive device to transmit controlling impulses to said relay, and means to render said relay responsive only to alternate ones of said impulses.

2. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a stepping relay to control the action of said counting device, means operative during the selective movement of said switch to transmit controlling impulses to said relay, and means to render said relay responsive only to alternate ones of said impulses.

3. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a stepping relay to control the action of said counting device, means operative during the selective movement of said switch to transmit a controlling impulse to said relay corresponding to each selective position of said switch, and means to render said relay responsive only to alternate ones of said impulses.

4. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a stepping relay to control the action of said counting device, means operative during the selective movement of said switch to transmit a controlling impulse to said relay corresponding to each selective position of said switch, and means to render said relay responsive only to either impulses transmitted in the even numbered positions of said switch, or to impulses transmitted in the odd numbered positions of said switch.

5. In a telephone exchange, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a polarized stepping relay to control the action of said counting device, a control circuit, means operative during the selective movement of said switch to transmit controlling impulses over said circuit to said relay of alternating positive and negative polarity corresponding to successive positions of said switch, and means in said sending device for reversing the connection of said relay with respect to said control circuit whereby it is rendered responsive either to impulses transmitted in the even numbered positions of said switch or to impulses transmitted in the odd numbered positions of said switch.

6. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a relay to control the action of said counting device, means operative during the selective movement of said switch to transmit controlling impulses to said relay of alternating positive and negative polarity, and means to render said relay responsive only to either said positive or to said negative impulses.

7. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a polarized relay to control the action of said counting device, a control circuit, means operative during the selective movement of said switch to transmit controlling impulses to said relay over said circuit of alternating positive and negative polarity, and means for reversing the connection of said relay with respect to said control circuit whereby it is rendered responsive only to either said positive or to said negative impulses.

8. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a stepping relay to control the action of said counting device, means operative during the selective movement of said switch to transmit controlling impulses to said relay of alternating positive and negative polarity, and a relay operative in accordance with whether the number of impulses to be counted is odd or even to render said stepping relay responsive only to either said positive or to said negative impulses.

9. In a telephone exchange system, an electro-responsive device, a sending device for controlling the operation of said responsive device, said sending device including a count-

ing device, a register and a stepping relay to control the action of said counting device in accordance with the setting of said register, means operative during the selective movement of said responsive device to transmit controlling impulses to said relay corresponding to each selective position of said responsive device, and means controlled by said register in accordance with its setting to render said relay responsive only to either impulses transmitted in the even numbered positions of said responsive device or to impulses transmitted in the odd numbered positions of said responsive device.

10. In a telephone exchange system, an electro-responsive device, a sending device for controlling the operation of said responsive device, said sending device including a counting device, a register and a stepping relay to control the action of said counting device in accordance with the setting of said register, means operative during the selective movement of said responsive device to transmit controlling impulses to said relay of alternating positive and negative polarity, and means controlled by said register in accordance with its setting to render said relay responsive to either said positive or to said negative impulses.

11. In a telephone exchange system, a selector switch, a sending device for controlling the operation of said switch, said sending device including a counting device and a relay to control the action of said counting device, a control circuit extending between said relay and said switch, a commutator associated with said switch, means including said commutator operative during the selective movement of said switch for successively reversing the connection of battery and ground to the conductors of said control circuit, and means in said sending device to render said relay responsive only to current flowing in either one or the other direction in said control circuit.

12. In a telephone exchange system, a selector switch having a plurality of selective movements, a sending device for successively controlling the selective movements of said switch, said sending device including a counting device and a relay to control the action of said counting device, a control circuit extending between said relay and said switch, commutators in said switch, each of said commutators operative respectively during a particular selective movement of said switch for successively reversing the connection of battery and ground to the conductors of said control circuit, and means in said sending device operative during each selective movement of said switch to render said relay responsive only to current flowing in either one or the other direction in said control circuit.

In witness whereof, we hereunto subscribe our names this 24th day of February, 1928.

FRANKLIN A. STEARN.
EDGAR H. CLARK.